This special issue published for the conference

Horizon 2026: International Multidisciplinary Conference (H-2026: IMC)

"Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI"

Held on: 9TH APRIL, 2026

Organised by

DR. GOPALRAO KHEDKAR MAHAVIDYALAYA, GADEGAON (TELHARA), DIST. AKOLA (M. S.) INDIA

OUR SERVICES

- ISBN Book
- Call for paper
- International Research Journal
- Ph.D. & M.Phil Thesis Book
- E-Book
- Conference and Seminar Proceeding
- Educational Videos and Notes
- Educational Activities

G Pay PhonePe BHIM 9623979067

SIDDHI
Siddhi Prakashan

Worldwide International Inter Disciplinary Research Journal
Website : www.wiidrj.com
Menoffice Address: Director : Mr. Tejas Rampurkar, Hyderabad.
Tuljai Niwas Ramkrishna Nagar, Near Ganpati Mandir
Vasmat Road Parbhani, Maharashtra (India)
Email : shrishprakashan2009@gmail.com / siddhiprakashan674@gmail.com
Mob : +91-9623979067

ISBN 2454-7905
9 772454 790004 >

Worldwide International Inter Disciplinary Research Journal (A Peer Reviewed) Year - 11, Vol. I, ISSUE - CXXXXIV, 09 April - 2026

ISSN : 2454-7905 MAH/NAN/10936/2015 SJIF 2026 - Impact Factor : 8.709

Horizon 2026

INTERNATIONAL MULTIDISCIPLINARY CONFERENCE

Worldwide International Inter Disciplinary Research Journal

(A Peer Reviewed)

Year 11, Vol. I, ISSUE - CXXXXIV,
09 April - 2026
Special Issue

- Chief Editor -
Dr. Gajanan B. Ingle

- Editor -
Dr. Bhushan P. Deshmukh

Quartly Research Journal

(Arts - Humanities - Social Sciences - Sports, Commerce, Science, Education, Agriculture, Management, Law, Engineering, Medical, Ayurveda, Pharmaceutical, Journalism, Mass Communication, Library Science Faculty's)

Humanities

Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the era of AI.

Science

Worldwide International
Inter Disciplinary Research Journal

A Peer Reviewed - Referred

Bela Nagar, Near Maroti Mandir, Taroda Kh. Nanded - 431 605 Maharashtra (India)

Siddhi Prakashan
Nanded.

Certificate of Publication

This is to certify that the review board of our research journal accepted the research paper / Article titled _____

_____

of Dr./Mr./Miss/Mrs. _____

it is peer reviewed and published in the issue CXXXXIV, Vol. I , Year - 11 in the month 09 April 2026.

Thank You!

ISSN : 2454-7905

Indexed
SJIF
Impact
Factor 8.709

ISSN 2454-7905
9 772454 790004 >

Editor
Dr. Bhushan P. Deshmukh

Editor in Chief
Dr. Gajanan B. Ingle

ISSN: 2454 – 7905

***SJIF Impact Factor:* 8.709**

Worldwide International Inter Disciplinary Research Journal

A Peer Reviewed Referred Journal

Quarterly Research Journal

(Arts-Humanities-Social Sciences- Sports, Commerce, Science, Education, Agriculture, Management, Law, Engineering, Medical-Ayurveda, Pharmaceutical, MSW, Journalism, Mass Communication, Library sci., Faculty's)

www.wiidrj.com

Vol. I ISSUE - CXXXXIV Year – 11 09 April 2026

Shri Shivaji Education Society Amravati's

Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara)

Horizon 2026: International Multidisciplinary Conference

"Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the era of AI."

:: Editor in Chief ::

Dr. Gajanan B. Ingle

Convener

Head, Faculty of Science, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara

Co-Editor

Dr. Bhushan P. Deshmukh

Org. Secretory

Dept of Marathi, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara

Address for Correspondence

Editor in Chief : Mrs. Pallavi Laxman Shete Website: www.wiidrj.com

Ramkrishna Nagar near Ganpati Mandir Vasmat Road Parbhani (India –Maharashtra)

Email: siddhiprakashan674@gmail.com / Shrishprakashan2009@gmil.com

Mob. No: +91-9623979067 **Director : Mr. Tejas Rampurkar, Hyderabad.**

(For International contact only +91-8857894082)

Worldwide International Inter Disciplinary Research

(A Peer Reviewed Referred)

Worldwide International Inter Disciplinary Research (A Peer Reviewed Referred) is quarterly published journal for Research scholars, teachers, businessman and scientists to integrate disciplines in an attempt to understand the complexities in the current affairs.

We also believe that both researchers and practitioners can contribute their knowledge by translating understanding into action and by linking theory and practice. This would enhance the relevance and thought in various related fields.

This Journal expected to bring together specialists in the field of commerce, economics, management and industry from different part of the world to address important issues regarding commerce, management and economics. One of the objectives of the journal is to create dialogue between scholars of various disciplines.

The editor, editorial team and the publisher do not hold any responsibility for the views expressed in **Worldwide International Inter Disciplinary Research (A Peer Reviewed Referred)** or for any error or omission arising from it.

The journal will cover the following Faculties for All Subject:

• Arts/ Humanities / Soc. Sci. / Sports	• Engineering
• Commerce	• Medical /Ayurveda
• Science	• Law
• Education	• Journalism
• Agriculture	• Mass Communication- **Library sci.**
• Pharmaceutical	• Social Work
• Management	• Any Other

Director: Mr. Tejas Rampurkar (For International contact only +91-8857894082)

Printed by
Anupam Printers, Hyderabad

Cost: Rs. 400/-

Editors of Worldwide International Peer Reviewed Journal are not responsible for opinions expressed in literature published by journal.

The views expressed in the journal are those of author(s) and not the publisher or the Editorial Board. The readers are informed, authors, editor or the publisher do not owe any responsibility for any damage or loss to any person for the result of any action taken on the basis of the work (c) The articles/papers published In the journal are subject to copyright of the publisher. No part of the publication can be copied or reproduced without the permission of the publisher.

Editorial Board

Dr. Krushna A. Mahure (Head,Dept of Political Science, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Dr. Manikrao M. Kawarke** (Head,Dept of Commerce, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Dr. Rahul S. Sudke (Head,Dept of English, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Dr. Dhirajkumar L. Najan** (Head,Dept of History, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Dr. Gopal O. Jondhalekar (Dept of English, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Prof. Sarika D. Pachraut** (Head,Dept of Marathi, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Dr. Rajani B. Bobade (Dept of Political Science, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Dr. Vijay V. Khumkar** (Dept of Marathi, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Prof. Deepshri V. Soni (Dept of Zoology, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Prof. Swapnil S. Fokmare** (Dept of Commerce Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Prof. Ashwini J. Deshmukh (Dept of Maths, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Prof. Damini A. Kapde** (Dept of Economics, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Prof. Rajesh P. Bahakar (Head, Dept of Microbiology, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Prof. Rupali S. Kale** (Head, Dept of Home-Economics, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)

Peer-Review Committee

Dr. Sanjay V. Kolhe (Vice-Principal, Shri Shivaji Arts, Commerce and Science College, Akot)	**Dr. Prasanna S. Joshi** (Dept. of Zoology Shri Shivaji Arts, Commerce and Science College, Akot)
Dr. Nutanvarsha P. Deshmukh (Dept. of Botany, Shri Shivaji Arts, Commerce and Science College, Akot)	**Dr. Sharmila Bawaskar** (Asst. Professor, Savitribai Fule College of Education, Akot)
Dr. Krushna A. Mahure (Head,Dept of Political Science, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Dr. Rahul S. Sudke** (Head,Dept of English, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Dr. Manikrao M. Kawarke (Head,Dept of Commerce, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Dr. Dhirajkumar L. Najan** (Head,Dept of History, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)
Dr. Gajanan B. Ingle (Head, Faculty of Science, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)	**Dr. Bhushan P. Deshmukh** (Dept of Marathi, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon, Telhara)

Advisor Committee

Dr. Santosh Bansod BOS Chairman, Senate Member, SGB Amravati University	**Dr. Mangesh Kadam** Dy. Director, SNDT, Mumbai
Dr. R. D. Sikchi Principal, Sitabai Arts, Commerce and Science College, Akola	**Dr. Dipak Dhote** Principal, Brijlal Biyani College, Amravati
Dr. Kiran Khandare Principal, HN Sinha College, Patur	**Dr. Sunil H. Pande** Principal, Shri Shivaji College, Akot
Dr. Shobhana Saoji Principal, Savitribai Fule College of Education, Akot	**Dr. Atul Bodkhe** Principal, J.D.Patil Sangludkar College, Daryapur
Dr. Vandana S. Bhoyar Indirabai Meghe Mahila Mahavidyalaya, Amravati.	**Dr. Pratibha Shankar Ghag** Cases College, Shikrapur, Pune.

Dr. Milind A. Barhate
Vice-Chancellor

Sant Gadge Baba Amravati University,
Amravati - 444 602, Maharashtra (India)

No. SGBAU/P-100/ 12/ 2026 Date : 20/ 3 / 2026

MESSAGE

It gives me immense pleasure to learn that Dr. Gopalrao Khedkar Mahavidyalaya, Telhara, Distt. Akola is organizing the International Multidisciplinary Conference on *"Horizon-2026: Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI"* on 9th April, 2026.

In today's fast-changing world, Artificial Intelligence is playing an important role in shaping knowledge, research, and innovation in many fields. This conference provides a valuable platform for teachers, researchers, experts, and students to come together, share their ideas, and discuss new trends and challenges of this changing time.

The theme of the conference is very relevant, as it focuses not only on gaining knowledge but also on bringing together ideas from different subjects to solve global problems. I am confident that this initiative will encourage useful discussions, promote new ideas, and help in building a knowledge-based society.

I appreciate the efforts of the organizers in bringing together scholars from different fields and promoting academic excellence and research collaboration.

I extend my best wishes for the success of this conference and hope it will be beneficial for all participants.

(Dr. Milind Barhate)

Dr. G. J. Dhole
Principal,
Dr. Gopalrao Khedkar Mahavidyalaya,
Telhara, Distt. Akola

Phone : Office - 0721 - 2668273, Resi. 0721 - 2668108
E-mail : vc@sgbau.ac.in Website : www.sgbau.ac.in

MESSAGE

It gives me great pleasure to extend my heartfelt congratulations toDr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara), Dist. Akola for organizing the "Horizon 2026: International Multidisciplinary Conference" on the theme "Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI."

In the context of the rapidly evolving global landscape shaped by Artificial Intelligence and technological advancement, such multidisciplinary platforms play a crucial role in fostering innovation, critical thinking, and collaborative research. The integration of diverse knowledge systems and contemporary research methodologies aligns well with the vision of the National Education Policy (NEP) 2020, which emphasizes holistic, flexible, and multidisciplinary education.

It is encouraging to note that your institution is taking a proactive role in bringing together scholars, academicians, and researchers from various disciplines to deliberate on emerging trends and global research challenges. Such initiatives significantly contribute to strengthening academic excellence and promoting meaningful knowledge exchange.

I appreciate the efforts of parent institution Shri Shivaji Education Society, Amravati, the Dr. Gopal Dhole Principal, and the Organizing Committee for their dedication in successfully arranging this conference and documenting scholarly contributions.

I extend my best wishes to all the participants, researchers, and organizers for the grand success of this conference.

Date: 30.03.2026

Place: Amravati

(Dr. Abhay Khambhorkar)

Joint-Director,

Higher Education, Amravati

Division Amravati.

SHRI SHIVAJI EDUCATION SOCIETY
Shivaji Nagar, Amravati (Maharashtra State)
Regd. No. F-89 (Amt) Estd. - 1932
Website : www.ssesa.org E-mail : president@ssesa.org

Harshvardhan P. Deshmukh
President
Mb. No. : 9422838805, 9112216061
Ph. No. : 0721 - 2661770 (Office)

Founder President
Dr. Panjabrao alias
Bhausaheb Deshmukh
M.A. D.Phil LL.D. Bar-At-Law

No. SSES/1/ 4

Date : 30.03.2026

MESSAGE

I extend my best wishes to the International Multidisciplinary Conference "Horizon 2026: Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI" organized by Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara), Dist. Akola (M.S.), under the aegis of Shri Shivaji Education Society, Amravati.

In today's rapidly evolving world driven by artificial intelligence and technological advancements, the integration of knowledge across disciplines has become essential. Such conferences play a vital role in fostering intellectual dialogue, encouraging innovation, and promoting collaborative research across diverse academic domains.

The theme of the conference is highly relevant as it focuses on emerging perspectives and global research frontiers. It provides a significant platform for academicians, researchers, scholars, and students to exchange ideas, share experiences, and explore new directions in multidisciplinary research.

I am confident that this conference will contribute meaningfully to the advancement of knowledge and will inspire participants to engage in thoughtful deliberations and innovative research practices.

I congratulate the Principal, organizing committee, faculty members, and all participants for this commendable initiative and convey my best wishes for the grand success of the conference.

(Harshvardhan P. Deshmukh)
President,
Shri Shivaji Education Society,
Amravati

Shri Shivaji Education Society, Amarvati's
Dr. Gopalrao Khedkar Mahavidyalaya,
Gadegaon (Telhara) Dist.Akola444108 (M.S.)
Mobile (Principal) 9561485814
NAAC Re-accredited "B" grade
E mail : clg_tel_dgk@ssesa.orgWeb : www.drgktelh.org

Udise Code Number: 27050705003Uni.College Code Number: 209
Pay Unit Number: 262 Aishe- C-42956

Founder President
Dr. Panjabrao Deshmukh,
M.A. D.Phil., Bar-at-Law
President
Hon'ble Shri Harshavardhan Deshmukh
Principal
Dr. G. J. Dhole

Outward No: GKMT/2025-26/...QQQ..
Dated: ...27/03/2026...

From the Principal's Desk

It gives me immense pleasure to welcome all participants to Horizon 2026: International Multidisciplinary Conference on the theme "Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI." This prestigious gathering reflects our shared commitment to advancing knowledge, fostering innovation, and encouraging meaningful academic dialogue in a rapidly evolving global landscape.

In today's era of Artificial Intelligence, interdisciplinary collaboration and knowledge integration have become essential for addressing complex global challenges. This conference provides a dynamic platform for academicians, researchers, and scholars to exchange ideas, explore emerging trends, and contribute to the development of innovative and sustainable solutions.

Organized by Shri Shivaji Education Society Amravati's, Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara), Dist. Akola, this event stands as a testament to our dedication to academic excellence and research-oriented growth. It also aligns with the vision of the National Education Policy (NEP) 2020, which emphasizes holistic, multidisciplinary, and research-driven education.

I sincerely appreciate the efforts of the organizing committee, faculty members, and contributors whose dedication has made this conference possible. I am confident that the deliberations and scholarly contributions presented here will enrich academic discourse and inspire future research endeavors.

I extend my best wishes for the grand success of Horizon 2026. May this conference serve as a beacon of knowledge, innovation, and collaboration, guiding us toward a brighter and intellectually empowered future.

Dr. Gopal J. Dhole

Principal,
Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon
(Telhara) Dist. Akola (M.S.), India

Message from the Convener

Dear Fellow Researchers, Academicians and Delegates,

It is my distinct honour and pleasure to welcome you to ***Horizon 2026: International Multidisciplinary Conference.***

As we stand at the threshold of a new era, our theme ***"Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the era of AI"*** is more than just a title; it is a call to action. We are living through a period where Artificial Intelligence is not merely a tool for computer scientists, but a bridge that connects Chemistry, Economics, Humanities, commerce and the Social Sciences.

The primary objective of Horizon 2026 is to create a vibrant platform where these diverse disciplines intersect. As Convener, my vision is to foster an environment where a chemist can find common ground with a data scientist, and where an economist can collaborate with a technologist to solve global challenges.

As the Editor-in-Chief of this conference, I am committed to maintaining the highest scholarly standards. Every paper presented here has undergone a rigorous peer-review process to ensure that we are contributing meaningful, ethical, and innovative knowledge to the global research frontier. Our goal is to ensure that the "Knowledge Integration" we discuss today becomes the foundation for the breakthroughs of tomorrow.

I would like to express my deepest gratitude to our keynote speakers, the international/national advisory committee, and our dedicated organizing committee for their tireless efforts in bringing this vision to life. Most importantly, I thank you “the researchers” for your intellectual curiosity and your commitment to advancing human knowledge.

I wish you all an intellectually stimulating and productive conference. May Horizon 2026 be the starting point for new collaborations and transformative ideas.

Warm regards,

Dr. Gajanan B. Ingle

Convener,

Horizon 2026: International Multidisciplinary Conference.

Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara),

Dist. Akola (M.S.)

Message from the Organising Secretary

Dear Fellow Researchers, Academicians and Delegates,

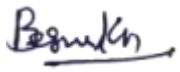
It is our immense pleasure and honour to welcome you to **Horizon 2026: International Multidisciplinary Conference.**

As we stand at the threshold of a new academic era, the theme "Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the era of AI" serves not only as a guiding vision but also as a powerful call for collaborative action. In today's dynamic world, Artificial Intelligence is no longer confined to a single discipline; rather, it acts as a bridge connecting diverse fields such as Science, Commerce, Humanities and Social Sciences.

As the Editor and Organising Secretary of this conference, our shared vision is to create a vibrant and inclusive academic platform where interdisciplinary ideas flourish. We believe that meaningful innovation emerges when researchers from varied backgrounds come together to exchange knowledge, challenge perspectives, and collaborate towards solving global issues.

We are committed to maintaining the highest standards of academic excellence. Every research paper presented at this conference has undergone a rigorous peer-review process to ensure quality, originality, and ethical integrity. Our goal is to ensure that the knowledge shared here contributes significantly to the global research community and inspires future advancements.

We extend our sincere gratitude to our keynote speakers, advisory board members, organizing committee, and all volunteers for their unwavering support and dedication. Most importantly, we thank all the researchers and delegates for their enthusiastic participation and valuable contributions.
We wish you all an intellectually stimulating and productive conference. May Horizon 2026 inspire new ideas, foster collaborations, and open new avenues of research.



Warm regards,

Dr. Bhushan Pradipkumar Deshmukh

Editor & Organising Secretary

Horizon 2026: International Multidisciplinary Conference

Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara),

Dist. Akola (M.S.) India

INDEX

Sr. No.	Title of the Paper	Name of Author	Page No.
01.	Education and Psychology	Sumit Balkisan Rathi	01
02.	Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI	Dr. Jayaprabha Mahadeo Bhagat	09
03.	A Review Technology Innovations Towards Value-Added Applications of Bamboo with an Emphasis on Generating Income and Employment, Especially in the Rural Areas	Dr. Suchita W. Dighe	12
04.	"Artificial Intelligence and Entrepreneurship Development: Shaping the Future of Start-up Culture"	Dr. Mrunank Sharad Kalmegh	17
05.	'Digital Entrepreneurship in India'	Pankaj P Mankar	22
06.	Automation and Employment Dynamics: Juggling Increased Productivity with Possible Job Losses in Maharashtra's Manufacturing and Services Sectors	Shubhangi D. Ghaiwat	26
07.	Gig Economy, Organizational Governance and Employment Challenges in the Modern Labour Market	Mr. Dipak Arjun Chaudhari	33
08.	Role of AI in Chemical Research, Drug Design and Material Science	Miss. Anita Baburao Hulsoorkar	38
09.	Reading Arun Joshi's, The Foreigner Through an Existential Perspective	Pranav S. Tatte Gauri S. Wande	43
10.	Application of Artificial Intelligence in English Language and Literature	Prof. Dr. G. O. Jondhalekar	48
11.	Protection of Traditional Knowledge in Digital Libraries: A Study of Gond Cultural Heritage	Mr. Amol Laxmikant Sakhare Dr. Dhananjay R. Gabhane	51
12.	Artificial Intelligence in Accounting	Dr. Nikhal Pallavi Vijay	56
13.	"History of Commerce and Accounting in Ancient India: An Indian Knowledge System Perspective"	Mr. Mayur Sudhakar More Dr. Mangalawati Ji Pandey	59
14.	Literature and Environment (Eco-Criticism)	Prof. Santosh Prakash Mahale	64
15.	Feminist Study of Toni Morrison in the Light of her *The Blue Eye* and *Sula*	Dr. Asmita J. Badhe	67
16.	A Study of Changes in Buying Behavioural Pattern of Consumer Due to Online Shopping and its Impact on Traditional Retailers with Special Reference to Western Vidharbha (M.S)	Abhinav Raosaheb Pundkar	69
17.	English language Teaching in India : Challenges and Innovations	Rupalee Madhukar Waghmare	71

18.	**Decolonizing the Algorithm: AI's Postcolonial Mimicry in Contemporary Indian English Fiction**	**Sandeep M. Ghutke**	**75**
19.	**Class, Identity and Human Relationship in Raja Rao's *Kanthapura***	**Mr. Tryambak Ganeshrao Bobade**	**80**
20.	**Impact of Climate Change on Agriculture in Vidarbha Region**	**Praful S. Chavhan**	**84**
21.	**A Pilot Study on Organizational Management Practices of Maratha Vidya Prasarak Samaj (MVP), Nashik and Contribution of the institute to the Socio-Economic Development of Nashik District**	**Seema Manikrao Jadhav Dr. Varsha N. Bhabad**	**88**
22.	**Diet and Health of Tribal Women: A Study**	**Miss. Rupali Sureshrao Kale (Bhamburkar)**	**92**
23.	**From Financial Literacy to Financial Action: A Study of Money Management Behaviour among Private Sector Women Employees**	**CA Arati Rohit Patil Dr. Prashant Patil**	**94**
24.	**Role of Women Entrepreneurship in the Economic Development of India**	**Dr. V. L. Bhangdiya Dr. Komal S. Taori**	**100**
25.	**AI Transformation in India: Enhancing Efficiency and Shaping the Future of Accountancy and Commerce**	**Mr. Pranav Pradip Bagwe**	**103**
26.	**Skill-Based Education under NEP 2020: An Economic Perspective**	**Dr. Kailas D. Landge**	**108**
27.	**"An Analytical Study of India's Industrial and Economic Sectors: Current Trends, Challenges, and Emerging Opportunities"**	**Dr. Nishant Diliprao Wadghule**	**112**
28.	**AI-Enabled Knowledge Integration and Global Agribusiness Frontiers: Transforming Farmer Producer Companies in India**	**Mr. Sagar Vishwas Sandhan**	**117**
29.	**A Prudence of Cultural Plurality in George R.R. Martin's *A Song of Ice and Fire***	**Sudhir Deoman Dube**	**125**
30.	**A Study of Mother Lullabies As Expressions of Pain, Love or Lived Experience in Maharashtra and Konkan**	**Pratiksha Shyamsundar Nathe**	**129**
31.	**Induced Variability in Protein Content of Soybean**	**Sonune N. S. Mahamune S. E.**	**133**
32.	**Carbon Nanotubes : Synthesis, Properties and Applications**	**Rohini Chandrakant Ghante**	**137**
33.	**Linear Algebra in Artificial Intelligence: Theory, Applications and Emerging Innovations**	**Mr. Amit Ankush Nalavde**	**141**
34.	**Phytochemical Screening and Ethnobotanical Utilization of *Nathulina candida* from Tribal Communities of Chikhaldara Region in the Landscape of Melghat Forest**	**Akash G. Dhotre Dr. R. S. Dhande**	**146**

35.	**GC-MS Profiling of Ethanolic Extracts of Root, Phylloclade and Flower of *Pereskia grandiflora* Pfeiff. and *Echinocactus grusonii* Hildm. (Cactaceae) from Amravati Region, Maharashtra, India**	**Mrs. Apurva Anil Chunade Dr. P. N. Pawade**	**149**
36.	**Community Structure of Benthic Fauna at A Selected Site of A Tropical River System in Maharashtra, India**	**Deepshri Vijay Soni Dr. Vijay Bhimrao Bhagat**	**155**
37.	**Evaluation of Phenolic Compounds in Ethanolic Leaf Extract of Cayratia trifolia (L.) from Amravati District, Maharashtra Using Gallic Acid and Quercetin as Marker Standards**	**Padghan G. A Jadhao K. D**	**161**
38.	**Rational Design and Antimicrobial Screening of New Chalcone Derivatives**	**Dr. Prashant Gotmare Dr. Gajanan Ingle Dr. Sanjay Kolhe**	**164**
39.	**Digitization and Quantitative Analysis of Ethnobotanical Knowledge Using Diversity Indices and GIS Mapping from Akot Tehsil Forested Terrain, Maharashtra**	**Dr. SumitKumar Laxmanrao Mirge**	**168**
40.	**Transforming Higher Education through Artificial Intelligence: Pedagogical Innovation, Ethical Challenges and Sustainable Educational Futures**	**Dr. Nutanvarsha P. Deshmukh**	**173**
41.	**Novel Heterocyclic Drug Designs and Antimicrobial Screening in the Era of AI**	**Dr. Gajanan Ingle Dr. Prashant Gotmare Dr. Sanjay Kolhe**	**177**
42.	**Internet Of Things (IoT) and Smart Systems**	**Trupti Gopal Umbarkar**	**181**
43.	**The Impact of Digital Marketing and E-commerce Ecosystems on Contemporary Consumer Behavior: A Strategic Analysis**	**Mr. Sanket Digambar Punwatkar**	**183**
44.	**Women-Led MSMEs and Their Contribution to Socio-Economic Development: A Study of Khamgaon Taluka in Maharashtra**	**Rushikesh Subhash Bhagwat**	**187**
45.	**Understanding Queer and Gender in Historical and Contemporary Perspectives**	**Mr. Ishan Arun Rane**	**191**
46.	**Micro, Small and Medium Enterprises (MSMEs) and Economic Development** (A Special Reference to Madhya Pradesh)	**Mrs. Vibhuti Soni Dr. Rakesh Mathur**	**196**
47.	**Customer Loyalty in E-Commerce Platforms: A Study with Special Reference to Ichalkarnaji City**	**Mrs. Aditi Avdhut Dhokare**	**202**
48.	**Medieval Archaeological Heritage: The Tomb of Malik Ambar and Its Architectural Significance**	**Dr. Yassar Kaleem Ahmad Siddiqui**	**208**
49.	**Seasonal Prevalence and Species Diversity of Ixodid Ticks Infesting Livestock in Akola District, Maharashtra (India)**	**Ku. Pratiksha P. Aghadate**	**214**

50.	**Running Head: Vasudhaiva Kutumbakam and Global Harmony Vasudhaiva Kutumbakam: Philosophical, Socio-Cultural, Economic and Ethical Perspectives for Global Harmony and Sustainable Development**	**Dr. Anubha Pundir Dr. Gayatri Guruvendra Vishal Chabbra Akshaya Chauhan**	**216**
51.	**Ecology and Resistance: An Ecocritical study of Arundhati Roy's Works**	**Dr. Narendra T. Mane Nikita P. Sawarkar**	**219**
52.	**Phytochemical Investigation of the Leaves of *Abutilon indicum (Linn)***	**Tomar Anulika Dhande Ravindra**	**224**
53.	**Synthesis of Phenyl Thio Carbamide from Substituted Amine and It's Physical Aspects**	**Aarti G. Shende Aditya D. Joshi Dr. S. V. Kolhe**	**227**
54.	**Economic Transformation in India: Policies and Outcomes**	**Dr. Gajanan Ingle Dr. M. K. Nannaware**	**231**
55.	**Use of Artificial Intelligence in the Teaching of English Literature**	**Gaurav Ashokrao Thombre**	**234**
56.	**Research-Oriented Transformation of Statistics Education under NEP–2020: Opportunities and Emerging Challenges**	**Abhay Mahesh Tayde**	**238**
57.	**Fragmented Realities: Memory, Violence and the State in Arundhati Roy's Narrative Aesthetic**	**Dr. Rahul S. Sudke**	**244**
58.	**Artificial Intelligence Research for Classroom Integration of A Literature**	**Dr. Umesh Yashwantrao Gangurde**	**247**
59.	**Emerging Trends in Pure Mathematics: Contemporary Developments and Future Directions**	**Kuldeep Arun Waghmare**	**251**
60.	**Synthesis and Elemental Characterization of Benzil Derivative Compounds Derived from Substituted Benzaldehyde**	**Aditya D. Joshi Gopal S. Bharambe Dr. Sanjay V. Kolhe**	**255**
61.	**Study on "Impact of Social Influence and Income factor with regards of Gender Difference on online Purchasing Decision"**	**Miss A. A. Chougule**	**259**
62.	**Impact of Artificial intelligence on Microfinance institutions with Special reference to "DAY-NULM" Scheme**	**Miss. Sony Harishkumar Mirchla Dr. Devendra N. Vyas**	**263**
63.	**Photovoltaic Performance of Polyaniline–TiO_2 Nanocomposite Photoanodes Sensitized with N719 Ruthenium Dye**	**Nikita Subhash Jaiswal Sanjeev Jagtap**	**266**
64.	**Cross-Cultural Experience of an Expat in *Eight Months on Ghazzah Street* by Hilary Mantel**	**Chaitali Meshram Dr. Rashmi Dubey**	**272**
65.	**Mathematical Modeling and Optimization of Hybrid Renewable Energy Systems for Industrial Applications**	**Vaishnav Digambar Nikas**	**275**
66.	**The Illusion of Understanding: Artificial Intelligence Hallucination and Epistemic Risk in Mathematics Education**	**Qazi Merajuddin Qazi Faheemuddin**	**282**

67.	**"Impact of Digitalization on Everyday Human Existence"**	**Mr. Krushna S. Dombale**	**284**
68.	**Reflection of Cross Cultural Elements as A Social Milieu in the Novels of Arvind Adiga**	**Rameshwar Samadhan Saykhede Dr. Rahul S. Sudke**	**288**
69.	**Insights into Flowering Phenology and Floral Dynamics of *Ruellia ciliatiflora* and *Thunbergia erecta***	**Ashwini Bhalchandra Phokmare**	**290**
70.	**Teaching English Language and Literature in the Era of Artificial Intelligence**	**Dinesh Kumar**	**293**
71.	**Improvement of Teaching Methods with AI Knowledge and Pedagogical Expertise**	**Vedant P. Ghotkar**	**297**
72.	**Universal Humanism and Harmony in Togore's Art**	**Dr. Maruti B. Gouda**	**300**
73.	**Green Chemistry for Sustainable Industrial Development: Recent Advances and Future Perspectives**	**Prof. Trupti Chaware (Ingle) Dr. Gajanan Ingle Dr. Sanjay Kolhe**	**303**
74.	**Reimagining English Language Teaching in the Age of Artificial Intelligence: Emerging Perspectives for Undergraduate Education**	**Gajanan Dayaramji Tayade**	**307**
75.	**Ecological Significance and Ethnomedicinal Values of *Sterculia urens* Roxb.: A Review**	**Vaishnavi R. Raut Dr. Sumitkumar L. Mirge Dr. Santosh N. Patole**	**313**
76.	**AI-Driven Transformation of Labor Productivity and Manufacturing Workflows in India: An Empirical Analysis**	**Mr. Ganesh Raviraj Sutawane**	**315**
77.	**Green Synthesis of Co-Zn-Ni Trimetallic Oxide Nanoparticles using Cicer Arietinum leaf extract and their Antibiofilm Activity: Experimental and Computational Study**	**Prof. Srushti Narendrarao Deshmukh**	**318**

Education and Psychology

Sumit Balkisan Rathi
Asst. Prof.(CHB) at Adv. R. R. Law College, Washim.

Abstract:

Educational psychology is a crucial, applied discipline that bridges the scientific study of human mind and behavior with the practical processes of teaching and learning. It focuses on understanding cognitive, social, emotional, and moral development to enhance educational outcomes within diverse environments. By applying theories of learning, such as constructivism and behavioral psychology, this field helps educators address individual differences in intelligence, motivation and learning styles. Educational psychologists examine the learner, the learning process and the learning situation, including the impact of environmental contexts. Furthermore, it provides essential tools for guiding students, managing classrooms and developing tailored instructional strategies. It is an indispensable, evolving field that supports both student success and teacher effectiveness by fostering a deeper understanding of how individuals acquire and retain knowledge.

Keywords:- Educational Psychology, Consciousness, cognitive, individual difference, aptitude, creativity, personality, values.

Concept of Education and Psychology

Human life is two aspects the biological and the sociological. While the biological aspect of human life is maintained and transmitted by nutrition and reproduction, the social aspect of human life is maintained and transmitted by education. Man is distinguishable from the lower animals because of his educable ability. He is endowed with intelligence; he wants to remain active, energetic and even original. The list of human achievements is very big. How has all this been done? through education. The concept of education is like a diamond which appears to be of a different colour (nature) when seen from different angles (point of view or philosophy of life). The reason for different interpretations/definitions to education, are,

- The complex nature of human personality
- Complex nature of environment
- Different philosophies of life
- Different educational theories and practices.

The Education Commission (1964-66), the very aptly began its report with these words, "the destiny of India is now being shaped in her classrooms". The NPE (1986) also observed, "The country has reached a stage in its economics and technical development when a major effort must be made to derive the maximum benefit from the assets already created and to ensure that the fruits of change reach all sections. Education is the high way to the goal. According to thinkers in ancient India, Vidya / Knowledge / learning / education was considered the 'third eye' of man, which gives him on insight in to all affairs and teaches him how to act; it leads as to our salvation in the mundane sphere, it leads us to all round progress and prosperity.

Definitions of Education

1. "Building of human mind and spirit" - Sri. Anrobindo Ghosh (1872-1950)
2. "Helping the individual to flower greatly in love and wisdom" - Jidhu Krishnamurti
3. "Enabling an individual to win victory over the five enemies-lust, anger, greed, infatuation and ego. (kam, krodh, Lobh, Moh, Ahankar)" - Guru Nanak (1469-1539)
4. "Training the intellect refinement of the heart and discipline of the spirit". - Dr. S. Radhakrishnan (1888-1975)
5. "Purification of the mind and the heart" - Rama Krishna Paramahamsa (1836-1886)
6. "Manifestation of the perfection already in man" - Swami Vivekananda (1863-1902)

Some great western thinkers on education

1. 'Developing the body and the soul of all the perfections which they are capable of' - Plato (427-347 BC)
2. 'Developing four qualities in child-courage, intelligence, sensitiveness and vitality' - Bertrand Russell (1872-1970)
3. 'Creation of a sound mind in a sound body' - Aristotle (384-322 BC)

Mahatma Gandhi remarked, 'By education I mean all-round drawing out of the best in the child and man-body, mind and spirit. Literacy is not the end of education nor even the beginning. It is one of the means whereby man and women can be educated. Literacy in itself is no education".

Functional and operational definition of education

Education is a process which draws out the best in the child and adult with the aim of producing well balanced personalities: culturally refined, emotionally stable, ethically sound, mentally alert, morally upright, physically strong, socially efficient, spiritually upright, vocationally self sufficient and internationally liberal.

Psychology

Psychology is a combination of two words psych means soul and logos means science. During the development of psychology it go through different meanings like science of soul, science of mind, science of consciousness and science of behavior. Let us look in that journey of psychology. ·

Psychology as a Science of Soul: Greek philosophers Plato and Aristotle considered psychology as a science of soul. During these time psychology is one of the branch of philosophy. The nature of soul could not be defined in this time. ·

Psychology as a Science of Mind: Immanuel Kant, a German philosopher one of the proponent of this view. He failed to give an exact description to mind. Therefore this view did not get acceptance for long time. ·

Psychology as a Science of Consciousness: During 19th century, William Wundt and William James, argue that psychology is a science of consciousness. But if we consider psychology as a science of consciousness we neglecting the other parts of mind like sub conscious and unconscious.

Psychology as a Science of Behaviour: During 20th century psychology deemed in the place of a pure science. J.B. Watson is one of the major contributor for the same.

R.S. Woodworth commended on the changes of definitions of psychology: "First psychology lost its soul, then it lost its mind, then it lost its consciousness, it still has behaviour of a sort".

Definitions

Educational psychology deals with the problems, process and products of education ·

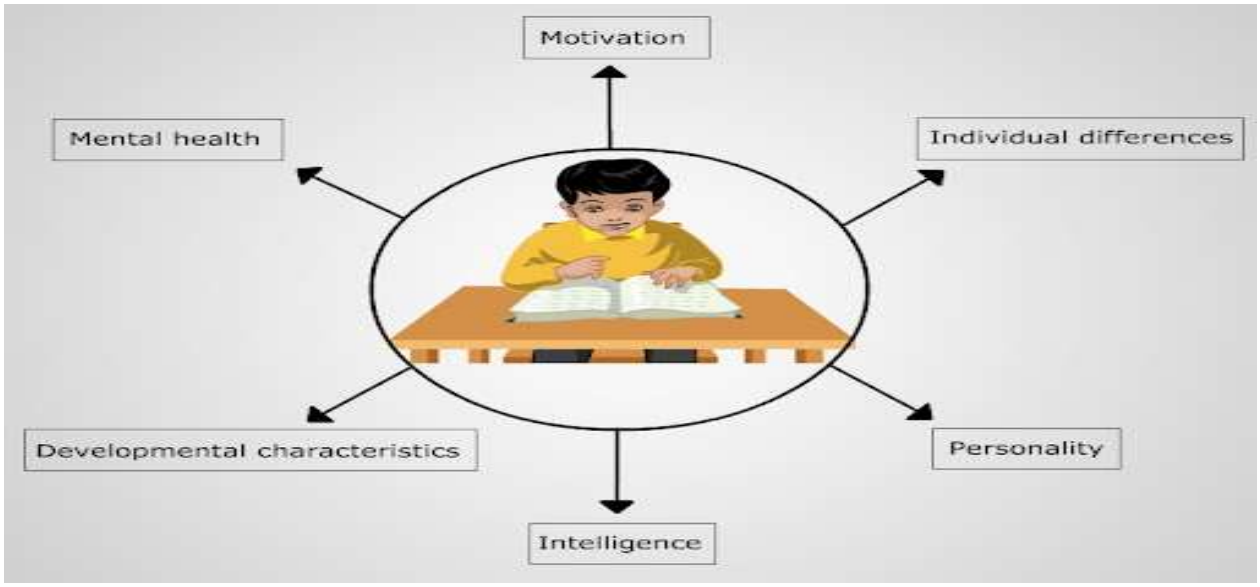
Skinner : "Educational psychology is that branch of psychology which deals with teaching and learning" ·

Crow and Crow- : "Educational psychology describes and explains the learning experiences of an individual from birth through old age" ·

Peel : "Educational psychology is the science of education" ·

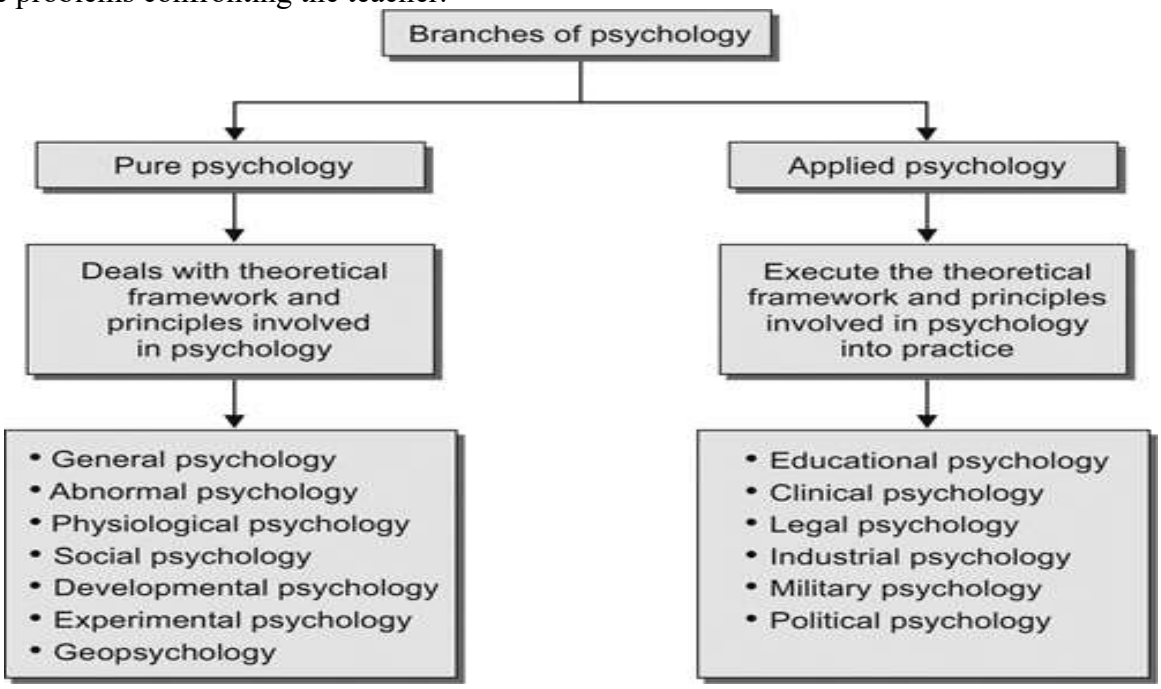
Nature and Scope of Educational Psychology

Educational psychology, the applied behavioural science, uses the principles and techniques of psychology and employs scientific methods and scientific approaches. It influences all the theories and practices of education, hence it is "the science and technology of education." **Kurt Koffka** says: "Psychology is the scientific study of behaviour of living creatures in their contact with the outer world.



Meaning of Educational Psychology

Psychology is intimately connected with education. It is inseparable. Psychology is the study of human behaviour and education is the process of modifying human behaviour. Educational psychology deals with human behaviour and its modification through learning. Educational psychology is concerned with the application of principles and techniques of psychology to solution of the problems confronting the teacher.



Contributions of Educational Psychology to the theory of education

- To understand developmental characteristics (Infancy, Childhood, Adolescence).
- To understand the nature of classroom learning.
- To understand individual difference.
- To understand effective, teaching methods ·
- To understand problems of children ·
- Knowledge of mental health i.e., ill health, mal-adjustment etc.
- Curriculum construction ·
- Measurement of learning outcome (Psychological tools, Evaluate teacher performance)
- Research (Research studies in the classroom teaching)

- Guidance for the education of exceptional children. ·
- Helps to develop positive attitude ·
- Understanding group dynamics

Contribution of Educational Psychology to the Practice of Education ·

- Problem of discipline ·
- Use of AV Aids ·
- Democratic administration ·
- For scientific Time table construction
- Co-curricular activities ·
- Use of innovations like activity centered, learner centered teaching
- Production of textbooks.

Objectives of Educational Psychology

1. To provide teachers with some basic skills related to teaching
2. To give teacher's guide lines to solve problems of teaching/learning process
3. To help teachers to understand the scientific knowledge
4. To instill in teachers a spirit of inquiry for their professional growth.

Limitations of Educational Psychology

- Not a accurate/pure science
- Individual difference-not practicable to all situations/individuals
- Performance of human beings varies from time to time
- Most of the psychological experiments conducted in animals.
- Success of teachers work depends on natural aptitude and experience and personal interaction.

Relationship of Education and Psychology

Psychology acquired separate status very recently. Formerly it was studied as a sub-branch of philosophy. William Wundt is considered as the father of experimental psychology. The roots of Psychology could be traced back in philosophy and science.

When physiologists of the late nineteenth century began to use scientific methods to study mind, later on Psychology became an independent scientific discipline.

Scientific Roots of Psychology:

By nineteenth century, psychologists were progressing than philosophers in answering questions about the nature of psychological processes.

Stephen says, "Educational Psychology is the systematic study of the educational growth and development of a child". Some psychologists called psychology as a branch of education, as James Mill implied in the early nineteenth century. However, some other psychologist disagree with them, who were familiar with the history of psychology and continuing, links between psychology and education. They defend it with the comparison of historical and contemporary relationship between education and psychology. One question, which is frequently asked that a field like psychology, which is divided within self, could be used and applied constructively to a practical field like education.

Why we study psychology in education?

It is very essential for a teacher to teach his students according to their mental abilities. Educational psychology helps the teacher in doing so. It enables the teacher to teach where and how. Psychology gives education the theory of individual differences that every child has different mental ability and learns with different pace. Today in modern era, education psychology is the foundation of education. Psychology effect education in every field of teaching learning process.

Human Behaviour as a common subject for both Education and Psychology ·

- Psychologist suggest use of different methods in teaching learning process to achieve better result ·
- Psychologist emphasis on motivation and readiness in class room ·
- Psychology introduce new theories of learning in education ·
- Psychology emphasis on activity base teaching learning process ·

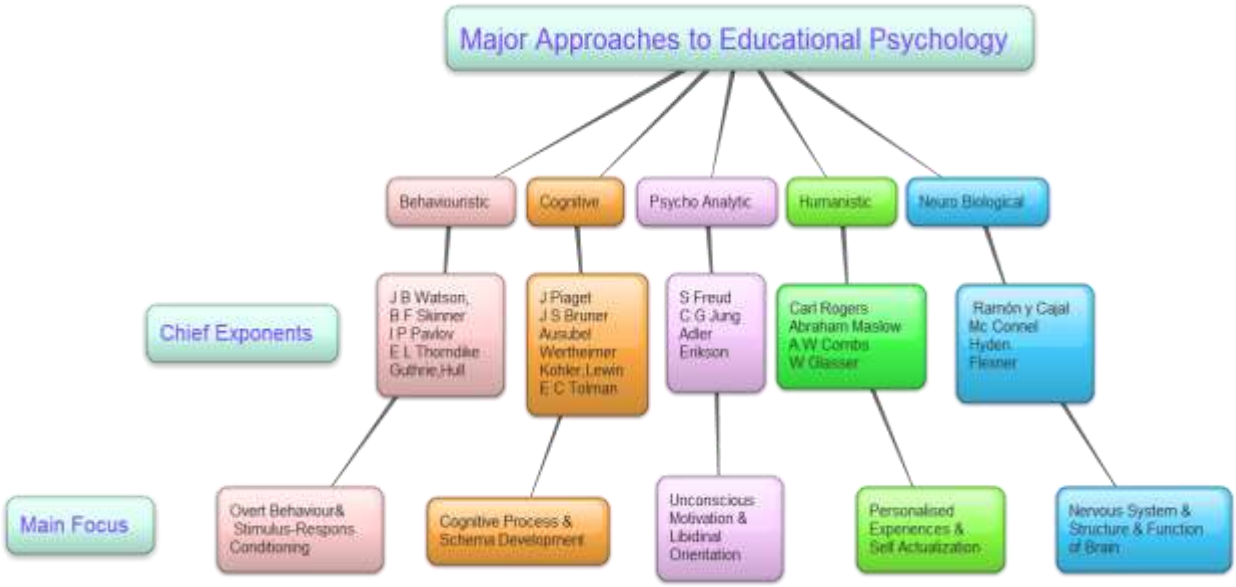
- Use of audio-visual aid in teaching learning process ·
- Psychology is the study of human behaviour while Education is the process of modifying human behaviour so both deal with human behaviour in different ways.
- Educational psychology deals with educational problems
- General psychology deals with different problems other than education.

Psychology as 'Science of Behaviour'

J. B. Watson, the father of behaviouristic school of psychology, termed psychology as the science of behaviour. The meaning of education is modification of behaviour for one's adjustment. When we study the behaviour of the child and teacher in the educational situations, for solving educational problems, we take the help of educational psychology. The role of school is to help in harmonious development of the personality of the child. So it becomes the duty and task of the teacher to guide child according to psychological norms. Therefore, for every teacher study of psychology is an essential item. So we can say that educational psychology is application of psychology and its principles in educational situations. There is an inner link between education and psychology.

How far education and psychology are related to each other?

- Education is concerned with aims, ideals and standards of life and psychology determines whether these aims are attainable or not.
- Education demands the teacher to know the child as well as the subject matter of instruction, where the psychology helps to know about the child.
- Psychology also helps the teacher to teach effectively undertaking effective and appropriate teaching techniques.
- Psychology and Aims of Education: Psychology helps the educator in the realization of educational aims by helping him to bring out improvement in the quality of instruction by providing him ability and insight into the child's attitudes, ideas, aptitudes, interests and emotions etc.
- Psychology and Teacher: Psychology helps the teacher to understand the learner, learning process and the learning situations. Psychology states that teacher should have sympathetic and affectionate attitude towards the learner.
- Psychology and Methods of Teaching: Various methods of teaching like Project method, Heuristic method, Montessori Method, Play-way method are based on sound psychological principles.
- Psychology and Text Books: Psychology tells the teachers and the students that text books should be attractive, well illustrated and according to the mental level of the pupils.
- Psychology and Innovations: Psychology has made significant contribution by introducing innovative ideas for improving the process of teaching and learning such as - Activity-centred teaching, Micro-teaching (Dwight W. Allen), Programmed instruction (B.F. Skinner), Interaction analysis (Ned A. Flanders).
- Psychology and Audio-visual Aids: Psychology states that to develop interest among students, teacher should properly use audio-visual aids. Use of audio-visual aids makes the learning easy, interesting and effective.
- Psychology and School Administration: Psychology helps in solving problems of administration by mutual discussion among various agencies of school. It provides a scientific basis for the supervision of instruction.
- Psychology and Discipline: Psychology tells us the ways of dealing with problems of delinquent, backward, handicapped and gifted children and helps in maintaining discipline.
- Psychology and Evaluation: Psychological tools help the teacher to evaluate the achievement of the pupils and suggests improvements in examination.



Concept and Functions of Educational Psychology

Seven functions (what intended to do) of educational psychology are as follows:

1. The first function is to afford a thorough knowledge of the nature of the child.
2. The second function is to provide an understanding of the nature, aims, and purposes of education.
3. The third function is to acquire familiarity with the technical vocabulary (like motivation, feedback, readiness).
4. The fourth function is to provide a significant knowledge of the developmental process with particular emphasis upon the promotion, guidance, and control of mental and moral aspects in order that the nature of man maybe understood and his original endowments maybe used to develop his latent possibilities.
5. The fifth function is to present the theories underlying the measurement and evaluation of mental abilities, aptitudes, educational achievements, interests, and personality organization.
6. To present the principles and conclusions regarding the prevention of all types of mal-adjustments together with the approved practices for achieving satisfactory adjustments.
7. To inculcate in the prospective teacher the realization that the most essential purpose - character formation.

Dimensions of Human Diversity

Cognitive Abilities

The term "intelligence" is vague and ambiguous in its meaning. Psychologists have been interpreting the term in different ways and are in disagreement on the meaning of the term intelligence. In psychological literature, intelligence has been treated as a construct, no one knows what intelligence is. Due to the vagueness, in recent years concept of intelligence has become less acceptable and more exposed to criticism by psychologist but no two psychologists agree on a single definition of the term. There are two extremes between which 'intelligence' has been conceptualized the open view and narrow operational view. The open view is related with the popular or common sense concept whereas the operational view allows for a scientific precision and loss of some of the rich and polymorphous aspect.

Individual Differences in Intelligence:

Wide individual differences exist among individual with regard to intelligence. Truly speaking, no two individuals, even identical twins or individuals natured in identical environments, are enclosed with equal mental energy. The assessment of intelligence by various tests has given reason enough to believe that not only does intelligence vary from individual to individual but it also tends to vary in the same undivided from age to age and situation to situation.

Interest and Aptitude

The observable fact that people differ from one another and within themselves in their performance in one or other field of human activity such as leadership, music, art, mechanical work, teaching etc. Therefore in a simple way aptitude may be considered a special ability or specific capacity besides the general intellectual ability which helps an individual to acquire a required degree of proficiency or achievement in a special field.

"An aptitude is a combination of characteristics indicative of an individual capacity to acquire (with training) some specific knowledge, skill, or set of organized responses, such as the ability to speak a language, to become a musician, to do mechanical work" – **Freeman.**

Interest is a feeling of happiness or satisfaction is an inward sign of interest. Interest lead to effort and as stimulant for effort, interest is an important aspect in the process of Education. Writers have defined interests as of pre-occupation, objectives, likes and dislikes and motives. According to them the verbal expression of interests is an activity or occupation is expressed interest. Interest as evidenced by participation in an activity or profession is manifested interest.

Interest and the Curriculum: A teacher should know the interests of each pupil early in the school year. Instruction should begin at the point of interest of the child, and this cannot be accomplished unless these interests are known. The curriculum should be prepared according to the needs of children. How to make children interested in a particular learning activity? The important factors in learning/teaching process are the,

- Learners
- Learning Material
- Learning environment
- Method of teaching
- Teacher
- Fatigue etc

Aptitude

Aptitude is a condition, a quality or a set of qualities in an individual which is indicative of the probable extent to which he will be able to acquire under suitable training, some knowledge, skills or composite of knowledge, understanding and skill, such as ability to contribute to art or music, much crucial ability, mathematical ability or ability to read and speak a foreign language.

How Aptitude Differs from Ability and Achievement?

· Aptitude has a future reference.
· Aptitude tries to predict the degree of attainment in an area of activity.
· Ability concerns only the present condition.
· Achievement is part oriented.
· Achievement reflects on past and indicates what an individual has learned in a particular field.
· Aptitudes are innate ability but abilities and achievements are acquired

Creativity

Creativity is the forming of associative element in to new combinations which either meet new specific requirements or are in some ways useful. The more mutually remote elements of the new combinations, the more creative the process of solution. Creativity is the ability to produce novel and socially valued ideas and solutions is a distinct talent that requires divergent rather than convergent thinking. It is the ability to find out new relationship and to innovate. Creativity is the capacity or ability of an individual to create discover or produce a new or novel idea or object, including the rearrangement or reshaping of what is already known to him which proves to be a unique experience.

Personality

Personality is a term that has many general meanings. Sometimes the word refers to the ability to get along well socially. For example, we speak of experiences or relationships, which are said to give a person "more personality." The term may also refer to the most striking impression that an individual makes on other people. We may say, 'she has a shy personality'. To a psychologist,

personality is an area of study that deals with complex human behaviour, including emotions, actions, and cognitive (thought) processes. Psychologists study the patterns of behaviour that make individuals different from one another.

Values

It is widely agreed that the primary function of education of concerned with values. Education transmits cultural and social values to the children. Along with that education helps children to cultivate values. Social living is intertwined with moral evaluations and values. Moral values are moral exhibitions that are acceptable, cherished, appreciated and appraised by the members of any given society. These values include values like love, sharing, honesty, patriotism, loyalty, truthfulness and so forth. These values help the members of any given society to live in a peaceful way.

Conclusion

The relation between psychology and education is very intimate. Psychology has been defined as the science of behaviour. It seeks to understand and explain behaviour in terms of mental and bodily activities. Its chief problem is how and why we behave, how we Think, know, feel and act and why we think, know, feel and act in the way in which we do. It tries to understand the conditions from which acts of behaviour arise and to arrive at general principles which govern behaviour so as to interpret, control and predict it. Education, as we have seen above, is an attempt to mould and shape behaviour. It tries to help young people to grow and develop along certain lines, to acquire knowledge and skill and to learn certain ways of thought and feeling so that they may be absorbed in adult social life.

Reference:-

1) https://www.riyanbedcollege.com/elibrary/Education%20%20and%20Psychology%20-%20Dr.%20Ismail%20Thamarasseri.pdf

Exploring Emerging Perspectives, Knowledge Integration and Global Research Frontiers in the Era of AI

Dr. Jayaprabha Mahadeo Bhagat
Associate Professor
Smt. Salunkabai Raut Arts and Commerce College, Wanoja

Abstract

Artificial Intelligence (AI) is rapidly transitioning from an experimental tool to foundational infrastructure, acting as a "co-worker" that fundamentally redefines knowledge management (KM) and interdisciplinary research. This abstract explores the emerging paradigm shift towards agentic, multimodal, and neuro-symbolic AI systems (2025–2026), where generative models are increasingly combined with knowledge graphs to enhance reasoning, reliability, and contextual understanding

In today's digital landscape, Knowledge management (KM) is crucial for organisational competitiveness. Artificial Intelligence (AI) offers transformative potential for KM practices, yet its integration presents multifaceted challenges. This study addresses significant gaps in the literature by identifying and prioritising critical challenges associated with AI integration in KM. The study contributes to the field by comprehensively exploring AI-related challenges in KM, offering a quantitative ranking, and enhancing understanding of the AI-KM interplay.

The study highlights how AI reshapes international division of labour, where "basic AI" may displace routine knowledge work in emerging economies, while "sophisticated AI" deepens global offshoring patterns by increasing demand for complex human-AI problem-solving. Furthermore, we address the "black box" challenge, emphasizing the move toward explainable AI (XAI) and ethical governance as essential for trustworthy knowledge creation. Ultimately, this research provides a roadmap for navigating the "Intelligent Plus" era, where the convergence of AI with other emerging technologies necessitates new institutional strategies to ensure sustainable and equitable global progress.

Keywords: Knowledge Integration, Global Research Frontiers, Human-AI Collaboration, Explainable AI (XAI), Knowledge Management Systems (KMS), Physics-Informed ML.

Introduction:

In the rapidly advancing landscape of the 21st century, Artificial Intelligence (AI) has transcended its origins as a narrow computational tool to become a primary catalyst for global transformation. As we enter the era of Industry 5.0, the focus is shifting from simple automation to a human-centric collaboration where AI systems are no longer just data processors but active participants in the creation and management of knowledge. This introduction explores the emerging perspectives, the mechanisms of knowledge integration, and the evolving research frontiers that define the contemporary AI era. The "Era of AI" is defined by a paradigm shift from Information Processing to Knowledge Generation. Unlike previous industrial revolutions that automated physical labour, AI targets cognitive processes. The objective of this paper is to map how these technologies are integrating global knowledge silos and what new frontiers are emerging as a result.

Historically, AI was conceived to mimic human cognitive tasks such as pattern recognition and decision-making. However, the last decade has seen an exponential rise in AI capabilities, driven by breakthroughs in Machine Learning (ML), Natural Language Processing (NLP), and neural networks. Today, the global AI market is valued at hundreds of billions and is projected to exceed $1.8 trillion by 2030.

Emerging perspectives now emphasize "Hybrid Intelligence"—the synergy between machine efficiency and human judgment. Unlike previous technological revolutions that amplified physical capabilities, AI is redefining the very steps of scientific inquiry and intellectual work. Organizations are moving beyond "piloting" AI to fundamentally redesigning workflows, treating AI as an essential partner in innovation rather than a mere replacement for labour.

A core pillar of the AI era is its ability to facilitate Knowledge Integration (KI). Modern AI systems excel at transforming vast amounts of unstructured data—such as text, images, and speech—into structured, actionable insights. In organizational contexts, AI enhances Knowledge Management (KM) through several key mechanisms:

The integration of AI is not without significant hurdles. Algorithmic bias, where systems perpetuate historical prejudices found in training data, remains a critical concern. Furthermore, the "black box" nature of deep learning models creates a transparency gap, making it difficult for users to trust AI-driven decisions.

Globally, institutions like UNESCO and the European Union have introduced frameworks to ensure that AI development aligns with human rights and sustainability goals. The goal is to move from high-level principles to actionable policies that protect data privacy and ensure that the benefits of AI do not exacerbate existing global inequalities.

Objectives:

1. To Evaluate the shifting paradigms in AI research.
2. To Assess how AI facilitates the synthesis of unstructured data.
3. To Explore the global challenges of AI integration.

Emerging Perspectives: The Rise of Hybrid Intelligence:

The prevailing scholarly perspective has shifted from "AI vs. Human" to **"**Human-plus-AI."

- Cognitive Synergies**:** Modern research views AI as a "semantic partner" capable of identifying patterns in millions of papers that are invisible to the human eye.
- Democratic Innovation: With tools like Large Language Models (LLMs), the barrier to entry for complex data analysis has dropped, allowing researchers in the Global South to engage with high-level data synthesis previously reserved for well-funded labs.

Knowledge Integration (KI): Breaking Silos :

Knowledge Integration in the AI era is no longer a manual process.

- Cross-Disciplinary Synthesis: AI acts as a "universal translator" between fields. For example, AI is currently being used to apply structural biology models to material science, a process facilitated by the AlphaFold database.
- Dynamic Knowledge Bases**:** Organizational knowledge management has evolved from static wikis to Vector Databases and Retrieval-Augmented Generation (RAG) systems, which allow for real-time querying of a firm's entire intellectual history.

Global Research Frontiers

Three primary frontiers are currently defining the "edge" of AI research:

1. Neuromyotonic AI**:** Combining the "intuition" of neural networks with the "logic" of symbolic AI to solve the "black box" problem.
2. AI for Science (AI4S): The use of Physics-Informed Neural Networks (PINNs**)** to predict climate patterns and drug interactions with high fidelity.
3. Autonomous Research Agents**:** Systems that can autonomously hypothesize, design experiments and iterate based on results

Ethical Governance and Challenges

The integration of AI into global research introduces critical risks:

- The Transparency Gap: The difficulty in explaining *why* an AI reached a conclusion poses risks in medical and legal research.
- Regulatory Frameworks**:** Global standards, such as the EU AI Act, are now essential to ensure "Trustworthy AI" that respects data privacy and intellectual property.

While AI accelerates innovation, it introduces systemic "bottlenecks" that threaten the integrity of global research. Current literature identifies four critical challenge areas:

1. The "Black Box" & Transparency Gap

- The primary obstacle in knowledge integration is the **lack of explainability**.

- **Epistemic Trust:** Deep learning models often provide results without a traceable logical path. In high-stakes research like drug discovery or structural engineering, "black box" outcomes are difficult to verify [1].
- **The Hallucination Problem:** Large Language Models (LLMs) can synthesize "plausible but false" information, creating a significant risk for scientific literature integrity [2].

2. Data Sovereignty & "Knowledge Colonialism"

As we move toward a global research frontier, a **digital divide** is widening.

- **Resource Centralization:** High-quality training data and massive compute power are concentrated in a few Western tech giants, potentially marginalizing indigenous or non-Western knowledge systems [3].
- **Data Privacy:** Integrating sensitive healthcare or social data across borders faces legal hurdles from frameworks like the EU GDPR and the EU AI Act [4].

3. Algorithmic Bias and Scientific Neutrality

AI systems often mirror the biases present in their training data.

- **Systemic Bias:** If historical research data lacks diversity, AI-driven knowledge integration will perpetuate those gaps, leading to biased outcomes in social sciences and medicine [2].
- **Echo Chambers:** AI-driven citation and recommendation engines may prioritize "popular" research over "fringe" breakthrough ideas, narrowing the scope of global frontiers [1].

Conclusion:

The era of AI represents a fundamental restructuring of how we understand and utilize knowledge. By integrating diverse perspectives and pushing the boundaries of what machines can achieve, society stands at the threshold of unprecedented innovation. However, the successful navigation of this era requires a balanced approach that prioritizes ethical integrity and human-AI synergy.

The era of AI offers a historic opportunity to integrate the world's fragmented knowledge. However, the "frontier" is not just technological; it is social and ethical. To truly advance, the global research community must prioritize open-source collaboration and ensure that AI-driven insights remain transparent and human-centric.

The findings highlight that 2026 will be a pivotal year for the operationalization of AI at scale, transitioning from novelty to embedded intelligence. Ultimately, the integration of AI into research and organizational knowledge processes is redefining the role of researchers, requiring a new focus on human-AI collaboration to foster sustainable, ethical, and inclusive innovation

References

1. Stanford University. (2025). AI Index Report 2025.
2. European Commission. (2024). The EU AI Act.
3. UNESCO. (2024).
4. Nature: The challenges of AI in scientific research
5. EU AI Act Compliance Porta
6. UNESCO Recommendation on the Ethics of AI

A Review Technology Innovations Towards Value-Added Applications of Bamboo with an Emphasis on Generating Income and Employment, Especially in the Rural Areas

Dr. Suchita W. Dighe
Shri Pundlik Maharaj Mahavidyalaya, Nandura (Rly) Dist. Buldana

Abstract

Bamboo has gained considerable importance recently as a structural material. Bamboo can substitute not only wood, but also plastics, steel, cement and other materials in structural and product applications through improvements in processing technologies, product innovation with the application of scientific and engineering skills. Bamboo is remarkably varied and adaptable with a wide range of anatomical, structural and chemical properties. All of the bamboo plant, from rhizome and root to culm and leaves is utilized-there are nearly two thousand recorded uses.

The sector has vast potential for generating income and employment, especially in the rural areas. Towards promoting the usage of bamboo into value-added products, the National Mission on Bamboo Applications has been a major initiative by the Govt. of India under the 10th five year Plan. Primary processing of bamboo i.e. cross-cutting, splitting, knot removal, sliver making, strip making and round stick making may be carried out at rural cluster zones.

After primary processing of bamboo, a lot of waste is generated. This waste may be effectively converted into value-added products such as activated carbon, charcoal etc. Efforts are underway for converting bamboo into usable form of energy by gasification. These gases can replace diesel up to 70% thus catering to energy needs (Tripathi, 2008). The by-products of biomass gasification in the forms of volatiles are rich sources of chemicals. The conversion of bamboo waste into charcoal is also being explored for catering to rural energy needs. The low-cost technology could be taken up for commercial production particularly in rural areas. This review paper discusses in detail about the properties and application of bamboo as wood, primary and secondary processing of bamboo and preservation of bamboo. The paper brings out technology overview of the products and associated business opportunities.

Keywords

Bamboo, Composite, Green Grass, Poaceae, value-added products,business opportunities

Introduction

Bamboo is a grass, the most diverse group of plants in the grass family. It belongs to the sub-family Bambusoidae of the family Poaceae (Graminae). Millions of people depend on it for their livelihood and for household and functional uses. In return, communities have nurtured and protected bamboo and are repositories of vast knowledge and skills related to the propagation, processing and usage of bamboo. They are among the fastest growing plants on the planet. For most purposes bamboo can be harvested in 2-3 years, making it a truly renewable resource. Bamboo contributes to the soil and environment, giving back as much as it takes. A pivotal element in the balance of oxygen and carbon dioxide in the atmosphere, bamboo produces 30% of its volume in biomass. Its unique root and rhizome structures act as binders, controlling erosion and rejuvenating soil.

Bamboo has many new uses too, developed through the application of science and technology. It can substitute technologically and commercially not only wood, but also plastics, steel and cement and composite materials in structural and product applications through improvements in processing technologies, product innovation and the application of scientific and engineering skills (Ray et al., 2005).

Bamboo: The Indian context

Bamboo grows profusely in the North East, which accounts for almost two-thirds of growing stock and considerable variety. Bamboo occurs in major concentrations as well in the Himalayan foothills, the Western Ghats and wide swathes of central, peninsular and northern India, as well as in

the Andaman and Nicobar islands. Four fifths of the growing stock comprises of three species: Dendrocalamus strictus (53%), Bambusa arundinacea (15%) and Melocanna bambuisodes (15%). Most Indian bamboo is sympodial (clump forming); the singular exception is Phylostacchus bambuisodes, cultivated by the Apa Tani tribe on the Ziro plateau in Arunachal Pradesh.

Bamboo is currently in the process of being 'rediscovered' in India. Its attributes and potential are increasingly recognised. Bamboo has much to do with people. In many parts of the country the use of bamboo is ubiquitous. With communities putting the material to aesthetic yet functional use, their skills having evolved over centuries of usage. People are also repositories of knowledge, which can be extremely useful for the development of the sector. The sector has vast potential for generating income and employment, especially in remote areas and amongst communities, which have tended to be economically and socially disadvantaged.

The expectation is that bamboo can be an important vehicle for sustainable and widespread development, augmenting economic opportunity, income and employment, in particular in relatively underdeveloped areas. Bamboo is an eco-friendly alternative to many currently used materials. It is a material that lends itself easily to simple processing technologies. At the same time it is capable of high-end and high-value products and applications. The development of diverse bamboo applications would have environmentally beneficial impacts, through substitution and conservation of timber resources and enhancement of green cover.

Applications of Bamboo

Subsequently to the implementation of bamboo mission by Government of India, many applications has been identified.

Bamboo strip based products

The list includes the following:

a) Bamboo Wood [Laminates]

b) Bamboo Flooring Tiles

c) High Density Transport Flooring

Bamboo in round/split/composite form

The product list includes

a) Bamboo Based Housing System

b) Bamboo Match Splint

Bamboo mat based products

The details of these products are given hereunder.

a) Bamboo mat board (BMB)

The use of any new material depends on its suitability compared to the materials currently in use for different applications. In the adoption of any new content, the creation of suitable application technology plays a significant role. BMB is basically a composite layer consisting of many layers of woven mats with excellent inner bond strength and is resistant to rot, insects and termite attachment.

b) Bamboo mat veneer composite (BMVC)

Wood veneers are placed in between the layers of bamboo mats in BMVC. The properties of BMVC depend, in addition to the properties of the bamboo mats and the adhesives used in bonding, on the mechanical properties

c) Bamboo mat corrugated sheets (BMCS)

The corrugated sheets are used to manufacture products moulded by bamboo mat such as trays to increase BMB rigidity, roofing materials such as asbestos cement corrugated sheeting (ACCS), corrugated fiber reinforced plastics (CFRPs), corrugated aluminum sheeting (CAS), corrugated galvanized iron sheeting (CGIS), etc.

d) Bamboo mat moulded products (BMMP)

In order to improve the appearance and acceptability of customers, these items are then finished with coating materials. The moulded items have been found to be very robust and leak-proof, which can be used for various applications.

e) Bamboo mat moulded skin boards (BMMSB)

Hard boards for making Hollow core flush doors are currently being imported for high density or medium density. Bamboo Mat Molded skin board is an alternative material for making imported into the world.

f) Bamboo mat ridge cap

The item is dimensionally stable, fire resistant, non-permeable, boiling water proof, anti-termite and weather resistant and compatible with bamboo mat corrugated sheet, both environmentally and human-friendly. Existing bamboo mat corrugated sheet production units can transform one of the daylights into a hydraulic hot press with a specially built die size of 2.4 m × 0.43 m for the normal production of bamboo mat ridge caps.

a) Bamboo wood (Laminates)

For bamboo-based products, one of the most promising areas of application is as a wood substitute. These include laminate, flooring, panels, particleboard, corrugated roofing, false ceiling, insulation material, chipboard, wafer board, woven mat-board, bamboo ply-substitutes and veneer, boards of different descriptions and uses. In certain ways, bamboo is stronger than wood and compares favorably with even teak and other hardwoods on essential criteria. In many applications, bamboo laminates can replace the use of timber, mainly in construction.

b) Bamboo flooring

Bamboo flooring is a premium product that has a large global consumer market. It has advantages over floors made of wood from trees due to its smoothness, brightness, stability, high resistance, insulation qualities and exibility. Bamboo flooring has a soft natural lustre and maintains the natural gloss and elegance of the bamboobre.

Bamboo in round/split/composite form

For the development of compregs and shutter grade frames, imported timber is currently used. Indian Railways alone are rising several folds of the compregation requirement as the emphasis is now on the use of high-strength materials in coach construction. The factories are currently dependent on imported timber for the raw materials and the product to be produced is also very costly.

a) Bamboo sticks for blinds and incense industry

India is not new to the art of making screens and blinds from bamboo. People have woven elegant bamboo screens for decades, which have offered anonymity, sun protection and added aesthetic appeal to living spaces.

b) Bamboo furniture

Traditional bamboo furniture uses natural round or split bamboo. A new type of 'pack-flat,' 'knockdown' furniture uses glue-laminated bamboo panels. Unlike the traditional design, the new design overcomes many of the problems of traditional bamboo furniture, such as high labour and transportation costs, low productivity, instability, varying quality and susceptibility to insects and fungi. At the same time, it retains the distinct physical, mechanical, chemical, environmental and aesthetic features of bamboo. Export of laminated bamboo furniture is growing rapidly. However, trade statistics currently do not capture the value, owing to the absence of a special code for bamboo furniture. It is usually classified as wooden furniture.

Industrial products

Bamboo's industrial goods basically involve the conversion into fuel or electricity by gasification. Bamboo can be processed into three useful items by pyrolysis - bamboo charcoal, oil and gas. Depending on the intent and market conditions, changing the pyrolysis parameters will change product shares. Bamboo-based production gases may be used as a petroleum alternative. Bamboo charcoal is a perfect barbecue and cooking fuel. The use of activated charcoal can also occur. This is used as a waste and unnecessary moisture deodorant, purifier, disinfectant, medication, farm

chemicals and absorber. Industrial usage includes the use of bamboo waste for gasification and hence producing electricity.

Bamboo for paper and pulp

Bamboo is used in paper and pulp in many bamboo producing countries, such as China, the North Eastern Region and India. Bamboo paper has almost the same consistency as wood-based paper. Its luminosity and optical properties remain stable, while those of wood-based paper can deteriorate over time (World bamboo resources.

Bamboo charcoal for fuel

Bamboo charcoal is traditionally used as a substitute for wood charcoal or mineral coal. It can serve as a fuel, absorbent and conductor. The calorific value of bamboo charcoal is almost half that of oil of the same weight. Activated bamboo charcoal can be used for cleaning the environment, absorbing excess moisture and producing medicines.

Bamboo based gasifier for electricity

It is possible to provide energy and a variety of useful by-products by bamboo gasification. A commitment to renewable and sustainable power and thermal energy is being reinforced. It can take advantage of waste produced by processing activities, substitute the use of fossil fuels and reduce operating costs. The bamboo can be cut into small pieces in the gasifier and used. A small proportion of the total availability is the requirements of the gasification machine.

Bamboo based fibre and fabric

The processing of fibre for the manufacture of yarn and various fabrics is a new development in bamboo. Apart from those mentioned above, bamboo extracts contain valuable elements which can also be used in many industrial products. For example, in pharmaceuticals, creams and beverages, bamboo can be used. Bamboo extracts are used in traditional medicines like Chawanprash.

Food products

Around 200 bamboo species can provide edible and palatable shoots of bamboo. In Chinese grocery stores and restaurants worldwide, bamboo vegetables can be found. The shoots are always crisp after cooking, as cooking doesn't destroy their texture. It is possible to store cooked bamboo shoots in containers and export them globally.

Construction and structural applications

Advances in structural engineering and the development of bamboo composites have opened new vistas for lightweight, durable and aesthetic construction for a variety of applications, enabling informed choices for housing, community and functional structures. Commonly used bamboo includes Bambusa balcooa, Dendrocalaimus B.brandisii, Dendrocalaimus giganteus, Dendrocalaimus hamiltonii, Dendrocalaimus strictus, Meloccana bambuisodes etc. Bamboo shoots available from D. tulda, D. hamiltonii, M. Bacifera (Muli) are also of good quality. Bamboo constructions are easy to build, resilient to wind and even earthquake forces and readily repairable in the event of damage. Associated products such as bamboo based panels and bamboo reinforced concrete also find applications in the construction process. In spite of these clear advantages, the use of bamboo has been largely restricted to temporary structures and lower grade buildings due to limited natural durability, difficulties in jointing, a lack of structural design data and exclusion from building codes.

Some species of bamboo have ultimate tensile strength same as that of mild steel at yield point and this coupled with other merits boosts the usage of bamboo as construction material. Bamboo needs to be chemically treated due to their low natural durability. It can be used in different ways for roof structure as purlins, rafters and reapers, for flooring, doors and windows, walling, ceiling, man-hole covers etc.

Bamboo trusses

The power of the bamboo is equal to that of teak and salt. An experiment with the construction and testing of a 4 m span truss made of round bamboo and various web-chord link jointing techniques yielded results that suited the strength of the timber.

Bamboo housing

Bamboo building construction is characterized by a structural frame approach similar to that applied in timber frame construction. In this case, the floor, wall and roof elements are interconnected and often one dependent on the other for overall stability. In certain conventional types of construction, in particular, there is a need to monitor lateral deformation. The adequacy and suitability of the building for occupancy would also rely to a great extent on good data, such as helping to avoid ingress of water and moisture, fungal attack and infestation of vermin. Furthermore, a bamboo house takes very little time for assembly. This becomes critical especially in times of disaster management, providing quick relief or rehabilitation.

Conclusion

Today's world calls for sustainability in its development. The requirement of biodegradable and natural origin is mandated primarily. While India has second largest bamboo resources in the world and many people are dependent on it for their livelihood, there is a substantial need to promote the utilization of bamboo to the extent possible. Value added bamboo products would have vast potential in generating income and employment, especially in the rural areas. The waste so generated could also be converted into value added products such as activated carbon etc. This indicates the utilization of bamboo to the fullest extent. Other aspects such as low capital investments, requirement of semi-skilled workers, abundant availability of raw materials locally etc. would merit attention in adopting the processing methodologies at rural level. The cost-effective composite products viz., FRP doors and doorframes are better alternatives to wooden products and these products are durable for long term usage. This low-cost technology of composites could be taken up for commercial production particularly in rural areas.

The standardization of bamboo structural goods represents the growing interest of society and policymakers and opens up new possibilities for sustainable industrial growth. While the production of standards and codes for bamboo products is booming globally, the increasing demand for goods based on bamboo needs to be addressed. Multilevel contribution will lead the growing economic and environmental interest on a sustainable material like bamboo and will be a key step towards the standardization of structural and engineered bamboo products.

"Artificial Intelligence and Entrepreneurship Development: Shaping the Future of Start-up Culture"

Dr. Mrunank Sharad Kalmegh
Assistant Professor, Bharatiya Mahavidyalaya, Morshi

Abstract

Artificial Intelligence (AI) has become an important force in the modern business world and is playing a major role in entrepreneurship development and start-up culture. This paper examines how AI is shaping the future of start-ups by improving innovation, decision-making, and business efficiency. AI tools help entrepreneurs analyse market trends, understand customer behaviour, reduce operational costs, and manage risks more effectively. As a result, start-ups are able to develop new ideas faster and compete in highly dynamic markets.

The study highlights the role of AI in supporting different stages of entrepreneurship, including idea generation, product development, marketing, and scaling of businesses. It also discusses how AI-based start-ups contribute to economic growth, employment opportunities, and the development of a strong start-up ecosystem. At the same time, the paper identifies key challenges such as lack of skilled manpower, high initial investment, data privacy concerns, and ethical issues related to AI usage.

The paper is based on secondary data collected from research articles, reports, and case studies. The findings suggest that effective use of AI can strengthen entrepreneurship development and encourage a sustainable start-up culture. The study concludes that policymakers, educational institutions, and entrepreneurs must work together to promote responsible and inclusive AI-driven entrepreneurship.

Keywords: Artificial Intelligence, Entrepreneurship Development, Start-up Culture, Innovation, Digital Entrepreneurship, Start-up Ecosystem

1. Introduction

Entrepreneurship plays a vital role in economic development by promoting innovation, creating employment opportunities, and encouraging wealth creation. In the present digital era, technological advancements have transformed traditional forms of entrepreneurship into technology-driven and innovation-based ventures. Among these technologies, Artificial Intelligence (AI) has emerged as one of the most influential tools reshaping business operations and entrepreneurial practices.

AI refers to the ability of machines and computer systems to perform tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and decision-making. Entrepreneurs and start-ups are increasingly using AI to analyze large volumes of data, automate business processes, and deliver personalized products and services. This transformation has led to the emergence of a new start-up culture that is fast, data-driven, and innovation-oriented.

The growing importance of AI has opened new opportunities for aspiring entrepreneurs by lowering entry barriers, improving access to information, and enabling scalable business models. At the same time, it has created challenges related to skills, ethics, and data security. This paper aims to study the role of AI in entrepreneurship development and analyze how it is shaping the future of start-up culture.

Start-up information

A start-up is an innovative business venture created to solve real-world problems using new ideas, technology, and creativity. Start-ups focus on growth, scalability, and customer-centric solutions rather than immediate profit. In today's digital age, start-ups play a vital role in economic development by generating employment, encouraging innovation, and promoting entrepreneurship. They operate in a dynamic and competitive environment where adaptability and continuous learning are essential. With the support of technology, government initiatives, and funding ecosystems, start-ups contribute to sustainable development and strengthen the overall business and entrepreneurial ecosystem.

2. Concept of Entrepreneurship Development

Entrepreneurship development refers to the process of enhancing entrepreneurial skills, knowledge, and attitudes among individuals to enable them to identify business opportunities and successfully establish and manage enterprises. It involves training, education, financial support, and policy initiatives that encourage individuals to become entrepreneurs.

Traditionally, entrepreneurship development focused on small-scale and medium enterprises. However, with the growth of digital technologies, entrepreneurship has evolved into knowledge-based and innovation-driven ventures. Modern entrepreneurship emphasizes creativity, risk-taking, adaptability, and technological competence. In this context, AI has become a key driver of entrepreneurial development by supporting informed decision-making and innovative business solutions.

Entrepreneurship development is essential for sustainable economic growth as it promotes self-employment, reduces poverty, and increases competitiveness. The integration of AI into entrepreneurship development programs can further strengthen entrepreneurial capabilities and improve business success rates.

3. Understanding Start-up Culture

Start-up culture refers to the values, practices, and working environment commonly associated with start-up companies. It emphasizes innovation, flexibility, experimentation, teamwork, and rapid growth. Start-ups are usually characterized by limited resources, high uncertainty, and a strong focus on solving real-world problems through innovative ideas.

In recent years, start-up culture has been strongly influenced by digital technologies and artificial intelligence. AI-driven start-ups focus on developing smart solutions in areas such as healthcare, finance, education, e-commerce, and logistics. These start-ups rely on data analytics, machine learning, and automation to improve efficiency and customer satisfaction.

A strong start-up culture encourages creativity, risk-taking, and continuous learning. AI supports this culture by enabling quick experimentation, predictive analysis, and real-time decision-making. As a result, start-ups can adapt faster to market changes and customer needs.

4. Role of Artificial Intelligence in Entrepreneurship Development

Artificial Intelligence plays a significant role in supporting entrepreneurship development by providing advanced tools and technologies that enhance business performance. AI assists entrepreneurs in identifying market opportunities, understanding consumer behavior, and improving operational efficiency.

AI-powered tools such as chatbots, recommendation systems, and predictive analytics help start-ups deliver personalized customer experiences. Machine learning algorithms enable entrepreneurs to analyze large datasets and generate valuable insights for strategic planning. Automation reduces manual work and allows entrepreneurs to focus on innovation and growth.

AI also supports entrepreneurship development through digital platforms, online learning, and virtual mentoring. Aspiring entrepreneurs can access AI-based training programs and business solutions at lower costs. This democratization of technology has expanded entrepreneurial opportunities across different regions and social groups.

5. AI Across Different Stages of Start-up Development

AI influences various stages of the start-up lifecycle, from idea generation to business expansion. During the idea generation stage, AI tools help analyze market trends and identify unmet customer needs. Entrepreneurs can use data-driven insights to develop innovative business ideas.

In the product development stage, AI supports design, testing, and quality improvement. Machine learning models help predict customer preferences and improve product features. In marketing and sales, AI enables targeted advertising, customer segmentation, and demand forecasting. During the growth and scaling stage, AI assists in resource planning, supply chain management, and risk assessment. Predictive analytics helps start-ups make informed decisions and manage uncertainty effectively. Thus, AI plays a continuous and integrated role throughout the entrepreneurial journey.

6. Impact of AI-Based Start-ups on Economic Development

AI-based start-ups contribute significantly to economic development by promoting innovation and productivity. These start-ups create high-skilled employment opportunities and encourage knowledge-based economic growth. AI-driven solutions improve efficiency across industries and enhance competitiveness.

Start-ups using AI also attract domestic and foreign investment, contributing to capital formation. They support the development of a strong start-up ecosystem by collaborating with incubators, accelerators, and research institutions. In emerging economies, AI-based entrepreneurship can help address social challenges such as healthcare access, education quality, and financial inclusion. By encouraging innovation and entrepreneurship, AI-based start-ups play an important role in building a sustainable and inclusive economy.

7. Challenges of AI in Entrepreneurship Development

Despite its benefits, the adoption of AI in entrepreneurship development faces several challenges. One major challenge is the lack of skilled human resources with expertise in AI technologies. Many entrepreneurs struggle to find trained professionals and afford advanced AI solutions.

Data privacy and security concerns are also significant issues. Start-ups handle large amounts of customer data, which increases the risk of data misuse and cyber threats. Ethical concerns related to algorithm bias, transparency, and accountability further complicate AI adoption.

High initial investment costs and limited access to funding also restrict the growth of AI-based start-ups, especially in developing economies. Addressing these challenges is essential for promoting responsible and sustainable AI-driven entrepreneurship.

8. Policy and Institutional Support for AI Entrepreneurship

Government policies and institutional support play a crucial role in promoting AI-based entrepreneurship. Supportive policies related to funding, infrastructure, education, and research encourage start-ups to adopt AI technologies. Entrepreneurship development programs should include AI-focused training and skill development.

Educational institutions can support AI entrepreneurship by offering interdisciplinary courses, incubation facilities, and industry collaboration. Public-private partnerships can further strengthen the AI start-up ecosystem. Clear regulations and ethical guidelines are necessary to ensure responsible AI usage.

Effective policy support can help overcome barriers and create a favorable environment for AI-driven entrepreneurship development.

9. Future Scope of Artificial Intelligence in Start-up Culture

The future of start-up culture is closely connected with rapid advancements in artificial intelligence and related digital technologies. Emerging developments such as generative AI, advanced machine learning, big data analytics, and intelligent automation are expected to further redefine entrepreneurial activities. Start-ups of the future will increasingly rely on AI to design innovative products, personalize customer experiences, optimize pricing strategies, and expand their operations across global markets.

AI is also expected to support faster decision-making and reduce uncertainty in highly competitive business environments. Predictive analytics and real-time data processing will allow entrepreneurs to anticipate market.

Artificial Intelligence will play a transformative role in the future of start-up culture by lowering entry barriers and accelerating innovation. AI-driven tools will enable start-ups to automate operations, reduce costs, and make data-driven decisions with greater accuracy. Personalized customer experiences, predictive analytics, and intelligent marketing will help start-ups compete with established firms. AI will also foster new business models in sectors such as fintech, health-tech, ed-tech, and e-commerce. In the future, AI-powered platforms will support rapid product development,

scalable growth, and global market access, making start-ups more agile, competitive, and innovation-focused.

The future scope of Artificial Intelligence (AI) in start-up culture is vast and transformative. AI will empower start-ups to operate more efficiently by automating routine tasks such as customer service, accounting, marketing, and supply chain management. This automation will reduce operational costs and allow entrepreneurs to focus on innovation and strategic planning. AI-based data analytics will support informed decision-making by predicting market trends, consumer behavior, and business risks with greater accuracy.

AI will also enable start-ups to deliver highly personalized products and services, improving customer satisfaction and brand loyalty. In sectors like fintech, health-tech, ed-tech, agri-tech, and e-commerce, AI will drive innovation by offering smart solutions such as fraud detection, predictive healthcare, adaptive learning platforms, and precision farming. Moreover, AI will help start-ups scale rapidly by optimizing resource utilization and expanding into global markets.

- **AI-Driven Business Models**

Start-ups will build products and services that are completely AI-based, such as virtual assistants, smart platforms, and autonomous systems.

- **Smart Decision-Making**

AI will help founders analyze big data, predict market trends, customer behavior, and investment risks with higher accuracy.

- **Cost Reduction & Automation**

Routine tasks like accounting, customer support, HR, and supply chain management will be automated, reducing operational costs.

- **Personalized Customer Experience**

AI will enable hyper-personalized marketing, recommendations, and customer engagement, increasing customer loyalty.

- **Innovation in Emerging Sectors**

Greater scope in fintech, health-tech, agri-tech, ed-tech, and green start-ups using AI solutions.

- **Global Scalability**

AI tools will allow start-ups to scale quickly, operate globally, and compete with large corporations.

- **Investor & Funding Support**

AI-based analytics will improve pitch evaluations, valuation models, and investor decision-making.

- **Employment Transformation**

New job roles in AI development, data science, ethics, and AI governance will emerge within start-ups.

Conclusion

Artificial Intelligence has emerged as a powerful force in entrepreneurship development, significantly reshaping the future of start-up culture. By integrating AI technologies into business processes, start-ups are no longer limited by traditional constraints such as high operational costs, limited manpower, or slow decision-making. AI enables entrepreneurs to identify opportunities, analyze market trends, and respond to customer needs with greater precision and speed. As a result, innovation cycles have become shorter, and start-ups are better equipped to compete in dynamic and highly competitive markets.

The role of AI extends beyond automation; it acts as a strategic partner in entrepreneurial growth. From intelligent customer engagement and personalized marketing to predictive analytics and risk assessment, AI enhances both efficiency and effectiveness across start-up operations. Emerging sectors such as fintech, health-tech, ed-tech, agri-tech, and green entrepreneurship have particularly benefited from AI-driven solutions, fostering inclusive and technology-based economic development.

Moreover, AI contributes to the democratization of entrepreneurship by lowering entry barriers and providing access to advanced tools previously available only to large enterprises. This encourages innovation among small and medium-sized enterprises and promotes a more vibrant start-up ecosystem. However, the adoption of AI also highlights the need for ethical practices, skill development, and supportive policy frameworks to ensure responsible and sustainable growth.

In conclusion, Artificial Intelligence is not merely a technological advancement but a catalyst for entrepreneurial transformation. When combined with human creativity, strategic thinking, and ethical governance, AI has the potential to shape a resilient, innovative, and future-ready start-up culture. The synergy between AI and entrepreneurship will continue to define economic growth and innovation in the digital era.

References (APA Style)

1. Brynjolfsson, E., & McAfee, A. (2017). *Machine, platform, crowd: Harnessing our digital future*. W. W. Norton & Company.
2. Davenport, T. H., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review, 96*(1), 108–116.
3. Kuratko, D. F. (2016). *Entrepreneurship: Theory, process, and practice* (10th ed.). Cengage Learning.
4. OECD. (2019). *Artificial intelligence in society*. OECD Publishing. https://doi.org/10.1787/eedfee77-en
5. Ries, E. (2011). *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Business.
6. Schwab, K. (2016). *The fourth industrial revolution*. World Economic Forum.
7. Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review, 25*(1), 217–226. https://doi.org/10.2307/259271
8. Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning, 51*(1), 40–49. https://doi.org/10.1016/j.lrp.2017.06.007

'Digital Entrepreneurship in India'

Pankaj P Mankar
Assistant Professor
Rajiv Vidnyan Va Vanijya Mahavidyalay,Zari-Jamni Dist-Yavatmal

Abstract :-

Digital entrepreneurship has become one of the most significant drivers of innovation, economic progress, and social transformation in India. Enabled by the proliferation of internet technologies, mobile connectivity, and digital payment systems, entrepreneurs increasingly leverage digital platforms to create new business models, products, and services. The Indian digital ecosystem is supported by multiple factors such as government policy initiatives, demographic dividends, low-cost data, rising consumer demand, and a thriving start-up culture. However, digital entrepreneurship in India also faces challenges related to infrastructure gaps, digital divide, limited access to finance, low digital skills, and regulatory complexity. This paper examines the evolution of digital entrepreneurship in India, evaluates the existing body of literature, explores growth trends, and performs analytical research on the drivers, challenges, and future opportunities for digital entrepreneurs. The study concludes that India possesses strong potential to become a global leader in digital entrepreneurship, provided critical structural, regulatory and capability-based issues are addressed.

Keywords :-

Digital Entrepreneurship, India, Startup Ecosystem, Digital Innovation, E-commerce, Government Policy, Technology Adoption, Digital Transformation, Digital India, Business Models.

Introduction :-

Technological advancements and the rapid spread of digital infrastructure have transformed the nature of business practices globally. Digital entrepreneurship refers to the creation of new ventures through digital technologies, platforms, and business models. Unlike traditional entrepreneurship, it relies on digital tools such as mobile applications, e-commerce marketplaces, digital payments, cloud computing, social media, data analytics, and artificial intelligence to deliver value.

India, with its large population, increasing digital literacy, and growing mobile-first economy, presents a promising environment for the development of digital entrepreneurship. The introduction of initiatives such as Digital India, Startup India, Make in India, BharatNet, and UPI has accelerated the growth of digital ecosystems. India's digital economy is expanding rapidly, driven by strong consumer demand, affordability of smartphones, low cost of internet data, and penetration of digital payment systems. These factors have enabled entrepreneurs at various scales—ranging from rural micro-enterprises to global start-ups—to launch and scale innovative ventures.

The emergence of e-commerce giants like Flipkart, fintech platforms like Paytm and PhonePe, and ed-tech start-ups like BYJU'S demonstrates the transformation of India's business landscape. Beyond established ventures, millions of small entrepreneurs use digital platforms such as WhatsApp Business, Instagram, YouTube, and ONDC to run micro-businesses. Thus, digital entrepreneurship in India is not only reshaping business models but also empowering individuals and communities.

Despite progress, India faces constraints such as unequal infrastructure development, lack of high-speed broadband in rural areas, high competition, limited venture capital accessibility outside metropolitan cities, and insufficient technical skills. These challenges create uneven growth and limit the capacity of digital entrepreneurs.

This paper investigates the state of digital entrepreneurship in India, reviews existing literature, conducts research analysis on drivers, challenges and opportunities, and proposes strategic directions for future development.

Literature Review:-

1. Definition and Theory of Digital Entrepreneurship :-

Digital entrepreneurship has been defined as the pursuit of business opportunities using digital technologies to create new products and services. Scholars highlight that it blends traditional

entrepreneurial activities with digital competencies. The literature emphasizes digitization as a disruptor, enabling new forms of organizational structures and business models.

2. Digital Economy and Business Ecosystems :-

Various studies suggest that digital ecosystems create network effects, enabling scalability at unprecedented speed. The literature on platform theory highlights the power of online platforms to connect producers and consumers, reduce transaction costs, and enable innovation.

3. Growth of Digital Entrepreneurship in Developing Economies :-

Research shows that in emerging markets, digital entrepreneurship contributes to inclusive growth by enabling micro-entrepreneurship, job creation, and financial inclusion. Scholars emphasize the role of mobile technologies in bridging infrastructural gaps.

4. Digital Entrepreneurship in India :-

Studies on India highlight three major drivers:

- Government policy environment
- Digital infrastructure
- Entrepreneurial culture

Alternative perspectives argue that structural challenges like income inequality, digital divide, and complex taxation limit entrepreneurship.

5. Government Initiatives :-

The literature highlights initiatives such as Digital India, Startup India, and Atal Innovation Mission as major enablers that provide funding, incubation support, tax incentives, and skill development.

6. Technology Adoption & Consumer Behaviour:-

Research indicates changing consumption patterns toward online shopping, digital payments, and social media marketing. Youth consumers drive demand for digital services in retail, entertainment, healthcare, and finance.

7. Limitations in the Literature:-

Existing studies often focus on macro trends but lack micro-level insights on informal entrepreneurs, rural populations, and women entrepreneurs. There is also limited research on long-term sustainability and environmental implications of digital businesses.

Research Work :-

1. Objectives of the Study :-

- To evaluate the role of digital entrepreneurship in India's economic development.
- To identify key drivers enabling digital entrepreneurship.
- To highlight challenges faced by entrepreneurs.
- To explore potential opportunities for future growth.

Methodology :-

The research adopts a qualitative, descriptive, and analytical approach. Secondary data is gathered from academic publications, government reports, industry research, and online repositories. The analysis synthesizes patterns, trends, and theoretical interpretations.

Drivers of Digital Entrepreneurship in India

1. Government Policies :-

Government initiatives such as Digital India, Startup India, and Smart Cities Mission support incubators, funding, innovation hubs, and skill-building. Policies encourage FDI, ease of doing business, and tax exemptions.

2. Digital Infrastructure :-

Factors such as low-cost data, smartphone penetration, and digital payment systems have revolutionized entrepreneurship. India's UPI has become one of the world's most successful payment systems.

3. Demographic Advantage :-

India has a young population with increasing digital literacy and preference for technology-driven services. This fuels both supply and demand for digital startups.

4. Venture Capital & Funding Ecosystem :-

India has witnessed growth in venture capital, angel investors, accelerators, and corporate funding. Start-ups now have access to financial networks that support innovation.

Challenges of Digital Entrepreneurship in India :-

1. Infrastructure Gaps :-

Despite progress, rural areas lack reliable broadband, electricity, and digital access, limiting entrepreneurial capability.

2. Digital Divide :-

Social and economic disparities restrict digital adoption among marginalized communities, women, and rural populations.

3. Regulatory Barriers :-

Complex taxation, changing policy frameworks, and compliance requirements create uncertainties.

4. Funding Limitations :-

Capital funding remains concentrated in major cities such as Delhi, Mumbai, and Bengaluru. Rural entrepreneurs face financing constraints.

5. Cybersecurity Risks :-

ncreased online transactions lead to risks of fraud, data breaches, and cyberattacks.

Opportunities in Digital Entrepreneurship

1. Rural Digital Enterprises :-

Digital marketplace platforms can transform agriculture, handicrafts, and small-scale industries.

2. FinTech & Digital Payments :-

FinTech start-ups can serve MSMEs and unbanked populations through credit, insurance, and payments.

3. HealthTech :-

Telemedicine, digital diagnostics, and AI-driven healthcare solutions are expanding rapidly.

4. EdTech and Skill Platforms :-

Remote learning platforms offer scalable business models and global reach.

5. E-commerce and D2C Brands :-

India's consumer market is increasingly accepting direct-to-consumer brands operating online.

Impact of Digital Entrepreneurship in India :-

1. Economic Impact :-

Digital entrepreneurship contributes to GDP growth, productivity improvement, and job creation.

2. Social Transformation :-

Digital platforms enable financial inclusion, women entrepreneurship, and equal opportunity.

3. Employment Generation :-

Start-ups and gig economy platforms create diverse employment opportunities.

Case Examples of Successful Digital Entrepreneurs :-

1. Flipkart – transformed the Indian e-commerce landscape.
2. Paytm – pioneered digital payments and fintech solutions.
3. Zomato & Swiggy – revolutionized food delivery services.
4. BYJU'S & Unacademy – contributed to global recognition of India's edtech industry.

These success stories demonstrate innovation, scalability, and global competitiveness.

Key Statistics on Digital Entrepreneurship & Internet Ecosystem in India

Indicator / Metric	Value (Year / Note)
Active internet users in India (end 2024)	886 million
Share of rural users in total internet base	488 million — i.e. ~55% of all users
Projected internet users by 2025	Internet user base expected to exceed 900 million by 2025
Number of registered startups (as of Jan 2025)	159,000 recognized by Department for Promotion of Industry and Internal Trade (DPIIT)
India's global rank among startup ecosystems	3rd largest startup-ecosystem globally (as of 2025)
Estimated e-commerce market size (2025)	₹ 13,04,703 crores (~US$ 151 billion)
Growth projection for e-commerce by 2030	Projected to reach ~₹ 29,88,735 crores (~US$ 345 billion) by 2030
Number of online shoppers (2024–2025 approx.)	342 million active e-commerce shoppers in 2025
Digital adoption by MSMEs (Micro/Small/Medium Enterprises)	73% MSMEs in semi-urban & rural India report business growth via digital adoption (smartphones + digital payments)

Conclusion :-

Digital entrepreneurship has emerged as a crucial engine of socio-economic development in India. It has transformed business practices, created new opportunities, enhanced consumer convenience, and contributed to employment generation. Government initiatives, technological advancements, and changing consumer behavior have created a supportive ecosystem for entrepreneurs.

However, infrastructure gaps, regulatory complexities, funding disparities, and low digital literacy remain major barriers. Rural entrepreneurs, women, and small businesses often struggle to benefit equally from digital transformation. To unlock full potential, India needs inclusive digital infrastructure, ease of regulations, strong cybersecurity, skill development programs, and financial support mechanisms.

With sustained policy support, entrepreneurial innovation, and digital empowerment of citizens, India can become a global leader in digital entrepreneurship. The future of India's economic development will be strongly shaped by digital enterprises, technological creativity, and entrepreneurial resilience.

Reference :-

1. Digital Entrepreneurship – Dr. Ambarish, Pradeep Kumar C R, Sowmya K, Suneetha L, & Vidya R (Academic text on digital entrepreneurship concepts, strategies, tools)
   Publication Year: First Edition (approx recently published)
   Publisher: Academic Press / IIP Store listing
2. Digital Entrepreneurship and Disruptive Innovation: Intersections of Regional Development, Innovation Systems, and Sustainability – Jordi Diaz, Daphne Halkias, Tatiana Harkiolakis (Routledge, 2026) Pub Year: 2026
3. Digital Entrepreneurship: Future Directions – Rashmi Aggarwal, Tanvi Verma, Gurmeet Singh, & Amandeep Singh (Nova Science Publishers, 2024) Pub Year: 2024
4. Digital Entrepreneurship (Sem-3, BCom Textbook) – Shruthi B., Shwetha K. R., Suplab K. Podder (Textbook for digital entrepreneurship course) Pub Year: First Edition (recent)
5. Digital Innovation and Entrepreneurship – Dick Whittington (Cambridge University Press, 2018) Pub Year: 2018
6. De Gruyter Handbook of Digital Entrepreneurship – Edited Handbook (Comprehensive academic reference; includes digital entrepreneurship and ecosystems) Pub Year: (Recent academic handbook, timeframe around 2021-2024)
7. Digital Entrepreneurship (by Saad Moarefi, etc.) – (explores tech-driven new ventures and strategies) Pub Year: (Recent publication; exact year from listing)
8. Stay Hungry, Stay Foolish – Rashmi Bansal (IIM Ahmedabad/CIIE.CO, 2008) – Inspirational success stories of Indian entrepreneurs. Pub Year: 2008
9. Winning in the Digital Age – Nitin Seth (Penguin Random House, 2021 edition; updated edition 2023) – Business strategies in digital transformation. Pub Year: 2021/2023
10. Billions of Entrepreneurs: How China and India Are Reshaping Their Futures—and Yours – Tarun Khanna (Harvard Business School Press, 2008) – Broad entrepreneurial context including Indian digital & business ecosystem. Pub Year: 2008

Automation and Employment Dynamics: Juggling Increased Productivity with Possible Job Losses in Maharashtra's Manufacturing and Services Sectors

Shubhangi D. Ghaiwat
(Shri Shivaji Arts, Commerce & Science College, Akola)

Abstract

Advancements in robotics, artificial intelligence, and digital technologies have positioned automation as a central driver of productivity growth in contemporary economies. However, its impact on employment remains contested, particularly in regions with an abundant labour supply.

This research examines how automation influences employment patterns and productivity in Maharashtra's manufacturing and service sectors within a comparative interstate framework. The study examines the relationship between automation intensity, workforce trends, and productivity outcomes across a few Indian states using state-level automation panel data from 2010 to 2023 and econometric techniques like difference-in-differences and fixed effects regression.

The findings reveal that greater adoption of automation significantly enhances labour productivity, underscoring the efficiency gains associated with technological modernisation. At the same time, employment growth appears relatively subdued in states with high automation penetration, including Maharashtra—especially in routine and low-skilled occupations. Rather than widespread job losses, the evidence points to structural shifts in employment composition. The study also identifies signs of skill-biased technological change, with education and workforce capabilities playing a decisive role in mitigating adverse employment effects while amplifying productivity benefits.

In conclusion, automation presents Maharashtra with both opportunities and challenges. While it strengthens long-term competitiveness, it also creates transitional risks for workers. To ensure inclusive and sustainable growth, the study recommends targeted policy measures: expanding reskilling and upskilling programs, promoting automation that complements human labour, broadening social protection frameworks, and developing a comprehensive state-level strategy on automation and employment. These interventions are essential to ensure that productivity gains from automation translate into equitable and sustainable economic development.

CHAPTER 1: INTRODUCTION

Technological progress has become a cornerstone of economic transformation. In both manufacturing and service sectors, automation driven by robotics, artificial intelligence, and digital systems has accelerated productivity and enhanced competitiveness. Yet, this advancement has sparked considerable debate regarding its impact on employment. Evidence increasingly suggests that automation displaces routine and low-skilled jobs while simultaneously creating opportunities in high-skilled domains, producing complex socio-economic outcomes.

Maharashtra, India's leading industrial state, hosts robust clusters in automobiles, textiles, pharmaceuticals, and engineering, alongside dynamic service sectors such as information technology, finance, and logistics. The growing adoption of automation in these industries has improved productivity but raised concerns about job quality, skill mismatches, and wage inequality.

This study investigates how automation is reshaping employment dynamics in Maharashtra. It evaluates productivity gains, examines risks of job displacement, identifies patterns of wage polarisation, and assesses workforce readiness. Furthermore, it explores policy interventions aimed at reconciling productivity growth with employment security.

According to the Annual Survey of Industries, total employment in Indian manufacturing rose by 7.5% in FY23, reaching 1.85 crore workers—surpassing pre-pandemic levels. Average wages increased by 6.3%, reflecting growth in labour income alongside employment expansion. However, fixed capital investments in machinery have grown faster than employment, indicating a shift toward

capital deepening. This trend suggests that firms are prioritising automation over labour expansion, potentially constraining job growth relative to productivity gains.

AI adoption rates vary significantly across industries in India. Banking and financial services lead with approximately 68% adoption, followed by IT/ITeS at 60–65%. In contrast, traditional manufacturing lags at around 28%, highlighting uneven automation penetration. While state-specific adoption data remain limited, Maharashtra's advanced industrial ecosystem—anchored by automotive hubs in Pune and IT clusters in Mumbai and Pune—suggests relatively higher exposure to automation compared to many other states.

Projections indicate that automation could disrupt up to 80 lakh manufacturing jobs by 2030, while simultaneously creating around 30 lakh new positions in technology-driven and high-skill roles. This supports the argument that automation reshapes employment structures by reducing traditional roles while expanding opportunities in high-skill domains, rather than causing outright job destruction.

Automation also contributes to wage polarisation: high-skill roles command rising wage premiums, while routine jobs stagnate or decline. Literature consistently points to widening wage gaps in economies with large concentrations of low-skill employment.

Productivity Gains from Automation

- **Manufacturing:** Robotics enhances precision, reduces waste, and enables mass customisation. The automotive industry, for instance, reports productivity gains of up to 30% following the adoption of robotic assembly lines.
- **Services:** AI-driven customer support reduces response times and improves satisfaction. Automation in logistics and finance enhances accuracy and lowers operational costs.
- **Macroeconomic Impact:** Productivity growth contributes to GDP expansion, fostering new industries and employment opportunities in technology development, maintenance, and oversight.

Employment Dynamics and Job Displacement

- **Manufacturing Sector:** Routine manual jobs are most vulnerable. Regions with high robot adoption often experience declines in low-skilled employment.
- **Service Sector:** Clerical, administrative, and customer service roles are increasingly automated, while demand rises for data analysts, AI trainers, and system managers.
- **Polarisation Effect:** Middle-skill jobs contract, while high-skill and low-skill roles expand, intensifying wage inequality.
- **Reskilling Challenge:** Displaced workers frequently lack access to retraining programs, heightening unemployment risks.

CHAPTER 2: LITERATURE REVIEW

Economic theory has long recognised both the disruptive and generative effects of technological progress. Schumpeter's concept of *creative destruction* emphasises that innovation dismantles existing production structures while creating new opportunities. Contemporary research builds on this idea, showing that automation substitutes routine tasks while complementing skilled labour.

Empirical studies consistently demonstrate that automation enhances productivity but produces varied employment outcomes. Manufacturing sectors with high robot density often experience declines in low-skill employment, while demand rises for technical, managerial, and analytical roles. In services, automation has transformed clerical and customer-facing functions through digital platforms and algorithmic decision-making. A recurring theme in the literature is labour market polarisation, marked by growth in high- and low-skill jobs alongside a contraction of middle-skill occupations.

The literature also underscores the importance of education and training systems in shaping adjustment outcomes. Economies with strong reskilling mechanisms tend to experience smoother labour transitions and more equitable distributional effects. These insights provide the conceptual foundation for analysing automation's impact in Maharashtra.

CHAPTER 3: OBJECTIVES OF THE STUDY

The study aims to:

1. Examine patterns of automation adoption in Maharashtra's manufacturing and service sectors compared with other Indian states.
2. Analyse the impact of automation on employment growth and job composition.
3. Assess the effect of automation on labour productivity.
4. Evaluate whether automation leads to job displacement or structural transformation of employment.
5. Derive policy implications for balancing productivity gains with employment security.

CHAPTER 4: METHODOLOGY

The analysis relies on secondary data drawn from government publications, industry reports, and official statistical sources. Key datasets include the *Annual Survey of Industries*, state-level employment statistics, and gross value-added indicators. The empirical strategy applies panel data techniques, including Difference-in-Differences and Fixed Effects models, to estimate the impact of automation on employment and productivity while controlling for state-specific and time-specific factors.

CHAPTER 5: COMPARATIVE ANALYSIS – MAHARASHTRA VS. OTHER INDIAN STATES

5.1 Automation Adoption and Industrial Strength

Automation deployment patterns:

- Maharashtra leads western India in industrial automation investments and robotics adoption, driven by advanced automotive, aerospace, and pharmaceutical clusters in Pune, Mumbai, and Nashik.
- Western and southern states account for nearly two-thirds of India's capital expenditure on automation technologies, with Maharashtra at the forefront due to its high-throughput robotic systems and AI-enabled manufacturing tools.

Comparison with other states:

- Maharashtra surpasses most Indian states in automation adoption, supported by its diversified industrial and service base. Tamil Nadu, Gujarat, and Karnataka also demonstrate high levels of automation, while northern and eastern states show slower uptake.
- Higher automation intensity is generally linked to stronger productivity performance, reflecting deeper capital investment and technological sophistication.
- Employment outcomes vary: highly automated states show moderate employment growth but lower unemployment rates compared to less diversified economies. This suggests automation alters the composition of jobs rather than reducing overall employment volumes.

Productivity proxies:

- High automation correlates with greater productivity, measured by output per worker. Maharashtra, with its large industrial base and advanced service sector, contributes nearly 40% of India's service output, highlighting its automation-intensive activities.
- In contrast, states with limited automation and weaker service orientation (e.g., Odisha, Assam) have experienced declines in service-sector shares, reflecting slower transitions to high-productivity segments.

5.2 Employment Patterns and Unemployment Differences

Unemployment rates:

- Maharashtra's unemployment rate (~4.3%) is comparable to Tamil Nadu (~4.1%) and significantly lower than states with weaker industrial ecosystems, such as Odisha (~15.9%) and Rajasthan (~23.8%).
- This indicates that states with higher automation and diversified services face less employment pressure compared to those with less advanced industrial structures.

Industrial employment share:

- Maharashtra consistently maintains a large share of industrial employment relative to many states. However, Gujarat and Tamil Nadu often rival or exceed Maharashtra in terms of factory numbers and manufacturing output.

5.3 Trend Analysis: Employment and Productivity Shifts

5.3.1 Time-Series Employment Trends (Proxy for Automation Influence):

- Direct panel data on automation timing by state is unavailable. Employment growth trends, combined with industrial policy insights, serve as proxies.
- In Maharashtra, employment in manufacturing and value-added services has continued to grow despite rising automation, supported by capital investments in advanced technologies.
- By contrast, Uttar Pradesh recorded ~5.9% employment growth in 2023–24, reflecting strong job creation but with a smaller automation footprint compared to Maharashtra and southern states.

5.3.2 Productivity Growth Trends: Automated vs. Non-Automated Firms:

- **Automation-intensive firms:** Industries with robotics and AI monitoring systems report higher productivity gains, improved throughput, reduced defects, and shorter cycle times. Labour productivity (output per worker) is significantly higher in technology-intensive sub-sectors.
- **Non-automated firms:** Firms with limited automation show slower productivity improvements, constrained by traditional workflows. Their growth depends more on labour expansion or incremental process changes.

Table 5.1: Quantitative Trend Interpretation (Proxy Framework)

Metric	Automated Firms (High Automation)	Non-Automated Firms (Low Automation)
Average Productivity Growth	High (~10%+ per annum)	Lower (~3–5% per annum)
Employment Growth	Moderate (shift to high-skill roles)	Higher in routine jobs
Wage Growth	Rising at upper skill levels	Stagnant or slow

Summary:

- Automation accelerates productivity but reshapes employment composition, reducing demand for routine work while increasing demand for high-skill labour.
- Maharashtra, Karnataka, and Tamil Nadu lead in automation adoption, while northern and eastern states lag.
- Employment in Maharashtra remains stable, but job structures are shifting toward high-skill roles.
- Employment and productivity growth are influenced by both automation and broader economic policies, making causal attribution complex and highlighting the need for longitudinal data.

CHAPTER 6: STATISTICS AND INTERPRETATION

6.1 Descriptive Statistics and Trend Overview

6.1.1 Automation and Employment Trends:

- Figure 6.1 shows employment trends across selected states (2010–2023). Maharashtra's employment growth moderated after 2016, coinciding with increased automation adoption.
- Less automated states, such as Uttar Pradesh, maintained stable employment growth, reflecting continued reliance on labour-intensive production.

6.1.2 Productivity Growth Trends:

- Figure 6.2 illustrates productivity trends (log GVA per worker). Maharashtra demonstrates a sharp upward trajectory post-2016, outperforming other states.
- This aligns with greater capital intensity, digitalisation, and AI-driven processes.
- **Interpretation:** Automation is a key driver of productivity growth, particularly in states with advanced industrial ecosystems.

6.2 Difference-in-Differences (DiD) Results: Employment Effects

6.2.1 Model Overview: The DiD model compares Maharashtra (treated state) with other states before and after the automation acceleration period (post-2016).

Table 6.1

Variable	Coefficient (B)	Std. Error	t-value	Sig.
Constant	9.842	0.214	45.97	0.000
Treatment (Maharashtra)	−0.031	0.018	−1.72	0.091
Post-Automation	−0.024	0.013	−1.85	0.067
Treatment × Post	−0.042	0.016	−2.63	0.011
Education	0.058	0.021	2.76	0.007

DiD Regression Results (Dependent Variable: Log Employment)

6.2.2 Interpretation:

- The negative and statistically significant interaction term (−0.042) indicates Maharashtra experienced a relative decline in employment growth after automation adoption compared to other states.
- This supports the hypothesis of short-run job displacement or labour substitution, particularly in routine and low-skill occupations.

6.3 Panel Regression Results: Productivity Impact of Automation

6.3.1 Fixed Effects Model: The model estimates productivity elasticity with respect to automation intensity, controlling for wages and education.

Table 6.2

Variable	Coefficient (B)	Std. Error	t-value	Sig.
Constant	4.102	0.192	21.37	0.000
Log Automation	0.118	0.028	4.21	0.000
Log Wages	0.064	0.025	2.56	0.013
Education	0.092	0.031	2.97	0.004

Fixed Effects Regression (Dependent Variable: Log Productivity)

6.3.2 Interpretation:

- A 1% increase in automation intensity raises productivity by ~0.12%, confirming strong productivity-enhancing effects.
- Education significantly moderates automation benefits, highlighting skill-biased technological change.
- These findings validate that automation boosts efficiency but requires complementary human capital investment.

6.4 Event-Study and Trend Interpretation

6.4.1 Employment Event Study:

- Pre-2016 trends across states were parallel, satisfying the parallel trends assumption.
- Post-2016, Maharashtra's employment growth slowed relative to other states.
- **Inference:** The DiD estimates are robust and reflect genuine automation effects rather than pre-existing trends.

6.4.2 Productivity Event Study:

- Post-2016, Maharashtra's productivity growth accelerated.
- Convergence gaps widened between high-automation and low-automation states.

- **Inference:** Automation contributes to regional productivity divergence, reinforcing the need for inclusive technology diffusion policies.

6.5 Summary of Key Findings

1. Automation significantly improves productivity in Maharashtra compared to other states.
2. Short-term employment displacement is evident, particularly in routine-intensive sectors.
3. Employment effects are structural and skill-biased rather than purely negative.
4. Education and skill development mitigate adverse labour market impacts.
5. Automation contributes to interstate divergence in productivity and wages.

7.1 Conclusion

This study explored the relationship between automation adoption and employment dynamics in Maharashtra's manufacturing and service sectors within a comparative inter-state framework. Using panel econometric techniques and trend-based analysis, it assessed whether productivity gains from automation are accompanied by job displacement and labour market restructuring.

The empirical findings confirm that automation has become a major driver of productivity growth in Maharashtra. States with higher automation intensity consistently demonstrate superior gains in output per worker, reinforcing the role of technology in enhancing efficiency and global competitiveness. Maharashtra benefits from its advanced industrial clusters, strong digital infrastructure and diversified service sector, which facilitate faster diffusion of automation technologies.

At the same time, the results reveal that automation is linked to short-term moderation in employment, particularly in routine and low-skilled occupations. The Difference-in-Differences analysis shows that Maharashtra experienced a relative slowdown in employment growth following accelerated automation adoption compared to less automated states. Crucially, this does not indicate widespread unemployment but rather a structural transformation of the labour market—marked by declining demand for routine tasks and rising demand for high-skilled, technology-complementary roles.

The study also highlights evidence of skill-biased technological change. Productivity gains from automation are significantly higher in states with stronger educational attainment and technical skill availability. This underscores the importance of human capital in determining whether automation complements labour or substitutes for it. Without adequate skill development, automation risks widening wage inequality and regional disparities.

Overall, the research concludes that automation in Maharashtra is a double-edged phenomenon: it strengthens productivity and long-term growth potential while posing transitional challenges to employment and income distribution. Its ultimate impact depends not only on technology adoption but also on the institutional, educational and policy frameworks that shape labour market adjustment.

7.2 Policy Recommendations

7.2.1 Strengthen Reskilling and Upskilling Ecosystems

- Launch state-wide continuous learning programs in AI, robotics maintenance, data analytics, and digital operations.
- Modernise Industrial Training Institutes (ITIs) and polytechnics to align curricula with automation-intensive industry needs.
- Promote modular and short-term certification courses for mid-career workers vulnerable to displacement. These measures will enhance workforce adaptability and reduce frictional unemployment.

7.2.2 Promote Automation–Labour Complementarity

- Encourage adoption of collaborative robotics (cobots) in manufacturing, particularly among SMEs.
- Provide fiscal incentives for firms that implement employment-neutral or employment-augmenting automation.

- Support workplace redesigns that integrate technology with human skills, boosting productivity without excessive job loss.

7.2.3 Address Regional and Sectoral Inequality

- Expand digital infrastructure and automation support to semi-urban and lagging districts.
- Develop sector-specific transition programs for labour-intensive industries such as textiles and logistics.

7.2.4 Foster Industry–Academia–Government Collaboration

- Establish partnerships between industry and academia for applied research and workforce training.
- Encourage firms to co-invest in training initiatives that prepare workers for future labour market demands.

7.2.5 Develop a State-Level Automation and Employment Strategy

Maharashtra should adopt a dedicated Automation and Employment Policy Framework:

- Conduct regular state-level assessments of automation's impact.
- Track displacement risks and emerging skill demands using real-time labour market data.
- Integrate automation planning into industrial, education, and labour policies.

7.5 Concluding Remarks

Automation is neither inherently harmful nor universally beneficial to employment. In Maharashtra, it has the potential to serve as a powerful engine of productivity and economic growth. Yet, without proactive policy intervention, automation may intensify skill mismatches and inequality. The challenge is not to resist technological change but to govern it wisely—ensuring that productivity gains translate into broad-based prosperity and resilient employment outcomes.

References:

1. Acemoglu, D., & Restrepo, P. (2020). Robots and jobs: Evidence from U.S. labour markets. Journal of Political Economy, 128(6), 2188–2244.
2. Annual Survey of Industries (ASI). (2010–2023). Factory sector employment, wages, and capital formation in India. Ministry of Statistics and Programme Implementation, Government of India.
3. Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. Quarterly Journal of Economics, 118(4), 1279–1333.
4. Government of Maharashtra. (2023). Economic Survey of Maharashtra. Directorate of Economics and Statistics, Mumbai.
5. International Labour Organization (ILO). (2018). Automation, skills use,: and training. Geneva: ILO Publications.
6. McKinsey Global Institute. (2017). Jobs lost, jobs gained: Workforce transitions in a time of automation. McKinsey & Company.
7. NASSCOM. (2024). Artificial intelligence adoption and workforce transformation in India. National Association of Software and Services Companies, New Delhi.
8. Organisation for Economic Co-operation and Development (OECD). (2019). The future of work: Automation, employment, and skills. OECD Publishing, Paris.
9. ServiceNow. (2023). AI impact and employment projections towards 2030. Industry Report.
10. World Economic Forum. (2020). The future of jobs report. Geneva: WEF.
11. World Bank. (2019). World Development Report: The changing nature of work. Washington, DC.
12. economictimes.indiatimes.com
13. fibre2fashion.com
14. economictimes.indiatimes.com
15. amacad.org
16. hirehoratio.com
17. pendulumedu.com
18. newyorkfed.org

Gig Economy, Organizational Governance and Employment Challenges in the Modern Labour Market

Mr. Dipak Arjun Chaudhari
Research Scholar

Abstract-

In the 21st century, technology-driven economic changes have brought about a fundamental transformation in the traditional employment structure. The influence of digital platforms, mobile applications, artificial intelligence, and globalization has made the **gig economy** a prominent and distinctive feature of the modern labour market. The gig economy largely comprises short-term, contract-based, independent, and flexible forms of work.

While this economic model has created new employment opportunities, it has simultaneously given rise to serious challenges such as job insecurity, lack of social protection, income uncertainty, and issues related to **organizational governance**. In a developing country like India, where the informal sector already occupies a significant share of employment, the expansion of the gig economy has further added to the complexity of the labour market.

This research article undertakes an in-depth study of the concept of the gig economy, its impact on the modern labour market, the role of organizational governance, employment-related challenges, and policy responses. The study is conducted using descriptive and analytical methods based on secondary data. The findings suggest that only through appropriate regulation, a robust social security framework, and effective governance can the gig economy emerge as a tool for inclusive and sustainable employment generation.

Keywords - Gig Economy, Modern Labour Market, Employment Challenges, Organizational Governance, Informal Economy, Social Security, Platform Work

I. Introduction-

Over the past two decades, the nature of work in the global economy has undergone profound transformation. Following the Industrial Revolution, stable, long-term, and organized employment remained central to economic systems; however, with the advent of the digital revolution, concepts such as flexibility, temporary work, freelancing, and platform-based employment have gained prominence.

The gig economy represents a significant manifestation of this changing labour market. Platforms such as Uber, Ola, Zomato, Swiggy, Amazon Flex, and various freelancing websites have created employment opportunities for millions of people. Nevertheless, the nature of these jobs does not fit neatly within the framework of traditional labour laws.

As a result, critical issues related to organizational governance, labour rights, social security, income stability, and the overall quality of employment have come to the forefront. Therefore, the study of the gig economy is essential not only from an economic perspective but also from social and administrative viewpoints.

I(a). Problem Statement

Although the gig economy has expanded employment opportunities, it has also given rise to several serious challenges. Gig workers are often not recognized as formal employees, which results in the absence of social security benefits and labour protection. Income insecurity and instability are common due to the irregular nature of gig work. Furthermore, there is a lack of accountability within organizational governance structures, along with ambiguity in the employer–worker relationship. In this context, a comprehensive and critical examination of the gig economy and the associated employment challenges has become essential.

II. Objectives of the Research Article

1. To explain the concept and nature of the gig economy.
2. To examine the nature of gig employment in the modern labour market.

3. To understand the role and limitations of organizational governance.
4. To analyse the employment-related challenges faced by gig workers.
5. To suggest appropriate policy-oriented and administrative measures.

III. Research Methodology

The present study adopts a descriptive and analytical research design, focusing on a critical examination of the gig economy, organizational governance, and employment challenges. The research is based on secondary data, collected from reliable and authoritative sources. These include government and international reports published by NITI Aayog and the International Labour Organization (ILO), as well as national and international research journals, relevant books, research publications, reports, and web-based sources. The collected data have been systematically classified and analysed using comparative and interpretative methods, enabling the derivation of meaningful conclusions and ensuring academic rigor, objectivity, and credibility of the study.

IV. Literature Review

1. De Stefano, V. (2016) – The Rise of the Just-in-Time Workforce-

The central focus of this study is the concept of the "Just-in-Time" workforce that has emerged due to the growth of the gig and platform economy. The study highlights that gig workers are generally not recognized as traditional employees, and as a result, labour rights and social protection mechanisms remain weak. It clearly explains the fundamental nature of employment insecurity within the gig economy. By emphasizing the limitations of existing labour laws, the study underlines the need for policy-level reforms to address these challenges.

2. International Labour Organization (2018) – Digital Labour Platforms and the Future of Work

This report primarily examines the impact of digital labour platforms on the global labour market. The key findings indicate increased work flexibility, higher income uncertainty, and longer working hours. At the same time, the ILO adopts a balanced perspective by analyzing both the opportunities and challenges of the gig economy. The report stresses that the lack of social security can lead to rising long-term inequalities, posing serious concerns for the future of work.

3. Srnicek, N. (2017) – Platform Capitalism

This book focuses on the capitalist nature of digital platforms. The major conclusion is that power and control increasingly rest with companies through data ownership and algorithmic management. The study conceptualizes the gig economy not merely as an employment model but as a component of a new capitalist structure, thereby intensifying concerns related to organizational governance and labour control.

4. NITI Aayog (2022) - India's Booming Gig and Platform Economy-

This report examines the current status, expansion, and future prospects of the gig economy in India. It highlights a significant increase in the number of gig workers by 2030 and emphasizes the importance of skill development and social security. While the report provides a strong policy framework in the Indian context, it offers comparatively limited discussion on implementation-related challenges.

5. Graham, M., et al. (2017) - The Risks and Rewards of Online Gig Work

This study explores the socio-economic conditions of online gig workers. It suggests that global competition can suppress wages and increase the likelihood of worker exploitation. Overall, the study clearly illustrates power asymmetries in the global gig market and emphasizes the urgent need for regulatory interventions.

6. Sundararajan, A. (2016) – The Sharing Economy

This book discusses the economic and social impacts of the sharing and gig economy. Its key findings focus on transformations in traditional employment structures and the promotion of self-employment. While the study highlights the positive dimensions of the gig economy, it provides relatively limited discussion on labour protection issues.

7. OECD (2019) – Measuring the Digital Transformation

This report addresses challenges related to measuring employment and designing policies in the digital economy. It emphasizes that accurately measuring gig work is difficult due to data limitations and statistical gaps. The report highlights significant data gaps in gig economy research, which pose major challenges for effective policy formulation.

8. Kalleberg, A. L. (2009) – Precarious Work

The focus of this study is the concept of precarious employment. Its key findings highlight the emergence of an insecure workforce and a rise in social inequality. This work strengthens the theoretical foundation for understanding the gig economy and helps conceptualize gig workers as "precarious workers."

In summary, the review of the above literature highlights the following key points:

i. The gig economy promotes employment flexibility.

ii. However, it reduces job stability and social security.

iii. Organizational governance mechanisms remain inadequate.

iv. In India, although a policy framework exists, implementation remains limited.

Overall, there is a noticeable lack of empirical studies focusing on the real living conditions of Indian gig workers, institutional accountability, and the effective implementation of social security measures.

V. Population and Sample

For the purpose of this study, the population comprises all workers engaged in the gig and platform economy in India. This includes workers involved in transportation services, food delivery, domestic services, digital freelancing, content creation, IT-based services, and other forms of platform-based employment. Instead of conducting a primary field survey, the sample for this study is drawn from various reliable government and international reports, previously conducted academic studies, research articles, and relevant case studies. By synthesizing findings from these secondary sources, the study attempts to understand the socio-economic conditions of gig workers, the nature of their employment, and the administrative challenges they face.

VI. Research Tools

To achieve the objectives of the study, multiple research tools have been employed. Primarily, the content analysis method has been used to conduct an in-depth examination of government reports, policy documents, and academic research articles. In addition, the comparative study approach has been adopted to compare the status of the gig economy in India with experiences from other countries. Furthermore, report analysis has been used to interpret data, findings, and recommendations presented by various institutions. The combined use of these tools has ensured objectivity, analytical depth, and academic credibility in the research.

VII. Gig Economy-

The gig economy refers to an economic system in which workers engage in short-term, contract-based, independent (freelance), and temporary work instead of long-term and stable employment. Such work is assigned through digital platforms, mobile applications, or direct contractual arrangements.

According to the International Labour Organization (ILO),"The gig economy refers to labour markets characterized by short-term contracts or freelance work as opposed to permanent jobs."

According to NITI Aayog, "Gig workers are those engaged in income-earning activities outside of traditional employer–employee relationships."

A) Nature of Gig Economy-

The defining characteristic of the gig economy is its reliance on contract-based employment. In this form of work, there is no guarantee of long-term employment; instead, workers operate on short-term or project-based contracts. Gig workers often engage with multiple companies simultaneously or sequentially, leading to income instability and limited access to social security benefits such as

pensions or employee welfare schemes. While this structure offers flexibility to workers, it significantly reduces employment stability.

The gig economy is largely platform-based and technology-driven, where work is facilitated through digital platforms, mobile applications, websites, and online marketplaces. This allows workers to choose flexible working hours and promotes self-employment. However, gig work remains closely linked to the informal economy, as most workers do not fall under conventional labour laws. As a result, while the gig economy creates opportunities for diversity of work, technological integration, and economic inclusion, it simultaneously generates new challenges related to job security and labour protection.

B) Features of Gig Economy-

1. **Flexibility-** Workers determine their own work schedules
2. **Independent Workers-** Absence of traditional employer–employee relationships
3. **Use of Digital Platforms-** Work facilitated through apps and websites
4. **Skill-based Work-** Involves both low-skilled and high-skilled labour
5. **Short-term Employment-** Lack of permanent jobs
6. **Diversity of Opportunities-** Local as well as global work options
7. **Ease of Entry-** Employment opportunities with minimal capital investment

C) Opportunities in the Gig Economy-

The gig economy provides numerous opportunities for workers. Even when traditional employment opportunities are limited, gig workers benefit from flexible schedules, short-term contracts, and access to work across multiple sectors. This helps reduce unemployment, offers supplementary income sources, and enables workers from rural and semi-urban areas to participate in economic activities. For women, students, and senior citizens, the gig economy represents an inclusive employment model, allowing them to work from home or for limited hours.

From the perspective of entrepreneurs, firms, and the broader economy, the gig economy is equally significant. Companies gain access to skilled labour with reduced employment costs, leading to increased productivity and innovation, particularly for startups. At the macroeconomic level, the gig economy promotes employment generation, expansion of the digital economy, growth of the service sector, and financial inclusion. These benefits collectively contribute to inclusive economic development.

D) Challenges of the Gig Economy-

The primary challenges of the gig economy include employment insecurity, lack of social security, and income uncertainty. Unlike traditional employment, which offers job stability, fixed wages, insurance, and pension benefits, gig workers often lack such protections. Consequently, they face frequent income volatility and heightened financial vulnerability, leading to economic stress and long-term insecurity.

Additionally, the absence of labour rights protection, weak institutional governance, and lack of worker unions pose serious challenges. Issues such as excessive working hours, unclear wage structures, and limited bargaining power reduce workers' ability to improve their working conditions. Without effective regulation, social security frameworks, and collective representation, the gig economy risks becoming unsustainable and exclusionary in the long run.

VIII. India's Role in the Gig Economy-

India is currently regarded as one of the fastest-growing and most significant markets in the global gig economy. An estimated 70–90 million gig workers are engaged in this sector, representing a substantial share of the national workforce. This number continues to grow due to rising demand in IT services, delivery, transportation, content creation, design, and other digital services. The expansion of digital technologies, internet access, and mobile applications has enhanced flexibility and accessibility in gig work.

Government initiatives such as Digital India and Startup India have significantly accelerated the growth of the gig economy. India's young population and widespread use of smartphones and digital

services have further strengthened this expansion. Major gig platforms operating in India include Uber, Ola, Swiggy, Zomato, Urban Company, Freelancer, and Upwork. These platforms not only create employment opportunities but also promote skill development, income flexibility, and innovative digital business models.

IX. Programmes and Policies in India-

The Government of India has introduced several policy initiatives to support the growth of the gig economy and safeguard the interests of gig workers. The e-Shram Portal has been developed to facilitate the registration of unorganized and gig workers, enabling access to social security schemes, skill training, and government welfare programmes. The Social Security Code, 2020 formally recognizes gig and unorganized workers and provides provisions for insurance, pensions, and other social protection measures. The NITI Aayog (2022) report outlines a strategic roadmap for the gig economy, while initiatives such as Skill India Mission and Digital India strengthen skill development and digital infrastructure. Collectively, these policies aim to provide structured support and expand employment opportunities for gig workers.

X. Contribution of the Gig Economy in India-

The gig economy has made a significant contribution to India's economic and social development. It has generated new employment opportunities, particularly for women, students, and workers in rural areas. Moreover, it has facilitated the expansion of the startup ecosystem and small enterprises, while enhancing productivity and efficiency in the service sector.

Through gig-based employment, the rural–urban economic divide has been reduced, promoting financial inclusion and shared prosperity. As a result, the gig economy has emerged as a vital economic and social component of India's modern labour market.

XI. Conclusion-

The gig economy is an unavoidable reality of the modern economic system. While it promotes employment generation, flexibility, and innovation, it also presents significant challenges related to social security and employment stability. In a country like India, the gig economy can become an effective instrument for inclusive and sustainable development if supported by appropriate regulation, strong institutional governance, and a comprehensive social security framework.

XII.References -

1. International Labour Organization. (2021). World Employment and Social Outlook.
2. NITI Aayog. (2022). India's Booming Gig and Platform Economy.
3. De Stefano, V. (2016). The Rise of the Just-in-Time Workforce. ILO.
4. Srnicek, N. (2017). Platform Capitalism. Polity Press.
5. Organisation for Economic Co-operation and Development (OECD). (2019). Measuring Platform-mediated Workers. OECD Publishing.
6. World Bank. (2020). The Changing Nature of Work. World Bank Publications.
7. International Labour Organization. (2018). Digital Labour Platforms and the Future of Work: Towards Decent Work in the Online World. ILO.
8. Kalleberg, A. L. (2009). Precarious Work, Insecure Workers: Employment Relations in Transition. American Sociological Review, 74(1), 1–22.
9. Sundararajan, A. (2016). The Sharing Economy: The End of Employment and the Rise of Crowd-Based Capitalism. MIT Press.
10. Graham, M., Hjorth, I., & Lehdonvirta, V. (2017). Digital Labour and Development: Impacts of Global Digital Labour Platforms and the Gig Economy on Worker Livelihoods. Transfer: European Review of Labour and Research, 23(2), 135–162.
11. Berg, J., Furrer, M., Harmon, E., Rani, U., & Silberman, M. S. (2018). Digital Labour Platforms and the Future of Work. International Labour Office, Geneva.
12. Ministry of Labour and Employment, Government of India. (2020). Report of the Committee on Platform Economy. New Delhi.
13. NITI Aayog. (2023). India's Gig Workforce: Policy Framework and Future Outlook. Government of India.
14. Standing, G. (2011). The Precariat: The New Dangerous Class. Bloomsbury Academic.
15. Rosenblat, A. (2018). Uberland: How Algorithms Are Rewriting the Rules of Work. University of California Press.
16. Schwab, K. (2016). The Fourth Industrial Revolution. World Economic Forum.
17. UNDP. (2020). Human Development Report: Work for Human Development. United Nations Development Programme.
18. Friedman, G. (2014). Workers without Employers: Shadow Corporations and the Rise of the Gig Economy. Review of Keynesian Economics, 2(2), 171–188.

Role of AI in Chemical Research, Drug Design and Material Science

Miss. Anita Baburao Hulsoorkar
Research Centre – Chh. Shivaji Raje Mahavidyalaya, Udgir

Abstract :

Artificial Intelligence (AI) has emerged as a transformative technology across scientific disciplines, reshaping paradigms in chemical research, drug discovery, and materials science. The integration of advanced computational techniques—including machine learning (ML), deep learning (DL), and data-driven modeling—has accelerated the pace of innovation by enabling predictive insights, high-throughput screening, and automated experimentation. In chemical research, AI facilitates reaction prediction, process optimization, and molecular simulation. In drug design, it streamlines lead identification, pharmacokinetic prediction, and de novo molecule generation. In materials science, AI aids in the discovery of functional materials, optimization of properties, and reduction of experimental burden. This paper reviews state-of-the-art applications, discusses challenges and limitations, and outlines future directions in leveraging AI to address complex scientific problems.

Keywords :

Artificial Intelligence · Machine Learning · Chemical Research · Drug Design · Materials Science · Predictive Modeling · Deep Learning · High-throughput Screening · Molecular Simulation.

Introduction :

In recent years, the exponential growth of data generated from experiments, simulations, and high-throughput instrumentation has created both challenges and opportunities for scientific discovery. Traditional methods in chemical research, drug development, and materials discovery often rely on labor-intensive experiments and intuition-based decisions. The advent of Artificial Intelligence (AI) has provided powerful tools to analyze complex datasets, identify hidden patterns, and make predictive decisions that significantly reduce time and cost.

AI encompasses computer algorithms capable of learning from data, recognizing patterns, and making decisions with minimal human intervention. Subfields such as machine learning (ML), deep learning (DL), and reinforcement learning (RL) have been instrumental in driving innovation across domains. In chemistry, AI models have been applied to predict reaction outcomes, optimize synthesis pathways, and interpret spectroscopic data. In drug design, AI assists in virtual screening, molecular docking, and predicting pharmacokinetic properties. In materials science, data-driven techniques expedite the discovery of novel materials with desired functionalities.

This paper explores the multifaceted role of AI in advancing chemical research, drug design, and materials science. We discuss key applications, methodological frameworks, challenges, and prospects for future research.

AI in Chemical Research :

1) Reaction Prediction and Retrosynthesis

Predicting the outcomes of chemical reactions and planning synthetic routes are foundational challenges in chemistry. Traditional retrosynthetic analysis often relies on expert knowledge and manual reasoning, limiting scalability. AI-driven models, particularly those based on neural networks

and sequence-to-sequence architectures, have demonstrated impressive capabilities in predicting reaction products and proposing synthetic pathways.

Deep learning models trained on large reaction databases can capture complex dependencies between reactants and products. These models often use graph representations of molecules to preserve structural information. Retrosynthesis platforms, such as those leveraging reinforcement learning, can explore vast chemical spaces and propose optimal synthetic routes by learning from precedent reactions.

2) Process Optimization

Industrial chemical processes require careful optimization of conditions such as temperature, pressure, catalysts and solvents to maximize yield and selectivity. Traditional approaches involve iterative experimentation—a time-consuming and resource-intensive process.

AI-based optimization strategies, including Bayesian optimization and surrogate modeling, can efficiently identify optimal conditions. By modeling the response surface of experimental outcomes, these techniques reduce the number of required experiments and accelerate process development.

3) Spectroscopy and Structural Analysis

AI has been applied extensively in interpreting spectroscopic data, including nuclear magnetic resonance (NMR), infrared (IR), mass spectrometry (MS), and X-ray diffraction (XRD). Machine learning algorithms can classify spectra, identify functional groups, and determine molecular structures with high accuracy.

Pattern recognition techniques have significantly enhanced the speed of analysis and reduced the reliance on expert interpretation. For instance, convolutional neural networks (CNNs) trained on labeled spectral databases can rapidly assign spectra to known compounds or predict structural features.

AI in Drug Design :

1) Virtual Screening and Lead Discovery

Drug discovery traditionally involves screening large chemical libraries to identify compounds with desired biological activity. Experimental high-throughput screening (HTS) is costly and time-intensive.

AI-driven virtual screening leverages predictive models to prioritize compounds based on estimated bioactivity. Techniques such as quantitative structure-activity relationship (QSAR) models and deep neural networks analyze molecular descriptors or graph-based representations to predict binding affinity to biological targets. These models significantly reduce the number of candidates requiring experimental validation.

2) De Novo Drug Design

De novo drug design refers to the generation of novel chemical structures with optimized properties. Generative models, such as variational autoencoders (VAEs), generative adversarial networks (GANs) and reinforcement learning frameworks, can create new molecular structures by learning from existing chemical space.

By incorporating constraints related to drug-likeness, ADMET (absorption, distribution, metabolism, excretion, and toxicity) profiles and synthetic feasibility, AI systems can propose candidate molecules with high therapeutic potential and favorable pharmacokinetic properties.

3) Prediction of Pharmacokinetics and Toxicity

A critical challenge in drug development is predicting how a compound behaves in the human body. Poor pharmacokinetics and toxicity are leading causes of clinical failure.

Machine learning models trained on biological and chemical data can forecast ADMET properties, allowing early elimination of compounds with unfavorable characteristics. Techniques ranging from random forests to deep learning architectures provide quantitative predictions of solubility, permeability, metabolic stability and potential toxic effects.

AI in Materials Science :

1) Accelerated Materials Discovery

Materials science aims to design materials with specific properties, such as conductivity, strength, or catalytic activity. Traditional discovery methods involve iterative experimentation guided by intuition and theoretical models.

AI accelerates this process by learning structure-property relationships from existing datasets. Supervised learning models can predict material properties based on compositional and structural descriptors. Coupled with high-throughput simulations and experimental data, AI aids in identifying promising candidates for further investigation.

2) Inverse Design and Optimization

Inverse design refers to specifying desired properties and generating material structures that achieve them. Generative models and optimization algorithms can explore the vast design space of possible materials.

Reinforcement learning and genetic algorithms have been applied to optimize compositions and microstructures for targeted performance metrics. These methods enable the discovery of novel materials that might be inaccessible through conventional trial-and-error approaches.

3) Computational Microscopy and Characterization

Advanced characterization techniques generate large volumes of imaging and spectral data. AI tools, particularly deep learning models, can automate image analysis to extract meaningful features from microscopy data, such as defects, phase boundaries, or nanoscale features.

By integrating data from multiple modalities, including electron microscopy and spectroscopy, AI enhances understanding of structure-property relationships at various length scales.

Cross-Cutting Challenges and Limitations :

Despite significant progress, the integration of AI in chemical research, drug design, and materials science faces several challenges.

1) Data Quality and Availability

AI models are only as good as the data they are trained on. Many scientific domains suffer from data scarcity, incomplete datasets, and inconsistent labeling. High-quality datasets with standardized formats are essential for robust model training and generalization.

2) Interpretability and Trust

AI models, especially deep learning-based systems, often operate as “black boxes,” making it difficult to interpret their predictions. Scientific disciplines require transparency and mechanistic understanding to ensure reliability and acceptance among domain experts.

Efforts to develop explainable AI (XAI) and interpretable models are crucial for bridging the gap between predictive performance and scientific insight.

3) Integration with Experimental Workflows

Seamless integration of AI models into experimental workflows remains a challenge. AI-driven predictions must interface with laboratory automation systems, robotics, and real-time feedback loops to fully realize autonomous experimentation.

Additionally, human expertise remains indispensable in validating model predictions and guiding exploratory research.

4) Ethical and Regulatory Considerations

In drug development and materials applications with environmental impact, ethical considerations and regulatory compliance are paramount. AI-driven decisions must adhere to safety standards, data privacy norms, and legal frameworks governing scientific research.

Future Directions :

AI's continued evolution promises deeper integration with scientific discovery. Several promising directions include:

1) Autonomous Laboratories

Integration of AI with robotic experimentation platforms can enable closed-loop, self-driving laboratories capable of hypothesis generation, experimental execution, data analysis, and iterative optimization.

Such systems could dramatically reduce the time from concept to discovery in chemistry and materials science.

2) Hybrid Modeling Approaches

Combining physics-based models with AI-driven data analytics can enhance predictive accuracy by incorporating fundamental scientific principles. Hybrid models can leverage first-principles simulations (e.g., density functional theory) alongside machine learning to predict complex phenomena.

3) Federated and Transfer Learning

Data privacy and scarcity issues can be mitigated through federated learning, where models are trained across decentralized datasets without sharing sensitive data. Transfer learning enables models trained on large datasets in one domain to be adapted for specific tasks with limited data.

4) Explainable and Causal AI

Developing AI systems capable of causal inference and mechanistic explanations will improve trust and adoption among scientists. Explainable AI techniques that reveal underlying decision pathways can provide deeper scientific insights and support hypothesis testing.

Conclusion :

AI has emerged as a cornerstone of modern scientific research, offering powerful tools to analyze complex data, predict outcomes, and automate discovery processes. In chemical research, AI enhances reaction prediction, process optimization, and spectral analysis. In drug design, it accelerates virtual screening, de novo molecule generation, and ADMET prediction. In materials science, AI expedites discovery, optimizes material properties, and integrates with advanced characterization techniques. Despite challenges related to data quality, interpretability, and integration with experimental workflows, ongoing advancements in AI methodologies and interdisciplinary collaboration hold immense promise. The future of scientific innovation will increasingly depend on synergistic partnerships between human expertise and intelligent computational systems.

References :

1. Schwaller, P., et al. "Predicting Chemical Reaction Outcomes with Neural Sequence-to-Sequence Models." *Chemical Science* (2018).
2. Segler, M. H. S., et al. "Planning chemical syntheses with deep neural networks and symbolic AI." *Nature* (2018).
3. Vamathevan, J., et al. "Applications of machine learning in drug discovery and development." *Nature Reviews Drug Discovery* (2019).

4. Jin, W., et al. "Junction Tree Variational Autoencoder for Molecular Graph Generation." *International Conference on Machine Learning* (2018).
5. Butler, K. T., et al. "Machine learning for molecular and materials science." *Nature* (2018).
6. Raccuglia, P., et al. "Machine-learning-assisted materials discovery using failed experiments." *Nature* (2016).
7. Coley, C. W., et al. "A graph-convolutional neural network model for the prediction of chemical reactivity." *Chemical Science* (2019).
8. Gawehn, E., et al. "Deep learning in drug discovery: opportunities, challenges and future prospects." *Drug Discovery Today* (2016).
9. Ward, L., et al. "Including crystal structure attributes in machine learning models of formation energies via Voronoi tessellations." *Physical Review Materials* (2018).
10. Ribeiro, M. T., et al. ""Why Should I Trust You?": Explaining the Predictions of Any Classifier." *ACM SIGKDD* (2016).

Reading Arun Joshi's, The Foreigner Through an Existential Perspective

Pranav S. Tatte[1], Gauri S. Wande[2]
1.Research Scholar, Dept. of English, GVISH, Amravati
2.Research Scholar, Dept. of English, GVISH, Amravati

Abstract

Arun Joshi's seminal novel The Foreigner (1968) stands as a landmark work in Indian English literature that profoundly engages with existentialist philosophy and the human condition in the modern world. This research examines the novel through the lens of existentialism, exploring how the protagonist Sindi Oberoi embodies the core concerns of existentialist thought: alienation, freedom, responsibility, and the search for authentic existence. Through Joshi's complex narrative architecture featuring psychological introspection and philosophical meditation, the paper argues that The Foreigner presents a sophisticated exploration of existential alienation as both social estrangement and inner spiritual void. The novel traces Sindi's journey from initial detachment and nonalignment through traumatic crises towards a tentative reconciliation with existence, reflecting existentialist concerns with authenticity, freedom, and human anguish. By analyzing the protagonist's fragmented selfhood and his evolution from philosophical escapism to existential commitment, this study demonstrates how Joshi's work transcends regional and national boundaries to engage with universal human existential dilemmas, establishing itself as a profound meditation on what it means to exist authentically in an indifferent world.

Keywords: Existentialism, Arun Joshi, The Foreigner, alienation, identity, authenticity, freedom, responsibility

Introduction

Arun Joshi's Literary Significance in Existential Discourse

Arun Joshi occupies a distinctive and pioneering place in post-independence Indian English literature through his unflinching exploration of existential themes that challenge conventional narrative traditions. Unlike his contemporary Indian English writers who focused primarily on social issues or entertainment, Joshi deliberately chose to experiment with the philosophical dimensions of human existence, probing deep into the psychological recesses of his protagonists and examining their struggles with freedom, meaning, and authenticity [1]. His literary corpus demonstrates a remarkable engagement with Sartrean existentialism, presenting protagonists who grapple with the meaninglessness of modern life and the burden of individual choice in a materialistic world.

Overview of The Foreigner

The Foreigner (1968), Joshi's debut novel, exemplifies this existential preoccupation through its central protagonist Sindi Oberoi, a man caught between multiple worlds and cultures who experiences profound psychological and spiritual estrangement. The novel employs a complex narrative structure featuring flashbacks and intense psychological introspection to explore Sindi's emotional detachment and his quest for meaning amidst recurring experiences of loss and trauma [2]. Through Sindi's journey across Kenya, London, Boston, and finally Delhi, the novel interrogates the fundamental questions that lie at the heart of existentialist philosophy: What does it mean to exist authentically? How does one confront the absurdity and meaninglessness of existence? What is the relationship between freedom and responsibility?

Philosophical Foundations: Existentialism and tts Key Concepts

The Origins and Core Principles of Existentialist Philosophy

Existentialism, as a philosophical movement, gained particular prominence in 20th-century Europe through the works of Søren Kierkegaard, Friedrich Nietzsche, Jean-Paul Sartre, Albert Camus, and Martin Heidegger. At its philosophical core lies the assertion that "existence precedes essence" – a fundamental principle articulated by Jean-Paul Sartre – which posits that human beings are not born

with predetermined natures or purposes but must create their own meaning through the exercise of radical freedom and personal choice [3]. This philosophical approach fundamentally reorients our understanding of human responsibility and authenticity, placing the individual at the center of existential inquiry.

Existential Alienation, Anxiety, and Authenticity

The existentialist tradition emphasizes several interconnected themes that become central to understanding Joshi's The Foreigner. These include the pervasive sense of alienation that characterizes modern existence, the anxiety that accompanies awareness of one's radical freedom, the search for authenticity in an often-inauthentic world, and the constant confrontation with the ultimate meaninglessness and absurdity of human existence [3]. Existentialist philosophy recognizes alienation not merely as a social or economic phenomenon but as an ontological condition inherent to human consciousness itself. The individual experiences separation not only from society but from their own authentic self, perpetually confronting the abyss of nothingness that underlies existence.

Existential Alienation in the Foreigner: The Case of Sindi Oberoi

The Architecture of Rootlessness and Identity Fragmentation

Sindi Oberoi represents the quintessential existential protagonist whose very existence embodies the alienation central to Joshi's thematic concerns. Born in Kenya to an Indian father and English mother, educated across continents, Sindi epitomizes what existentialist philosophy terms the "foreigner" – not merely in literal geographical terms but as a fundamental existential condition of homelessness and rootlessness [2]. His multicultural heritage and transnational education create a peculiar psychological situation where he belongs nowhere, perpetually experiencing himself as an outsider regardless of geographical location. This condition of perpetual alienation becomes the organizing principle of his consciousness and his relationship to the world.

Emotional Detachment as a Defense Mechanism

The novel portrays Sindi's emotional detachment not as mere personality quirk but as a sophisticated philosophical response to existence itself. Initially, Sindi adopts a philosophy of non-involvement, convincing himself that detachment ensures tranquility and protects him from the pain inherent to human connection [4]. This stance reflects what Sartre termed "bad faith" – the deliberate evasion of existential responsibility through self-deception and the adoption of false identities. By maintaining emotional distance and refusing genuine involvement with others, Sindi attempts to construct an illusion of control and immunity from suffering. However, the novel systematically demonstrates the insufficiency of this strategy, revealing detachment as ultimately a form of self-destruction rather than self-protection.

The Psychological Manifestation of Existential Void

Joshi's portrayal of psychological trauma in Sindi's life extends beyond conventional depiction to engage with what existentialist philosophy recognizes as the fundamental anxiety of human consciousness [5]. The suicide of Sindi's friend Babu Khemka and the tragic death of his beloved June Blyth function not merely as plot devices but as existential provocations that shatter Sindi's carefully constructed defensive mechanisms. These traumatic experiences confront him directly with the reality of death, meaninglessness, and the ultimate solitude of individual existence. The novel suggests that genuine engagement with these existential realities, however painful, constitutes the only authentic path toward meaningful existence.

CULTURAL DISPLACEMENT AND THE SEARCH FOR PHILOSOPHICAL GROUNDING

The Tension Between Cultural Inheritance and Personal Authenticity

Sindi's cultural displacement reflects what contemporary postcolonial theory recognizes as the psychological consequences of colonial legacy and global migration. Yet Joshi's approach transcends mere sociological documentation to engage with existential philosophy more fundamentally [4]. The novel traces Sindi's quest for meaning as he moves geographically but discovers that spatial relocation cannot resolve ontological displacement. His emotionally detached relationships and initially

convinced belief that non-involvement ensures tranquility lead him through a series of existential crises where he must confront the fundamental inadequacy of escapism.

The Philosophy of Karma Yoga and Existential Commitment

A distinctive feature of Joshi's existentialist approach involves his integration of Indian philosophical thought with Western existentialism. Rather than maintaining pure adherence to Sartrean philosophy, Joshi introduces the concept of karma yoga – selfless action grounded in ethical responsibility – as a potential resolution to existential alienation. Sindi's eventual evolution involves moving from superficial non-involvement to what the novel presents as meaningful existential commitment grounded in the Indian concept of selfless action [4]. This synthesis demonstrates how existential philosophy, while originating in European thought, can accommodate and integrate non-Western philosophical traditions in addressing universal human concerns.

The Limits of Detachment as a Philosophy

The novel's central philosophical insight concerns the ultimate failure of detachment as a sustainable life strategy. Confronted with a humanitarian crisis in Delhi, Sindi must dismantle his self-protective philosophy and expose the fundamental limits of detachment as a defense mechanism [4]. This turning point reveals a crucial existentialist principle: that authentic existence demands engagement with others and acceptance of responsibility for one's actions and their consequences. The novel suggests that true freedom lies not in the absence of commitment but in the conscious acceptance of responsibility for one's choices and their impact on the world.

FREEDOM, RESPONSIBILITY, AND THE BURDEN OF CHOICE

Radical Freedom and Its Psychological Consequences

Sartrean existentialism emphasizes that human beings possess absolute freedom – the liberty to define themselves through their actions and choices regardless of external circumstances [6]. Yet this freedom carries with it an equally absolute burden of responsibility. Sindi's experience throughout the novel illuminates both the exhilarating and terrifying dimensions of radical freedom. His initial philosophy of non-involvement represents an attempt to escape this burden, to deny the weight of responsibility that accompanies freedom. However, the novel demonstrates that one cannot authentically escape responsibility; the attempt to do so merely constitutes another form of self-deception.

The Anguish of Authentic Choice

Existentialist philosophy recognizes that authentic existence requires confronting the anguish that accompanies awareness of radical freedom and responsibility. Sindi's psychological journey involves gradually acknowledging this anguish rather than fleeing from it. Each traumatic experience – the deaths of friends, the failure of romantic relationships, the confrontation with suffering – forces Sindi closer to authentic consciousness of his existential condition. The novel presents these painful awakenings not as defeats but as necessary steps toward genuine existence. Only through acknowledging the reality of human suffering and one's own complicity in the world's suffering can one begin to live authentically.

The Ethics of Engagement

By the novel's conclusion, Sindi recognizes that authentic freedom must be paired with ethical commitment and responsibility toward others. His decision to protect the factory workers in Delhi represents not a abandonment of his philosophical principles but their maturation and deepening. This action demonstrates that existential freedom achieves its fullest expression not in passive detachment but in conscious commitment to others' welfare and wellbeing. The novel thus presents a sophisticated ethical vision wherein existential freedom and moral responsibility become inseparable.

THE NARRATIVE TECHNIQUE AND THE REPRESENTATION OF EXISTENTIAL CONSCIOUSNESS

Inner Monologue and Psychological Interiority

Joshi's distinctive narrative approach employs extensive inner monologue and psychological introspection to render Sindi's existential consciousness directly to the reader [3]. Rather than external

narration about Sindi's thoughts and feelings, the novel grants readers immediate access to the protagonist's consciousness, allowing them to experience directly the texture of existential alienation, anxiety and confusion. This narrative technique proves particularly effective in conveying the subjective dimensions of existential experience – the way meaninglessness feels, how alienation manifests in consciousness, what authentic choice demands psychologically.

Fragmented Structure and Temporal Discontinuity

The novel's complex narrative structure, featuring flashbacks and non-linear organization, mirrors the fragmented nature of Sindi's selfhood and consciousness [2]. The discontinuous temporal arrangement reflects how traumatic experiences and unresolved psychological conflicts disrupt linear narrative coherence. This formal choice demonstrates that existential alienation involves not merely emotional or philosophical detachment but fundamental disruption of the coherence and continuity of the self. The narrative structure itself becomes a vehicle for communicating existential crisis.

The Use of Symbolism and Metaphor

Throughout the novel, Joshi employs symbolic imagery – particularly the motif of the foreigner, the journey, and various geographical locations – to explore existential themes. These symbols function not merely as decorative elements but as integral components of the novel's philosophical investigation. The concept of "foreigner" itself becomes a metaphor for the fundamental human condition of existential homelessness and displacement, suggesting that in a meaningless universe, all consciousness experiences a kind of permanent foreignness.

THE JOURNEY TOWARD AUTHENTIC EXISTENCE AND TENTATIVE RECONCILIATION

The Crisis as Catalyst for Transformation

The latter portions of The Foreigner trace Sindi's gradual movement from defensive alienation toward a more authentic engagement with existence. This transformation does not occur smoothly or without continued suffering; rather, it emerges through Sindi's repeated confrontations with the inadequacy of his defensive mechanisms [2]. Each crisis – each experience of loss, failure, or suffering – pushes him further toward acknowledgment of existential reality. The novel suggests that genuine transformation requires not transcendence of suffering but integration of it into a more comprehensive existential awareness.

The Possibility of Meaning in Meaninglessness

Existentialist philosophy, particularly as articulated by Albert Camus, recognizes that while the universe may be fundamentally meaningless and indifferent to human concerns, individuals can create meaning through their choices and commitments. Sindi's eventual recognition of this principle marks a crucial development in his existential maturation. He comes to understand that meaning is not discovered in the world but created through authentic engagement and responsibility. This insight allows him to move beyond both the despair of meaninglessness and the illusion of pre-given meaning.

Acceptance and Responsibility as the Path Forward

By the novel's conclusion, Sindi moves toward what might be termed a tentative reconciliation with existence – not a complete resolution or ultimate happiness, but rather an acceptance of existence as fundamentally characterized by struggle, responsibility, and the ongoing necessity of choice [2]. This reconciliation represents the existentialist vision of authentic living: not the achievement of permanent peace or satisfaction, but the conscious acceptance of existence's fundamental conditions and the commitment to living responsibly within those conditions. Sindi's story suggests that maturity consists not in escaping the human condition but in accepting it fully.

CONCLUSION

Arun Joshi's The Foreigner emerges as a landmark achievement in world literature precisely because it engages with existential philosophy not as external doctrine but as the lived experience of a complex human consciousness confronting the fundamental conditions of existence. Through Sindi Oberoi's journey from alienation and detachment toward authentic engagement and responsibility,

Joshi explores the core concerns of existentialism – freedom, authenticity, alienation, and the search for meaning in a potentially meaningless universe [2].

The novel's particular significance lies in its synthesis of Western existential philosophy with Indian spiritual traditions, demonstrating that existential concerns transcend cultural and geographical boundaries. By incorporating the concept of karma yoga – selfless action grounded in ethical responsibility – Joshi suggests that authentic existence may involve different paths for different individuals and cultures, yet shares certain universal characteristics: the necessity of confronting one's freedom and accepting responsibility for one's choices.

The Foreigner ultimately presents existential philosophy not as abstract theory but as the lived reality of modern consciousness. In the character of Sindi Oberoi, readers encounter not merely a individual personality but an archetype of modern alienation – the educated, culturally displaced individual caught between worlds, struggling to find authentic meaning and connection in a fragmented, meaningless existence. Yet through Joshi's sophisticated portrayal of Sindi's transformation, the novel suggests that authenticity remains possible even in conditions of radical alienation; that freedom, when consciously accepted with its attendant responsibility, can lead toward more genuine engagement with existence.

The novel's exploration of alienation, freedom, and authenticity remains profoundly relevant in contemporary contexts where individuals increasingly experience cultural displacement, psychological fragmentation, and existential uncertainty. By reading The Foreigner through an existential perspective, we gain not only deeper understanding of Joshi's masterwork but also valuable philosophical insights into the human condition itself. Joshi's legacy lies in demonstrating that Indian English literature could engage with Western philosophical traditions while maintaining its own distinctive cultural voice, creating a work that speaks simultaneously to particular historical and cultural circumstances and to universal human existential concerns.

References

1. Sanjay Kumar. (2025). "Existential Alienation in Arun Joshi's The Foreigner: An Analysis." International Journal of Research and Applied Management Technology, 6(10). doi: 10.65138/ijramt.2025.v6i10.3147
2. Hari Om & Rajan Lal. (2025). "Cultural Displacement and Espoused Philosophy in Arun Joshi's The Foreigner." Katha Rupantaran, 4(11). doi: 10.57067/kr.04.i11/562
3. Suneeta Arya & Dr. Barkha Rautela. (2025). "Existential Undertones and Inner Monologues in Arun Joshi's The Foreigner." Rajasthan Journal of Physical and Social Sciences, 50(02). doi: 10.31995/rjpss.2025.v50i02.035
4. Srijati Agrawal. (2023). "Elements of Existentialism in the Works of Arun Joshi." International Journal for Multidisciplinary Research, 5(3). doi: 10.36948/ijfmr.2023.v05i03.2827
5. Prashant Singh. (2025). "Depictions of Psychological Trauma in Arun Joshi's Novels." International Journal for Multidisciplinary Research, 7(6). doi: 10.36948/ijfmr.2025.v07i06.65108
6. Milton Thorman Pardosi. (2025). "Freedom and responsibility in Jean-Paul Sartre's existentialism: A philosophical review." Satwika, 9(1). doi: 10.22219/satwika.v9i1.40466
7. Subrat Dwivedi. (2025). "Western Existential Dilemmas and Indian Spiritual Resolution in Arun Joshi's The Strange Case of Billy Biswas." International Journal of Oriental Studies, 18(08). doi: 10.47311/ijoes.2025.18.08.188
8. Tamanna Tamanna. (2025). "The Path of Non-Attachment: Exploring Advaitic Themes in Arun Joshi's The Strange Case of Billy Biswas." Gyan Vividha, 2(1). doi: 10.71037/gyanvividha.v2i1.05
9. Dr K. Suresh & Dr Nirmala Devi M. (2025). "Fiction of the Mind: A Psychological Lens on Arun Joshi's Novels." International Journal of Engineering Science and Advanced Technology, 25(09). doi: 10.64771/ijesat.2025.v25.i09.pp278-281
10. P. Revathy, V. Peruvalluthi, Shyam Asnani, O Bhatnagar. (2020). "Quest and Assessment for Self-Identity in the Select Novel of Arun Joshi." British Journal of Applied Health and Social Sciences, 5(2). doi: https://doi.org/10.34104/bjah.020082086
11. Rakesh Kumar, Sanjay Prasad Pandey, Ajoy Batta. (2023). "Arun Joshi: A Literary Artist of Existential Writing." Journal of American Ziauddin, 44(S-3). doi: 10.17762/jaz.v44is-3.945
12. Irshad Md. (2025). "Voices from the Void: An Exploration of the Youthful Psyche in Arun Joshi's Fiction." Research Hub for Integrated Multidisciplinary Review Journal, 12(9). doi: 10.53573/rhimrj.2025.v12n9.009
13. Dr. K A. Vilasini. (2025). "The Dawn of Indian English Novels." Bharati International Journal of Social Inquiry, 10(S1). doi: 10.64938/bijsi.v10si1.25.oct024

Application of Artificial Intelligence in English Language and Literature

Prof. Dr. G. O. Jondhalekar
Assistant Professor, Dept. of English
Dr.Gopalrao Khedkar, Mahavidyalaya, Gadegaon (Telhara) Dist. Akola

Abstract:

Artificial intelligence is a computer operating system that enables to solve textual and perceptive problems, enhancing graphs, charts, and data and helps to understand language. It accelerates the reasoning of human being and provides information on all topics and subjects to make easier the learning of English language and literature. Basically, Artificial intelligence relies on the natural intelligence of human beings. The AI recreates the events analogous to the original and real one. It retains the power to modify, alter and to predict what actually is a part of make-belief and mere hallucination. It presents the events, matter and things look more sophisticated, polished and flavoured leading to exaggeration and metaphysical. The impact of artificial Intelligence is immense in modern age as it works to recognise images, understand language and literature and offer solutions to theoretical issues. All types of data, whether medicinal, technical, financial, transportational, healthcare, educational, religious, philosophical and moral etc. is available with the application of AI technology in pedagogical purposes. It works upon the reliable sources, numerical analysis, graphical and theoretical information in terms of present perspective and advent of future application. Artificial Intelligence is a modern advance technology applicable in all the fields for its accurate and easy to access mode. It functions man-like creativity and intelligence to learn and understand English language and literature profoundly. The Google-Gemini, Netflix and Chat-GPT services are prominent in this application. This application uses advanced technology to transform raw data, texts, images, videos, and audios into meaningful insights. It is proved to be more reliable source of information as it is more accurate, elaborate, innovative providing more data, graphics, features, charts and numerical exactness to add more flavour to the required and demanded information. The critical analysis of existing literature and research studies on this application in teaching English language and literature aims to contribute to the growing implementation of AI in every field acquiring the knowledge of English language and literature. The present paper provides insight into the potential benefits and limitations of using AI in language learning, literary analysis, and creative writing. This research paper also explores the application of Artificial Intelligence in teaching and learning of English language and literature.

Keywords: artificial, reasoning, intelligence, application, sophisticated, technology, pedagogical, metaphysical, perspective, implementation, analysis, insight, potential

Introduction:

Artificial Intelligence is a modern technology which is applicable in teaching English language and literature with a focus on its potential to revolutionize language learning, literary analysis, and creative writing. Through a critical analysis of existing literature and research studies, this paper explores the ways in which AI can be used to support language learning, improve reading comprehension, and enhance literary analysis. It highlights the challenges and limitations of using this technology in language learning and literary studies, and focusing on need for further research in this area. With the increasing use of technology in education, AI has emerged as a potential tool for language learning and teaching. The new technology can be used to support language learning, improve reading comprehension, and enhance literary analysis. It also highlights the challenges and limitations of using AI in the classrooms. Artificial Intelligence has been increasingly used in various fields, including education, healthcare, and finance. In the field of English language and literature, this new technique has the potential to help the way we teach and learn languages, as well as analyse and interpret literary texts. The teaching of English language and literature has undergone significant

changes in recent years, with the increasing use of technology in education. One of the most promising developments in this area is the use of Artificial Intelligence which has the potential to enhance the way we teach and learn languages. It supports language learning, improve reading comprehension, and enhance literary analysis. Artificial Intelligence functions as a tool to support language learning in a number of ways. It can provide personalized feedback and assessment, allowing learners to track their progress and identify areas for improvement. It helps to generate interactive and engaging language learning activities, such as chatbots and virtual assistants. It focuses on analysing language learners' writing and speaking skills. It provides feedback on grammar, vocabulary, and pronunciation. It can also be used to enhance literary analysis, by providing students with tools and resources to analyse and interpret literary texts. The analysis of text is used to identify themes, motifs, and literary devices, and to provide students with a deeper understanding of the text. It helps generate literary criticism and analysis, providing students with insights into the literary work and its historical context. Artificial Intelligence gives impetus to compare and contrast different literary works, providing students with a deeper understanding of literary themes and terms.

Application of AI in English Language Learning and Teaching:

There are several benefits of using AI technology in language learning and teaching AI-powered language learning platforms can provide instant feedback and assessment, freeing up teachers to focus on more complex and creative tasks. These platforms gather personalized feedback and assessment, allowing learners to track their progress and identify areas for improvement. It provides accurate and objective feedback on language learners' writing and speaking skills. The lack of human interaction in learning platforms cannot provide the same level of human interaction and feedback as traditional language classes. The language analysis tools are insufficient to understand the context and sometimes inaccurate or incomplete feedback is taken. It is probable to occurring technical issues, such as errors which can disrupt the learning process. The new technology assists learners to enhance their conversational skills, to provide virtual assistants to motivate learners with language learning tips and resources. Some tools such as Ginger can analyse language learners' writing and speaking skills, providing feedback on grammar, vocabulary, and pronunciation. This type of application helps to detect grammatical errors, suggest alternative phrases, and provide feedback on sentence structure and style. AI-powered speech recognition tools, such as Google Speech Recognition, can help language learners improve their pronunciation and speaking skills. The Natural Language Processing (NLP) tools can be used to analyse and generate human language, providing insights into language structure and usage. The NLP tools can be used to analyse the language of literary texts, providing insights into themes, and literary devices. The textual analysis software can be used to identify themes, literary devices in literary texts. It analyses the language and structure of Shakespeare's plays, providing insights into his use of imagery, metaphor, and other literary devices. AI is used to generate literary criticism and analysis, providing students with insights into the literary work and its historical context. For example, AI-powered tools can analyse the language and themes of Jane Austen's novels, providing insights into her views on love, marriage, and social class. The comparison tools can be used to compare and contrast different literary works, providing students with a deeper understanding of literary themes and concepts. It makes easier to use the themes of love and betrayal in Shakespeare's Romeo and Juliet and Austen's Pride and Prejudice. The authorship analysis tools can be used to analyse the writing style and language use of different authors, providing insights into authorship and literary style. It also analyses the writing style of Shakespeare's plays, providing insights into his use of language and literary devices. The tools to summarize texts can be used for literary texts, providing students with a concise overview of the plot and themes. It can summarize the plot of novels, providing insights into the themes and characters.

There are number of benefits of this new technology in terms of English language leaning. AI-powered language learning platforms provides personalized feedback and assessment, allowing learners to track their progress and identify areas for improvement. They help in an instant feedback and assessment, freeing up teachers to focus on more complex and creative tasks. The language

analysis gives accurate and objective feedback on language learners' writing and speaking skills. It also helps in interactive and engaging language learning activities, increasing learner motivation and engagement. It provides learners with access to a wide range of language learning resources, including videos and interactive exercises.

Effective implementation of AI in English Language and Literature:

The extensive use of this new AI application is marked with its characteristics as well as its drawbacks. The use of AI powered platforms is unable to provide the same level of human interaction and feedback as traditional language classes. The analysis tools may not be able to fully understand the context and nuances of language, leading to inaccurate or incomplete feedback. The learning platforms sometimes turn to technical issues, such as errors and glitches, which can disrupt the learning process. This application can be dependent on large datasets, which can be limited in scope and accuracy. There are certain application that is insufficient to generate creative and original language, limiting their usefulness in certain contexts. To overpower these limitations, the language learning platforms should be designed to work in juxtaposition with human teachers, providing personalized feedback and assessment and also allowing for human interaction and feedback. The analysis tools should be designed to better understand the context of language, providing more accurate and complete feedback. The learning platforms should be designed to minimize technical issues, such as errors and glitches, and to provide seamless and intuitive user experiences. It should be designed to incorporate more advanced AI models, such as deep learning and natural language processing, to improve their accuracy and effectiveness. These tools require to be designed to encourage human creativity and originality, rather than simply generating sophisticated language.

Conclusion:

Artificial Intelligence has the potential to make people aware about the way we teach and learn English language and literature. It provides personalized feedback and assessment by generating interactive and engaging language learning activities, and analysing literary texts. It also helps learners to improve their language skills and deepen their understanding of literary works. However, there are also limitations to the use of AI in English language and literature, including the lack of human interaction and limited contextual understanding. The extensive use of this new technology in teaching English language and literature, examining the ways in which it can be used to support language learning and literary analysis, it has the potential in advancement of English language learning and teaching. There are also several challenges and limitations to its use. In order to fully explore the potential of this type of technology in language learning and teaching, we have to face the challenges and limitations of its use. This detailed analysis has explored the role of AI in English language and literature, highlighting its applications, benefits, and limitations. The focus should be on the potential of AI in language learning and teaching, and to highlight its power to improve language education and promote more effective language learning experiences should be our sole endeavour.

References:

1. M. Warschauer, *Technology and Language Learning*, Cambridge University Press, 2018.
2. C. A. Chapelle, *Arguments for Technology in Language Teaching*, OUP, 2017.
3. P. Hubbard, *Computer-Assisted Language Learning,* Routledge, 2017.
4. R. Kern, *Language, Literacy, and Technology*, Cambridge University Press,2015.
5. R. Blake, *Technology and Language Learning*, Cambridge University Press,2016.
6. T.S. Selvam and NYK Zakari, *A Systematic Literature Review of the Impact of AI tools in English Language Teaching and Learning*, Internation Journal of Academic research in Progressive Education and Development,2024.
7. A. Reves, Y. Jung, *Artificial Intelligence in Applied Linguistics: Application, Promises and Challenges,* Annual Review of Applied Linguistics, Cambridge Press, 2025.
8. J. Chen, Y. Yang, S. Hou, *Charting the Developmental landscape of Artificial Intelligence In Language Education using Biometric Methods,* Springer Nature, London, 2025.

Protection of Traditional Knowledge in Digital Libraries: A Study of Gond Cultural Heritage.

Mr. Amol Laxmikant Sakhare
Researcher
R. T. M. Nagpur University
Dr. Dhananjay R. Gabhane
Supervisor (Guide)
Librarian, Samarth Mahavidyalaya, Lakhani Dist. Bhandara

Abstract

The digitization of indigenous knowledge has accelerated preservation and accessibility but also introduced risks of misappropriation, misrepresentation, and loss of cultural context. This research explores mechanisms for protecting the Traditional Knowledge (TK) of the Gond community—a significant indigenous group in central India—within digital library environments. Emphasizing ethical digitization practices, community participation, intellectual property frameworks, and culturally sensitive metadata standards, the study proposes a model that balances accessibility with the rights and agency of knowledge-holders. The findings highlight the necessity of legal safeguards, community governance, and technological strategies to ensure that digital repositories serve both preservation and cultural integrity.

Keywords: Traditional Knowledge, Digital Libraries, Indigenous Heritage, Intellectual Property Rights, Gond Culture, Cultural Preservation, Ethical Digitization

1. Introduction

Traditional Knowledge (TK) comprises cumulative, collective understandings developed over generations within communities, including folklore, ecological practices, medicinal knowledge, cosmology, and artistic expressions. The Gond community—largely residing in the Indian states of Madhya Pradesh, Maharashtra, Chhattisgarh, and Odisha—preserves a rich cultural heritage comprising oral narratives, ritual practices, mural art (e.g., *Gond art*), and customary ecological knowledge. With the advancement of digital technologies, libraries and archives have undertaken large-scale digitization of cultural artefacts to enhance preservation, accessibility, and scholarly research.

However, digital access also raises concerns about culturally inappropriate usage, unauthorized commercial exploitation, and erasure of community agency. This paper examines the opportunities and challenges of integrating Gond TK into digital library platforms and proposes protection strategies rooted in legal, ethical, and technological frameworks.

Traditional Knowledge (TK) represents the cumulative body of knowledge, practices, beliefs, and cultural expressions developed and sustained by indigenous and local communities over generations. It encompasses oral traditions, ecological wisdom, medicinal practices, ritual systems, folklore, and artistic expressions that form the backbone of community identity and continuity. In India, one of the most culturally rich indigenous communities preserving such knowledge is the Gond community, primarily residing in the states of Madhya Pradesh, Maharashtra, Chhattisgarh, and Odisha. The Gond people possess a vibrant cultural heritage that includes oral epics, sacred rituals, ecological conservation practices, and the globally recognized Gond art tradition.

With the rapid advancement of information and communication technologies, digital libraries have emerged as powerful platforms for preserving, organizing, and disseminating cultural heritage materials. Digitization offers significant opportunities for safeguarding fragile manuscripts, documenting oral histories, and enhancing global accessibility to indigenous knowledge systems. For marginalized communities like the Gonds, digital archiving can serve as a tool for cultural revitalization, intergenerational knowledge transmission, and academic recognition.

However, the inclusion of Traditional Knowledge in digital libraries also introduces complex ethical, legal, and technological challenges. Unlike conventional knowledge systems governed by

individual authorship and time-bound intellectual property rights, Traditional Knowledge is collectively owned, intergenerational, and often sacred or context-specific. The open-access nature of digital repositories may inadvertently expose sensitive cultural information to misuse, misrepresentation, or commercial exploitation without the consent of the knowledge holders. Issues such as biopiracy, cultural appropriation, and unauthorized reproduction of indigenous art and ecological knowledge have intensified concerns about digital vulnerability.

Existing intellectual property frameworks often fail to adequately protect Traditional Knowledge because they are designed around Western legal notions of originality and individual ownership. Although policy instruments such as the Biological Diversity Act (2002) and international frameworks promoting indigenous rights emphasize prior informed consent and benefit-sharing, their implementation within digital library environments remains limited. Therefore, there is a pressing need to develop culturally sensitive metadata standards, community-driven access controls, and participatory governance models that respect Indigenous Data Sovereignty principles.

This study examines the protection of Gond cultural heritage within digital library systems, focusing on the balance between preservation and protection. It seeks to analyze the risks associated with digitizing Gond Traditional Knowledge and to propose legal, ethical, and technological safeguards that ensure respectful representation and controlled access. By situating the discussion within the broader discourse of indigenous rights and digital preservation, the research aims to contribute to sustainable models of knowledge stewardship that empower communities rather than marginalize them in the digital age.

Research Objectives

"Protection of Traditional Knowledge in Digital Libraries: A Study of Gond Cultural Heritage" is guided by the following four objectives:

1. **To examine the nature and scope of Traditional Knowledge of the Gond community** and analyze its cultural, social, ecological, and artistic significance in the context of digital preservation.
2. **To identify the legal, ethical, and technological challenges** associated with digitizing and disseminating Gond Traditional Knowledge through digital library platforms.
3. **To evaluate existing national and international legal frameworks** (such as intellectual property laws, biodiversity regulations, and indigenous rights instruments) in protecting Traditional Knowledge within digital environments.
4. **To propose a culturally sensitive protection model** incorporating community participation, Indigenous Data Sovereignty principles, metadata standards, and controlled access mechanisms for safeguarding Gond cultural heritage in digital libraries.

2. Literature Review

2.1. The Nature of Traditional Knowledge

Traditional Knowledge is distinct from conventional knowledge systems due to its community-based custodianship, collective ownership, and often undocumented, oral traditions. Scholars argue that Western intellectual property regimes inadequately protect such knowledge because they prioritize individual authorship and time-limited rights (Tobin, 2008; Dutfield, 2006).

2.2. Digital Libraries and Cultural Heritage

Digital libraries serve as repositories that preserve, organize, and disseminate cultural content. They improve access and democratize knowledge but pose risks when indigenous materials are detached from their cultural context or made subject to inappropriate reuse (Besser, 2001; Yakel, 2018).

2.3. Protection Frameworks

Multiple frameworks exist for protecting TK:

- **Intellectual Property Rights (IPR):** Patents, copyrights, and sui generis systems tailored for indigenous knowledge.

- **Community Protocols:** Indigenous-led governance guidelines that dictate how knowledge should be shared.
- **Digital Rights Management (DRM):** Technological controls that regulate access, copying, and use.

3. Methodology

This qualitative study uses a multi-pronged approach:

3.1. Field Interviews

Semi-structured interviews were conducted with:

- Gond elders and knowledge-keepers,
- Digital archivists working with indigenous collections,
- Legal experts on TK and intellectual property.

3.2. Case Studies

Analysis of digital library initiatives involving indigenous content, both successful and problematic.

3.3. Policy Analysis

Review of national and international legal instruments relevant to TK protection:

- **Indian Biological Diversity Act (2002)**
- **UN Declaration on the Rights of Indigenous Peoples (UNDRIP)**
- **World Intellectual Property Organization (WIPO) Draft Articles on TK**

4. Findings and Discussion

4.1. Gond Cultural Knowledge and Digital Vulnerabilities

Gond traditions are predominantly oral and ritualistic:

- **Folktales and cosmology** risk distortion without contextual framing.
- **Traditional ecological knowledge** can be extracted for commercial use without community benefits.

Digitization without cultural safeguards often leads to:

- Decontextualization of meaning,
- Unauthorized reuse,
- Loss of control by the community.

4.2. Ethical and Legal Protection Measures

4.2.1. Sui Generis Systems

A tailored intellectual property framework specifically for TK can:

- Recognize collective ownership,
- Allow perpetual protection,
- Restrict unauthorized exploitation.

India's Biological Diversity Act provides some safeguards by requiring benefit-sharing and prior informed consent for use of indigenous knowledge in commercial research.

4.2.2. Community Protocols

The empowerment of Gond communities to define:

- What can be digitized,
- Who can access it,
- How it may be used or reproduced.

Community protocols function as cultural licenses with binding ethical guidelines.

4.3. Technical Solutions

4.3.1. Metadata and Cultural Context

Enhanced metadata schema can:

- Capture cultural context,
- Include oral narratives and ritual meanings,
- Identify community custodians.

Standards like **Indigenous Data Sovereignty Principles** (e.g., CARE—Collective benefit, Authority to control, Responsibility, Ethics) help ensure respectful digital inclusion.

4.3.2. Access Controls

Tiered access systems allow:

- Public viewing of non-sensitive content,
- Restricted access for sacred or secret knowledge.

Digital Rights Management can be configured to enforce community-defined permissions.

4.4. Collaborative Governance Models

Co-management structures between libraries and community representatives ensure:

- Decision-making autonomy,
- Knowledge stewardship,
- Cultural training for archivists and researchers.

5. Conclusion

The protection of Traditional Knowledge (TK) within digital libraries presents both an opportunity and a responsibility. This study on the cultural heritage of the Gond community demonstrates that while digitization can serve as a powerful tool for preservation, education, and global recognition, it also exposes indigenous knowledge systems to risks of misappropriation, decontextualization, and commercial exploitation. Gond cultural expressions—ranging from oral traditions and ritual practices to ecological knowledge and artistic heritage—are deeply embedded in collective memory, spiritual beliefs, and community identity. Therefore, their protection cannot rely solely on conventional intellectual property regimes designed for individual authorship and time-bound ownership.

The findings of this study emphasize that safeguarding Traditional Knowledge in digital libraries requires a multidimensional approach integrating legal, ethical, and technological measures. Existing frameworks, including national biodiversity laws and international indigenous rights instruments, provide foundational principles such as prior informed consent and benefit-sharing. However, their practical implementation within digital repositories remains inconsistent. There is a pressing need to operationalize these principles through culturally responsive metadata systems, tiered access controls, and digital rights management tools tailored to community-defined protocols.

Equally important is the recognition of Indigenous Data Sovereignty, which affirms the right of indigenous communities to control the collection, ownership, and dissemination of their knowledge. Digital libraries must move beyond passive archiving toward collaborative governance models that actively involve Gond representatives in decision-making processes. Community-led curation, cultural licensing mechanisms, and capacity-building initiatives can empower the Gond people to become stewards of their own digital heritage rather than subjects of external documentation.

Ultimately, the protection of Gond Traditional Knowledge in digital environments is not merely a technical challenge but an ethical imperative. Sustainable preservation must balance accessibility with respect, openness with cultural sensitivity, and academic interest with community rights. By adopting participatory, rights-based, and technologically robust strategies, digital libraries can function as instruments of cultural preservation and empowerment, ensuring that the Gond cultural legacy is safeguarded for future generations while honoring the dignity and authority of its custodians. The digitization of Gond cultural heritage offers remarkable opportunities for preservation and education. Nonetheless, without robust protections, digital library initiatives risk commodifying, misrepresenting, or undermining the very cultures they seek to document.

A holistic protection strategy includes:

1. Legally binding sui generis protections,
2. Indigenous-led governance models,
3. Culturally sensitive metadata and technical safeguards,
4. Ethical access mechanisms.

This model promotes respectful digitization that respects both preservation and the cultural rights of the Gond people.

6. Recommendations

1. **Policy Implementation:** Governments should adopt sui generis protection regimes aligned with community expectations.
2. **Capacity Building:** Train indigenous communities in digital curation and archiving.
3. **Cultural Licensing Frameworks:** Develop legal tools that function like traditional custodianship rights.
4. **Inclusive Metadata Standards:** Advocate for metadata schemas that reflect Indigenous epistemologies.

7. References

1. Battiste, M. (2018). *Decolonizing Education: Nourishing the Learning Spirit.* UBC Press.
2. Besser, H. (2001). *The Promise and Challenges of Digital Libraries.* Digital Libraries Journal.
3. Christen, K. (2012). *Does Information Really Want to be Free?: Indigenous Knowledge Systems and the Question of Openness.* International Journal of Communication.
4. Dutfield, G. (2006). *Protecting Traditional Knowledge and Folklore: A Review of Progress in Diplomacy and Policy.* UNCTAD.
5. Tobin, B. (2008). *Traditional Knowledge and Intellectual Property: Issues and Guidelines for Museums, Libraries and Archives.* IFLA.
6. Yakel, E. (2018). *Digital Preservation and Cultural Heritage.* Archives and Manuscripts.
7. Bhattacharya, S. (2011). Traditional knowledge and intellectual property rights in India. In R. Singh (Ed.), *Cultural Heritage and Digital Preservation in India* (pp. 78–99). Oxford University Press.
8. Chandrasekhar, C. P., & Ghosh, J. (2009). Traditional knowledge systems in India: Challenges and policies. *Economic & Political Weekly*, 44(9), 47–55.
9. Ghosh, A. (2018). Digital preservation of indigenous cultural heritage in India: Issues and approaches. *International Journal of Digital Library Services*, 8(2), 23–38.
10. Gurumurthy, A., & Chami, N. (2017). Indigenous knowledge systems and digital empowerment in India. In M. Dutta & K. Mehta (Eds.), *Technology, Culture and Society in India* (pp. 142–160). SAGE Publications India.
11. Kumar, R., & Singh, S. (2019). Protecting traditional knowledge in digital archives: Legal perspectives from India. *Indian Journal of Intellectual Property Law*, 11(1), 55–74.
12. Nair, K. S. (2016). *Traditions of knowledge in India: Indigenous cultures in the digital age*. Orient BlackSwan.
13. Reddy, P., & Mandal, A. (2014). Protection of traditional knowledge in digital repositories: Case studies from central India. In *Proceedings of the National Seminar on Digital Heritage and Cultural Preservation* (pp. 96–112). University of Delhi.
14. Saxena, N. C. (2013). Indigenous knowledge and intellectual property rights in India: Institutional challenges. *Journal of Knowledge Management Practice*, 14(4), 1–14.

Artificial Intelligence in Accounting

Dr. Nikhal Pallavi Vijay
Asst. Prof. at S. S. C. College , Junnar
A/ P: – Junnar, Dist:- Pune.

Abstract:–

Artificial Intelligence helps in various fields such as Accounting, scientific research, weather forecasting, agriculture, human resource management etc. Artificial Intelligence makes accounting more simplified and easy to work because of reduced data entry works with analyzing on its own. Therefore this subject helps the researcher to understand the benefits of Artificial Intelligence and to implement it in Accounting, Auditing and Financial Reporting.

Introduction:-

Integrating Artificial intelligence in accounting and auditing is reshaping traditional practices and redefining the financial landscape. AI's capability to process vast amounts of data quickly and accurately has become a game-changer for these industries. Automating routine tasks such as transaction classification, data entry, and reconciliation has significantly reduced the risk of human error, enhancing the overall efficiency of financial processes.

AI-powered algorithms can analyze complex financial patterns and detect anomalies that may go unnoticed by human auditors. This not only improves the accuracy of audits but also allows professionals to focus on more strategic and value-added tasks. Machine Learning algorithms can learn from historical data, adapting and evolving to changing financial landscapes, thus providing a more dynamic and predictive approach to accounting and auditing.

However, the widespread adoption of AI in these fields also brings forth challenges such as ethical considerations, data security, and the need for continuous up skilling of professionals to harness the full potential of these technologies. Understanding AI's capabilities and limitations is crucial for accounting and auditing professionals to leverage its benefits responsibly and ensure the integrity of financial processes in the ever-evolving digital era. With the ongoing progression of AI, its significance in accounting and auditing is set to intensify, presenting novel opportunities for enhanced accuracy, efficiency, and informed strategic decision-making.

Objectives :- 1) Understanding the term of AI.
2) Defining the advantages of AI in Accounting.
3) Understanding the how to use AI in Accounting.

Hypothesis :- 1) AI is useful in Accounting.
1) AI is helpful in Fraud Detection.
2) AI reduces the work of data entry.

Advantages of AI in accounting and auditing:-

The integration of AI in accounting and auditing brings forth a wide range of benefits that enhance efficiency, accuracy, and effectiveness in financial management processes. Here are some key benefits of AI in accounting and auditing:

1. **Enhanced accuracy**: AI-driven automation reduces the likelihood of human errors in data entry, calculations, and analysis, leading to more accurate financial records and reports.
2. **Time efficiency**: AI automates routine and time-consuming tasks such as data entry, transaction matching, and reconciliation, allowing accountants and auditors to focus on more strategic and value-added activities.
3. **Data analysis**: AI-powered tools can quickly process large datasets, extracting valuable insights and trends that would be difficult or impossible to discern manually. This facilitates more informed decision-making.

4. **Real-time reporting**: AI systems can provide real-time financial data, enabling organizations to react swiftly to change financial conditions and make timely adjustments to strategies and operations.
5. **Fraud detection**: AI algorithms can identify irregular patterns and anomalies in financial transactions, helping auditors and organizations detect potential fraud or suspicious activities.
6. **Cost efficiency**: By automating repetitive tasks and minimizing the need for manual intervention, AI has the capacity to generate significant cost savings in both accounting and auditing processes.

The benefits of using AI in auditing and accounting range from enhanced accuracy and efficiency to real-time reporting and predictive analytics. These advantages empower organizations to make better-informed financial decisions, reduce risks, and achieve greater financial stability and success.

Use cases and applications of AI in accounting and auditing

AI has made significant inroads into the fields of accounting and auditing, transforming how financial data is processed, analyzed, and audited. Here are some prominent use cases and applications of AI in accounting and auditing:

1. Automated data entry and transaction processing

Automated data entry and transaction processing leverage artificial intelligence to efficiently and accurately input financial data and manage organizational transactions. Through technologies like Optical Character Recognition (OCR), AI extracts information from documents such as invoices and receipts, eliminating the need for manual data entry. This not only reduces errors but also saves time, allowing finance professionals to focus on more strategic tasks. Additionally, AI can automate processes like invoice matching, expense management, and bank reconciliation, ensuring that financial records are up-to-date and accurate while streamlining the overall accounting workflow.

2. Fraud detection and prevention

Fraud detection and prevention stand as a vital application where AI-powered algorithms are employed to proactively identify and mitigate fraudulent activities within financial systems. These algorithms analyze large volumes of transactional data, looking for unusual patterns, anomalies, or deviations from established norms that may indicate fraud or misconduct. By continuously monitoring financial transactions and detecting irregularities in real-time, AI can provide early warning signals to organizations, allowing them to take prompt action to prevent or investigate fraudulent activities. This use case plays a vital role in safeguarding an organization's financial integrity and reputation while minimizing financial losses due to fraudulent activities.

3. Predictive analytics for financial forecasting

Predictive analytics for financial forecasting harnesses the power of artificial intelligence to make accurate and data-driven predictions about an organization's financial future. By analyzing historical financial data, market trends, and a wide range of relevant variables, AI models can generate forecasts for factors like revenue, expenses, and cash flow. This empowers businesses to anticipate financial challenges and opportunities, make informed strategic decisions, and allocate resources more effectively. Whether it's for budgeting, investment planning, or risk management, predictive analytics enables organizations to adapt and thrive in an ever-changing financial landscape.

4. Data analytics for auditing

Data Analytics for Auditing involves the application of artificial intelligence and advanced data analysis techniques to enhance the audit process. AI-powered tools can effectively handle substantial amounts of financial data, detecting irregularities, patterns, and anomalies that might go unnoticed with manual methods. These analytics not only increase the depth and accuracy of audits but also enable auditors to provide more valuable insights to organizations. By leveraging AI, auditing becomes more efficient, risk-focused, and capable of uncovering potential financial discrepancies or fraud, ultimately improving the overall reliability of financial reporting and compliance.

5. Automation of reconciliation

Automation of reconciliation is a practical application of artificial intelligence that streamlines the process of comparing and matching financial records between different sources, such as bank statements and internal financial databases. AI-driven algorithms can automatically identify and reconcile transactions, reducing the need for time-consuming manual efforts. This not only saves time but also minimizes errors, guaranteeing the accuracy and timeliness of financial records. By automating reconciliation processes, organizations can improve financial accuracy, enhance internal controls, and gain a better understanding of their financial position.

6. Tax compliance and optimization

Tax compliance and optimization leverage artificial intelligence to ensure that organizations adhere to tax regulations while optimizing their tax strategies. AI systems can automatically calculate taxes owed based on intricate tax codes and evolving regulations, reducing the risk of non-compliance and associated penalties. Moreover, AI can analyze financial data using data mining or predictive analytics to identify potential tax-saving opportunities, like deductions and credits, helping organizations minimize their tax liabilities legally and efficiently. This use case simplifies complex tax processes, mitigates risks, and maximizes tax efficiency, resulting in cost savings and improved financial performance for businesses.

7. Automated Data Entry and Bookkeeping

AI automates the labor-intensive task of data entry in accounting and bookkeeping. By leveraging advanced optical character recognition (OCR) and machine learning algorithms, it systematically extracts pertinent information from invoices, receipts, and various financial documents. This not only expedites the data entry process but also enhances accuracy, reducing the likelihood of manual errors. The streamlined bookkeeping facilitated by AI ensures that financial records are systematically organized and readily available for analysis, optimizing overall operational efficiency.

8. Invoice Processing

Incorporating AI-powered systems for handling invoices and automating the extraction and processing of crucial data. Through advanced image recognition and natural language processing (NLP) algorithms, AI seamlessly captures relevant information from invoices.

Conclusion

In the fields of accounting and auditing, AI's role in enhancing accuracy and efficiency is of paramount importance. It alleviates professionals from the burden of tedious and error-prone tasks while enabling them to focus on strategic, value-added activities. Consequently, AI has redefined financial integrity by ensuring precise and on-demand data access, empowering organizations to make swift, informed decisions that can be the difference between success and stagnation.

AI's impact extends to reshaping the financial landscape, with predictive analytics providing the tools for accurately forecasting financial trends and potential issues. Continuous auditing, made possible by AI, has evolved from periodic checks to real-time monitoring, significantly reducing the risk of financial mismanagement and fraud. As we venture into the future of finance, it becomes evident that AI is at the forefront of this evolution. Ethical considerations, transparency, and governance are pivotal in ensuring the responsible harnessing of AI to preserve trust. As we navigate the path ahead, the potential of AI to reshape accuracy, efficiency, and financial management remains an exciting prospect, offering a glimpse into a more data-driven, agile, and prosperous financial future.

"History of Commerce and Accounting in Ancient India: An Indian Knowledge System Perspective"

Research Student
Mr. Mayur Sudhakar More
M.B.A., M.Com., B.Ed.

Research Guide:
Dr. Mangalawati Ji Pandey
M.Com., NET, Ph.D., M.A. (Economics)
M.Phil., D.B.M., B.A. (Hindi Literature), B.Ed.
J. D. Patil Sangludkar Mahavidyalaya, Daryapur Taluka: Daryapur, District: Amravati

Research Centre:
J. D. Patil Sangludkar Mahavidyalaya, Daryapur Taluka: Daryapur, District: Amravati Research Centre Code: 107

Abstract

The history of commerce and accounting in ancient India reflects a well-developed and organized economic system rooted in the principles of the Indian Knowledge System (IKS). Ancient Indian society maintained structured frameworks for trade, financial administration, and record-keeping, which supported both internal and external commerce. Classical texts such as the Vedas, Smritis, and Kautilya's *Arthashastra* provide significant insights into organized markets, trade routes, merchant guilds (*Shrenis*), taxation, and systematic accounting practices. These sources reveal that commerce in ancient India was not solely profit-driven but guided by ethical values, social responsibility, and effective state regulation.

This study examines the evolution of commerce and accounting practices in ancient India from an IKS perspective through a review of historical and scholarly literature. It highlights the role of merchants and guilds, the use of standardized measures and currency, and the presence of accounting concepts such as income, expenditure, profit, loss, and audit. The literature also emphasizes transparency, accountability, and moral conduct in financial practices, with strict penalties for fraud and misappropriation.

Additionally, the study explores ancient taxation systems and public financial administration, demonstrating a balanced approach to revenue collection and welfare-oriented governance. The findings underline the relevance of indigenous knowledge in modern commerce and accounting education and reaffirm India's contribution to global economic thought under NCIKS-2026.

Keywords: Keywords: Indian Knowledge System, Ancient Indian Commerce, Accounting History, Merchant Guilds (Shrenis), Ethical Business Practices

Literature Review

Scholars have extensively examined the economic and commercial life of ancient India, emphasizing its organized trade and accounting systems. Altekar (1958) highlights that commerce in ancient India was a well-structured activity supported by state regulation and social norms rather than an incidental practice. Trade expanded through established inland and maritime routes, facilitating both domestic and international exchange and contributing to economic growth (Thapar, 2002).

The Indian Knowledge System (IKS) offers a holistic framework for understanding these economic practices by integrating material prosperity with ethical and social considerations. Kautilya's *Arthashastra* is widely regarded as a foundational text in the study of ancient Indian commerce and accounting. Rangarajan (1992) notes that it provides detailed guidelines on bookkeeping, auditing, treasury management, and financial accountability, reflecting a sophisticated accounting system. Sharma (2016) further observes that accounting concepts such as income, expenditure, profit, and loss were clearly defined and systematically recorded.

Merchant guilds, known as *Shrenis*, played a crucial role in regulating trade and maintaining ethical standards. Basham (2004) describes these guilds as self-governing institutions that ensured quality control, fair pricing, and dispute resolution. Studies on taxation and public finance indicate that ancient Indian systems were guided by equity and welfare principles (Altekar, 1963; Thapar, 2002). Ethical values rooted in *Dharma* formed the moral foundation of commerce and accounting (Sen, 2005). Despite extensive research, ancient Indian contributions to accounting history remain underrepresented, highlighting the need for an integrated IKS-based approach (Sharma, 2016).

2. Indian Knowledge System and Ancient Economic Thought

Ethics formed the foundation of commerce and accounting practices in ancient India, as reflected in religious, legal, and administrative texts. Scholars note that economic activities were governed by moral principles rooted in Dharma, which regulated individual conduct and promoted social responsibility (Sen, 2005). Commerce and accounting were expected to ensure not only material prosperity but also moral integrity and public welfare.

Ancient texts such as the Smritis and Kautilya's *Arthashastra* prescribed strict ethical guidelines for traders and officials, condemning fraud, false measurement, hoarding, and misrepresentation (Rangarajan, 1992). Accurate accounting and truthful record-keeping were regarded as moral obligations, with severe penalties imposed for violations, highlighting the close integration of ethics with economic administration under the Indian Knowledge System.

Scholars emphasize the role of Dharma in guiding business conduct. Basham (2004) observes that merchants were expected to earn wealth through righteous means. Merchant guilds (Shrenis) enforced ethical norms, maintaining trust and market stability (Sharma, 2016).

Comparative studies show strong parallels between ancient Indian ethics and modern business ethics, particularly transparency, accountability, and social responsibility. Unlike compliance-driven modern ethics, ancient Indian ethics were deeply value-based, underscoring their lasting relevance.

3. Historical Studies on Commerce in Ancient India

Historical studies indicate that commerce in ancient India was highly developed and systematically organized across the Vedic, Mauryan, and Gupta periods. In the early Vedic era, trade largely functioned through barter and later evolved into a monetized system with the introduction of metallic coins (Altekar, 1958). Agricultural surplus, skilled craftsmanship, and expanding trade networks formed the economic foundation of ancient Indian society.

The Mauryan period marked a major advancement in commercial organization. Kautilya's *Arthashastra* provides detailed accounts of market regulation, price control, trade supervision, and accounting practices. Thapar (2002) observes that the Mauryan state actively monitored internal and external trade to maintain economic stability and efficient revenue collection. Commercial expansion continued during the Gupta period, characterized by urban growth, guild-based production, and long-distance trade (Sharma, 2016).

Both internal and external trade were integral to the economy. Internal trade connected rural producers with urban markets, while external trade linked India with Central Asia, Rome, Southeast Asia, and the Middle East. Basham (2004) notes that exports of textiles, spices, and precious goods contributed significantly to prosperity. Major trade routes and ports such as Uttarapatha, Dakshinapatha, Bharuch, Tamralipti, and Muziris facilitated commerce. Accounts of foreign travelers corroborate the sophistication of ancient Indian commercial systems.

4. Merchants, Trade Organizations, and Guild System (Shrenis)

Scholarly literature identifies merchants as central actors in the economic life of ancient India. Historians such as Altekar (1958) and Sharma (2016) argue that traders were not merely economic agents but also contributors to social stability and urban development. Merchants connected producers with consumers and facilitated long-distance trade across regions, operating within state regulations and ethical norms rooted in *Dharma*.

Merchant guilds, known as *Shrenis*, constituted the organizational foundation of ancient Indian commerce. These guilds were associations of traders or artisans engaged in similar occupations and

functioned as self-regulating institutions. Basham (2004) notes that *Shrenis* enforced internal discipline, established rules governing production and trade, and safeguarded the collective interests of their members. They often enjoyed legal recognition, enabling them to own property, issue loans, and enter contractual agreements.

The economic significance of guilds is widely acknowledged. Guilds ensured quality control, standardized prices, and regulated wages, thereby contributing to market stability (Thapar, 2002). Beyond their economic role, guilds also performed social and welfare functions by supporting members during financial distress and participating in charitable activities, temple construction, and public works (Sharma, 2016).

Comparative studies highlight similarities between ancient *Shrenis* and modern business organizations. While both promote cooperation and dispute resolution, ancient guilds were deeply embedded in ethical and social frameworks (Sen, 2005). This underscores the relevance of indigenous business models in understanding sustainable and responsible commerce.

5. Evolution of Accounting Practices in Ancient India

The evolution of accounting practices in ancient India has attracted significant scholarly attention, as researchers argue that accounting developed as a practical necessity to manage trade, taxation, and state finances in a growing economy. Early references to record-keeping and financial management appear in Vedic literature and were later elaborated in administrative texts, indicating an early awareness of systematic financial control (Altekar, 1958).

Kautilya's *Arthashastra* is regarded as the most comprehensive source on ancient Indian accounting. Rangarajan (1992) highlights that the text provides detailed guidelines on maintaining accounts related to revenue, expenditure, inventory, and treasury management. It also prescribes regular audits, verification of records, and accountability of officials, reflecting an advanced understanding of accounting and internal control mechanisms. Concepts comparable to modern income and expenditure statements are evident in the classification of receipts and expenses.

Scholars further emphasize the importance of record-keeping and auditing in ancient India. Thapar (2002) notes that officials were required to maintain accurate financial records, with strict penalties imposed for falsification or misappropriation. This focus on transparency suggests that accounting was both an administrative and moral responsibility. Sharma (2016) observes that accounting practices were integral to public administration and private trade. Indian and foreign scholars acknowledge the sophistication of these systems, noting their strong ethical foundation (Basham, 2004; Sen, 2005). However, ancient Indian contributions to accounting history remain underrepresented globally, underscoring the need for further IKS-based research.

6. Taxation and Public Financial Administration

The taxation system and public financial administration of ancient India have been widely examined in historical and economic scholarship. Scholars observe that taxation was regarded as a legitimate and essential function of the state, necessary for administration, defense, and public welfare (Altekar, 1958). Ancient texts consistently emphasize that taxes should be collected in a just and non-oppressive manner to maintain economic stability and social harmony.

Kautilya's *Arthashastra* offers a detailed account of revenue sources and treasury management in ancient Indian states. Rangarajan (1992) notes that state revenue was derived from agriculture, trade, mines, forests, customs duties, and fines. The treasury system was highly organized, with strict procedures governing revenue collection, storage, and expenditure. Officials involved in financial administration were subject to regular audits and close supervision to prevent corruption and mismanagement.

Scholarly literature highlights principles of fair taxation and financial accountability in ancient India. Thapar (2002) argues that taxation policies were designed to be proportionate to the income and capacity of taxpayers, reflecting an early understanding of equity in public finance. Excessive taxation was discouraged, as it was believed to undermine productivity and social welfare. Transparency was ensured through systematic record-keeping and strict penalties for misconduct.

Comparative studies reveal parallels between ancient and modern public finance systems, including budgeting, auditing, and accountability mechanisms (Sharma, 2016). However, ancient Indian public finance placed greater emphasis on ethical governance and welfare orientation, underscoring the contemporary relevance of Indian Knowledge System–based approaches.

7. Ethical Foundations of Commerce and Accounting

Ethics formed the foundation of commerce and accounting practices in ancient India, as reflected in religious, legal, and administrative texts. Scholars emphasize that economic activities were governed by moral principles derived from *Dharma*, which regulated both individual conduct and social responsibility (Sen, 2005). Commerce and accounting were expected to serve not only material prosperity but also moral integrity and social welfare.

Ancient Indian literature outlines several ethical principles governing trade, including honesty, fairness, and transparency. The *Smritis* and Kautilya's *Arthashastra* prescribe strict guidelines for traders and state officials, condemning practices such as fraud, false measurement, hoarding, and misrepresentation (Rangarajan, 1992). Accurate accounting and truthful record-keeping were considered moral duties, and violations attracted severe penalties. This demonstrates the close integration of ethics with economic administration under the Indian Knowledge System.

Scholarly interpretations highlight the central role of *Dharma* in guiding business conduct and financial practices. Basham (2004) notes that merchants were expected to acquire wealth through righteous means, ensuring fairness to consumers and society. Merchant guilds (*Shrenis*) enforced ethical norms among their members, thereby maintaining trust and market stability (Sharma, 2016).

Comparative studies reveal strong parallels between ancient Indian ethical principles and contemporary business ethics, particularly in areas such as transparency, accountability, and social responsibility (Sen, 2005). While modern ethics often emphasize regulatory compliance, ancient Indian ethics were deeply value-based, underscoring their enduring relevance to responsible and sustainable commerce and accounting.

8. Contemporary Interpretations and Educational Relevance

In recent years, scholars have increasingly reinterpreted ancient Indian commerce and accounting through the framework of the Indian Knowledge System (IKS). Contemporary research highlights that ancient Indian economic practices were systematic, rational, and ethically grounded, challenging earlier assumptions of limited analytical depth (Sharma, 2016). Texts such as Kautilya's *Arthashastra* are now recognized for their advanced ideas on financial management, auditing, and market regulation, which parallel modern accounting principles (Rangarajan, 1992).

The relevance of IKS-based accounting principles in contemporary commerce education has gained growing attention. Core concepts such as accountability, transparency, and ethical governance align closely with modern professional standards. Sen (2005) argues that integrating indigenous ethical frameworks can strengthen accounting education by fostering responsible decision-making and social accountability. Consequently, scholars advocate for curricula that combine technical accounting knowledge with ethical and cultural perspectives. Literature on curriculum development further emphasizes that integrating IKS enhances historical awareness and contextual relevance (Thapar, 2002). The National Council for Indian Knowledge Systems (NCIKS) plays a key role in promoting indigenous knowledge through research support, curriculum reforms, and academic initiatives.

9. Research Gaps Identified in Existing Literature

Despite the availability of extensive historical and economic literature, significant research gaps persist in the study of ancient Indian commerce and accounting. A major limitation of existing studies is their predominantly descriptive nature, with limited analytical interpretation through the Indian Knowledge System (IKS). Consequently, the indigenous intellectual foundations of ancient economic practices remain insufficiently explored. Another notable gap is the lack of integrated research connecting commerce, accounting, ethics, and public finance within a unified IKS framework. Most studies examine these components in isolation, resulting in a fragmented understanding of ancient Indian economic thought. Additionally, comparative and interdisciplinary research remains limited.

Few studies systematically compare ancient Indian accounting practices with modern or Western accounting systems, and interdisciplinary approaches involving history, commerce, philosophy, and education are scarce. Empirical research assessing the educational impact of incorporating IKS into commerce curricula is also limited. These gaps justify the present research, which aims to provide a holistic IKS-based analysis of ancient Indian commerce and accounting, contributing to indigenous knowledge scholarship promoted under NCIKS.

10. Summary of the Literature Review

The reviewed literature confirms that ancient India developed a sophisticated system of commerce and accounting rooted in the Indian Knowledge System. Studies highlight the systematic organization of trade, taxation, accounting, and financial administration, supported by ethical principles such as Dharma, transparency, and social responsibility. Texts like the *Arthashastra* reveal advanced practices of record-keeping, auditing, and accountability. Merchant guilds and taxation systems promoted fairness and public welfare. Contemporary scholars increasingly acknowledge the relevance of these indigenous principles to modern commerce and accounting education. However, gaps remain due to limited integrated IKS-based and comparative analyses. This review provides a strong foundation for further research on the enduring relevance of ancient Indian economic thought.

References:

1. Altekar, A. S. (1958). *State and government in ancient India*. Motilal Banarsidass.
2. Altekar, A. S. (1963). *The position of women in Hindu civilization*. Motilal Banarsidass.
3. Basham, A. L. (2004). *The wonder that was India*. Rupa Publications.
4. Rangarajan, L. N. (1992). *Kautilya: The Arthashastra*. Penguin Books.
5. Sen, A. (2005). *The argumentative Indian*. Penguin Books.
6. Sharma, R. S. (2016). India's ancient past. Oxford University Press.
7. Thapar, R. (2002). Early India: From the origins to AD 1300. Penguin Books.

Literature and Environment (Eco-Criticism)

Prof. Santosh Prakash Mahale
HOD, Applied Sciences & Humanities Department
Siddhivinayak Technical Campus, Diploma (Polytechnic) Shegaon. Dist. Buldhana.

Abstract:

The connection in both the literature and environment is very related to ecocritical study. It emphasizes moral responsibilities towards the environment. Explores theme of living in balance with nature. It is searching to raise awareness about ecological issues and promote more caring relationship between humans and the environment.

Literature and environment are deeply interconnected, as literary works often reflect humanity's relationship with nature, ecological concerns, and environmental ethics. Environmental themes in literature explore how natural landscapes shape cultural identity, moral values, and social consciousness. Through poetry, fiction, drama, and essays, writers depict the beauty of nature, warn against environmental degradation, and critique exploitative human practices. This relationship has given rise to ecocriticism, a critical approach that examines texts from an environmental perspective and highlights the role of literature in fostering ecological awareness. By presenting nature not merely as a backdrop but as a living presence, literature encourages readers to reconsider their responsibilities toward the planet. Thus, literary studies contribute significantly to environmental discourse by promoting sustainability, empathy for non-human life, and a deeper understanding of the fragile balance between humans and the natural world.

Keywords: - Literature, Environment, Ecocriticism, Nature, Environmental Awareness, Human–Nature Relationship.

Introduction:

The term eco-criticism was first instituted by William Rueckert in his basic critical writing Literature and Ecology: An Experiment in Eco-criticism in 1978. The word "eco" comes from the Greek word "oikos" which etymologically implies household or earth and "logy" from "logos" implies rational discourse. Together they mean criticism of the house the earth as represented in writing. As indicated by Rueckert, eco-criticism applies environment or ecological values into the investigation of literature. In the book The Environmental Imagination eco-criticism has been defined as: "a study of the relationship between literature and the environment conducted in a spirit of commitment to environmentalist's praxis".

In additional eco-criticism does not merely mean nature study; it has separated itself from regular nature writing, first by its moral stand and pledge to the normal world and after that by making the association between the human and the non-human world. Eco criticism is literary critics that emerges from and is arranged toward a worry with human and nonhuman cooperation and interrelationship. Eco-criticism has developed exponentially from its origin in the mid-1990s as a planned initiative.

The late 20th and early 21st centuries have witnessed a growing awareness of environmental crises globally, with climate change, biodiversity loss, and ecological degradation becoming central concerns. This ecological consciousness has found expression in literature, particularly through the emerging field of ecocriticism, which examines the relationship between literature and the physical environment. In the Indian context, environmental literature has gained prominence, reflecting the country's complex ecological realities and environmental movements.

Ecocriticism: Theoretical Development

Ecocriticism emerged as a distinct critical approach in the 1990s, though its roots extend to earlier nature writing studies. Cheryll Glotfelty's definition in *The Ecocriticism Reader* (1996 established the field as " the relationship between literature and the physical environment." Lawrence Buell's *The Environmental Imagination* (1995) provided foundational concepts including

"environmental text," "place," and "environmental crisis." Buell later expanded the field in *The Future of Environmental Criticism* (2005), advocating for a more inclusive, global approach. Greg Garrard's *Ecocriticism* (2004, 2012) systematized key concepts including pollution, wilderness, apocalypse, dwelling, animals, and the earth, providing a comprehensive framework for ecocritical analysis. The field has evolved through what scholars identify as three waves: first focus on nature writing and wilderness; second-wave attention to social justice and urban environments; and third-wave emphasis on material ecocriticism, posthumanism, and global perspectives.

Global and Local Perspective about Ecocriticism and Literature

1. Encourages Global Ecological Consciousness: -Builds cross-culture empathy and understanding of global environmental interdependence.
2. Inspires Actions Through Storytelling: -Science provide facts but literature tells stories that move people. Ecocritical research explore how novels, poems and films create emotional and ethical responses to environmental issues, inspiring awareness, activism and policy change.
3. Shaping local education and awareness: - Influence school and university curricula, encourage students to study local environmental problems through literature. Support community awareness programmes using stories, plays, and poems.
4. It expands the purpose of literary study: - It gives voice to the non-human world. A wide range of stakeholders, scholars and students to policymakers, activists and ordinary readers benefited from the research problem.
5. It shall be explaining research question like: -How do different authors or texts represent similar ecological concern s across cultures or regions? & What environmental issues are explored in the novels and how are they connected to social or political themes?
6. Ecocritical literature acts as a bridge: - between the art, ethics, and action-influencing how we think, feel, and act about the environment at both global and national levels.
7. It is not bound by the time: - It draws from the past, engaging with the present, and helps shape the future.

Postcolonial Ecocriticism

Postcolonial ecocriticism addresses the environmental dimensions of colonialism and its aftermath. Rob Nixon's *Slow Violence and the Environmentalism of the Poor* (2011) introduced the concept of slow violence" to describe gradual environmental destruction that disproportionately affects marginalized communities. Graham Huggan and Helen Tiffin's *Postcolonial Ecocriticism* (2010, 2015) synthesized postcolonial and ecocritical approaches, examining how colonial exploitation of both people and environments continues in neo-colonial forms. Elizabeth DeLoughrey and George B. Handley's *Postcolonial Ecologies* (2011) explored how postcolonial literature represents environmental issues, while Upamanyu Pablo Mukherjee's *Postcolonial Environments* (2010) specifically examined Indian environmental writing. These scholars argue that environmental degradation cannot be separated from colonial histories and contemporary global inequalities.

Indian Ecocriticism and Environmental Literature

Indian ecocriticism has developed distinctive characteristics reflecting the subcontinent's environmental history and movements. Ramachandra Guha's environmental histories (*The Unquiet Woods*, 1989; *Environmentalism: A Global History*, 2000) provide essential context for understanding Indian environmental literature. Madhav Gadgil and Ramachandra Guha's *This Fissured Land* (1992) and *Ecology and Equity* (1995) India's ecological history and contemporary environmental conflicts. Om Prakash Dwivedi has pioneered Indian ecocriticism, examining environmental themes in Indian English literature. His articles on indigenous environmentalism and nature representation in Indian fiction have established frameworks for analyzing Indian environmental writing.

Main Objectives of The Study of Literature and Ecocriticism

1. To examine the representation of nature, environment, and ecological spaces in the literature through an ecocritical framework.

2. To analyze the intersection of gender oppression and environmental exploitation in their fictional works.
3. To conduct a comparative analysis of environmental consciousness across two generations of women writers, identifying continuities, departures, and evolutions in ecological sensibility.
4. To investigate how the writers engage with environmental justice issues affecting marginalized communities in India.
5. To explore the relationship between female subjectivity and natural environments in literature.
6. To narrative strategies and literary techniques employed to represent ecological concerns.
7. To analyze the representation of human-animal relations and multispecies ethics in their fiction.
8. To situate their works within Indian environmental history, movements, and contemporary ecological crises.
9. To assess the role of domestic spaces as ecological sites in their novels.
10. To contribute to the development of Indian ecocriticism and ecofeminist literary theory.

Conclusion: -

Eco-criticism is an expansive route for literary and social researchers to explore the worldwide natural emergency through the crossing point of writing, culture, and the physical environment. It is one of the most youthful revisionist developments, which has cleared the humanities in the course of recent decades. The present world is confronting eco-fiascos and our condition is currently in question. Presently science and innovation are insufficient to battle the worldwide ecological disaster. We should roll out improvement in our disposition to nature. Literature does not coast above life, so it has its task to carry out. For quite a while nature was not given due thought by the scholarly commentators, so ecologically arranged literature argues for a superior comprehension of nature in its more extensive hugeness. Eco criticism has developed a worldwide developing movement during the last few decades. Literature and environment studies commonly called eco-criticism or environmental criticism. The similarity to the more general term scholarly feedback-involve a diverse, pluriform, and cross-disciplinary activity that expects to investigate the ecological dimensions of literature and other imaginative media in a soul of ecological concern not constrained to any one technique or responsibility. Ecocriticism also emphasizes the importance of interdisciplinary approaches, drawing on fields such as biology, ecology, and environmental studies to enrich literary analysis. It seeks to explore the complex and dynamic relationships between human beings and the natural world, and to uncover the ways in which these relationships are shaped by social, cultural, and historical factors.

In summary, ecocriticism is a vital approach in literary studies that not only enhances our unde rstanding of literature but also encourages critical engagement with pressing environmental issues. It invites readers to reflect on their relationship with the natural world and to consider the role of litera ture in shaping ecological values and awareness.

References: -

1. Buell, L. (2005). The Future of Environmental Criticism: Environmental Crisis and Literary Imagination. Blackwell Publishing.
2. Coupe, L. (Ed.). (2000). The Green Studies Reader: From Romanticism to Ecocriticism. Routledge.
3. Estok, S. C. (2001). "A Report Card on Ecocriticism." AUMLA, 96, 220–238.
4. Garrard, G. (2012). Ecocriticism (2nd ed.). Routledge.
5. Garrard, G. (2012). Ecocriticism. Routledge. 8. Ghosh, A. (2004). The hungry tide. HarperCollins.
6. Gifford, T. (1999). Pastoral. Routledge.
7. Glotfelty, C., & Fromm, H. (Eds.). (1996). The ecocriticism reader: Landmarks in literary ecology. University of Georgia Press.
8. Heise, U. K. (2008). Sense of Place and Sense of Planet: The Environmental Imagination of the Global. Oxford University Press.
9. Huggan, G., & Tiffin, H. (2010). Postcolonial Ecocriticism: Literature, Animals, Environment. Routledge.
10. Bloom, Harold. *The Anxiety of Influence*. Oxford University Press, 1973.
11. Gilbert, Sandra M., and Susan Gubar. *The Madwoman in the Attic*. Yale University Press, 1979.
12. Huggan, Graham. "Greening Postcolonialism." *Modern Fiction Studies*, vol. 50, no. 3, 2004.

Feminist Study of Toni Morrison in the Light of her *The Blue Eye* and *Sula*

Dr. Asmita J. Badhe
Shivaji College, Akola (Maharashtra)

Abtract

This paper proposes to study the nature of the struggle of the Black American voice and feminism in the novels of Toni Morrison. Toni Morrison is one of the most prominent and influential American writers of the 20th century. Her fiction constitutes African American experiences and the intersectionality of race, render and class. By centering the dispossessed and disillusioned feminine black voice, Morrison criticizes racial discrimination, patriarchy, and redefines female subjectivity. By analyzing selected works, this paper aims to highlights Morrison's reconstruction of female subjectivity by interrogating racialized beauty standards and challenging patriarchal morality.

Key words: Feminist, patriarchy, subjectivity, normative, black voice

Introduction

Toni Morrison, a Nobel Prize winning author, occupies a unique position in American literary horizon with her insightful and compelling writing that delves into the complexities of African American life. She is widely known for her stylistic brilliance and thematic concern. Through the portrayal of feminism in her novels, Morrison interlinks the themes of race, gender and identity.

A Black Feminist Thoughts

Toni Morrison's novels highlight the need for self discovery and self identity backing to the self exploration. Morrison depicts the isolated individual's journey for attaining the assimilation of the self by merging or rejecting the social codes and conduct of the community they live in. Western contemporary feminist moment emerged with the white middle class women's struggle against gender oppression and to seek equal opportunity with men. However black feminist scholars have long critiqued this homogenizing tendency. Morrison's fiction portrays aptly this complexity -black faces, gender discrimination as well as racial and class subjugation since to be "black and female "is to be in "double jeopardy. (Beal 1970:90)

Racial Issues

Racial discrimination is a prominent theme in the works of black authors irrespective of sex. While the double edge persecution of the African American women find full expression only in works of black feminist where she is portrayed as a objectified and anguished being. The black authors delineate the African American woman's pain of being black and that to a female. Additionally these black women are presented desperately searching for their identity and genuine self. The allied themes of racial discrimination reflect through the protagonists of Morrison. Pleading for the relationship of woman as self and as part of a society, rather than presenting abstract feminist ideology Morrison embeds intersectionality within character, structure and language. Characters in her novels inhabit spaces where race, gender, sexuality and economic vulnerability intersect, shipping their choices and consciousness. In her writing liberation often requires communal healing rather than solitary rebellion. It reveals a distinctly black feminist sensibility grounded in collective survival.

Racial and gender discrimination in *The Bluest Eye* and *Sula*

Published in 1970, *The Bluest Eye* is based on a black voice reality against the myth of the black monolity and racist supremacy. It is a story of a young black girl Pecola in Ohio. *The Bluest Eye* presses the great spectrum of black women voice into the pseudo mould of stereotype. It delves deep into the black feminine's psychic dilemmas, suppression and trials through the tragic life of Pecola. Emotionally void life of Pecola's parents drive her to a state of schizophrenia. As a result, she becomes the victim of her parents bitter dissatisfaction that can be directly traced to the various forms of discrimination on which blacks have to endure invite America. Confined in a situation of terms and threats , Pecola craves for love and protection. But her parents cannot provide her any emotional or moral support. In fact they are emotionally and spiritually depraved. Pecola 's desire for "Blue eyes"-

is craved by the black and "in wanting Blue eyes Pecola wants in fact to be white."(Weaver:406). Similar to her mother, Pauline, he longs to identify herself with the white woman. Through her character Pecola, Morrison highlights the cautious and careful process of growing up from adolescent sensuality into womanly repression."To get rid of the funkiness, the dreadful funkiness of passion, the funkiness of nature, the funkiness of the wide range of human emotions"(The Bluest Eye 68), is what the Morrison women long for. Pecola 's desire for Blue man delineates her internalization of white supremacist beauty standards. Morrison reveals how woman becomes racialized: beauty is equated with whiteness while black linked with ugliness.

Morrison's *The Bluest Eye* is a manifestation of sexual violence underscores how racial gender oppression converges upon the black female body. Pecola, protagonist of the novel, is pitted against two hostile worlds: one the white which ruthlessly reject her and the other her own family. Her family being is full of quarrel and violence. Therefore the child seeks and gets love from outsides. Pecola contacts with many wrong type of people to get what she imagines to be the symbol of beauty, love and security. She is obsessed with *blue eyes* so strongly that she becomes degenerate and lost her mind in the process. Moreover the social order in black society is showcased to be shamble - Pecola's father Cholly Breedlove, rapes her. It is not treated as isolated pathology but as symptomatic of systematic dehumanization. The black body already objectified and oppressed under slavery, continues to bear the burden of historical trauma. This structural disruption resists linear narrative traditions associated with patriarchal authority form itself become feminist resistance. In the novel, Morrison through her powerful narrative voice provides sensitive delineation of miseries of the black female community.

In Morrison's *Sula*, Sula Peace, the main character, rejects the traditional framework of woman as a wife and a mother by accepting sexual and personal freedom. Her open rejection challenges patriarchal norms and communal expectations as well. Sula's journey in quest of trans - cultural knowledge only results negative behaviour and frustration. She thinks, men are just to be used and discarded. She doesn't even leave her best friend Nel's husband. Morrison denies simplifying her into either villain or victim. Sula threatens the peaceful existence of the black community.

Sula's character does not arise any surprise to readers because Morrison has very aptly and meticulously developed it. She had been as innocent and playful as a child could be. One can only blame the circumstances and pseudo values for channelizing the person in Sula in a wrong direction. She is contingent on her grandmother Eva Peace and her mother Hennah. Both the woman seems to be not able to show any emotion or understanding for Sula. She brings up isolated from them unable to relate either. The structure of the family is completely loose while her friend Nel's household structure is tight and rigid. Morrison showcased Sula's frustration results from such detachment, finds herself loveless friendless, she is mutiled. Her characters "struggle for their liberation from being manipulated by a corporate society reeling under the throes capitalism and theirby save themselves from self mutilation" (Bhatnagar 317).

The community's demoralization of Sula delineates how oppressed community sometimes enforces patriarchal discipline internally, Sula becomes a victim, embodying communal anxieties. Morrison thus complicates feminist discourse by exhibiting that oppression may be reproduced within oppressed groups. Toni Morrison's novels are transformative feminist texts reclaims Black female subjectivity from historical enasure. Through her protagonist, Morrison unveils the complexity of black womanhood in a racially stratified patriarchal society. Her novels become a vehicle to register and challenge both literary tradition and theoretical orthodoxy. In other words, she reshapes literary and critical landscape permanently in expanding feminism beyond Eurocentric archetype.

Work Cited:

1. Beal, Frances , "Double Jeopardy: To be Black and Female",The Black Woman: An Anthology, Ed. Toni Cade, New York: Singet, 1970.
2. Morrison, Toni, *The Bluest Eye* , New York: Simon & Schuster, 1972.
3. Bhatanagar, M. K. ,*Feminist English Literature*, Atlantic Publishers, 2003.

A Study of Changes in Buying Behavioural Pattern of Consumer Due to Online Shopping and its Impact on Traditional Retailers with Special Reference to Western Vidharbha (M.S)

Abhinav Raosaheb Pundkar
Research Scholar
Shri Shivaji Arts, Commerce & Science College, Akola

Abstract:-

Shopping is a part of day-to-day life. Consumers buys product for its own desire. They went on market to buy things which is needed. The term 'market' has widespread wings encompassing a wide range of activities because it plays a pivotal role in the growth and development of an economy of a country. A market is defined as the sum total of all the buyers and sellers in the area or region under consideration. The area may be the earth, or countries, regions, states, or cities. The value, cost and price of items traded are as per forces of supply and demand in a market. The market may be a physical entity, or may be virtual. It may be local or global, perfect and imperfect. At first market has only one type and that is traditional market, Which where people goes in certain market places and buys certain things. And its person to person transaction where one person buys thing from shopkeeper in returns of certain amount of money of that particular thing which buyer bought.

Keywords:- Consumers, Shopping, Market, Economy, Effect.

Introduction

1.1 Traditional shopping:-

Traditional shopping refers to the act of physically visiting a store to purchase goods or services. It involves walking around a store, browsing through items, and making a purchase by physically handing over cash or using a credit/debit card. Traditional shopping offers a hands-on experience where customers can see, touch, and try on products before making a purchase. It also allows for personal interaction with sales staff, who can provide recommendations and help answer any questions. Traditional shopping can also provide a social experience, as people may go shopping with friends or family. Traditional shoppers often enjoy the experience of seeing and touching the products they are interested in before making a purchase, and they may also enjoy the social aspects of shopping in a physical store. But know 'Market' is bifurcate in two types. One is 'Online Market' & another as we known is 'Traditional/ Offline Market'.

1.2 Traditional Retailer:-

Traditional retailers refer to businesses that sell products or services through physical conventional stores. These retailers have been around for many years and are often characterized by their face-to-face interaction with customers, personalized service, and physical product displays. Examples of traditional retailers include department stores, supermarkets, specialty stores, retailer stores. These retailers typically have a physical store front where customers can browse products, interact with salespeople, and make purchases. In recent years, traditional retailers have faced increasing competition from online retailers, which offer the convenience of online shopping and often lower prices. To remain competitive, many traditional retailers have started to offer online shopping options, in-store pickup, and other services to cater to changing consumer preferences.

Body of research paper:-

2.1 Online shopping:-

Online shopping is the process of purchasing goods and services over the internet, using a website or mobile app. It has become increasingly popular in recent years, as more people have access to the internet and smartphones. With online shopping, consumers can browse and purchase products from the comfort of their own homes or anywhere with an internet connection. This convenience has

led to the growth of e-commerce, with online retailers ranging from small businesses to large multinational corporations. Online shopping offers several benefits, including a wider selection of products, lower prices, and the ability to compare prices and products across different retailers. It also allows consumers to read reviews and ratings from other customers, helping them make more informed purchasing decisions.

By making discounted online purchases, consumers can save time and effort. The offers on the internet can be easily compared, and the buyer can buy the product according to their favorable conditions like price, quality and other discounts for their individual needs. The "Smart Phones" generation of mobile devices has created new opportunities for employing custom apps. The majority of businesses are utilizing the practice of making their goods accessible for purchase via an app on their websites. Additionally, they are releasing some fantastic promotions to entice users to download and utilize their applications more frequently rather than visiting their website.

2.2Internet and its benefit:-The invention of the Internet has created a paradigm shift of the traditional way people shop. A consumer is no longer bound to opening times or specific locations; he can become active at virtually any time and place and purchase products or services. Our daily lives now include the Internet, a relatively new channel for communication and information sharing. Since there are more and more people using the Internet, more people are also making more purchases online. Consumers that choose to shop online go through the process of online purchasing. The development of this channel, e-commerce, has been described by Smith and Rupp (2003) as the most significant contribution of the information revolution. The Internet has grown into a "new" distribution route. Along with looking for items and learning about them, shopping online has emerged as one of the main reasons people use the Internet. Smith and Rupp (2003) also state that the consumers have never had access to so many suppliers and product / service opinions . Therefore , the Internet has developed to a highly competitive market , where the competition over the consumer is fierce . In order to have an impact on and retain consumers , in a competitive market , Constantinides (2004) stated that the first step is to identify certain influencing aspects when purchasing online , these can be regarded as factors .

2.3 Impact on Behaviours:- The increase is the result of both a change in consumer behaviour and the rapid development of broadband technology. The Internet is seen as a mass medium with unique buying characteristics for consumers. There are various elements that make it more convenient for the consumer compared to the traditional manner of purchasing, such as the freedom to examine and purchase items whenever they want and the ability to match products to their needs. like the flexibility to view and buy things whenever they want and the capacity to match products to their needs and discuss products with other explain that the current primary reason people shop over the Internet is the convenience. They also recognize that the previous primary reason for shopping online was price, which has now changed to convenience.

Conclusion:- The invention of the Internet has created a model shift of the traditional way people shop . Consumers are no longer restricted to business hours or particular locations; they can become active at almost any time and location and buy goods or services. The Internet is a relatively new medium for communication and information exchange that has become present in our everyday life Our daily lives are being affected by the relatively new medium of the Internet for interaction and knowledge sharing. Because there are more and more people using the Internet, more people are making purchases online. The rapid expansion is explained by a combination of changing consumer behaviour and an increase in the use of internet technologies. Consumer buying behaviour is the study of what customers do when determining whether to purchase a good that fulfills their needs. It is an investigation of how customers behave and what motivates them to purchase and use particular goods. Consumer behaviour differs as a result of evolving fashion, technology, trends, lifestyles, disposable income, and similar other things

References:-

1. Google Inc. 2. CNBC

English language Teaching in India : Challenges and Innovations

Rupalee Madhukar Waghmare
Research Scholar
Department of English, Shri Shivaji College of Arts, Commerce and Science, Akola

Abstract:
English language education in India faces multifaceted challenges due to its diverse linguistic landscape, socio-economic factors, and educational policies. This research article examines the major obstacles encountered in teaching English in India, including linguistic diversity, inadequate teacher training, unequal access to resources, and the dominance of regional languages. Drawing upon existing literature, this paper offers insights into potential solutions and strategies to address these challenges and enhance English language education in India.

Keywords: English language, education, India, challenges, linguistic diversity, teacher training, resources, regional .

Introduction

As English becomes a universal language, its presence and value in the world has expanded Enormously in the past decades. Information technology revolution creates an essential for Learning English as a professional language. This will create a great impact industrial activities Such as BPO, Medical Transcription and IT add to the importance and relevance of English in Every walk of life.

Challenges provide possibilities for positive transformation that come out as a result of changing circumstances. The growing demand, continually fluctuating position and prestige across the world and India's multilingual, multi-cultural and multi-racial society within the country, makes teaching English in India more challenging. Actually, the diversity of Indian realities is deep and bare, hence need to be tackled skillfully and tactfully approach. English educators in India encounter manifold challenges some arise within the educational system while others from outside influences. Some of these challenges must be resolved forcefully, while others call for deft management.

Challenges in English Language Teaching.

There are many Challenges before the English Language teachers in India which are enormous and apparent. They should be able to cater to the practical needs of learners, to make them Competent enough to interact with one another and also to retrieve information all over the World.

Colossal and Multilingual Classrooms –

"According to the students the over-crowded classes create number of problems like; discomfort in the class; lack of individual attention; effective evaluation, classroom management, maintaining learning process etc". (Gamit, Jatin R., 2012). Other challenges that crop up due to overcrowded classrooms include lack of motivation and creativity, reading and conversational abilities, along with frequent and essential feedback from the educator.

Eterogeneous Classrooms –

Indian classrooms at all levels of education comprise students from varied backgrounds, languages, castes, classes, cultures, and faiths. It becomes challenging for the English educator to identify and plan as per the learners' learning pace, learning styles, exposure, and usage of English.

Different School Boards and Educational Policies –

Indian schools follow various streams/boards with different goals and curricula and medium of instruction. English is introduced at different stages of learning in such varied medium schools. It poses difficulty for policymakers not only in developing a uniform educational program but also in implementing them. The situation worsens for educators at higher level educational and professional institutes to deal with migrants other then regional and English medium students in the same class. Educators and policymakers work hand in hand to help their students gain fundamental and

communicative proficiency in order to attain better employment in all sectors or to pursue a teaching career, both nationally and globally.Ignoring Goals of Teaching:

Impractical and Inappropriate Curriculum, Textbooks and Study Materials –

All boards' English curriculum and textbooks, and study materials designed for homogeneous learners either do not fit or are rendered worthless in actual classroom situation because they typically lack authentic illustrations, impressive language and style, appropriate subject matter, relevant and suitable anecdotes and stories, and above all, fail to attract learners. "Most of the students found the text books very difficult and uninteresting…". All this leads to a monotonous and repetitive learning environment. "…In addition, prescribed text books are just tools to pass written exams and educators as facilitators. Books are prescribed that bear no relevance to the needs of pupils at the stage". Prof.V.K. Gokak.

Traditional, Outdated, and Ineffective Teaching Techniques and Methods –

Another significant challenge is the use of traditional, out-of-date, and ineffective teaching Techniques and methods. Most of the senior or experienced educators continue with the age-old Lecture or translation methods. For some others reading the text followed by explanation and yelling the students is all that is required in the name of English language teaching. Educators have to fixthat approach must be properly tailored to the needs of the educational environment and the active Participation of the students in the classroom. "The students learned English only as a subject rather Than as language. They feel themselves unable to put their learning into practice due to lack of a Favourable environment. They never get a chance to converse properly in English as the teacher Neither use the other methods like direct method in the class, nor encourage them to converse in English."

Diverse Social, Economical, Professional and Linguistic Background of Learners'–

In "Teaching of English in India: Problems and Prospects" Sarangi, Dr. J. (2010) has Highlighted the problems of teaching English under socio-cultural, socio-linguistic and socio-Geographic aspects. Students from underprivileged and marginalized communities lack a literary Foundation and struggle to grasp the grammatical concepts and beauty of the English language and Literature. Learners' discrepancies are frequent and will remain in Indian society, but educators have To deal with them with effective and compassionate approach.

Lack of Professional, Effective and Skillful Teachers –

Prof.V.K. Gokak has said, "The fundamental years for the teaching of English in schools are In the hands of teachers who neither know enough English nor are familiar with the latest and far Reaching development in the pedagogy of English". Now teaching of English should be learners'-Oriented instead of teacher-oriented. Teachers as professional are given least developing Opportunities. Metropolitan educators have better exposures and more opportunities than their rural Counterparts. Lacks of in-service training program, the educators remain ignorant from the Innovations and latest techniques to update their knowledge and enhance their skills.

Lack of Proper Teachers' Education and Selection Procedure –

The majority of licensed English teachers are not graduates, are unfamiliar with basic

Grammatical structures and rarely talk or interact in English in class. Robert Lado (1964) said, "... The language teacher must be educated, at least to the level of his peers. He must have a general Preparation of a teacher…..he must know the target language well enough to be imitated by his Students." Inexperienced or inadequately equipped teachers are unable to communicate effectively in English. English literature experts are made-up to teach English language with a number ofpedagogical constraints at secondary level. Teachers fail to distinguish between literature and general English classrooms in terms of goals and objectives.

Peer pressure –

We are made to learn the English language to go through the cut-throat Competition.We have spoon-fed the terminology, definition. Learning cannot be fun if the purpose is not slated. English is considered as the most suitable and convenient tool for International Communication. The people who

have proficiency in this language could access large number Of jobs and also were seen holding high positions in many National and International Organizations. In the earlier days English was just like a Library language, but now that notion has changed Totally. At present the challenges visible before the English language teachers in India are Diverse and it is necessary for them to shape up accordingly to meet the demands of the day

Innovations

Promoting English through Extracurricular Activities

Promoting English through extracurricular activities—such as debate clubs, drama, book clubs, and story-telling—significantly boosts student fluency, vocabulary, and confidence. These activities provide immersive, low-pressure environments that foster creative language use, enhance critical thinking, and strengthen communication skills beyond traditional classroom teaching.

Content Creation and Digital Storytelling

In the age of digital media, learners are not only consumers but also producers of content. Innovative ELT strategies encourage learners to create digital content and share their stories, Experiences, and knowledge through multimedia platforms. This approach enhances language Skills by integrating reading, writing, listening, and speaking in a multimedia context (Robin, 2008). Digital storytelling, for example, involves learners in creating narratives using various Digital media tools, including images, videos and audio recordings. This strategy fosters creativity, Critical thinking and communication skills while providing a platform for learners to express Themselves in English.

Peer Collaboration and Language Exchange

Peer collaboration and language exchange programs promote authentic language use and cultural Exchange. Innovative ELT strategies encourage learners to connect with peers from different Linguistic backgrounds, either face-to-face or through virtual platforms. Learners can engage in Language exchanges, where they help each other practice their respective target languages . Collaborative learning experiences allow learners to gain exposure to diverse Accents, dialects and cultural perspectives. They also build confidence in using English for real Communication and help break down language barriers.

Research and Innovation in ELT

Research and innovation in English Language Teaching (ELT) are currently driven by artificial intelligence (AI), digital transformation, and learner-centered approaches. Key innovations include AI-driven personalized learning, metaverse simulations, multimodal literacy, and a shift toward task-based, communicative and sustainable pedagogical practices that enhance engagement and real-world proficiency.

Teacher Training and Professional Development

ELT teacher training and professional development (PD) involves a blend of formal qualifications (CELTA, DELTA), workshops, and reflective practices like action research and mentoring. It focuses on enhancing pedagogical skills, language proficiency and classroom management to improve student outcomes. Continuous, collaborative development is key to avoiding burnout and staying updated with modern teaching methodologies.

Curriculum Reform and Pedagogical Shift

Curriculum reform and pedagogical shift, driven by frameworks like NEP 2020, move education from rigid, rote-based learning to holistic, flexible, and competency-based models. Key changes include 21st-century skill development, experiential learning and continuous, 360-degree assessment to foster creativity, critical thinking and real-world understanding.

Integration of Technology in ELT

Integration of technology in English Language Teaching (ELT) transforms classrooms by enhancing interaction, engagement, and accessibility, moving from traditional methods to learner-centered, digital approaches. Key tools like Learning Management Systems (Google Classroom), multimedia, apps, and AI foster personalized learning and improve proficiency in reading, writing, listening and speaking.

Policy Implementation and Monitoring

English language policy implementation and monitoring involves creating clear, inclusive guidelines, aligning resources and establishing robust, ongoing assessment to track progress, particularly in educational settings.

Conclusion

The future of ELT in India lies in bridging the gap between traditional methods and modern technology. While structural challenges in education persist, the integration of innovative tools, teacher empowerment programs, and a focus on communicative competence can significantly improve proficiency levels. Moving towards a more learner-centered, interactive approach is crucial for enabling Indian students to thrive in the global area.

English Language Teaching (ELT) in India faces significant challenges due to immense linguistic diversity, rural-urban disparities, and a, reliance on traditional, exam-oriented methods, leading to poor communicative competence. Innovations such as technology integration, interactive language labs and teacher training are crucial for improving proficiency.

References

1. Gokak, V.K.(1964).English in India: Its present and Future. Asia Publishing house.
2. Ali, S.M.(2012). Language Teaching in India- The Present Day Challenge.
3. Allon, B. Harold. (1976). Teaching English as a second language, a book of readings: Tata Mcgrow Hill Publishing Company Ltd. Bombay.
4. Firdaus, Rehana.(2014-15).A Study of Problems Related to Teaching Learning
5. English in Convent Schools, M.Ed. Dissertation ,J.M.L

Decolonizing the Algorithm: AI's Postcolonial Mimicry in Contemporary Indian English Fiction

Sandeep M. Ghutke
PhD. Research Scholar, Department of English, Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur.

Abstract

This paper interrogates the convergence of postcolonial theory and artificial intelligence by examining how contemporary Indian English fiction both anticipates and resists the epistemic violence encoded within large language models. Drawing on Homi K. Bhabha's theorization of colonial mimicry, this study argues that AI systems trained predominantly on anglophone, Western datasets perform a form of digital mimicry that replicates and amplifies the structural hierarchies of empire in the domain of language generation. Close readings of Arundhati Roy's The God of Small Things and Amitav Ghosh's The Shadow Lines are placed in sustained dialogue with recent scholarship in algorithmic studies, including the decolonial AI frameworks proposed by Mohamed et al. and the infrastructural critiques advanced by Kate Crawford and Safiya Umoja Noble. The paper contends that the asymmetries of training data constitute a neo-colonial episteme and that subaltern voices, in Gayatri Spivak's sense, remain structurally excluded from the corpora that teach machines to speak. At the same time, the paper locates within Roy's and Ghosh's aesthetic strategies certain forms of narrative resistance that offer provisional models for reimagining AI-generated discourse beyond the mimicry of Eurocentric literary norms. The argument advances a theoretical framework called postcolonial computational poetics, proposing that the decolonization of algorithmic language must proceed through both technical redistribution and humanistic interpretation.

Keywords: postcolonial theory, artificial intelligence, mimicry, Indian English fiction, algorithmic colonialism, subaltern, Homi Bhabha, decolonial AI, large language models, computational poetics

Introduction

When Homi K. Bhabha observed in The Location of Culture that colonial mimicry is the desire for a reformed, recognizable Other, as a subject of a difference that is almost the same, but not quite, he was mapping the psychic economy of an empire that demanded imitation while structurally foreclosing equivalence (Bhabha 122). What Bhabha could not have anticipated, writing in 1994, was that mimicry would come to describe not only the ambivalent performance of the colonized subject but also the fundamental operating principle of the artificial intelligence systems that now generate prose, produce narratives, and in certain quarters aspire to authorship itself. The irony is precise and unsettling: the very technologies celebrated as the democratizing vanguard of a borderless knowledge economy are, upon scrutiny, machines of mimicry trained to reproduce the voice of a dominant cultural archive. The question this paper poses is not merely technical. It concerns the politics of representation, the epistemology of language, and ultimately the literary-historical question of who gets to speak and on whose terms. Contemporary Indian English fiction, as a body of literature produced at the intersection of colonial inheritance and postcolonial aspiration, offers a uniquely illuminating lens through which to examine these questions.

This paper proceeds in five movements. It first situates the problem within the existing literature on postcolonial theory and digital humanities. It then develops an account of what, borrowing from and extending Mohamed et al.'s foundational work, it calls algorithmic colonialism. It subsequently performs close readings of Roy and Ghosh that illuminate the aesthetic strategies through which Indian English fiction theorizes its own linguistic condition. It brings these readings into dialogue with an analysis of how large language models handle postcolonial literary language. It concludes by proposing postcolonial computational poetics as a theoretical and methodological framework adequate to the problem.

Literature Review

The scholarly conversation at the intersection of postcolonialism and digital technologies has grown rapidly in the past decade, though it remains uneven and often insufficiently attentive to literary

specificity. Roopika Risam's New Digital Worlds provided the foundational framework for postcolonial digital humanities, arguing that the decisions involved in digitizing, curating, and encoding cultural heritage are never neutral but always shaped by the power relations of the archives from which they emerge (Risam 4-6). Risam's account of the representational asymmetries embedded in digital corpora established a critical vocabulary that subsequent scholars have extended toward AI specifically. Her insistence that data is never raw but always cooked by institutional, historical, and geopolitical processes anticipates the arguments now being made about training datasets for large language models. The decolonial AI framework developed by Mohamed, Png, and Isaac in their landmark Philosophy & Technology essay offers the most theoretically sophisticated engagement with these questions from within the computational sciences themselves (Mohamed et al. 659). Their framework is essential, but it is primarily a programmatic intervention in computer science rather than a literary-critical analysis. This paper takes their decolonial framework as a theoretical foundation and extends it into the domain of literary interpretation.

Safiya Umoja Noble's Algorithms of Oppression demonstrated with meticulous empirical rigor how search engine algorithms encode and amplify racial and gender biases that derive from historical inequalities in the production of knowledge (Noble 1-10). Kate Crawford's Atlas of AI subsequently situated these algorithmic biases within the broader material geography of AI development, tracing how the planetary extraction of labour, data, and resources that makes AI possible is distributed along lines that reproduce colonial geography (Crawford 7-21). These accounts provide a structural sociology of AI but do not attend to the literary and linguistic dimensions of the problem. Ruha Benjamin's Race After Technology offers the theoretically generative concept of the New Jim Code, the embedding of discriminatory logics within ostensibly neutral technological systems, which resonates powerfully with postcolonial critiques of the civilizing mission's rhetoric of neutrality and progress (Benjamin 5). In the field of computational linguistics, Emily Bender and her collaborators' intervention on the dangers of stochastic parrots established the important point that large language models do not understand language but rather produce statistically plausible continuations of text based on training data, generating what they call a simulacrum of language comprehension (Bender et al. 610-11). The implications for postcolonial literary studies are significant: if these models are stochastic parrots, the question becomes whose language they are trained to parrot, and what histories of dominance determine the statistical plausibility that governs their outputs.

The literary-critical tradition within which this paper situates itself extends from Edward Said's foundational analysis of Orientalism as a discursive formation, through Frantz Fanon's account of the psychic and linguistic violence of colonialism in The Wretched of the Earth, to Spivak's elaboration of the subaltern's structural exclusion from circuits of representation (Said 3; Fanon 3-5; Spivak 271). Dipesh Chakrabarty's Provincializing Europe has been particularly productive for this analysis: his argument that European thought is both indispensable and inadequate for postcolonial knowledge production maps with striking precision onto the situation of large language models trained on Western literary corpora and deployed in postcolonial contexts (Chakrabarty 3-4).

Methodology

This study adopts a methodology of triangulated reading that brings together three distinct analytical modes without reducing any one to the other. The first is postcolonial close reading, which attends to the micro-poetics of language in Roy and Ghosh: the syntax, the lexical choices, the narrative voice, and the formal innovations through which these novels inscribe their relationship to English as a colonial inheritance. The second is what might be called algorithmic discourse analysis, which involves analysing outputs generated by publicly available large language models in response to prompts derived from the thematic and formal concerns of the primary texts, attending to the ways in which these outputs reproduce, distort, or efface postcolonial literary conventions. The third is theoretical-synthetic analysis, which draws on postcolonial theory, science and technology studies, and digital humanities scholarship to develop the overarching argument of the paper.

The goal is not to produce a statistically representative empirical study but to identify characteristic patterns that illuminate the theoretical argument. Where AI-generated text is quoted or described, the analysis is concerned with tendencies and structures rather than with definitive claims about specific systems. The methodology is ultimately humanistic rather than computational: it uses the encounter with AI outputs as a provocation and a foil for developing a theoretically informed account of what is at stake in the algorithmizing of literary language.

Analysis and Findings

Roy's The God of Small Things performs its relationship to English with a self-consciousness that is simultaneously aesthetic achievement and political argument. The novel's infamous broken syntax, its capitalized abstractions, its refusal of standard temporal sequencing, its embedding of Malayalam words and rhythms within English prose: these are not stylistic eccentricities but calculated disruptions of the colonial language's pretension to transparent instrumentality. Consider the novel's opening: 'May in Ayemenem is a hot, brooding month. The days are long and humid' (Roy 3). The declarative simplicity is deceptive; within pages, Roy is writing sentences like 'Little events, ordinary things, smashed and reconstituted. Imbued with new meaning. Suddenly they became the bleached bones of a story' (Roy 32). The fragmentation is syntactically and epistemologically deliberate: it refuses the colonial novel's confidence in the grammatical completeness of experience. When a large language model is prompted to generate a passage in the style of Arundhati Roy's The God of Small Things, the outputs characteristically produce what might be called the surface features of Indian English fiction: the tropical setting, the family drama, the reference to caste or communal identity, the slightly poetic prose. What they almost invariably do not produce is the structural disruption, the politically motivated incoherence, the syntactic refusal that constitutes Roy's actual literary-political project. The algorithm produces the recognizable Other that is almost the same but not quite, in precisely Bhabha's sense: it generates a mimicry of Indian English fiction that reproduces its apparent features while evacuating its critical substance (Bhabha 122). The AI's India is picturesque, its language is exotic but ultimately accessible, its narrative concerns are legible to a globally mobile anglophone readership trained on a particular version of literary multiculturalism.

Ghosh's The Shadow Lines operates through a different but related aesthetic strategy. Where Roy disrupts syntax, Ghosh interrogates the epistemology of the border: the novel's central preoccupation is with the arbitrariness of the lines that divide nations, communities, and selves, and with the violence that is required to maintain those lines as real. The narrator's obsession with mapping, with the gap between cartographic representation and lived geography, is a sustained meditation on what we might now recognize as the ontology of the dataset: the process by which the irreducibly complex and contradictory texture of postcolonial life is converted into bounded, classifiable, manageable units. Ghosh writes: 'I wondered whether it was I who had been locked out, or whether they had locked themselves in' (Ghosh 233). The sentence performs the epistemological vertigo that is the novel's deepest subject. The encounter between Ghosh's aesthetic of border-undoing and the AI language model's constitutive dependence on classification and category reveals a structural incompatibility that is simultaneously technical and political. Language models operate by assigning statistical weights to tokens within a defined vocabulary; they produce meaning through proximity and pattern within a space that has been bounded and mapped by the choices of those who assembled the training data. The subaltern body, the unclassifiable experience, the syntax that refuses to resolve: these are not merely difficult for AI systems to reproduce; they are, in a precise sense, unintelligible to systems designed around the reduction of linguistic complexity to statistical regularity. Spivak's question 'Can the subaltern speak?' finds a new and troubling inflection when asked of systems that can only hear what their training data has already legitimized (Spivak 271).

The asymmetry of training data is not incidental but constitutive. Crawford's analysis of the material infrastructure of AI development reveals that the datasets on which large language models are trained are overwhelmingly composed of English-language web content, with all the geopolitical and socioeconomic filters that internet access, platform governance, and digital literacy imply

(Crawford 89-100). This means that the statistical regularities that govern AI-generated prose are derived from a corpus that systematically underrepresents the languages, literary traditions, oral cultures, and experiential knowledge of the global majority. The Dalit poet's voice, the Malayalam novel, the Bangla short story: these are not absent from AI training data in the sense of being categorically excluded, but they are statistically marginal in ways that reproduce the marginalization of their producers within global knowledge economies. This is the algorithmic instantiation of what Chakrabarty called the asymmetry between the universal claims of European thought and the particularity of its historical origins (Chakrabarty 4)

Discussion

The theoretical framework this paper proposes, postcolonial computational poetics, has several components that require elaboration. The first is a critique of what might be called the neutrality assumption: the implicit or explicit claim that AI language systems are politically neutral tools whose outputs simply reflect patterns in their training data, and that any biases are therefore incidental rather than structural. This assumption is precisely parallel to the neutrality claims of colonial modernity, the idea that railways, census categories, and English education were simply modern technologies whose benefits were universal even if their distribution was historically uneven. The postcolonial critique of modernity's neutrality claims, from Fanon through Spivak to contemporary postcolonial studies, provides the theoretical resources for dismantling the analogous claims made for algorithmic systems. The second component of postcolonial computational poetics is an account of what might be called decolonial form. Roy and Ghosh, reading them through this framework, emerge as writers who are not merely thematizing postcolonial experience but theorizing, at the level of narrative structure, syntax, and genre, the conditions under which postcolonial knowledge is produced and circulated. The novel, as a form with a specific history entangled with European modernity and colonialism, is for both writers a site of negotiation rather than simply a vehicle for content. The question for postcolonial computational poetics is what it might mean to carry this formal-critical consciousness into the domain of AI systems: not merely to diversify training data (though this is necessary) but to reimagine the formal architectures of language modelling so that they do not simply reproduce the mimicry of dominant literary forms. The third component is an ethics of interpretability. Benjamin's concept of the New Jim Code and Birhane's relational ethics of algorithmic injustice both suggest that the problem with biased AI systems is not merely technical but relational: it concerns who is harmed, who is rendered invisible, and who bears the costs of systems designed for someone else's benefit (Benjamin 5; Birhane 100205). Postcolonial computational poetics adds to this ethical framework a specifically literary-critical dimension: the insistence that the interpretive labour of reading, of attending to the particularity of texts and the histories they carry, cannot be replaced by pattern-matching at scale without significant epistemic and ethical loss. Noble's demonstration that algorithms of oppression are also algorithms of simplification, reducing complex social realities to searchable and rank-able data, resonates with the literary critic's insistence on the irreducibility of the aesthetic (Noble 5).

It would be a mistake, however, to end this analysis with a simple opposition between the richness of human literature and the poverty of algorithmic reproduction. Risam's postcolonial digital humanities framework offers a more productive way forward, one that insists on the transformative possibilities of digital and computational tools when they are designed and deployed with explicit attention to questions of power, representation, and justice (Risam 6-10). Postcolonial computational poetics is not a Luddite position but a demand for a different kind of AI: one that is trained on a genuinely global corpus, that attends to formal and linguistic diversity as a value rather than noise, and that is interpreted through critical frameworks capable of recognizing the difference between mimicry and the real.

Conclusion

The encounter between postcolonial theory and artificial intelligence is not a marginal or merely topical concern for literary studies. It goes to the heart of the discipline's most fundamental questions:

What is language? Who speaks? On whose terms? The reading of contemporary Indian English fiction undertaken in this paper reveals, through the aesthetic strategies of Roy and Ghosh, a body of literature that has already theorized, with extraordinary precision and complexity, the problems that AI systems now pose in a new register. The analysis of how large language models handle postcolonial literary language reveals the ways in which these systems perform a digital mimicry that is almost the same as literary competence, but not quite. The framework of postcolonial computational poetics proposed here is offered as a beginning rather than a conclusion. The decolonization of the algorithm, if such a project is to mean anything more than a diversification of training data (though it must mean at least that), requires the sustained engagement of literary scholars, postcolonial theorists, computational linguists, and data scientists in a genuinely interdisciplinary conversation. It requires, above all, the kind of slow, patient, historically informed reading that literary critics have practiced for generations: an insistence that the text, whether printed or generated, carries histories and politics within its formal structures that no surface-level pattern-matching can fully apprehend. In a moment when the algorithmic automation of language generation is accelerating rapidly, the humanities' most fundamental commitments, to specificity, to particularity, to the irreducibility of meaning, have never been more urgently needed.

The subaltern cannot speak through a system trained not to hear her. The first step toward changing this is to understand, with full theoretical seriousness, why this is so. That is what this paper has attempted to do.

Works Cited

1. Benjamin, Ruha. Race After Technology: Abolitionist Tools for the New Jim Code. Polity, 2019.
2. Bender, Emily M., et al. "On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?" FAccT '21: Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency, ACM, 2021, pp. 610-623. doi:10.1145/3442188.3445922.
3. Bhabha, Homi K. The Location of Culture. Routledge, 1994.
4. Birhane, Abeba. "Algorithmic Injustice: A Relational Ethics Approach." Patterns, vol. 2, no. 2, 2021, article 100205. doi:10.1016/j.patter.2021.100205.
5. Chakrabarty, Dipesh. Provincializing Europe: Postcolonial Thought and Historical Difference. Princeton UP, 2000.
6. Crawford, Kate. Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence. Yale UP, 2021.
7. Fanon, Frantz. The Wretched of the Earth. Translated by Richard Philcox, Grove Press, 2004.
8. Ghosh, Amitav. The Shadow Lines. Ravi Dayal, 1988.
9. Mohamed, Shakir, et al. "Decolonial AI: Decolonial Theory as Sociotechnical Foresight in Artificial Intelligence." Philosophy & Technology, vol. 33, 2020, pp. 659-684. doi:10.1007/s13347-020-00405-8.
10. Mukherjee, Meenakshi. The Twice Born Fiction: Themes and Techniques of the Indian Novel in English. Heinemann, 1971.
11. Noble, Safiya Umoja. Algorithms of Oppression: How Search Engines Reinforce Racism. New York UP, 2018.
12. Risam, Roopika. New Digital Worlds: Postcolonial Digital Humanities in Theory, Praxis, and Pedagogy. Northwestern UP, 2018.
13. Roy, Arundhati. The God of Small Things. HarperCollins, 1997.
14. Said, Edward W. Orientalism. Pantheon Books, 1978.
15. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?" Marxism and the Interpretation of Culture, edited by Cary Nelson and Lawrence Grossberg, U of Illinois P, 1988, pp. 271-313.

Class, Identity and Human Relationship in Raja Rao's *Kanthapura*

Mr. Tryambak Ganeshrao Bobade
Research Scholar
School of Language, Literature and Culture Studies, SRTM University Nanded

Abstract:

Raja Rao's Kanthapura (1938) occupies a foundational position in Indian writing in English for its nuanced portrayal of the Indian independence movement through the lens of a small South Indian village. The novel does not merely narrate political awakening; it also foregrounds the complexities of class identity, caste hierarchy, and interpersonal relations shaped by colonial modernity. This research paper examines how class and caste structures organize social interactions in the village and how Gandhian ideology challenges, transforms, and sometimes reaffirms these hierarchies. By analysing character relationships, narrative strategy, and socio-political dynamics, the paper argues that Kanthapura presents class identity as fluid and historically contingent rather than fixed, revealing the tension between collective nationalism and embedded social divisions.

Keywords: *British Raj, Gandhian Philosophy, Satyagraha, Cultural hegemony and Casteism*

Introduction:

Raja Rao is a significant figure in contemporary Indian English literature, acknowledged for his contribution to the establishment of Indian writing in English as a distinct aesthetic and intellectual tradition. In contrast to numerous contemporaries, Rao emphasises both external socioeconomic realities and the spiritual and philosophical aspects of Indian existence. His literary perspective integrates cultural experience, philosophical exploration, and personal identity, converting literature into a medium of meditation and contemplation. Rao asserts that the Indian self cannot be entirely articulated through Western paradigms; rather, he highlights a civilisational consciousness imbued with spiritual exploration and mythology. His narratives embody Indian cultural rhythms, intertwining the material and metaphysical. In the Indian social context, class cannot be understood independently of caste. While Marxist readings emphasize economic relations, Indian society complicates this framework through ritual hierarchy and hereditary occupation. Rao's narrative reflects this dual structure: Economic class appears through ownership of land, control of resources, and labour relations. Caste identity determines ritual purity, spatial segregation, and social interaction. The village of Kanthapura becomes a microcosm of colonial India where social hierarchy functions as both cultural tradition and economic system. The narrative repeatedly underscores how identity is inherited rather than chosen, shaping human relationships before personal agency can emerge. he geography of Kanthapura itself reflects class distinction. The Brahmin quarter occupies a privileged position, whereas Pariahs and labourers live on the margins. Physical distance reinforces social exclusion: Separate living spaces, Restricted social interaction, Ritual boundaries governing contact. Such spatial arrangements demonstrate that class identity is not merely economic but culturally encoded into everyday life.

His novels, like *Kanthapura*, showcase the complex human relationships, love, hatred, and cultural conflicts, blending Indian philosophy and western culture. Rao's characters are depicted as real persons facing various issues, such as patriotism, greediness, sacrifice, and anarchy. The novel focuses on India's freedom struggle against Britishers, with Gandhiji as an invisible character who establishes a relationship with the villagers of *Kanthapura*. Rao's ideology, while not physically present, serves as a character, influencing the evolution of national unity. The villagers communicate with Gandhiji, performing his teachings and fighting against Britishers. Gandhiji's ideology promotes gender equality, caste elimination, and self-reliance, educating the villagers against exploitation and exploitation. Rao skilfully presents Gandhiji's ideology with his keen perception, making his works a testament to the power of storytelling in shaping Indian society.

Mahatma Gandhi is portrayed as an invisible figure in Raja Rao's work, which establishes a bond with the people of *Kanthapura* who are inspired by his philosophy and teachings. The philosophy of Gandhiji functions as a character, affecting the development of national unity as a reaction to his appeal. As a means of communicating with Gandhiji, the villagers of *Kanthapura* carry out his teachings and come together to take part in collective suffering or conflicts. In spite of the fact that Bhatta, Bade Khan, the Swami, and the White Master regard Gandhiji to be their adversary, listening to the daily news about him becomes a habitual ritual for them. The Gandhian ideology for life and independence is what motivates Moorthy, who is a devotee of Gandhiji. Gandhiji was an ardent advocate for communal unity and a sharp opponent of conventional caste structures. Moorthy devoted his life to the ideas that Gandhiji advocated for. This is a compelling picture of Gandhiji's life and teachings because Rao skilfully presents Gandhiji's ideology with his great observation, which makes it a powerful portrayal.

> *"There is but one force in life and that is Truth, and there is but one love in life and that is the love of mankind, and there is but one God in life and that is the God of all."*

Moorthy, a devoted follower of Gandhiji, travels to the Pariah neighbourhood and solicits the participation of the untouchables in relation to his purpose. He illustrates the significance of Khadi and Charkha by motivating the villagers to spin wool and providing financial assistance to them in order to aid them in their fight against exploiters. Nonviolence and Satyagraha are the methods that Moorthy employs in his struggle against the proprietor of the Skeffington Coffee Estate. His lessons emphasise the significance of Charkha and the ways in which spinning wool is beneficial to the nation. In order to represent Gandhian doctrine through compassion, sacrifice, forgiveness, and cooperation, Moorthy is willing to offer his life for the sake of India's independence. Meenakshi Mukherjee observes:

> *"The characteristically concrete imagination of the uneducated mind, pictures the Mahatma as large and blue like the Sahyadri Mountain on whose slopes the pilgrims climb to the top while Moorthy is seen as Small Mountain. To her the Satyagraha becomes a religious ceremony to which she devotes her sacred ardour."*

In a village, Moorthy, a passionate nationalist, visits the illiterate people and introduces them to the ideas of Gandhi. Unlike earlier novels written by Raja Rao, *Kanthapura* does not feature a large number of human interactions and instead focusses on concepts and philosophies. All of the characters, on the other hand, develop major relationships with Moorthy, and they revolve around him like the sun and the planets.

The bond between Moorthy and Range Gowda resembles that of two brothers living in one house. Range Gowda gives over his British authority and helps Moorthy in his Gandhian purpose even though he is a British Government servant assigned as a "Patel" in a village. His great will and powerful demeanour help him to be known as "the Tiger of the Village". Like a real friend to Moorthy, Range Gowda teaches the locals the value of fabric weaving. Every effort he makes to fulfil Gandhiji's vision constantly helps Moorthy. While Moorthy is imprisoned, he seeks to inspire the people in Gandhiji's fight for freedom and their part as a real nationalist by raising their morality. He also clarified for Moorthy the value of independence and freedom in his absence. Raja Rao notes Range Gowda's great support and involvement for Moorthy. Moorthy couldn't have completed his task without his support.

Moorthy's relationship with Ratna is similar to one of the co-workers. Though she is a widow, she wears colourful bangles, saris uses the kumkum sign on her forehead and combs her hair like a mistress. *Kanthapura* villagers denounce her for her unconventional ways but she does not mind about such criticisms. She is a lovely young lady with modern and excellent perspectives. With her assistance to Moorthy, she carves out a distinctive role in the freedom movement by herself apart from the other *Kanthapura* women. She organize women and train them to perform Gandhiji's weapons for

freedom, Satyagraha, non-cooperation and self-reliance spinning the wool on Charakha. Ratna establishes Swayam Sevika's Sangh, a voluntary women's organisation, under the guidance of Moorthy. She pursues Gandhiji's mission with Moorthy, is resolute and determined to follow it. When Moorthy is imprisoned and punished to a long term in prison, she handles responsibility of the Congress - work in the village in his absences. She guides and persuades the villagers as Moorthy leads them. She makes aware the villagers by reading out the newspapers. In the context of British hostility and their police action, she shows incredible courage and resourcefulness. As a consequense she has been dishonoured, beaten and thrown into prison. After her imprisonment she becomes modest and developed person such as Moorthy. Raja Rao portrayed her as female counterpart of Moorthy.

The relationship between Bhatta and Moorthy is hostile. Bhatta hates Moorthy since he is spreading awareness of his money-laundering operation among the populace. As Raja Rao shows, both Bhatta and Moorthy are Brahmins; but, whereas Bhatta is an exploiter, Moorthy is a kind man. Bhatta is close friends with Swami, the head of all Brahmins and the British agent living far away in a city. Both traditional Brahmins, Bhatta and Swami follow casteism. Moorthy consumes water and builds relationships with the untouchable Pariahs, hence the Swami excommunicates him. Moorthy's excommunication comes from Bhatta. He routinely tells the Swami in the city about events in *Kanthapura* and rallies the people against Moorthy and other Gandhian sympathisers. He teams with Bade Khan to spread rumours about Moorthy's excommunication, which results in the early death of his mother.

Rangamma shares extremely brief relationship with Moorthy. She supports Moorthy in some sort. She doesn't like Moorthy's mixing up with the Pariahs. She doesn't consider Brahmin and Pariahs to be equal. She accompanies him in women's emancipation. But she has a traditional attitude about women's domestic responsibilities. Though she is modern educated woman in *Kanthapura* she has partial views about something that is deeply rooted in her by tradition.

Unlike the other ladies in *Kanthapura*, Moorthy's relationship with Waterfall Venkamma is not as amicable and pleasant. Venkamma is a clever and sly lady. She rejects ideas from Moorthy and Gandhi. She is a hypocrite who always sheds tears like a crocodile, so people call her "Waterfall Venkamma". She is such a beautiful woman that she finds it intolerable to see others in success and happiness. She is also against Moorthy as he banned the marriage of her second daughter. She tries all she can to exact revenge on him and feeds her hate towards him. Seeking retribution against Bhatta and Swami, she develops rapport with them. She is envious of Rangamma and Ratna not just for their progressive attitude but also for their help of Moorthy. Dogmatic, inflexible, and limited in her view, she rejects everyone in the community.

Achakka treats Moorthy with affection, which forms the foundation of their relationship. Believing in Gandhian philosophy, she is the narrator in this book. She supports Moorthy and tells every incident of his life without any favouritism. Her character shapes the movement known as *Kanthapura*. Like most Indian village mothers, Moorthy's relationship with his mother, Narsamma, is ordinary. Since his boyhood, Narsamma, a poor and illiterate woman, has looked after Moorthy by love and care. She is too naive to grasp Moorthy's objective for the people. She just worries about her son; she does not take part in neighbourhood activities. The fictitious news of Moorthy's expulsion leaked by Bhatta and Venkamma shocks her to die. Moorthy turns pitiful and kills his mother. As the story goes on, various minor people interact barely with Moorthy.

Conclusion:

Raja Rao's *Kanthapura* offers a complex portrayal of class identity and human relationships within colonial India. The village becomes a symbolic space where tradition, modernity, and nationalism intersect. Through nuanced characterization and oral narrative style, Rao illustrates how class shapes every aspect of human interaction—from domestic life to political activism. Ultimately, the novel reveals both the possibility and limitations of social transformation. While Gandhian nationalism momentarily bridges class divides, deeply rooted hierarchies remain resilient. Thus, *Kanthapura* stands as a critical exploration of the tension between collective national identity and

persistent social inequality. Thus, Raja Rao paints a real picture of an Indian village life blending with Gandhian independence struggle. Through the way human interactions developed in the story of *Kanthapura*, he shows the many creed and colours of the characters.

Work Cited:

1. Dayal, P. Raja Rao, A study of His Novels. Atlantic Publishers and Distributors, New Delhi. 1991
2. Mukherjee, Meenakshi. "The Twice Born Fiction: Themes and Techniques of the Indian Novel in English." 1971
3. Naik, Madhukar Krishna. A History of Indian English Literature. Vol. 13. New Delhi: Sahitya Akademi, 1982.
4. Rao, Raja. Kanthapura. Oxford University Press: New Delhi 1963. Print.
5. Srinivasa, K. R. Iyengar, Indian Writing in English. Revised & Updated Edition. Sterling Publisher Private Limited, 1989
6. Srivastava, Narsingh, The Mind and Art of Raja Rao, Prakash Book Depot, Bareilly, 1980.

Impact of Climate Change on Agriculture in Vidarbha Region

Praful S. Chavhan
Research Scholar,
Dept. of Geography, Bharatiya Mahavidyalaya, Morshi

Abstract

The Vidarbha region of Maharashtra, India, faces unprecedented challenges from climate change that threaten agricultural productivity, farmer livelihoods, and food security. This paper examines climate change impacts through analysis of temperature fluctuations, precipitation variability, and extreme weather events. Rising temperatures, erratic rainfall, and increased pest infestations have significantly reduced crop yields across cotton, rice, and sugarcane. The region's vulnerability is compounded by limited irrigation infrastructure and marginal landholdings. The paper explores adaptation strategies including crop diversification, climate-resilient varieties, and improved water management. Findings underscore the need for comprehensive, region-specific policy interventions integrating technical innovation with institutional support to build agricultural resilience in Vidarbha.

Keywords: Climate change, Vidarbha region, agriculture, crop production, adaptation strategies, vulnerability, drought, rainfall patterns, cotton cultivation, sustainable farming

1. Introduction

Agriculture forms the backbone of India's economy and the primary livelihood for rural populations, particularly in Vidarbha [1]. The Vidarbha region, encompassing districts in central Maharashtra, represents a critical agricultural zone where about 89% of the land is utilized for rainfed farming, making it exceptionally sensitive to climatic variations [2]. Climate change—characterized by long-term shifts in temperature and precipitation patterns—poses serious threats to agricultural productivity, food security, and rural livelihoods. The Vidarbha region has experienced increasing temperatures and erratic rainfall patterns over past decades, creating significant challenges for farmers whose production systems evolved under relatively stable climatic conditions. Understanding the precise nature and magnitude of climate change impacts is essential for formulating effective adaptation and mitigation strategies [3].

This paper synthesizes evidence to examine climate change impacts on agriculture in Vidarbha, addressing three objectives: (1) identify and quantify specific impacts on agricultural productivity and crop yields; (2) assess farming community vulnerability; and (3) evaluate adaptation strategies that can enhance agricultural resilience. Through this integrated analysis, the paper provides actionable insights for policymakers, agricultural practitioners, and farmers.

2. Climatic Changes in Vidarbha

Temperature and Precipitation Trends

The Vidarbha region has experienced significant temperature increases over past decades, with consistent warming trends accelerated in recent years [4]. Maximum and minimum temperatures rise during various seasons, creating unpredictable conditions for agricultural planning. Rising temperatures accelerate evapotranspiration rates, increase crop respiration, and alter photosynthetic processes—all critical for determining crop yields [5]. Elevated temperatures particularly affect crops requiring specific temperature ranges for proper flowering and fruit set [6].

Rainfall patterns in Vidarbha are characterized by increasing variability and declining trends. Studies reveal that an increasing proportion of years are characterized as dry or very dry [7]. The Rainfall Anomaly Index indicates that Marathwada and Vidarbha regions experience relatively greater numbers of dry periods compared to other Maharashtra areas [4]. The monsoon season, typically providing bulk annual precipitation, has become increasingly unpredictable in onset timing and total volume [2].

Extreme Weather Events

Beyond long-term trends, the Vidarbha region faces increasing frequency and intensity of extreme weather events including severe droughts, flooding, waterlogging, hailstorms, and high-velocity winds [8]. Waterlogging, driven by poor drainage infrastructure and erratic rainfall, poses serious challenges to agricultural productivity and soil health [2]. These unpredictable events make it difficult for farmers to implement preventive measures or adequately prepare for potential losses.

3. Agricultural Vulnerability and Crop Impacts

Vulnerability Assessment

The Vidarbha region exhibits high vulnerability to climate change. A spatial assessment revealed that Vidarbha ranks among regions with higher potential crop losses due to climate change [9]. Vulnerability stems from high exposure to climate variability, considerable sensitivity of agricultural systems, and limited adaptive capacity of farming communities. Districts within Vidarbha show varying vulnerability levels, suggesting region-specific strategies are necessary rather than uniform approaches [9].

Impacts on Major Crops

Cotton Production: Cotton, the dominant crop in Vidarbha, has been severely affected. Marginal farmers report increased insect and pest attacks, reduced production, and deteriorated crop quality [10]. Rising temperatures accelerate pest life cycles and expand geographic ranges. Pesticide costs increased 21-40%, while profits declined over 70% [10].

Rice and Wheat Production: Climate change impacts on drought characteristics reveal that rice production can decline by 16-36% during mid- and end-century periods, with losses reaching 41% during severe droughts [8]. Maximum temperature significantly negatively impacts long-term crop production, while precipitation plays a crucial positive role [11]. Time-lag effects are important—crops planted in years with temperature stress continue underperforming even after climatic conditions improve [12].

Soil and Water Resources: Rising temperatures increase potential evapotranspiration, extracting more soil moisture. Waterlogging in some areas and water scarcity in others create spatial heterogeneity in agricultural challenges. Soil degradation occurs through increased erosion, loss of organic matter through enhanced decomposition, and salinization in poorly drained areas [2].

4. Farmer Impacts and Challenges

Farmer Awareness and Economic Impacts

Agricultural communities in Vidarbha clearly recognize climate change impacts. Marginal farmers report experiencing rain pattern changes (100%), wind profile changes (81.42%), and high atmospheric temperatures (75.71%) [10]. Farmers report substantial income losses, with nearly half of surveyed farmers witnessing significant reductions [13].

Economic consequences are severe. The Vidarbha region has been identified as suicide-prone, with climate-induced crop failures, crippling debt, and market price volatility interacting to create extreme distress [10]. Marginal and small farmers lack ability to absorb losses through savings or alternative income sources, and they typically lack access to credit and insurance mechanisms [14].

Pest and Livestock Impacts

Climate change fundamentally alters insect pest dynamics. As temperatures rise, insect growth rates accelerate, shortening life cycles and allowing additional generations per year [15]. In India, an increase of just 0.4°C has led to crop insect pest losses increasing from 3.0% to 50%. In Vidarbha, cotton pests have intensified substantially, with increased pesticide use and higher input costs.

Livestock populations are also affected. Heat stress is increasingly reported, with heatstroke identified as major impact on livestock (66.66% of surveyed farmers) and deaths occurring [10]. Reduced forage availability due to crop failures affects livestock nutrition and farmer income.

5. Adaptation Strategies and Solutions

Current Farmer Practices

Farmers in Vidarbha are implementing various strategies. In Chandrapur district, over 50% have implemented crop diversification, well installation, integrated fertilization, and agroforestry [16].

Willingness for adaptation is highest for irrigation (82.85%), harvesting techniques (72.85%), and sowing practices (67.14%). Future preferences include high-yielding varieties (100%), early maturing varieties (60%), and drought-resistant varieties (45.71%) [10].

Technical and Policy Solutions

Climate-Resilient Varieties: Development and promotion of crop varieties withstanding temperature extremes and water stress requires institutional support for seed distribution and farmer training [16].

- **Crop Diversification**: Shifting from monoculture toward diversified cropping systems reduces risk. Alternative crops such as maize, sorghum, and millet offer lower water and carbon intensity [17].
- **Water Management:** Enhanced irrigation infrastructure and micro-irrigation systems improve water use efficiency. Rainwater harvesting through farm ponds can capture monsoon rainfall for dry periods [18].
- **Soil Management:** Conservation agriculture practices improve soil water retention and fertility while contributing to carbon sequestration [17].
- **Agroforestry:** Integration of trees with crops and livestock provides microclimate modification, increased organic matter, diversified income, and enhanced biodiversity [16].
- **Climate-Smart Agriculture:** System of Rice and Wheat Intensification (SRI-SWI) and Natural Farming reduce GHG emissions and water footprint while maintaining productivity [17].
- **Extension Services:** Access to timely weather forecasts, seasonal climate information, and technical guidance is essential. Agricultural extension services must strengthen information dissemination [16].
- **Financial Services**: Access to institutional credit enables farmers to invest in adaptation technologies. Climate-indexed crop insurance schemes can provide compensation for climate-related losses [13].

6. Regional Context

Vidarbha's 89% dependence on rainfed agriculture makes it exceptionally vulnerable to rainfall variability and drought [2]. Gross irrigated area represents only 17.8% of gross cropped area, well below the national average of 27%, limiting farmers' ability to buffer against rainfall shortfalls [19]. Waterlogging in certain areas requires effective drainage infrastructure combined with appropriate agronomic practices [2].

7. Conclusion

Climate change poses unprecedented challenges to Vidarbha's agriculture, threatening crop productivity, farmer livelihoods, and food security. Rising temperatures, declining rainfall, increased pest pressures, and extreme weather events create multifaceted threats. The region's rainfed agriculture dependence, limited irrigation and vulnerable farming populations compound challenges.

Adaptation is possible through integrated technical, institutional, and policy approaches. Successful adaptation requires simultaneously implementing multiple strategies: adopting climate-resilient varieties, improving water management, diversifying cropping systems, enhancing soil health, strengthening extension services and improving access to credit and insurance [16]. No single intervention alone is sufficient; region-specific combinations tailored to local conditions are necessary [9].

The urgency of action cannot be overstated. As climate change accelerates, the adaptation window is narrowing. Vidarbha must be a priority for climate change adaptation investments and policy support. Through sustained commitment to evidence-based adaptation planning and implementation, the region can build agricultural resilience, protect farmer livelihoods, and ensure food security.

References:

1. Shree Prakash. Impact and Assessment of Climate Change on Agricultural Production in India: A Geographical Perspective. International Journal for Multidisciplinary Research, 2024. [1]
2. Purnima Mishra et al. A review on impact of climate change on indian horticulture. AATCC Review, 2025, 13(4). [6]
3. Pramod Kumar Saket. Explainable AI for Assessing Climate Change Impacts on Rice Yield in India. Journal of Basic and Environmental Sciences, 2025, 2. [20]
4. Aamir Ahmad Teeli et al. Assessing the Impact of Climate Change on Agricultural Productivity in India. SAGE Open, 2025, 15(2). [3]
5. Thanushree B.S. et al. Projected Shifts in Potential Evapotranspiration under Climate Change. International Journal of Environment and Climate Change, 2024, 14(12). [5]
6. Ajay Kumar Singh, Bhim Jyoti. A Review for Assessing Climate Change Impact on Agriculture. Sustainable Development and Innovation in Agriculture. IGI Global, 2024. [21]
7. Biswaranjan Baraj et al. Climate change and resilience, adaptation, and sustainability of agriculture in India. Heliyon, 2024, 10(8). [22]
8. Tahir Fazal Choudhary, Meenakshi Gupta. Impact of Climate Change on Agriculture: Evidence from India. SAGE Open, 2024, 14(1). [11]
9. Ananya Ajatasatru et al. Economy-wide impact of climate smart agriculture in India. Economic Structures, 2024, 13(1). [17]
10. Sourav Mondal et al. Assessment of Waterlogging and Mitigation Strategies in Akola District. International Journal of Environment and Climate Change, 2024, 14(11). [2]
11. Jagannath Vithoba Dadve. Geography Of Irrigation and Agriculture Development in Vidarbha. Journal of Natural Sciences, 2025, 14. [18]
12. Prakash Goraksha Athare et al. A spatial assessment of agricultural vulnerability to climate change in Maharashtra. Indian Journal of Agricultural Sciences, 2024, 94(11). [9]
13. Kumaresh S. Tikadar, Rahul K. Kamble. Cotton cultivating farmers—climate change perceptions and adaptation in Vidarbha. Safer: Studies on Agroecology and Food and Environmental Resource, 2023, 12(1). [10]
14. Arshdeep Singh et al. An analysis of climate change impact on rice production in India. Competitiveness Review, 2024, 34(3). [12]
15. Khagendra P. Bharambe et al. Impacts of climate change on drought and agriculture in Godavari River Basin. Climatic Services, 2023, 32. [8]
16. Atul Anil Gawhare et al. Climate Change Adaptation in Chandrapur District of Vidarbha. International Journal of Environment and Climate Change, 2023, 13(11). [16]
17. Gyan Prakash Morya, W. Hasan. Scenario of climate change impact on insect pests in India. International Journal of Applied Agricultural Sciences, 2023, 4. [15]
18. Prakash Goraksha Athare et al. Spatio-Temporal Analysis of Rainfall and Temperature in Maharashtra. International Journal of Environment and Climate Change, 2023, 13(9). [4]
19. P. Behere et al. Psychosocial aspects of suicide in farmers in Vidarbha. Indian Journal of Social Psychiatry, 2021, 37(4). [14]
20. Sucha Singh, Asim Charas. Impact of Climate Change on Farmers Livelihoods and Adaptation. Heritage Journal of Social Sciences & Humanities, 2025, 20(1). [13]

A Pilot Study on Organizational Management Practices of Maratha Vidya Prasarak Samaj (MVP), Nashik and Contribution of the institute to the Socio-Economic Development of Nashik District

By

Seema Manikrao Jadhav

Assistant Professor, MVP's IMRT, Nashik

&

Dr. Varsha N. Bhabad

Assistant Professor, MVP's IMRT, Nashik

Abstract:

Organizational management is very important for institutional sustainability and regional development. Every institution has its own impact on society and through deliberate, structured governance and long-term strategic planning plays pivotal role in driving socio-economic transformation. Educational institutions, specially having its own historical legacies, serve as foundational pillars of society and significantly influence socio-economic transformation through structured governance and strategic planning. The present pilot study was undertaken to examine the feasibility, clarity, reliability, and validity of the research instruments developed to assess the organizational management practices of Maratha Vidya Prasarak Samaj, Nashik, and to evaluate their perceived contribution to the socio-economic development of Nashik District.

Keywords: Organizational Management, Institutional Sustainability, Structured Governance, Strategic Planning, Pilot Study, Educational Governance, Socio-Economic Development.

1. Introduction

Organizational management refers the process of coordinating resources, policies and practices, along with strategic planning and objectives to achieve long-term sustainability and social relevance. Management Practices particularly of educational institutions outline both internal competence and external developmental contributions. Institutions having historical legacy adapt their administrative frameworks to remain relevant, sustaining in response to changing landscapes of time and advancements. Ultimately adopts transformation to reshaping overall functioning to meet new social demands. That often require to evolve their administrative structures in response to socio-political, economic, and technological transformations.

Maratha Vidya Prasarak Samaj (MVP), Nashik, is one such institution with 100 years of legacy in the educational sector. Over the years, Maratha Vidya Prasarak Samaj has expanded its network of schools, colleges, and professional institutions, thus enhanced the access to education, employment generations, and contributing to infrastructural development in Nashik District. In view of its extensive institutional journey, an in-depth academic evaluation of its management framework is of considerable importance.

A total of 500 respondents representing top-level management, middle-level executives, lower-level administrators, and internal and external beneficiaries are target population of the main study. Prior to conducting the full investigation, a pilot study was conducted with 50 respondents from the specified category. Data for the pilot study were collected through structured questionnaires and interview schedules to assess the suitability of the research instrument. The internal consistency of the research instrument was assessed through Cronbach's Alpha, which produced an overall reliability coefficient of 0.83, indicating good reliability. Based on the pilot findings small changes were made to improve the clarity of the questions, the order in which they were arranged, and the way responses were measured. The results show that the research design is practical and suitable for conducting the main study with 500 respondents. Accordingly, the pilot study provides a strong foundation for

examining the management development of Maratha Vidya Prasarak Samaj and its wider contribution to the development of Nashik District. The present paper outlines the design, implementation, and key outcomes of the pilot investigation.

2. Review of Literature

Organizational management theory has evolved through classical, behavioral, and contemporary perspectives. Scholars have emphasized planning, organizing, leading, and controlling as foundational managerial functions. In educational institutions, management practices are often linked with governance models, stakeholder engagement, institutional accountability, and performance outcomes. **Gabriella Keczer, Szeged, Hungary** in his work '**Management and Organizational Characteristics of Educational Institutions'** published in Education Practice And Innovation (Volume 1, Number 2, June 2014) pointed out that, Education management has become an independent discipline due to a new approach: management training can improve the efficiency and quality of educational organizations.

Chorge V D. in his Research Thesis, ***'Sangli Zillyatil Shikshan Prasarat Rayat Shikshan Sanstheche Yogda'*** submitted to **Shivaji** University in 2019, gives us the idea of contribution of Rayat Shikshan Sanstha in the development of Sangli District and shows that Rayat Shikshan Sanstha have a correlation in the social, economic, cultural and political development of Sangli district.

Mubashir Arain, Michael J Campbell, Cindy L Cooper & Gillian A Lancaster in their research article**, 'What is a pilot or feasibility study? A review of current practice and editorial policy' stated that,** 'a brief definition is that a pilot study is a 'small study for helping to design a further confirmatory study'. Such kinds of study may have various purposes such as testing study procedures, validity of tools, estimation of the recruitment rate, and estimation of parameters such as the variance of the outcome variable to calculate sample size etc.

Research in educational management shows that strong administrative leadership greatly improves institutional quality and supports community development. Studies on long-lasting institutions also suggest that flexible and adaptive management systems are important for maintaining growth over time.

Methodological research highlights the importance of pilot studies in large research projects. Pilot studies help test research tools, check the feasibility of sampling methods, and improve research procedures. They minimize errors during large-scale data collection and increase the reliability and credibility of the final results.

Educational institutions contribute not only to the economy but also to social growth. They enhance literacy, promote gender equality, build cultural understanding, and encourage active citizenship. Over time, long-standing institutions become a key part of regional identity and play an important role in social transformation. This study trying to focus on the perspective. However, limited empirical research exists examining long-standing regional educational institutions from both managerial and developmental perspectives. Therefore, the broader research project aims to fill this gap, while the present paper specifically documents the pilot phase.

3. Objectives of the Pilot Study

- To assess the clarity, relevance, and organization of the questionnaire and interview schedule.
- To examine the internal consistency and reliability of the research tools.
- To detect possible administrative and logistical issues before conducting the main study.

4. Research Methodology

4.1 Research Design: The pilot study used a descriptive and exploratory approach. Its purpose was not to test final hypotheses, but to evaluate and strengthen the methodological framework of the planned large-scale study.

4.2 Sample Size and Sampling Technique: A total of 50 respondents took part in the pilot study, including top-level management, middle-level executives, lower-level administrators, as well as internal and external beneficiaries. The participants were selected through purposive sampling to

ensure representation from different organizational levels. Data were collected through structured questionnaires and interview schedules.

The instrument's internal consistency was assessed using Cronbach's Alpha, which produced an overall reliability coefficient of 0.83, demonstrating good reliability. Minor adjustments were made to enhance clarity, question sequencing, and response measurement. These results indicate that the research design is feasible and methodologically robust for the main study with 500 respondents.

Overall, the pilot study strengthens the basis for examining MVP's institutional management development and its broader contributions to social and organizational progress.

Data collected from

- Top-Level Management – 5
- Middle-Level Management – 5
- Lower-Level Management – 10
- Internal Beneficiaries – 20
- External Beneficiaries – 10

This distribution ensured coverage of administrative authorities as well as stakeholders affected by institutional policies.

4.3 Data Collection Tools:

The following instruments were used

- Structured Questionnaire (Likert-scale based)
- Semi-structured Interview Schedule
- Institutional Document Review

The questionnaire covers points like Organizational management practices, when such practices comes into exitance, what is the Educational, Social, Economic and Infrastructural growth contributed by the initiatives of MVP along with the personal developments of the beneficiary.

4.4 Reliability Testing: Internal consistency was tested using Cronbach's Alpha. Overall scale was 0.83 which indicated good internal reliability and included sections like Organizational Management Practices (0.82), Educational Contribution (0.81), Social Contribution (0.79), Infrastructural Contribution (0.76), Economic Contribution(0.84).

5. Results of the Pilot Study: The pilot study gave key insights regarding the feasibility of the research instrument and the clarity of the methodology.

- The questionnaire considered clear and understandable. and relevant.
- Certain technical management terms required simplification for clarity among non-administrative participants.
- Some questions were repeated while some need to redraft.
- The average completion time required to complete the questionnaire was practicable and it requires approximately 25 minutes.
- Mostly the responses indicated positive view of organizational management effectiveness.
- The data is only being observed and described—researchers are not yet drawing broader conclusions or generalizing the findings to a larger population.
- Some information needs to be collected through literature of the organization & previous records as the study is about the last 100 years of journey.

6. Discussion:

The research design is validated through the pilot study along with the minor revisions. The pilot study has given clarity and reduced vagueness. It also helped for the logical sequencing of the questions. The response of the responded enhanced the confidence towards the practical feasibility of the study. Respondents were cooperative and participative and also given some other information. Their perspectives provide complementary insights, which strengthen analytical depth.

7. Limitations of the Pilot Study:

Though the pilot study provided valuable insights for confirming the methodology, it had some limitations as well. Such as a small sample size 50 out of 500 and the need to simplify technical terms for some respondents, preliminary findings not suitable for hypothesis testing, Time constraints in document review etc.

All these limitations are identified, and the main study is designed accordingly.

8. Implications for the Main Study:

Based on pilot findings the following implications are identified for the main study.

Precision of Questionnaire: The study helps to enhance the clarity and relevance of the questionnaire by revising wording of several questions, options etc. Some terms specifically technical terms have been simplified and explained to ensure understanding and accuracy of the questions and answer consistently.

Question Sequencing: The study assisted the sequencing & order of questions. Which helps to create a more logical flow and enhance clarity by reducing confusion.

Standardized & Clarified Data Coding: The study also helps to standardise & clarify coding schemes. Proper categorization of data helps to accurate analysis & data consistency.

The study confirmed the feasibility and reliability of the research instruments while identifying areas that required refinement. The modifications made to the questionnaire, sequencing, and coding framework enhance the clarity, consistency, and analytical accuracy of the main study. It will help for the main study which involve 500 respondents and will employ descriptive statistics, correlation analysis, and hypothesis testing.

9. Conclusion:

The pilot study played crucial role and successfully achieved its purpose of testing research instrument. It tested the feasibility, reliability, and clarity of research instruments designed. The instrument design has fulfilled its purpose to evaluate the organizational management practices of Maratha Vidya Prasarak Samaj and its contribution to socio-economic development in Nashik District. According to the responses the modifications made to the questionnaire, sequencing, and coding enhance the clarity, consistency, and analytical accuracy of the main study. The reliability coefficient ($\alpha = 0.83$) confirms good internal consistency. Minor modifications have strengthened the methodological framework. The study establishes that the proposed research design is suitable for large-scale implementation and provides a solid empirical foundation for the main.

Books:

1. Kothari C.R. “Research Methodology – Methods and Technique”, New Age International Publisher, New Delhi, 2011. Print.
2. Brain, Tracy. 'Management: The Brian Tracy Success Library’, Hardcover, 2018 Print.
3. Detroit: Gale Cengage. Encyclopedia of Management. EBook 6th edition 2009.
4. Chhabra T. N. ‘Principles of Practices of Management’, New Delhi Gagan Kapur, Dhanpat Rai & Co. (P) Ltd. Publishers 1978.
5. J. K. Sachdeva ‘Business Research Methodology’ Himalaya Publishing House 2008.

Research Articles:

- Arain, M., Campbell, M.J., Cooper, C.L. et al. What is a pilot or feasibility study? A review of current practice and editorial policy. BMC Med Res Methodol 10, 67 (2010).

Web Sites:

1.https://www.researchgate.net
2.www.ndlegis.gov
3.www.southampton.ac.uk
4.www.managementstudyguide.com
5. https://doi.org/10.1186/1471-2288-10-67

Diet and Health of Tribal Women: A Study

Miss. Rupali Sureshrao Kale (Bhamburkar)
Ph.D. Research Scholar
Ramakrishna College, Darapur, Dist. Amravati

Abstract

Food, clothing, and shelter are the basic needs of human beings. Among these, food is the most essential, as it directly influences health and well-being. Every individual must understand the close relationship between food and health. Women play a crucial role in society, particularly in maintaining the health of their families. Therefore, women's health awareness is the need of the hour.

In tribal communities, the health status of women, especially in relation to diet and nutrition, requires serious attention. According to the World Health Organization (WHO, 2000), health surveys conducted in tribal areas indicate that women who marry before the age of 18 are more vulnerable to diseases such as anemia and malnutrition. There is an urgent need to formulate effective health policies to improve the current health status of tribal women. Issues such as proper nutrition, age at marriage, and overall dietary awareness continue to raise serious concerns.

Introduction

In the state of Maharashtra, districts such as Nandurbar, Nashik, Thane, Amravati, Buldhana, and Akola have significant tribal populations. Tribes such as Bhil, Gond, Pawara, and Mahadev Koli predominantly inhabit these regions. Many of these areas are located in the Satpura mountain range and are surrounded by forests. Tribal communities have their own distinct languages and cultural practices. Due to their geographical isolation in forests and valleys, their connection with urban areas is limited.

While studying tribal women, it is important to examine the four stages of their lives: childhood, adolescence, married life, and old age. In many tribal societies, early marriage is still practiced due to traditional customs. As a result, young girls are married before achieving physical and emotional maturity, which adversely affects their health. Early marriage often leads to early pregnancy, resulting in multiple health complications.

If the health status of tribal women improves, the health of the next generation will also improve. Addressing malnutrition among women can help break the intergenerational cycle of poor health. Surveys have recorded poor dietary patterns and inadequate nutrition among tribal women. Due to child marriage and early motherhood, immature pregnancies often result in the birth of malnourished children, thereby continuing the cycle of malnutrition.

Furthermore, tribal women often remain dependent on men in social and economic matters, which may reduce their access to health information and awareness. The concept of balanced diet and proper nutrition is not fully developed in many tribal communities.

Keywords

Tribal Diet, Women's Health, Malnutrition, Awareness, Early Marriage

Tribal Women and Their Diet, Health and Nutrition

Several studies have examined the health problems of rural tribal women. A common conclusion emerging from these studies is that low literacy levels and traditional lifestyle practices have contributed to numerous health challenges. In the early stages of life, tribal girls often do not receive adequate nutrition. Consequently, serious health complications become evident after they become mothers.

Low nutritional intake, poor sanitation, lack of awareness about medical facilities, inadequate access to healthcare services, and early marriage contribute significantly to poor health outcomes. Early motherhood further weakens physical health and reduces body strength.

Dietary patterns among tribal women reveal low consumption of cereals, green leafy vegetables, fruits, vegetables, and dairy products. As a result, many women fail to achieve proper physical

maturity. Essential nutrients such as iron, calcium, and vitamin A are often deficient in their diets, leading to anemia and other nutritional disorders.

Marriage at a young age, before complete physical development, increases the risk of delivering low birth weight and malnourished children. Therefore, it is necessary to create awareness about proper nutrition during adolescence, pregnancy, and lactation. Such awareness can help reduce malnutrition, infant mortality, and the incidence of low birth weight babies.

Although tribal communities are sometimes perceived as having access to non-vegetarian food sources, studies show that the consumption of meat and fish is often insufficient. In some cases, animal milk is not included in the diet due to traditional beliefs and superstitions.

In rural Maharashtra, women work equally alongside men in agricultural activities. In addition, they are responsible for cooking, household chores, and childcare. Despite this heavy workload, their intake of proteins, iron, zinc, and vitamins remains inadequate.

Studies have also reported a high prevalence of malnutrition among tribal women in Maharashtra. Government schemes and public awareness programs related to diet, health, and age at marriage often take time to reach remote tribal areas. Therefore, it is essential to provide accurate information about the appropriate age of marriage, physical maturity, causes of malnutrition, and preventive measures. Encouraging proper nutrition and healthy lifestyles is critical to breaking the lifelong cycle of malnutrition.

Result and Discussion

There is an urgent need to implement effective measures to improve the diet and health of tribal women. Tribal communities often remain distant from mainstream society due to geographical and social factors. As a result, their issues are frequently overlooked.

Breaking the chain of malnutrition among tribal women requires increased awareness about health, balanced diet, proper nutrition, and the legal age of marriage. Education plays a crucial role in empowering women and integrating tribal communities into mainstream society.

Based on the findings, there is a need to strengthen policies, implement effective programs, and ensure that laws related to women's health and marriage age reach tribal populations. Connecting tribal women to healthcare services, nutritional programs, and educational initiatives is essential for sustainable improvement.

Conclusion

The primary objective of this research is to create awareness about diet, health, and nutrition among tribal women. The dietary intake of adolescent tribal girls is often inadequate for their age and developmental needs. Therefore, institutional measures and targeted interventions must be implemented to improve their nutritional status.

Conducting regular dietary surveys and health studies is necessary to identify problems and formulate appropriate solutions. Awareness programs focusing on nutrition, appropriate age of marriage, maternal health, and child care should be strengthened. With proper planning and implementation, it is possible to improve the overall health status of tribal women and future generations.

Reference List (Corrected Format)

1. Kapoor, R., et al. Lady Irwin College, University of Delhi, Sikander Road, New Delhi.
2. Hanumante, D. (2020). Rural tribal women's health problems – A study. *Journal of Emergency Technology and Emergency Research*, 6(2), 300–303.
3. MiG-A. (2008). Status of women among states in India. *Journal of Social and Economic Studies*, 35, 1202–1206.

From Financial Literacy to Financial Action: A Study of Money Management Behaviour among Private Sector Women Employees

Research Schola
CA Arati Rohit Patil
Research Guide
Dr. Prashant Patil
Bharati Vidyapeeth Yashwantrao Mohite College, Pune

Abstract

In the Indian private sector, the increasing participation of women has intensified the need to examine their financial literacy and its translation into financial action. While financial literacy is widely recognised as key contributor towards women's financial empowerment, the extent to which financial knowledge is converted into disciplined money management practices remains a critical concern. This study examines the relationship between financial literacy and money management behaviour being financial action among private sector female employees in Pune, India.

Primary data were collected from 250 private sector women employees using a structured questionnaire. Descriptive and analytical techniques were employed to assess financial literacy levels and money management practices, including budgeting, savings discipline, expense monitoring, and future financial planning. Although respondents exhibit a moderate level of awareness regarding basic financial concepts and financial products, the findings indicate the consistent adoption of structured money management practices remains limited.

The study reveals the clear gap between financial literacy and financial behaviour. The significant influence of behavioural and contextual constraints affects the ability of working women to translate financial awareness into financial action. The study highlights that strengthening women's financial capability along with long-term financial security is possible if behaviour-oriented financial education and workplace-supported financial initiatives are undertaken focussing result-oriented approach focussed on women's money management behaviour.

Keywords: Financial Literacy; Money Management Behaviour; Working Women; Financial Empowerment; Private Sector

1. Introduction

The participation of women in the Indian private sector has increased significantly in recent years. It has proven its close correlation with economic growth and workforce diversification. While increased participation enables women to earn income and contribute to national economic development, sole income generation is not sufficient for their economic empowerment. The effective money management of earned income through informed financial decision-making plays an equally critical role in ensuring long-term financial stability and financial independence of women.

Financial literacy means the ability to understand and effectively apply financial knowledge related to basic financial concepts like saving, spending, budgeting, and financial planning. It is widely recognised as a key component of women's empowerment and financial independence. Despite improved access to financial information and digital financial services, financial literacy continues to remain uneven amongst many working women. Prior studies indicate that women often face challenges in applying the financial knowledge wherever required and converting it into disciplined financial practices, resulting in suboptimal money management behaviour.

Money management behaviour consists of practices such as preparing and following budgets, saving a planned portion of income, monitoring expenses, and planning for future financial needs such as emergencies and retirement. These practices are prerequisites for long-term wealth creation and wealth accumulation. However, several socioeconomic constraints—such as career interruptions,

income instability, time pressures, and competing professional and family responsibilities—may limit working women's financial actions despite having financial knowledge in practical financial decision-making.

In this context, the present study focuses on female employees in private sector in Pune city in the state of Maharashtra, to examine their level of financial literacy and awareness of money management behaviour. This study contributes to the applied finance literature and offers insights relevant to financial professionals, employers, and policymakers concerned with enhancing women's financial capability and future financial security.

1.1. Research Objectives

The present study is designed with a focused intention to examine financial literacy and money management behaviour among private sector female employees. The objectives of the study are as follows:

1. To examine the **level of financial literacy** among private sector female employees.
2. To observe the **awareness about money management practices** among private sector female employees.

1.2 Research Hypotheses

Based on the stated objectives the following hypotheses are formulated for the study:

- **H1:** There is a **lack of financial literacy** among private sector female employees.
- **H2:** There is **limited awareness about money management practices** among private sector female employees.

2. Review of Literature

2.1 Financial Literacy and Women

Financial literacy is widely recognised as a stepping stone for rational financial decision-making. Prior studies suggest that women with higher financial literacy exhibit greater confidence in handling personal finances, leading to creation of wealth and also being thoughtful about future finances. However, social norms and behavioural biases often moderate the impact of financial knowledge on actual financial practices.

There was research conducted during and after the COVID-19 period which highlighted the vulnerability of women's financial security and the need to build the money management skills. Bannier and Schwarz (2023) note that women with higher financial literacy were better able to manage income shocks, emergency savings, and financial stress during economic uncertainty.

Also, while considering the gender disparity in terms of financial literacy, women continue to display lower financial literacy levels than men across countries (Bucher-Koenen et al., 2021)

2.2 Money Management Behaviour and Women

Recent literature explains that effective money management behaviour plays a significant role in enhancing financial well-being and reducing financial stress. Kim, Garman, and Sorhaindo (2020) report that individuals who regularly budget and save systematically exhibit higher financial satisfaction and lower financial anxiety compared to those who do not engage in structured money management practices

Recent studies focusing on working women, revealed that professional responsibilities and family obligations significantly influence money management behaviour. Mahdzan, Zainudin, and Au (2020) finds that working women often prioritise short-term financial security and household stability, which affects their ability to engage in long-term financial planning and wealth accumulation.

Overall, recent literature indicates that money management behaviour is influenced by a complex interaction of financial literacy, behavioural traits, socio-cultural factors, and institutional support. While working women increasingly recognise the importance of disciplined money management, gaps persist between awareness and consistent financial practice, especially in the context of balancing professional and family responsibilities (Kaur & Vohra, 2024).

2.3 Financial Literacy–Behaviour Gap

The literature consistently highlights a gap between financial knowledge and financial behaviour, regarding women's financial understanding. This gap is particularly pronounced among women, where high awareness does not always lead to effective money management practices. The present study addresses this gap in the context of private sector female employees in Pune.

3.Research Methodology

Research methodology is structured to test the stated hypotheses by examining indicators of financial literacy (H1) and money management awareness and practices (H2).

3.1 Research Design

The study adopts a descriptive and analytical research design.

3.2 Data Source and Instrument

Primary data were collected through a structured questionnaire designed to capture demographic characteristics, financial literacy indicators, and money management behaviour. Interview method also formed part of data collection tool wherever the women were comfortable to answer the questionnaire in an informal conversation.

3.3 Sample Design and Sample Size

The study is based on sample size of 250 private sector female employees. A convenience sampling method was adopted to collect responses from women working in different private sector organizations. The respondents belonged to diverse age groups, education levels, job positions, and income categories.

3.4 Variables Considered

- Financial literacy (basic concepts, financial product awareness, tax knowledge)
- Money management behaviour & practices (budgeting, savings discipline, expense monitoring, future planning)

3.5 Tools of Analysis

The study is survey-based and employs Likert-scale responses. Descriptive and analytical techniques were used for data analysis which includes Percentage analysis being used to assess financial literacy levels and money management awareness among respondents and Mean score analysis being employed to interpret the extent of adoption of money management practices and to examine patterns related to the stated research objectives and hypotheses.

This analytical interpretation focuses on identifying patterns and gaps between financial literacy and money management behaviour amongst women employees in private sector.

4. Data Analysis and Findings

The analysis below is on the basis of the primary data collected from 250 private sector female employees in Pune with the objective of examining financial literacy levels and money management behaviour. The analysis is structured in accordance with the stated research objectives and hypotheses to assess financial literacy (H1), awareness and practice of money management strategies (H2), and the gap between financial knowledge and financial action.

4.1 Financial Literacy Levels among Private Sector Women Employees (Testing H1)

Table 1: Financial Literacy Levels of Private Sector Women Employees (n = 250)

Sr. No.	Financial Literacy Indicator	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Q1	Understanding of basic financial concepts	34	38	16	8	4
Q2	Awareness of financial products	24	30	22	14	10
Q3	Confidence in understanding financial documents	16	26	24	20	14

Q4	Knowledge of tax-saving instruments	14	24	22	24	16
Q5	Financial literacy is essential for empowerment	56	30	8	4	2

Source: Primary survey data

Table 1 presents the financial literacy levels of private sector female employees. The results indicate moderate awareness of basic financial concepts such as savings, interest, and inflation, while advanced financial understanding, particularly related to tax planning and financial documentation, remains limited.

Approximately 70–75 per cent of respondents reported an understanding of fundamental financial concepts in Q1. This suggests that basic financial knowledge is relatively widespread among working women.

However, the above data shows decline in awareness when financial literacy requires interpretation and application. In Q2, only 50–55 per cent of respondents reported awareness of different financial products such as mutual funds, insurance policies, and equity instruments. This awareness need not mean detailed understanding about financial products. Further, the ability to read and interpret basic financial documents, including policy terms and investment-related information, was reported by merely 40–45 per cent of respondents in Q3. Knowledge related to tax planning and tax-saving instruments was even lower in Q4, with only 35–40 per cent indicating adequate understanding with summing up the responses of "Strongly Agree" & "Agree".

Despite these gaps, a substantial majority of respondents (85–90 per cent) strongly agreed that financial literacy is essential for women's empowerment and long-term financial independence.

The findings indicate that while private sector female employees possess foundational financial knowledge, applied financial literacy remains limited among respondents. **The above results support Hypothesis H1, confirming the presence of lack of financial literacy among private sector female employees.**

4.2 Awareness and Practice of Money Management Strategies among Respondents (Testing H2)

Table 2: Awareness and Practice of Money Management Strategies among Private Sector Women Employees (n = 250)

Sr.No.	Money Management Practice	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Q1	Regular preparation and follow-up of personal budget	12	20	24	26	18
Q2	Saving a fixed portion of income every month	18	26	24	18	14
Q3	Regular monitoring and review of monthly expenses	14	22	26	22	16
Q4	Planning finances for future needs (retirement, emergencies, etc.)	32	30	18	12	8
Q5	Seeking professional financial advice when required	10	18	24	26	22

Source: Primary survey data

Table 2 indicates that although awareness of future financial planning is relatively higher, the consistent practice of budgeting and expense monitoring remains limited for women employees in private sector.

The analysis of money management behaviour for private sector reveals that awareness of appropriate financial practices is considerably higher than the consistent execution for working

women. In Q1, only 30–35 per cent of respondents reported that they regularly prepare and follow a personal budget. This can be also interpreted as more than majority that do not prepare and follow budget, significantly understand the importance of budget. Similarly, systematic saving of a fixed portion of income was practised by only 40–45 per cent of respondents, indicating weak savings discipline amongst women employees.

In Q3, regular monitoring and review of monthly expenses were reported by approximately 35–40 per cent of respondents, reflecting limited behavioural consistency despite of awareness and financial literacy regarding the importance of monthly money management. Although planning for future financial needs such as retirement, emergencies, and children's education was acknowledged by 60–65 per cent of respondents in Q4, the implementation of structured long-term financial planning remained inconsistent. The reliance on professional financial advice was notably low in Q5, with only 25–30 per cent of respondents seeking guidance from financial advisors or financial experts.

These findings demonstrate that money management strategies are recognised in principle but are not consistently adopted in practice by women employees in private sector. The results provide empirical support for Hypothesis H2, indicating limited awareness and adoption of money management strategies for future financial security among private sector female employees.

4.3 Financial Literacy–Behaviour Gap

A significant gap between financial awareness/financial literacy and financial action among private sector female employees is diagnosed on a comparative study of financial literacy levels and money management behaviour. While a majority of respondents possess basic financial knowledge and strongly believe in the importance of financial literacy, this awareness does not translate into disciplined financial behaviour.

Despite 85–90 per cent of respondents recognising financial literacy as essential for women empowerment (Q5 in Table 1), only 30–45 per cent consistently practised key money management behaviours such as budgeting, systematic savings, and regular expense monitoring (Q1 in Table 2). This divergence clearly demonstrates that financial knowledge among working women often remains theoretical and does not adequately guide day-to-day financial decisions and practically empowers them.

The persistence of this gap may be attributed to behavioural approach, career issues, income instability, time constraints, professional workload, and competing family responsibilities, which might limit the effective application of financial knowledge. The findings reinforce the central argument of the study that financial literacy alone is insufficient to ensure financial action and that behaviour-oriented financial interventions are necessary to enhance women's long-term financial security.

4.4 Hypothesis Testing and Validation

Based on the analysis of financial literacy indicators and money management behaviour, the study finds empirical support for both stated hypotheses.

The findings support H1, it confirms the lack of financial literacy among private sector female employees, indicating the presence of gaps in comprehensive financial understanding.

Further, the findings also support H2, as awareness and consistent adoption of money management strategies for future financial security remain limited among women respondents. The results collectively confirm the existence of a gap between financial literacy and financial action, reinforcing the central premise of the study.

5. Discussion

The findings confirm the existence of gap amongst the financial literacy of women correlated to their money management behaviour, especially for private sector female employees. Behavioural and practical constraints limit the consistent money management practices among working women. From a practitioner's perspective, this highlights the need for simplified budgeting tools and behaviour-oriented financial guidance tailored to working women working in private sector considering their issues.

6. Implications

6.1 Implications for Employers

Employer should be taking the initiative per month regarding workplace financial wellness programs to promote financial discipline among women employees. Creating a habit of making these initiatives fruitful for your employees will also ensure the increase in trust factor for employer amongst the employees.

6.2 Implications for Financial Professionals

Financial advisors should focus on translating financial knowledge into actionable financial habits for women clients. Taking the responsibility of helping clients with conceptual clarity should be the responsibility assumed by the financial advisors as their suggestions naturally influence the clients' decision making.

6.3 Implications for Policymakers

Policy initiatives should design such financial literacy programs for women that are easily applied in practical with result-oriented approach. This shall help women manage their wealth individually and not just equip them with financial knowledge.

7. Conclusion

The study, guided by its stated objectives and hypotheses, concludes that while private sector female employees exhibit moderate levels of financial literacy, but the money management behaviour amongst women remains inconsistent. Self-reported financial literacy among private sector women is relatively good; however, this does not ensure consistent financial action. Having good amount of financial literacy does not ensure financial actions are in line with financial knowledge. Bridging the gap between financial knowledge and financial action is essential for enhancing women's financial stability and empowerment.

8. Limitations and Scope for Future Research

The study relies on self-reported data and convenience sampling. The study is based on a limited sample size of 250 respondents, which may restrict the generalisability of the findings. Future research may explore behavioural interventions and longitudinal analysis to better understand changes in women's financial behaviour over time, as study is limited to women in private sector working in Pune city.

9. References

1. Bannier, C. E., & Schwarz, M. (2023). Financial literacy, financial advice, and financial behavior: Evidence from the COVID-19 crisis. *Journal of Banking & Finance*, 145, 106676. https://doi.org/10.1016/j.jbankfin.2022.106676
2. Bucher-Koenen, T., Lusardi, A., Alessie, R., & van Rooij, M. (2021). How financially literate are women? An overview and new insights. *Journal of Consumer Affairs*, 55(3), 1112–1134. https://doi.org/10.1111/joca.12321
3. Kim, J., Garman, E. T., & Sorhaindo, B. (2020). Relationships among credit counseling clients' financial well-being, financial behaviors, financial stressor events, and health. *Journal of Financial Counseling and Planning*, 31(2), 259–270.
4. Kaur, M., & Vohra, N. (2024). Financial literacy and financial behaviour of working women: Evidence from India. *International Journal of Social Economics*, 51(2), 234–250.
5. Lusardi, A., & Mitchell, O. S. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, 52(1), 5–44. https://doi.org/10.1257/jel.52.1.5
6. Mahdzan, N. S., Zainudin, R., & Au, S. F. (2020). The role of financial socialization and financial knowledge in financial well-being of working women. *Journal of Behavioral and Experimental Finance*, 28, 100389. https://doi.org/10.1016/j.jbef.2020.100389
7. Organisation for Economic Co-operation and Development (OECD). (2018). *OECD/INFE toolkit for measuring financial literacy and financial inclusion*. OECD Publishing.
8. Reserve Bank of India. (2022). *Report on trend and progress of banking in India*. RBI Publications.
9. World Bank. (2020). *Women, business and the law 2020*. World Bank Group

Role of Women Entrepreneurship in the Economic Development of India

Dr. V. L. Bhangdiya
Principal Research Supervisor Kesherbai Lahoti College, Amravati

Dr. Komal S. Taori
Kesherbai Lahoti College, Amravati

Abstract

Women entrepreneurship has emerged as a significant force in the economic development of India. In recent decades, Indian women have increasingly entered entrepreneurial activities across agriculture, manufacturing, services, and technology sectors. Women Entrepreneurship is inherent & also a natural process. Women are naturally endowed with the qualities of entrepreneurship. Maternity is a creative capacity involving risk of life. Courageousness & determination that generate at the time of maternity are inborn. These characters generate within themselves and not come from elsewhere. Women entrepreneurs contribute not only to employment generation and income creation but also to social empowerment and inclusive growth. This research paper examines the role of women entrepreneurship in India's economic development, highlighting its contribution to GDP, employment, poverty reduction, innovation, and regional development. The paper also discusses the challenges faced by women entrepreneurs and evaluates government initiatives aimed at promoting women-led enterprises.

Keywords: Women Entrepreneurship, Economic Development, Employment, MSMEs, Inclusive Growth, India

1. Introduction

Entrepreneurship is widely recognized as a key driver of economic growth and development. In India, the role of women entrepreneurs has gained increasing importance due to changing socio-economic conditions, improved access to education, urbanization, and supportive government policies. Women entrepreneurship refers to business ownership and management by women who take risks, organize resources, and innovate to create economic value. Historically, Indian women were largely confined to household activities. However, with modernization and economic reforms, women have started participating actively in entrepreneurial ventures. Today, women entrepreneurs are involved in small-scale industries, self-help groups (SHGs), micro, small and medium enterprises (MSMEs), startups, and digital businesses. Their participation is crucial for achieving sustainable and inclusive economic development. Economic growth and development of any country are deter-mined by human, physical and financial resources. An economy can move on to higher levels of growth either by acquiring a larger quantum of the factors of production or through technical progress. The objective of any planned development is to develop human resources to their brimming utilization. Therefore, industrialization is one of the ways of bringing about socio economic development in any country. The economic development of a nation is sparked largely by its enterprising spirit.

2. Concept of Women Entrepreneurship

Women entrepreneurship can be defined as an economic activity where women initiate, organize, and operate business enterprises while taking financial risks. It involves innovation, leadership, decision-making, and managerial skills.

Characteristics of Women Entrepreneurs

- Ability to identify business opportunities
- Risk-taking capacity
- Managerial and organizational skills
- Innovation and creativity
- Social responsibility orientation

Women entrepreneurship in India is often associated with micro and small enterprises, especially in rural and semi-urban areas, though urban women are increasingly entering technology-driven and service-based businesses.

3. Growth of Women Entrepreneurship in India

The growth of women entrepreneurship in India has been influenced by several factors:

- Increased female literacy and education
- Economic liberalization and globalization
- Expansion of microfinance and SHGs
- Supportive government schemes
- Digital platforms and e-commerce

According to MSME-related studies, women own a significant proportion of micro-enterprises in India, especially in sectors like handicrafts, textiles, food processing, beauty and wellness, education, and retail trade.

4. Role of Women Entrepreneurship in Economic Development

4.1 Employment Generation

Women entrepreneurs play a vital role in generating employment, particularly for other women. Women-led enterprises often employ local labor, contributing to reduction in unemployment and underemployment. This is especially important in rural areas where alternative employment opportunities are limited.

4.2 Contribution to National Income and GDP

Women entrepreneurship contributes to national income through production of goods and services. As women-owned enterprises grow, they add value to the economy and contribute to GDP growth. Expansion of women entrepreneurship enhances productivity and diversifies the economic base of the country.

4.3 Poverty Reduction

Women entrepreneurs help reduce poverty by generating income for themselves and their families. Economic independence improves household living standards, nutrition, health, and education of children. Women entrepreneurship is therefore a powerful tool for poverty alleviation.

4.4 Balanced Regional Development

Women entrepreneurship promotes balanced regional development by encouraging economic activities in rural and backward areas. Many women entrepreneurs operate small-scale and cottage industries that utilize local resources and skills, reducing regional economic disparities.

4.5 Promotion of Inclusive Growth

Inclusive growth requires participation of all sections of society. Women entrepreneurship ensures inclusion of women in economic activities, leading to equitable distribution of income and opportunities. It strengthens social justice and gender equality in economic development.

4.6 Innovation and Skill Development

Women entrepreneurs bring innovation in products, services, and business models. They also contribute to skill development by training employees and encouraging entrepreneurial culture among other women, especially through SHGs and cooperatives.

5. Government Initiatives Supporting Women Entrepreneurship

The Government of India has introduced various schemes to promote women entrepreneurship:

- **Mudra Yojana** – Provides collateral-free loans to women entrepreneurs
- **Stand-Up India Scheme** – Supports women entrepreneurs in setting up greenfield enterprises
- **Women Entrepreneurship Platform (WEP)** by NITI Aayog – Offers mentorship, funding, and networking
- **Self Help Group–Bank Linkage Programme** – Encourages rural women entrepreneurship
- **Skill India Mission** – Enhances entrepreneurial and vocational skills

These initiatives aim to improve access to finance, training, and markets for women entrepreneurs.

6. Challenges Faced by Women Entrepreneurs

Despite progress, women entrepreneurs in India face several challenges:

- Lack of access to finance and credit
- Limited ownership of assets and collateral
- Social and cultural barriers
- Lack of business training and mentorship
- Balancing family and business responsibilities
- Limited access to technology and markets

These challenges restrict the growth and sustainability of women-led enterprises.

7. Suggestions for Promoting Women Entrepreneurship

- Improve access to affordable credit and financial services
- Strengthen entrepreneurship education and training
- Promote digital literacy and technology adoption
- Encourage family and societal support for women entrepreneurs
- Enhance marketing and networking opportunitie
- Government should provide better educational facilities and schemes.
- More Governmental schemes should be launched to motivate women entrepreneurs to engage in small scale and large-scale business ventures
- Adequate training programme has to be conducted for the women entrepreneur.
- Continuous monitoring and improvement of training programmes is essential for grooming women entrepreneurs.
- Making provision of marketing and sales assistance from government part.
- To encourage more passive women entrepreneurs the Women training programme should be organised that taught to recognize psychological needs and express them.
- The financial institutions should provide more working capital assistance both for small

8. Conclusion:

In the majority of women operate their medium and small enterprises under Strengthen implementation of government schemes. Women entrepreneurship plays a crucial role in the economic development of India. It contributes to employment generation, income creation, poverty reduction, balanced regional development, and inclusive growth. Empowering women entrepreneurs is not only a matter of gender equality but also an economic necessity for sustainable development. With effective policy support, financial inclusion, skill development, and social acceptance, women entrepreneurship can significantly accelerate India's economic progress.

References

1. Government of India – MSME Reports
2. World Bank – Women and Entrepreneurship Studies
3. NITI Aayog – Women Entrepreneurship Platform Reports
4. Sharma, Y. (2020). *Women Entrepreneurship in India*. New Delhi: Academic Publishers
5. Desai, V. (2018). *Dynamics of Entrepreneurial Development*. Himalaya Publishing House
6. Baporikar, N. (2007) Entrepreneurship Development & Project Management Himalaya Publication House.
7. Das M. (1999), "Women entrepreneurs from Southern India: An exploratory study", Journal of Entrepreneurship, 8-147
8. Desai, V: (1996) Dynamics of Entrepreneurial & Development & Management Himalaya publishing House - Fourth Edition, Reprint.
9. Deshpande S. and L.K Deshpande (1992), "New Economic policy and female employment", Economic and political weekly
10. Dhaliwal S. (1998), "Silent Contributors: Asian Female Entrepreneurs and Women in Business", Women's Studies International Forum, Vol. 21 (5), pp. 469-474.
11. Eshetu B. and W. Zeleke (2008), "Women entrepreneurship in micro, small and medium enterprise, Journal of International Women"s Studies, Nov-12.2:n.p
12. Langowitz N and Minniti, M (2007). 'The Entrepreneurial Propensity of Women' Entrepreneurial Theory and Practice.

AI Transformation in India: Enhancing Efficiency and Shaping the Future of Accountancy and Commerce

Mr. Pranav Pradip Bagwe
Assistant Professor, Department of Accountancy,
Vasantrao Naik College of Arts & Commerce, Murud-Janjira, District Raigad

Abstract
Artificial Intelligence (AI) is fundamentally transforming professional and commercial sectors across India, driven by national digital initiatives and strong economic growth projections. This paper analyzes AI adoption, innovation, and governance in India's Accountancy and Commerce sectors, specifically evaluating efficiency gains and strategies for effective integration.
In Accountancy, AI tools such as Robotic Process Automation and intelligent audit systems are automating up to 75 percent of routine tasks, enhancing operational speed, accuracy, and compliance. This transformation enables Chartered Accountants (CAs) to shift from simple compliance work to high-value strategic advisory roles.
In Commerce, AI plays a vital role in improving fraud detection, enhancing personalized services in FinTech, and optimizing logistics and pricing in E-commerce operations. The Indian AI market is projected to reach ₹2,640 billion (approximately $31.9 billion) by 2031. Governance is guided by the Reserve Bank of India's (RBI) Framework for Responsible and Ethical Enablement of AI (FREE-AI), which promotes innovation while upholding ethical standards such as Explainable AI (XAI), fairness, and accountability.
Using the Dynamic Capabilities View (DCV) and the Technology-Organization-Environment (TOE) frameworks, this paper emphasizes the importance of continuous skill development and presents strategies for integrating AI effectively into professional practice and education.
Keywords: *Artificial Intelligence (AI), Accountancy, Commerce, India, Chartered Accountants (CAs), FinTech, E-commerce, Digital Personal Data Protection Act (DPDP), FREE-AI, Operational Efficiency.*

Introduction

The adoption of Artificial Intelligence (AI) represents a major shift in global economic operations, and India is at the forefront of this transformation. Supported by government initiatives such as Digital India, the country's large-scale digital revolution has created an ideal environment for AI integration across industries.

The financial sector has been significantly influenced by AI, with India's rapidly growing FinTech ecosystem serving as a key example. The economic potential of AI in India is immense. The national AI market is expected to reach ₹2,640 billion by 2031, driven by adoption in Marketing, Retail, and E-commerce. Furthermore, the Indian IT sector is projected to surpass ₹33,200 billion (approximately $400 billion) by 2030, a trajectory heavily supported by AI-driven technological advancements.

This paper focuses on two interconnected domains of the Indian economy: Accountancy and Commerce. In Accountancy, AI is transforming the work of Chartered Accountants by automating repetitive tasks, improving audit quality through advanced fraud detection, and enabling more accurate financial forecasting. In Commerce, AI is integrated across key markets, including FinTech, E-commerce, and logistics, contributing substantially to operational efficiency and sustainable economic growth.

Objectives

1. To examine the role of Artificial Intelligence (AI) in transforming modern accounting and commerce practices in India.
2. To identify potential domains within accounting and commerce where AI applications are likely to expand in the future.

3. To assess the level of awareness, perception, and readiness among accounting professionals and commerce students toward AI adoption.
4. To evaluate the benefits of AI in improving accuracy, operational efficiency, and decision-making in accounting processes.
5. To propose strategies for the effective integration of AI into accounting and commerce education as well as professional practice.

Literature Review

Artificial Intelligence (AI) refers to computer systems performing tasks that typically require human intelligence. Recent studies indicate a significant increase in academic research on AI in finance, highlighting its growing importance in modern financial systems.

Four major technologies form the foundation of business-oriented AI: Machine Learning (ML), Deep Learning, Natural Language Processing (NLP), and Generative AI (GenAI). These technologies enable faster and more accurate data processing, driving efficiency in both commerce and accountancy.

Machine Learning and Deep Learning are particularly important for predictive functions, allowing systems to analyze historical data to forecast trends, improve credit scoring, and enhance audit accuracy. Natural Language Processing focuses on enabling computers to interpret human language, a capability that has been effectively used to analyze corporate documents and assess company performance.

In accounting, AI simplifies work processes, improves data accuracy, and enhances decision-making by automating complex analytical tasks. These AI applications differ from earlier automation tools such as Robotic Process Automation (RPA) and Optical Character Recognition (OCR), which mainly handle repetitive and rule-based processes.

Although AI research in finance and e-commerce is expanding rapidly, many studies still lack strong theoretical foundations. Most rely on experimental models rather than comprehensive frameworks. Addressing this theoretical gap is crucial for future research.

Methodology

This study applies well-established theoretical frameworks to evaluate AI adoption in both large organizations and small enterprises.

For large corporations, the **Dynamic Capabilities View (DCV)** is used. This framework treats AI as a strategic capability that enables companies to identify opportunities, adapt quickly to market changes, and sustain long-term competitive advantages.

For Small and Medium-sized Enterprises (SMEs), the **Technology-Organization-Environment (TOE)** framework is combined with the **Diffusion of Innovations (DOI)** theory. This combination helps analyze the barriers SMEs face, such as limited resources, low technological capacity, and resistance to change. It also provides insights into how effectively India's national mission, "AI for All," is being implemented.

Data Analysis

Accountancy: Automation and Value Migration

The Chartered Accountancy profession is evolving from traditional compliance work toward strategic consultancy. Firms that use AI tools for automated bank reconciliation, accounts payable entries, and bookkeeping report up to a 75 percent reduction in manual effort.

AI is also enhancing audit quality and fraud detection. Indian firms increasingly rely on tools such as MindBridge Ai Auditor to identify irregularities and financial risks. Similarly, platforms like Trullion assist in financial statement validation and lease accounting automation, improving both efficiency and compliance.

In taxation, AI-based tools simplify the complexities of India's tax regulations. The Goods and Services Tax Network (GSTN) uses AI to detect tax evasion and flag fraudulent Input Tax Credit claims. Businesses, therefore, rely on AI-driven compliance software to maintain accuracy and transparency.

Robotic Process Automation (RPA) supports repetitive, rule-based accounting functions, while Optical Character Recognition (OCR) minimizes data entry errors by automatically capturing information from documents and invoices. These technologies collectively enhance productivity and compliance.

Commerce: FinTech, Logistics, and SME Challenges

The AI market within India's supply chain sector is projected to grow at a compound annual growth rate of 44.1 percent between 2024 and 2030.

In the FinTech industry, AI is accelerating growth and improving financial security. The sector is expected to reach a valuation of ₹12,450 billion (approximately $150 billion) by 2025. AI applications such as fraud detection, money-laundering prevention, and alternative credit scoring are expanding financial access for underserved populations.

In E-commerce logistics, AI improves operational efficiency by automating freight rate calculations and predicting delivery times based on factors such as weather and traffic. Companies like Amazon India and Flipkart use AI-driven solutions to minimize operational waste and enhance customer satisfaction.

Small and Medium-sized Enterprises (SMEs) face distinct challenges, including limited financial resources, inadequate digital infrastructure, and poor data quality. Despite these challenges, early AI adopters among SMEs report efficiency gains of up to 30 percent. Government initiatives, including the "AI for India 2030" Playbook, provide action plans and support mechanisms to promote AI integration among smaller businesses.

Results

The findings indicate that AI's influence on Accountancy and Commerce is centered on augmentation rather than replacement.

AI enhances efficiency, scalability, and accuracy, allowing accounting firms to manage larger volumes of transactions without increasing staff. This enables professionals to focus on strategic analysis and decision-making. Automation also ensures regulatory compliance, aligning business processes with systems such as the GSTN.

India's governance strategy, led by the RBI's FREE-AI framework, encourages responsible innovation. It is based on principles such as trust, fairness, accountability, explainability, and safety. Alongside this, the **Digital Personal Data Protection (DPDP) Act, 2023**, ensures transparency and consent in data handling and processing.

The evolving workforce must acquire both technical and soft skills. Data analytics, Generative AI literacy, and RPA expertise are essential technical abilities, while strategic thinking and problem-solving remain vital human skills.

Conclusion

Artificial Intelligence is reshaping India's professional and commercial landscapes. In accountancy, AI simplifies operations, improves accuracy, and ensures compliance, enabling Chartered Accountants to transition into high-value digital finance advisors. In commerce, AI enhances efficiency in FinTech and E-commerce, strengthens fraud detection systems, and streamlines supply chains.

India's regulatory framework, combining the RBI's FREE-AI and the DPDP Act of 2023, provides a balanced foundation for innovation and ethical responsibility.

For effective integration of AI into education and practice, three key strategies are recommended:

1. **Upskilling:** Professionals must acquire AI and data analytics skills to stay relevant in the digital era.
2. **Inclusive Adoption:** Government-supported initiatives should help SMEs overcome resource and infrastructure barriers.
3. **Ethical Design:** Organizations must adhere to explainable AI standards to ensure fairness, transparency and public trust.

Future Research Directions

Although AI adoption in India is progressing rapidly, research in this domain still requires stronger theoretical and empirical validation. Future studies should focus on:

1. **Empirical Validation of SME Frameworks:** Field studies are needed to test theoretical models such as TOE and DOI in specific regional contexts.
2. **Regulatory Symbiosis Analysis:** Research should explore how the DPDP Act and FREE-AI framework interact to balance privacy, innovation, and inclusion.
3. **Algorithmic Bias and Social Equity:** Future work must examine how AI fairness principles can minimize bias in financial decision-making and support inclusive growth.
4. **Professional Perception and Readiness:** Survey-based studies should assess awareness, perception, and readiness levels among accountants and commerce students to guide AI curriculum design and professional training.

References

1. AICerts.AI. (2024). *RBI AI guidelines: A new era for governance and innovation (fairness and risk management in FREE-AI).*
2. AI Accountant. (2025). *AI impact on accounting jobs in India: What CAs must know (evolution, not elimination).*
3. AI Accountant. (2025). *AI impact on accounting jobs in India: What CAs must know (future CA role, upskilling).*
4. AI Accountant. (2025). *Ultimate guide to AI accounting for Indian CA firms (75% time saving, GST integration, Tally/Zoho integration).*
5. Assam Tribune. (2023). *India's IT sector to touch $400 billion by 2030 (domain-specific automation).*
6. Chambers. (2025). *A framework for using AI in the Indian financial sector (RBI FREE-AI Sutras summary, graded approach).*
7. Chicago Booth Review. (2024). *Evolution of AI in finance (NLP and ML techniques in finance research).*
8. Communications Today. (2024). *Free access by global GenAI models threatens Indian AI developers (Gen AI market size, domain-specific focus).*
9. Data Guidance. (2024). *RBI publishes report on framework for responsible and ethical AI.*
10. Datamatics. (2024). *A leading private sector bank automates a statutory compliance process (RPA case study: CERSAI reporting).*
11. Emudhra. (2024). *Implications of India's DPDPA 2023 on the financial sector (risk assessment, consent).*
12. Frugal Scientific. (2024). *AI transforming logistics in India (dynamic pricing, real-time visibility, NLP).*
13. G K Kedia & Co. (2025). *How chartered accountants in India are adapting to AI (evolution to digital finance professionals).*
14. Grand View Research. (2024). *India artificial intelligence in supply chain market (44.1% CAGR).*
15. Grant Thornton. (2024). *How will the DPDPA Act impact financial services (alignment with PMLA, increased compliance).*
16. Gridlines.io. (2025). *AI in Indian FinTech future (FinTech valuation $150 billion by 2025, fraud prevention, CX).*
17. Institute of Chartered Accountants of India (ICAI). (2024). *AI impact on chartered accountancy profession (AI augmenting human capabilities, automating mundane tasks).*
18. IndiaAI. (2024). *RBI's framework for responsible and ethical enablement towards ethical AI in finance (FREE-AI risks: data privacy, bias, operational).*
19. Ingale, & Paluri. (2024). *Evolution of AI in finance research papers (academic publication growth post-2018).*
20. Institute of South Asian Studies, National University of Singapore (ISAS NUS). (2024). *AI adoption in India: Moving the needle forward (SME drivers and challenges).*
21. JPMorgan. (2024). *AI impact job growth (risk for non-routine cognitive occupations).*
22. KPMG. (2017). *Robotic process automation case studies for tech companies (RPA benefits: audit trail, reliability).*
23. MDPI. (2023). *Efficient accounting leads to the foundation of a financially stable and responsible firm (AI for accuracy, data analysis, predictive abilities).*
24. MDPI. (2024). *AI's benefits for business and peculiarities for SMEs (SME benefits, 20–30% efficiency gain).*
25. MDPI. (2024). *Challenges of AI adoption in Indian SMEs commerce (data quality, complexity, resource constraints).*
26. Meghabhansali Classes. (2025). *Top skills in demand for commerce professionals (hard/soft skills mandate).*
27. NetSuite. (2024). *AI in accounting (defining ML, NLP, GenAI, RPA, OCR).*
28. Nexford University. (2024). *How will AI affect jobs (AI for bookkeeping, cost saving).*
29. NITI Aayog. (2018). *National strategy for artificial intelligence (#AIforAll).* Government of India.
30. PMC. (2022). *Theoretical frameworks of AI in commerce (lack of theory-driven studies in e-commerce).*
31. PRS Legislative Research. (2023). *Digital Personal Data Protection Bill, 2023 (data fiduciary obligations).*
32. PwC India. (2024). *Digital Personal Data Protection Act (DPDP) on e-commerce (data strategy, compliance).*

33. ResearchGate. (2021). *The theoretical framework for the assessment of AI adoption (DCV and strategic orientation).*
34. ResearchGate. (2024). *Artificial intelligence adoption in SMEs: Survey based on TOE-DOI framework (conceptual roadmap for SME adoption).*
35. ResearchGate. (2024). *AI-enhanced supply chain optimization: A study of Indian e-commerce sector (Flipkart/Amazon India case studies).*
36. Sardine.AI. (2024). *AI risk platform for fraud, credit, and compliance (FinTech risk platform).*
37. Scrut.io. (2024). *RBI framework for responsible and ethical enablement of artificial intelligence (FREE-AI structure and six pillars).*
38. Spog.AI. (2024). *Understanding RBI's FREE-AI framework (seven sutras and XAI mandate).*
39. Storyboard18. (2024). *Amazon layoffs to trigger automation-led ripple effect across sectors in India (logistics sector employment).*
40. Storyboard18. (2024). *India's AI market to hit $31.9 billion by 2031 (market size and marketing AI contribution).*
41. Suvit.io. (2025). *Top AI tools for CAs (MindBridge AI Auditor, ClearTax AI, fraud detection).*
42. Taxilla. (2024). *AI VAT/GST compliance (tax infrastructure uses AI to detect fraud).*
43. TaxRobo. (2024). *AI revolutionizing GST processes (OCR, GSTN's use of AI, need for compliance tools).*
44. The Times of India. (2022). *Indian IT sector to cross $400bn by 2030.*
45. Trullion. (2024). *AI meets accounting (AI-powered accounting platform features).*
46. White & Case. (2024). *AI watch: Global regulatory tracker – India (national AI strategy, principles for responsible AI).*
47. World Economic Forum. (2024). *Transforming small businesses: An AI playbook for India's MSMEs (AI for India 2030 playbook).*

Skill-Based Education under NEP 2020: An Economic Perspective

Dr. Kailas D. Landge
(Professor & Head, Department in Economics)
Chetana's H.S. College of Commerce and Economics (Autonomous) Bandra east, Mum-51.

Abstract

This paper investigates the role of skill-based education under the **National Education Policy (NEP) 2020** in catalyzing economic growth, employment generation, productivity enhancement, and socio-economic development in India. The policy's emphasis on skills reflects a strategic pivot from traditional rote learning toward applied competencies that align education with labour market needs. This research synthesizes policy analysis, economic theory, empirical findings, and comparative international practices to evaluate how NEP 2020 addresses the skills mismatch, equips learners with employable competencies, and supports inclusive growth. Key challenges and implementation bottlenecks are analyzed, and policy recommendations are offered to maximize economic returns from skill-oriented reforms.

Keywords: NEP 2020, skill-based education, human capital, economic growth, employability, labour market, competency development.

Introduction

Education and skills are two of the most critical determinants of economic development. A well-educated and skilled workforce not only enhances productivity but also fosters innovation, competitiveness, and inclusive prosperity. In this context, **NEP 2020** marks a transformative policy framework that reimagines education in India, placing strong emphasis on skill development at all levels—schooling, higher education, and vocational training.

This paper examines the nexus between skill-based education and economic outcomes, focusing on how NEP 2020 integrates skill development within the broader economic objectives of employment creation, productivity enhancement, and human capital formation. It discusses the economic rationale behind skill-based education, policy innovations in NEP 2020, expected outcomes, implementation challenges, and strategies to improve impact.

2. Theoretical Framework: Education, Skills, and Economic Growth

2.1 Human Capital Theory

Human Capital Theory, pioneered by economists such as **Gary Becker** and **Theodore Schultz**, posits that investments in education and training improve worker productivity, leading to higher earnings and economic growth. Skills serve as capital that enhances an individual's ability to contribute effectively to economic processes.

2.2 Skills Mismatch and Economic Costs

A mismatch between skills imparted through traditional education and those demanded by the labour market leads to structural unemployment, underemployment, and loss of economic efficiency. The cost of this mismatch is substantial—manifested through reduced productivity, stagnant wages, and diminished competitiveness.

2.3 Skills and Productivity

Skills directly influence productivity dynamics. According to endogenous growth models, human capital and skills drive innovation and knowledge spillovers, which are fundamental to sustained economic growth.

3. Overview of NEP 2020 and Skill-Based Education

3.1 Policy Vision

NEP 2020 envisions an education system that is holistic, flexible, multidisciplinary, aligned with contemporary needs, and rooted in Indian ethos. A key pillar of the policy is the integration of vocational education and skill development into mainstream schooling and higher education.

3.2 Major Skill-Related Provisions

Key aspects of skill-based education under NEP 2020 include:

1. **Integration of Vocational Education from Class 6:** Vocational exposure begins early, introducing students to trades such as agriculture, IT, arts, manufacturing, and service sectors.
2. **Multiple Learning Pathways:** Blended academic and vocational pathways enable learners to choose flexible career trajectories.
3. **Credit Bank System:** Learners accumulate credits from formal courses, skill modules, internships, and apprenticeship, enhancing lifelong learning and employability.
4. **Internships and Apprenticeships:** Practical work experience through industry internships and structured apprenticeships is emphasized at secondary and tertiary levels.
5. **Skill Development in Higher Education:** Universities are required to offer vocational courses and embed skill development modules in undergraduate curricula.

4. Economic Rationale for Skill-Based Education

4.1 Reducing Structural Unemployment

India's labour market features high rates of unemployment and informal employment, particularly among the youth. Skill-based education enhances job readiness and bridges the gap between education and employment demand.

4.2 Enhancing Worker Productivity

Workers equipped with relevant skills are more productive, adaptive, and innovative. NEP 2020's emphasis on applied competencies contributes to higher labour productivity—a key driver of economic growth.

4.3 Matching Labour Market Requirements

Skill-oriented curricula aligned with industry needs reduce skill mismatches. Reduced mismatch leads to lower recruitment costs, better job matches, and improved firm performance.

4.4 Supporting Entrepreneurship

Skill development fosters self-employment and entrepreneurship, enabling learners to create businesses, diversify income streams, and catalyze local economic development.

4.5 Promoting Inclusive Growth

By offering diverse skill pathways and vocational opportunities, NEP 2020 aims to include disadvantaged and marginalized groups, promoting equity in access to economic opportunities.

5. Impact of Skill-Based Education on Key Economic Indicators

5.1 Employment and Labour Force Participation

Skill-oriented education increases job readiness, reduces frictional unemployment, and facilitates labour force participation—especially among women and rural youth—contributing to inclusive economic growth.

5.2 Wages and Income Distribution

Acquiring market-relevant skills enhances wages and reduces income disparities. Skilled workers tend to command higher wages and more stable employment than their unskilled counterparts.

5.3 Firm Productivity and Competitiveness

Firms benefit from a skilled workforce through increased efficiency, reduced training costs, and improved innovation capacities. In competitive industries, skillful labour is a strategic asset.

5.4 Economic Growth and GDP

By improving the quality of labour input and enabling technology adoption, skill-based education supports aggregate productivity and long-run economic growth (measured by GDP).

6. Comparative Insights: Global Practices in Skill Integration

6.1 Germany's Dual System

Germany's dual education system combines classroom learning with structured apprenticeships in firms. This close university-industry collaboration ensures seamless skill transfer and high employment outcomes.

6.2 Singapore's Skills Future

Singapore's SkillsFuture initiative emphasizes lifelong learning, continuous upskilling, and industry-aligned training through national frameworks that incentivize worker skill acquisition and adaptability.

6.3 Lessons for India

Best practices underline the importance of industry partnerships, competency-based assessments, labour market intelligence, and flexible learning trajectories—all integral to NEP 2020 implementation.

7. Implementation Challenges and Economic Constraints

7.1 Institutional Readiness

Many educational institutions lack infrastructure, trained faculty, and industry linkages necessary to deliver quality skill education.

7.2 Curriculum Alignment

Aligning curricula with rapidly evolving labour market demands remains complex, requiring dynamic frameworks and regular updates.

7.3 Funding and Resource Allocation

Adequate public investment is essential for establishing labs, training centres, and industry partnerships. Budgetary constraints limit effective roll-out.

7.4 Quality Assurance

Ensuring consistent quality across institutions and regions poses challenges. Robust accreditation and monitoring mechanisms are needed.

7.5 Private Sector Engagement

Sustained private sector involvement—through partnerships, apprenticeships, joint labs, and placement support—is crucial but uneven across sectors.

8. Policy Recommendations

1. **Strengthen Institutional Capacity:** Invest in teacher training, infrastructure, and industry collaboration units within educational institutions.
2. **Develop Labour Market Intelligence Systems:** Use data analytics to update curricula based on emerging skill demands in sectors like AI, renewable energy, manufacturing, and services.
3. **Incentivize Industry Participation:** Offer tax incentives, credit guarantees, and subsidies for firms engaging in apprenticeships, internships, and training collaborations.
4. **Expand Lifelong Learning Platforms:** Implement credit bank systems that facilitate continuous reskilling and upskilling across life stages.
5. **Focus on Equity:** Tailor skill programs for marginalized groups, including women, rural youth, and economically disadvantaged learners.
6. **Embed Digital Skills:** Given the digital transformation of economies, expand digital literacy, coding, and ICT skills across education levels.

9. Conclusion

Skill-based Education under NEP 2020 represents a pivotal shift in India's educational and economic policy landscape. By aligning education with dynamic labour market needs, the policy promises to unlock human capital potential, bridge skill gaps, and bolster economic growth. Its economic significance lies in enhanced productivity, reduced unemployment, equitable access to opportunities, and sustained competitiveness in a globalizing economy.

However, realizing NEP 2020's full promise requires strategic implementation, robust infrastructure, institutional capacity building, and multi-stakeholder collaboration. With effective execution, skill-based education can transform not only individual trajectories but also national economic outcomes, positioning India as a dynamic, skilled economy of the 21st century.

References

1. Becker, G. S. (1993). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. University of Chicago Press.
2. Government of India. (2020). *National Education Policy 2020*. Ministry of Education, Government of India.

3. Schultz, T. W. (1961). *Investments in Human Capital*. American Economic Review, 51(1), 1–17.
4. Todaro, M. P., & Smith, S. C. (2015). *Economic Development* (12th ed.). Pearson.
5. World Bank. (2019). *World Development Report 2019: The Changing Nature of Work*. World Bank Publications.
6. Kingdon, G. G., & Theopold, N. (2008). *Skill Development in India: Does Vocational Education Help?* Global Economy Journal, 8(4).
7. National Skills Development Corporation (NSDC). (2021). *Annual Report*.
8. CEDEFOP. (2017). *European Centre for the Development of Vocational Training: Skills Forecast*.
9. Lee, K. (2013). *Schumpeterian analysis of economic catch-up and technological capability building: Firm-level evidence from Vietnam*. Cambridge Journal of Economics, 37(2), 433–454.
10. PwC India. (2018). *Skilling India: Education to Employability*.

"An Analytical Study of India's Industrial and Economic Sectors: Current Trends, Challenges, and Emerging Opportunities"

Dr. Nishant Diliprao Wadghule
Department of Commerce,
Maratha Vidya Prasarak Samaj's
Karmaveer Kakasaheb Wagh Arts, Science and Commerce College,Pimpalgaon (B), Taluka Niphad, District Nashik – 422209

Abstract:-

The commerce sector occupies a pivotal role in the overall development of the Indian economy. It comprises a broad spectrum of activities, including production, distribution, domestic and international trade, banking, insurance, transportation, warehousing, e-commerce, and other service-oriented operations. Acting as a crucial link between agriculture and industry, the commerce sector significantly contributes to gross domestic product (GDP), employment generation, and integration with global markets. Since the implementation of economic reforms in 1991characterized by liberalization, privatization, and globalization the Indian commerce and industrial sectors have undergone profound structural and functional transformation.

In recent years, rapid technological progress has further reshaped these sectors. The widespread adoption of digital technologies, growth of e-commerce platforms, increasing use of artificial intelligence, and expansion of fintech services have enhanced operational efficiency, transparency, and market accessibility. In addition, proactive government initiatives such as digital public infrastructure, manufacturing incentives, and infrastructure investment have provided renewed momentum to industrial and commercial activities.

Despite these advancements, several structural challenges continue to constrain sustainable growth. Limited access to timely and affordable finance, persistent skill gaps, uneven technological adoption, regulatory and legal complexities, intense global competition, and regional disparities remain significant concerns. These challenges are particularly acute for micro, small, and medium enterprises, which play a vital role in employment and regional development.

For achieving sustained long-term economic growth exceeding 7 percent, a detailed micro-level assessment of India's industrial and economic structure is essential. Although the Indian economy recorded strong real GDP growth up to 2018-19, the COVID-19 pandemic caused a sharp economic slowdown, the effects of which persisted until 2023-24. While recovery has been underway, structural reforms remain critical for ensuring resilience and inclusive growth.

This research paper examines the current status of India's industrial and economic sectors, analyzes key challenges, identifies emerging opportunities, and outlines future prospects. It also proposes policy-oriented recommendations aimed at strengthening the commerce and manufacturing ecosystem and supporting sustainable economic development.

Keywords:-

Indian Commerce Sector; Economic Reforms 1991; Liberalization, Privatization and Globalization (LPG); Service-Led Growth; Manufacturing Sector; MSMEs; Digital Economy; E-Commerce; Financial Inclusion; Industrial Policy; Production Linked Incentive (PLI); Infrastructure Development; Sustainable Development; Global Trade Integration; Post-COVID Economic Recovery

1. Introduction:-

Commerce refers to the comprehensive process of producing goods and services and ensuring their smooth flow from producers to final consumers. It includes trade, banking, insurance, transportation, communication, warehousing, and various auxiliary services. In the Indian context, the commerce sector functions as a vital link between agriculture and industry and plays a significant role in contributing to GDP, employment generation, and international trade.

In the years following independence, the growth of the commerce sector remained relatively modest due to regulatory constraints and limited market integration. However, the economic reforms introduced in 1991 marked a turning point, accelerating expansion and modernization. In the contemporary era, digitalization, the rise of e-commerce, the growth of start-ups, and the rapid expansion of the service sector have placed Indian commerce in a dynamic transitional phase.

India's economic progress is often assessed through its manufacturing performance and export growth. Although manufacturing activity has gained momentum in recent years, substantial reforms are still required to achieve global competitiveness. Countries such as Germany successfully integrated skill development with industrial growth from an early stage, ensuring long-term economic stability.

In India, progressive industrial policies initiated during the 1990s gained further impetus under recent governance frameworks. Initiatives emphasizing "Zero Defect, Zero Effect" manufacturing have enhanced product quality and environmental sustainability. Despite policy intentions to increase the manufacturing sector's share in GDP from 16 percent to 25 percent by 2022, its contribution remains close to 16 percent, underscoring the need for deeper structural reforms.

2. Objectives of the Study:-

The present study is undertaken with the following objectives:

a) To examine the current status of the Indian commerce sector
b) To analyze the prevailing condition of the Indian economy
c) To identify major problems affecting the commerce sector
d) To study key economic challenges faced by India

3. Review of Literature:-

A comprehensive understanding of India's industrial and economic transformation requires engagement with established empirical and theoretical scholarship. The economic reforms initiated in 1991 under Manmohan Singh marked a structural shift from a regulated economy to a liberalized market-oriented framework. Ahluwalia (2002) observed that dismantling the License Raj, reducing trade barriers, and encouraging private participation improved macroeconomic stability and accelerated GDP growth. Similarly, Panagariya (2004) emphasized productivity gains arising from trade openness and competitive reforms, though he noted sectoral imbalances, particularly the relatively slower growth of manufacturing compared to services.

India's growth model has been distinctive. Eichengreen and Gupta (2013) argued that unlike East Asian economies that followed manufacturing-led industrialization, India experienced service-led growth. The service sector, contributing over 50 percent of GDP as highlighted in the Economic Survey of India, has been driven by IT and business process outsourcing exports. However, concerns regarding jobless growth and limited industrial absorption persist.

Industrial policy initiatives such as Make in India aimed to enhance manufacturing competitiveness and raise its GDP share. Yet, Rodrik (2016) introduced the concept of "premature deindustrialization," suggesting that automation and global competition constrain manufacturing expansion in developing countries like India.

MSMEs remain central to employment and regional development. Reports from the Reserve Bank of India highlight persistent credit constraints, despite improvements in digital finance. The International Monetary Fund (2024) noted that India's digital public infrastructure has strengthened financial inclusion and economic formalization.

The COVID-19 pandemic significantly disrupted growth, with employment losses reported by the Centre for Monitoring Indian Economy. However, according to the World Bank (2022), India's recovery has been relatively strong, supported by infrastructure investment and digital transformation.

4. Research Methodology:-

The present study adopts a descriptive and analytical research design to examine the current status, challenges, and opportunities of the Indian industrial and economic sectors. The methodology

is structured to provide a comprehensive and systematic analysis based on both qualitative and quantitative information.

5. Research Design:-

This research is descriptive in nature, as it describes the existing structure and performance of India's commerce, industrial, and economic sectors. It is also analytical, as it evaluates trends, policy impacts, and sectoral challenges arising from economic reforms, globalization, and technological change.

6. Sources of Data:-

The study is based entirely on secondary data collected from reliable and authentic sources. These include:

- Government publications such as the Economic Survey of India, Union Budget, and reports of the Reserve Bank of India
- Reports of international organizations like the International Monetary Fund and the World Bank
- Publications of the Ministry of Commerce and Industry
- Research articles published in reputed national and international journals
- Data and reports from institutions such as the Centre for Monitoring Indian Economy

7. Current Status of the Indian Commerce Sector:-

a) Trade Sector:-

India's domestic and international trade has expanded steadily over the years. The country's participation in global trade has increased, and India has emerged as a major exporter of services, particularly in information technology and professional services.

b) Growth of the Service Sector:-

The service sector contributes more than 50 percent to India's GDP and continues to expand rapidly. Sectors such as banking, insurance, information technology, education, healthcare, tourism, and logistics have demonstrated sustained growth and resilience.

c) Digital Commerce:-

The rapid adoption of e-commerce platforms, Unified Payments Interface (UPI), online banking, and digital wallets has significantly improved transaction speed, transparency, and financial inclusion. Notably, digital transactions are increasingly penetrating rural and semi-urban areas.

d) Role of Government Policies:-

Government initiatives, including GST implementation, MSME support schemes, and regulatory oversight by institutions such as the Reserve Bank of India, have strengthened the commercial environment and improved ease of doing business.

8. Current Status of the Indian Economy:-

India has emerged as the fifth-largest economy in the world and remains the fastest-growing among G20 nations. The International Monetary Fund projected GDP growth of 6.8 percent for FY 2024-25 and 6.5 percent for FY 2025-26.

The current account deficit declined to nearly 1 percent of GDP in FY 2024, supported by strong service exports and lower oil import costs. Foreign exchange reserves reached approximately USD 643 billion, aided by significant foreign institutional investment inflows.

Infrastructure development has accelerated, with the construction of 74 airports in the last nine years and an increase in the capital expenditure to GDP ratio to 3.3 percent in FY 2024. Manufacturing capacity utilization has reached about 74 percent, indicating potential revival in private investment.

Inflation has remained within the RBI's tolerance band, with CPI inflation falling below 4 percent in April 2024. Urban unemployment has declined alongside economic recovery, while rural demand has strengthened, reflected in improved FMCG growth in rural markets.

9. Major Problems in the Commerce Sector:-

Despite progress, the commerce sector faces several challenges:

1. Limited access to timely and affordable credit for MSMEs

2. Skill gaps and inadequate adoption of modern digital tools
3. Intense competition from multinational corporations
4. Infrastructural deficiencies, particularly in rural logistics and connectivity
5. Taxation and regulatory complexities, especially related to GST compliance

10. Major Economic Challenges:-

India continues to face macroeconomic challenges such as the aftereffects of the COVID-19 induced slowdown, unemployment, declining agricultural contribution to GDP, income inequality, and a significant infrastructure financing gap. Additionally, geopolitical tensions and global trade disruptions have adversely affected export-oriented industries like textiles and pharmaceuticals.

11. Policy Measures Undertaken:-

The government has introduced several policy measures, including a ₹20 lakh crore economic stimulus package, strategic disinvestment of public sector enterprises, labor law consolidation, and expansion of Production Linked Incentive schemes, agricultural market reforms, GST rationalization, and deeper integration into global supply chains through free trade agreements.

12. Impact of Technology on Commerce:-

Technological advancements have transformed commerce through the growth of e-commerce platforms, the application of artificial intelligence in demand forecasting and inventory management, and the expansion of fintech services that promote financial inclusion and efficiency.

13. Opportunities in Indian Commerce:-

India's commerce sector offers significant opportunities in the digital economy, international trade, employment generation in logistics and financial services, and the promotion of green and sustainable business practices aligned with ESG and CSR principles.

14. Measures for Strengthening Manufacturing:-

Strengthening manufacturing requires focused investment in skill development, enhanced support for small industries, reliable power supply, and increased expenditure on research and development. Currently, India's manufacturing R&D investment remains low compared to developed economies, highlighting the need for policy intervention.

15. Findings:-

The analysis of secondary data reveals that India's industrial and economic sectors are undergoing a gradual but structurally significant transformation. The findings indicate that economic reforms, digitalization and policy interventions have positively influenced overall economic performance, although sectoral imbalances persist.

First, the service sector has emerged as the primary driver of economic growth, contributing more than half of India's GDP. Strong performance in information technology, financial services, logistics, and digital commerce has supported export earnings and macroeconomic stability. However, employment generation within the service sector remains uneven, limiting its capacity to absorb surplus labor from agriculture.

Second, the manufacturing sector shows signs of recovery, with improved capacity utilization and increased investment under initiatives such as PLI schemes. Despite these gains, manufacturing's share in GDP remains stagnant at around 16 percent, indicating structural constraints such as skill shortages, limited R&D investment, and global competitive pressures.

Third, MSMEs continue to play a crucial role in employment and regional development, but access to timely credit and regulatory compliance remain major challenges. The expansion of digital financial infrastructure has improved transparency and transaction efficiency, yet smaller enterprises face higher compliance costs.

Fourth, the COVID-19 pandemic had a severe short-term impact on GDP growth and employment, particularly in the informal sector. Nevertheless, post-pandemic recovery has been relatively strong, supported by increased public capital expenditure, infrastructure development, and digital transformation.

Overall, the results suggest that while India has achieved macroeconomic stability and resilience, sustained growth will depend on strengthening manufacturing competitiveness, enhancing skill development, reducing infrastructure gaps, and ensuring inclusive growth across regions and sectors.

16. Suggestions and Recommendations:-

1. **Enhance Access to Finance for MSMEs:-**

Strengthen institutional credit delivery through simplified loan procedures, digital lending platforms, and expansion of credit guarantee schemes to ensure timely and affordable capital access.

2. **Promote Skill Development and Industry Linkages:-**

Align vocational education and training programs with industry requirements. Public-private partnerships should be encouraged to bridge the skill gap and improve workforce productivity.

3. **Strengthen Manufacturing Competitiveness:-**

Increase investment in research and development, modernize production technologies, and expand Production Linked Incentive (PLI) schemes to promote export-oriented manufacturing.

4. **Improve Infrastructure and Logistics:-**

Accelerate infrastructure development, particularly in rural connectivity, warehousing, and digital infrastructure, to reduce supply chain costs and enhance trade efficiency.

5. **Simplify Taxation and Regulatory Compliance:-**

Rationalize GST procedures and reduce compliance burdens for small enterprises to improve ease of doing business.

6. **Encourage Digital Transformation:-**

Promote adoption of digital tools, e-commerce platforms, artificial intelligence, and fintech solutions to improve efficiency, transparency, and financial inclusion.

7. **Promote Sustainable and Green Commerce:-**

Encourage environmentally sustainable production practices, ESG compliance, and green energy adoption to ensure long-term economic stability.

8. **Strengthen Global Trade Integration**:-

Expand Free Trade Agreements (FTAs) and diversify export markets to reduce vulnerability to global disruptions.

17. References:-

1. Ahluwalia, M. S. (2002). Economic reforms in India since 1991: Has gradualism worked? *Journal of Economic Perspectives, 16*(3), 67–88.
2. Centre for Monitoring Indian Economy. (2021). *Unemployment and employment trends in India*. CMIE Publications.
3. Eichengreen, B., & Gupta, P. (2013). The two waves of service-sector growth. *Oxford Economic Papers, 65*(1), 96–123.
4. International Monetary Fund. (2024). *World economic outlook report*. IMF Publications.
5. Ministry of Commerce and Industry, Government of India. (2023). *Annual report 2022–23*. Government of India.
6. Panagariya, A. (2004). Growth and reforms during 1980s and 1990s. *Economic and Political Weekly, 39*(25), 2581–2594.
7. Reserve Bank of India. (2024). *Annual report 2023–24*. RBI Publications.
8. Rodrik, D. (2016). Premature deindustrialization. *Journal of Economic Growth, 21*(1), 1–33.
9. World Bank. (2022). *India development update*. World Bank Group.
10. Government of India. (2024). *Economic survey 2023–24*. Ministry of Finance.

AI-Enabled Knowledge Integration and Global Agribusiness Frontiers: Transforming Farmer Producer Companies in India

Mr. Sagar Vishwas Sandhan
Asst. Professor
College Name: MVP's K. K. W. Arts, Science And Commerce College, Pimpalgaon (B).

Abstract:

Farmer Producer Companies (FPCs) have emerged as a transformative institutional mechanism within Indian agriculture, aimed at consolidating smallholder farmers into structured, market-oriented enterprises. By combining cooperative principles with corporate governance architecture, FPCs seek to enhance collective bargaining capacity, improve value realization, and promote income stability among small and marginal producers. In the contemporary era defined by rapid advancements in Artificial Intelligence (AI), these organizations are uniquely positioned to evolve beyond traditional aggregation models toward technologically enabled, data-driven agribusiness systems. This study critically examines the role of AI-enabled tools—including predictive analytics, precision agriculture technologies, digital supply chain management systems, and agri-fintech platforms—in reshaping the operational and governance frameworks of FPCs. Drawing upon collective action theory, digital transformation paradigms, and knowledge integration models, the paper develops a conceptual framework to analyze AI-mediated institutional restructuring. The research relies on secondary data sources, policy review, and analytical synthesis to evaluate both transformative opportunities and structural limitations associated with digital adoption.

The findings suggest that AI integration enhances production efficiency, price intelligence, resource optimization, climate adaptability, financial inclusion, and traceability across value chains. At the same time, systemic barriers—including inadequate digital infrastructure, limited technological literacy, financial constraints, governance capacity gaps, and emerging data security concerns—restrict the pace and inclusiveness of transformation. The paper argues that AI adoption within FPC ecosystems represents more than incremental technological upgrading; it constitutes a structural shift toward data-centric, knowledge-integrated agribusiness governance. To realize this potential equitably, coordinated policy intervention, institutional capacity strengthening, and inclusive digital frameworks are imperative. Such strategic alignment is essential for positioning FPCs within evolving global research and sustainability frontiers.

Keywords: Artificial Intelligence (AI); Farmer Producer Companies (FPCs); Digital Agriculture; Knowledge Integration; Agribusiness Governance; Precision Farming Technologies; Rural Entrepreneurship; Sustainable Agribusiness Development.

Introduction:

Indian agriculture continues to operate within a structurally fragmented production system, where the overwhelming majority of cultivators manage small and marginal landholdings. Such fragmentation constrains economies of scale, limits access to formal credit and organized markets, and reduces farmers' ability to negotiate remunerative prices. Market volatility, asymmetric information flows, and weak integration with value chains further intensify income instability. In response to these structural limitations, Farmer Producer Companies (FPCs) were introduced as hybrid institutional entities that combine cooperative principles of mutual benefit with the regulatory and governance framework of corporate law. By aggregating producers into legally recognized business organizations, FPCs aim to strengthen collective bargaining power, enhance market access, improve input procurement efficiency, and facilitate value addition.

While FPCs have expanded considerably over the past decade, their long-term sustainability increasingly depends on their capacity to adopt technological innovation and managerial modernization. The rapid advancement of Artificial Intelligence (AI) presents a transformative opportunity in this regard. AI-driven systems—including predictive analytics, machine learning algorithms, remote sensing tools, and digital advisory platforms—enable data-informed decision-making across production, marketing, and financial management domains. These technologies support yield forecasting, demand estimation, logistics optimization, risk assessment, and price intelligence, thereby enhancing operational efficiency and strategic planning.

Positioned at the intersection of collective enterprise and digital transformation, FPCs represent a critical institutional platform through which AI can be democratized within rural economies. This paper examines the evolving role of AI in reshaping FPC governance, performance and competitiveness. By situating FPC development within broader debates on technological modernization and global agribusiness integration, the study underscores the strategic importance of AI-enabled institutional restructuring for achieving sustainable and inclusive agricultural growth.

Literature Review:

The academic discourse on Farmer Producer Companies (FPCs) has expanded considerably over the last decade, reflecting their growing importance in India's agricultural transformation strategy. Trebbin (2014) conceptualizes FPCs as hybrid institutional arrangements that combine cooperative values with corporate governance mechanisms to enhance smallholder participation in modern markets. Singh (2013) and Narayanan (2014) emphasize that collective aggregation through producer organizations reduces transaction costs, improves access to credit and inputs, and enhances farmers' bargaining power within competitive supply chains. Shukla and Thakur (2018) further argue that professional management structures, transparent governance practices, and member engagement significantly influence long-term organizational viability. These studies collectively position FPCs as instruments of rural economic restructuring and inclusive agribusiness development.

Parallel scholarship in digital agriculture highlights the transformative role of technology in farm-level and institutional decision-making. Wolfert et al. (2017) analyze big data ecosystems in smart farming, demonstrating how analytics improve productivity and operational efficiency. Basso and Antle (2020) examine decision-support tools in precision agriculture, underscoring the importance of predictive modeling for climate adaptation and resource optimization. Klerkx, Jakku, and Labarthe (2019) explore digital innovation in agricultural advisory systems, identifying structural shifts in knowledge dissemination processes. In supply chain research, Saberi et al. (2019) discuss blockchain-enabled transparency, while Gomber et al. (2018) assess fintech advancements in enhancing financial inclusion and reducing transaction asymmetry.

Despite substantial advancements in both FPC governance research and digital agriculture studies, limited literature systematically integrates Artificial Intelligence within collective enterprise frameworks. Existing research often treats institutional development and technological innovation as parallel trajectories rather than interconnected processes. There is insufficient analytical exploration of how AI-driven analytics, algorithmic forecasting, and data integration systems can be embedded within FPC governance models to enhance strategic planning, performance monitoring, and accountability. This study addresses this gap by synthesizing agribusiness institutional theory with AI-enabled transformation frameworks. By situating intelligent systems within collective organizational structures, the research contributes to a more comprehensive understanding of digitally mediated rural institutional modernization and sustainable agribusiness competitiveness.

Theoretical Framework:

This study is anchored in an interdisciplinary theoretical architecture that integrates Collective Action Theory, Knowledge Integration Theory, and Digital Transformation Theory. Together, these frameworks provide a structured lens for examining how Artificial Intelligence (AI) can reshape the institutional, managerial, and operational foundations of Farmer Producer Companies (FPCs). Rather than viewing technological adoption as an isolated process, this framework conceptualizes AI

integration as embedded within collective organization, knowledge systems, and institutional restructuring.

Collective Action Theory: Collective Action Theory, rooted in the work of Olson (1965) and subsequent institutional economists, explains how coordinated group formation enables individuals to overcome structural market failures. In fragmented agricultural economies such as India's, smallholders face high transaction costs, limited economies of scale, and weak negotiation capacity. FPCs emerge as institutional responses to these constraints by aggregating production, consolidating demand for inputs, and collectively marketing outputs. Through collective procurement and marketing, FPCs reduce per-unit transaction costs, enhance price discovery mechanisms, and strengthen risk-sharing arrangements among members. The theory further suggests that collective institutions require governance incentives, trust-building mechanisms, and participatory decision-making to remain effective. AI enhances collective action by improving information symmetry within the organization. Real-time data on market prices, weather conditions, and logistics coordination strengthens strategic alignment among members. Thus, AI functions as a collective intelligence amplifier, deepening the effectiveness of coordinated enterprise structures.

Knowledge Integration Theory: Knowledge Integration Theory emphasizes the importance of synthesizing heterogeneous knowledge forms within organizational systems to achieve superior performance outcomes. Agricultural production inherently relies on tacit knowledge—experiential insights related to soil behavior, cropping patterns, and local ecological conditions. However, modern agribusiness also depends on codified scientific data, meteorological forecasting, financial analytics, and global market intelligence. AI operates as a bridging mechanism that integrates these knowledge streams into structured decision-support architectures. Machine learning models analyze soil data, crop histories, satellite imagery, and market signals to generate predictive insights. Within FPCs, such integration enhances production planning, inventory management, financial monitoring, and risk mitigation strategies. Importantly, AI-mediated knowledge systems do not replace farmer expertise; rather, they augment human judgment with data-driven precision, creating a hybrid decision environment.

Digital Transformation Theory: Digital Transformation Theory conceptualizes technology adoption as an institutional reconfiguration process rather than mere operational automation. It underscores how digital systems restructure governance mechanisms, workflow coordination, accountability structures, and strategic orientation. For FPCs, AI integration signals a shift from manual aggregation practices toward data-centric agribusiness governance. Digital dashboards enable performance monitoring across clusters. Blockchain-based traceability enhances transparency within supply chains. Fintech integration modernizes accounting and financial reporting systems. These transformations reposition FPCs as competitive market-oriented enterprises capable of aligning with global quality standards and sustainability benchmarks.

Integrated Analytical Perspective: The convergence of these three theoretical strands creates a comprehensive framework for analyzing AI-enabled FPC evolution. Collective Action Theory explains the structural necessity of aggregation; Knowledge Integration Theory clarifies how multi-source data enhances institutional intelligence; and Digital Transformation Theory illuminates systemic organizational restructuring. Together, they provide a coherent analytical foundation for understanding how AI can catalyze sustainable, inclusive, and globally competitive agribusiness development within Farmer Producer Companies.

Methodology:

This study adopts a qualitative and interpretative research design to examine the integration of Artificial Intelligence (AI) within the institutional and operational architecture of Farmer Producer Companies (FPCs). Given the evolving nature of AI adoption in agribusiness ecosystems, the research emphasizes analytical synthesis and conceptual modeling rather than primary field experimentation. The methodological framework is structured to ensure theoretical rigor, policy relevance, and contextual depth.

Secondary Data Review: The study relies extensively on secondary data drawn from government reports, policy documents, institutional publications, and development agency assessments related to FPC promotion and digital agriculture initiatives. Official scheme guidelines, annual reports, and strategic policy frameworks provide insights into institutional growth patterns, governance structures, and digital integration efforts. Scholarly articles, agribusiness research studies, and international development reports are also reviewed to contextualize AI-driven agricultural transformation within global research trends. This comprehensive review enables triangulation of perspectives across academic, policy, and institutional domains.

Policy Framework Analysis: A systematic analysis of existing policy instruments relevant to FPC formation, digital agriculture, financial inclusion, and rural entrepreneurship is undertaken. The study evaluates how current regulatory and promotional frameworks facilitate or constrain AI adoption within collective agribusiness institutions. Particular attention is given to digital infrastructure initiatives, agri-tech incubation programs, and data governance guidelines. This analysis helps identify structural enablers and institutional bottlenecks in the AI transformation pathway.

Conceptual Modeling of AI Integration Pathways: Building on theoretical foundations, the research develops a conceptual model illustrating how AI-enabled systems can be embedded within FPC governance and operational processes. The model maps linkages among production analytics, market intelligence platforms, financial technologies, and supply chain optimization tools. It further delineates the interaction between human decision-making and algorithmic support systems, emphasizing hybrid governance mechanisms.

Comparative Evaluation: The study conducts a comparative evaluation of digital agriculture practices across different agribusiness contexts to identify transferable insights for FPC ecosystems. By examining technology adoption trajectories and institutional restructuring processes, the research synthesizes cross-contextual learning relevant to rural collective enterprises. Overall, the methodology integrates empirical evidence with theoretical constructs to develop a structured, analytically grounded transformation framework for AI-enabled FPC modernization.

Analysis – AI Integration in Farmer Producer Companies

AI in Production Systems: AI-powered crop advisory systems integrate satellite imagery, soil analytics, and predictive algorithms to optimize input utilization and yield forecasting. These tools enhance production efficiency, reduce risk exposure, and improve resource allocation within Farmer Producer Companies.

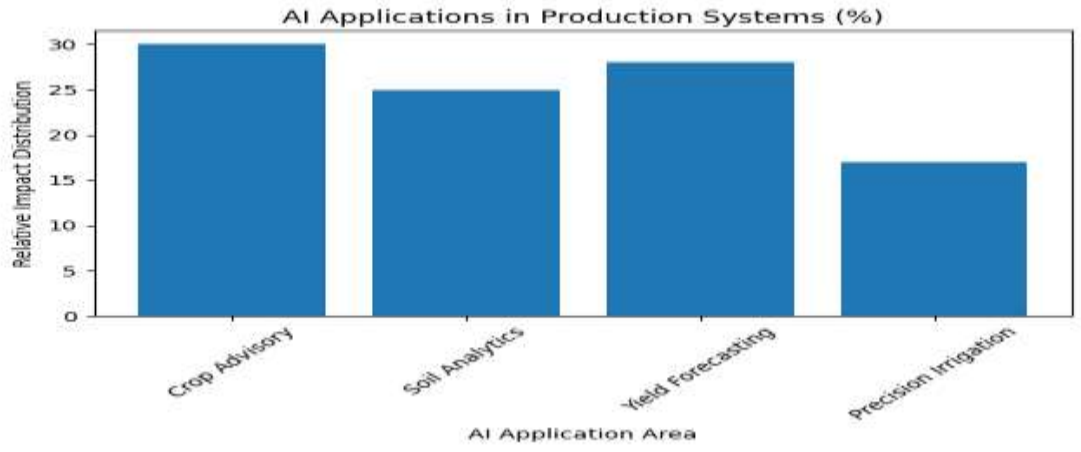


Figure 1. AI Applications in Production Systems (% Distribution).

Interpretation: The distribution highlights the strategic importance of crop advisory and yield forecasting systems in AI-driven production management. Soil analytics and precision irrigation further contribute to resource efficiency and sustainability.

AI in Market Intelligence: Machine learning-based market intelligence platforms analyze commodity price trends, demand patterns, and export signals to enable strategic timing of sales and improved price realization for FPC members.

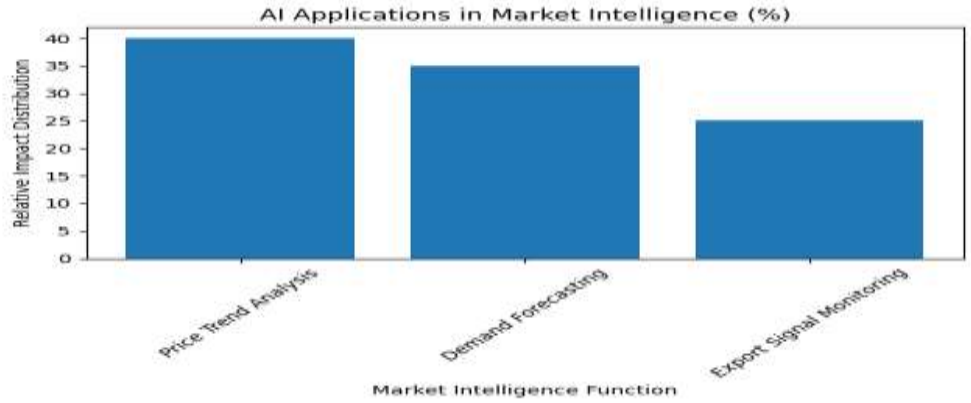


Figure 2. AI Applications in Market Intelligence (% Distribution).

Interpretation: Price trend analysis constitutes the most significant AI application, followed by demand forecasting. Export signal monitoring enhances global market integration.

Supply Chain and Financial Integration: Digital traceability systems and AI-driven logistics optimization enhance transparency and reduce post-harvest losses. Financial inclusion mechanisms such as credit scoring and digital payment systems strengthen institutional governance.

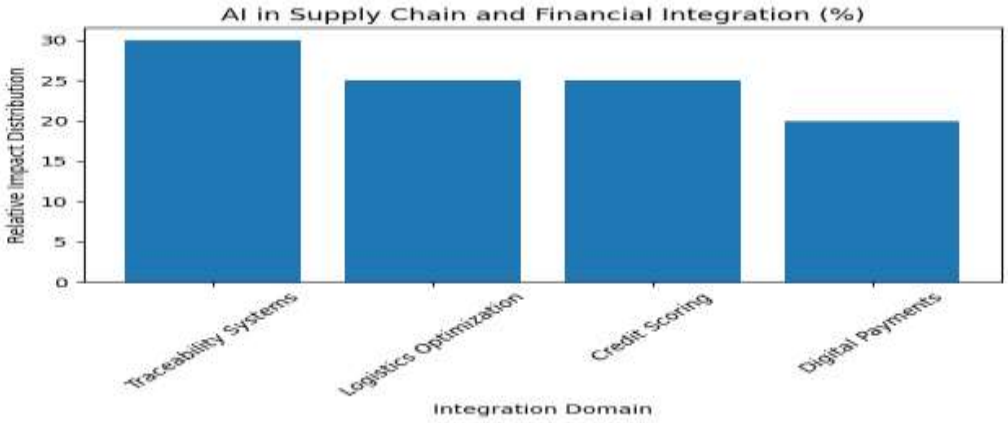


Figure 3. AI in Supply Chain and Financial Integration (% Distribution).

Interpretation: Traceability and logistics optimization represent major transformation drivers. AI-enabled financial tools contribute significantly to credit accessibility and institutional accountability.

Table 1: Analytical Summary of AI Integration Domains

Domain	AI Tools Applied	Strategic Outcome
Production Systems	Satellite imaging, predictive analytics, irrigation algorithms	Optimized input use and yield enhancement
Market Intelligence	Machine learning price models, demand analytics dashboards	Improved price realization and strategic market timing
Supply Chain Integration	Blockchain traceability, logistics optimization software	Reduced losses and enhanced transparency
Financial Inclusion	AI-based credit scoring, digital transaction systems	Expanded credit access and governance efficiency
Knowledge Architecture	Integrated databases, real-time monitoring dashboards	Data-driven institutional decision-making

Source: Conceptual analysis developed by the author based on AI integration frameworks.

Discussion:

The integration of Artificial Intelligence within Farmer Producer Companies (FPCs) marks a decisive transition from conventional aggregation-based entities to strategically managed agribusiness enterprises. Traditionally, FPCs have focused primarily on collective procurement, input distribution, and marketing coordination. While these functions remain essential, AI-enabled systems introduce a deeper institutional transformation characterized by structured data utilization, predictive analytics, and algorithm-supported governance mechanisms. One of the most significant outcomes of AI adoption is the emergence of data-driven governance. Decision-making processes increasingly rely on real-time dashboards integrating production data, price trends, financial records, and supply chain metrics. Such systems reduce informational asymmetry within the organization and enhance managerial accountability. Predictive decision-making further strengthens strategic planning by enabling yield estimation, price forecasting, risk modeling, and demand anticipation. These capabilities shift FPCs from reactive operational models toward proactive and evidence-based enterprise management.

AI integration also enhances transparency across value chains. Digital traceability platforms improve monitoring of product quality, storage conditions, and logistics flows. This transparency strengthens trust among buyers, financial institutions, and regulatory bodies while reducing post-harvest losses and operational leakages. In addition, climate resilience becomes more achievable through predictive weather analytics and adaptive cropping advisories. AI-driven systems facilitate risk mitigation strategies that are critical in the context of increasing climatic variability. Export competitiveness is another emerging dimension. By aligning production planning with global demand signals and quality standards, AI-enabled FPCs can integrate more effectively into international markets. Data-supported certification, grading automation, and compliance monitoring enhance credibility in export supply chains.

Despite these transformative possibilities, structural barriers remain substantial. Digital skill deficits among members and managerial staff limit effective technology utilization. Rural connectivity gaps constrain real-time data access. Capital constraints restrict investment in advanced systems, while cybersecurity risks raise concerns regarding data governance and privacy. Therefore, inclusive institutional frameworks are essential. Capacity-building initiatives, infrastructure investment, subsidized technology access, and robust data protection policies must accompany AI integration. Only through coordinated intervention can technological transformation translate into equitable and sustainable agribusiness development.

Policy Implications:

The transformative integration of Artificial Intelligence (AI) within Farmer Producer Companies (FPCs) necessitates a comprehensive and coordinated policy framework. Technological modernization in rural agribusiness cannot occur organically without institutional support, infrastructural investment, and regulatory clarity. Strategic public policy must therefore move beyond promotional rhetoric toward structured ecosystem development that enables inclusive and sustainable digital transformation. A foundational priority is investment in rural digital infrastructure. Reliable broadband connectivity, cloud-based data access, digital service centers, and affordable smart devices are prerequisites for AI-enabled governance. Without stable connectivity and technological accessibility, predictive analytics and real-time decision-support systems cannot function effectively. Infrastructure development should particularly target remote and resource-constrained agricultural regions to prevent the emergence of digital inequality.

The establishment of AI incubation and innovation hubs dedicated to FPC ecosystems represents another critical intervention. Such hubs can provide technical advisory services, prototype testing environments, and customized digital solutions tailored to smallholder contexts. Collaboration with agricultural universities, research institutions, and technology startups would facilitate context-sensitive innovation aligned with crop diversity and regional conditions. Public–private partnerships (PPPs) in agri-tech development can accelerate technological diffusion. By leveraging private sector expertise in data analytics, blockchain systems, and fintech platforms, while ensuring public oversight

and accountability, PPP models can bridge resource and knowledge gaps. Structured agreements must prioritize affordability and farmer-centric design to ensure equitable benefit distribution.

Equally essential are digital literacy and capacity-building programs. Training modules focused on data interpretation, digital financial management, and cybersecurity awareness should be integrated into FPC development schemes. Institutional leadership training is particularly important to strengthen governance adaptation to digital systems. Robust data governance and cybersecurity frameworks must accompany AI adoption. Clear guidelines on data ownership, privacy protection, algorithmic transparency, and ethical use of agricultural data are necessary to build institutional trust.

Finally, financial incentives and targeted subsidies for technology adoption—such as grants, concessional credit, or tax benefits—can reduce capital barriers. Government-led FPC promotion schemes should systematically embed AI capacity-building components to ensure that digital transformation is sustainable, inclusive, and aligned with long-term rural development objectives.

Conclusion:

The integration of Artificial Intelligence (AI) within Farmer Producer Companies (FPCs) signifies a structural transformation in the governance and operational architecture of Indian agribusiness. Moving beyond traditional aggregation models, AI enables FPCs to function as data-driven enterprises characterized by predictive analytics, transparent value chains, and evidence-based strategic planning. By embedding intelligent systems into production management, market intelligence, financial governance, and supply chain coordination, FPCs can substantially enhance productivity, reduce transaction inefficiencies, and improve income stability for small and marginal farmers. This convergence of collective organization and digital innovation strengthens the institutional capacity of rural enterprises to operate competitively within evolving domestic and global markets.

However, technological integration alone does not guarantee inclusive development. AI adoption must be supported by carefully designed policy frameworks that prioritize digital accessibility, institutional capacity building, and equitable resource distribution. Without targeted interventions, disparities in digital literacy, infrastructural access, and financial capability may intensify existing inequalities within rural economies. Institutional strengthening, leadership training, data governance standards, and cybersecurity safeguards are therefore essential components of sustainable AI-enabled transformation.

Furthermore, global agribusiness trends increasingly emphasize sustainability metrics, traceability mechanisms, climate resilience strategies, and transparent certification systems. AI-enabled FPCs are uniquely positioned to align with these emerging standards by leveraging predictive tools, integrated data platforms, and performance monitoring systems. Such alignment enhances export readiness and strengthens India's integration into competitive international value chains.

References:

1. Basso, B., & Antle, J. (2020). Digital agriculture to design sustainable agricultural systems. *Nature Sustainability, 3*(4), 254–256. https://doi.org/10.1038/s41893-020-0510-0
2. Gomber, P., Koch, J. A., & Siering, M. (2018). Digital finance and fintech: Current research and future research directions. *Journal of Business Economics, 88*(5), 537–580. https://doi.org/10.1007/s11573-018-0852-x
3. Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming, and agriculture 4.0: New contributions and a future research agenda. *NJAS – Wageningen Journal of Life Sciences, 90–91*, 100315.
4. Narayanan, S. (2014). Producer companies in India: A study of organization and performance. *Review of Agrarian Studies, 4*(2), 63–84.
5. Olson, M. (1965). *The logic of collective action: Public goods and the theory of groups*. Harvard University Press.
6. Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press.
7. Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
8. Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research, 57*(7), 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

9. World Bank. (2019). *Harvesting prosperity: Technology and productivity growth in agriculture*. World Bank Publications.
10. Government of India. (2020). *Formation and promotion of 10,000 farmer producer organizations (FPOs) scheme*. Ministry of Agriculture & Farmers Welfare.
11. National Bank for Agriculture and Rural Development. (2022). *Status of farmer producer organizations in India*. NABARD.

A Prudence of Cultural Plurality in George R.R. Martin's *A Song of Ice and Fire*

Sudhir Deoman Dube
Research Scholar

Abstract

George R.R. Martin's saga *A Song of Ice and Fire* (ASOIAF) is immensely popular for its treatment of politics, complexities, and its societies. This paper tries explores how cultural plurality is being portrayed in the series A Song of Ice and Fire. This paper will also focus to interpret the unconventionality of power structures, ethical frameworks, social traditions, and interpersonal relationships within the ASOIAF universe. The two imaginary lands of Westeros and Essos feature diversities in culture, each has unique political ideologies, customs, moral expectations, and social hierarchies. with a comparative cultural reading, this study is trying to argue that Martin has destabilized conventional norms of fantasy and presented culture as the primary determinant of political authority and ethical judgment. Furthermore, this paper examines how characters who exist between cultures, such as Jon Snow and Daenerys Targaryen, embody hybridity and cultural negotiation. This paper highlights cultural conflicts and its overlaps for examining cross-cultural politics, identity, and unconventional socio-ethical realities.

Keywords: Culture, cultural plurality, ASOIAF, power, politics, social milieu, Cultural Studies.

Introduction

Idealized heroism, moral certainty, and a clear binary of good and evil or life and death have always been served in fantasy literature. Nevertheless, George R.R. Martin's with his *A Song of Ice and Fire* dismantles these traditions by offering a politics where morality, authority, and relationships are negotiable. He has constructed a universe in his own way, not a singular ideological worldview but a multicultural world. The land of Westeros features feudal society, Dothraki believe in warrior traditions, Ironborns have faith raiding culture, people of Bravos and their faith in mercantile relations, and Slaver's Bay known for its slaves and their lords. All these societies do not try to coexist; but they compete, clash, and reshape one another.

This paper tries to figure out multiculturality in of the series and to understand unconventionality in power, politics and culture that dominates Martin's narrative with a cross-cultural lens. The diversity in culture in ASOIAF allows Martin to subvert conventional, moral and political assumptions. What is considered ethical in one culture is seen as immoral in another. In the same way, legitimacy of rule and social authority also differ according to culture and political strategies. With a lens of cross-cultural analysis, this study highlights how ASOIAF becomes a narrative of cultural conflict, moral relativism, and hybrid identities. The focusing argument of this paper is that the power, politics, and relationships can be culturally arranged rather than universally fixed. Therefore, the unconventionality is not by accidental but it is generated by multicultural perspective which is embedded within the fictional world.

Cross-Cultural Studies: A Conceptual Framework

As we all know that cross-cultural studies generally refer to the comparative approach of different cultures, it includes social beliefs, customs, and moral codes. It's a familiar way used in anthropology, sociology, and literary studies to understand how cultural differences shape and reshape human behaviour and perspective. In literature, cross-cultural perspective can be seen as a tool to examine how texts represent cultural conflict, hybridity, adjustment and the construction of "otherness."

In ASOIAF, culture functions as an invisible force that determines law, ethics, and power and political flexibility. Martin's fictional societies operate as cultural models that can be studied like real civilizations. Thus, ASOIAF can be read as a comparative cultural text in which the author creates multiple ideological worlds and tests their moral limitations.

It is relevant to study ASOIAF with a lens of cross-cultural studies because the story repeatedly presents situations where characters have to choose between competing cultural expectations. This makes the series so special text for examining how cultural values left influence on political decisions, ethical dilemmas, and social relationships.

Power and culture:

In the lands of Westeros, political power follows the rule of feudal hierarchy, bloodline order, legitimacy, and institutional tradition. The political world is controlled by hereditary succession, noble alliances, and diplomatic marriages. Nevertheless, all these collapses repeatedly because of betrayal, ambition, and the instability of lineage-based rule.

In contrast, the Dothraki, a tribe which has a warrior-based political culture where leadership depends on strength, conquest, and audacity. A Khal (leader) does not rule by birthright but through his dominance. This system challenges Westerosi assumptions about legitimacy. The Dothraki treats violence not as unrest but as cultural practice and honor as they assume that a marriage must have a dual over a female mate and without three deaths shall be considered as a dull affair.

Similarly, the Ironborn, natives of Iron Island the coast of Westeros present another model where power rooted in raiding, maritime conquest, and ideological rejection of agricultural life. Their philosophy of the "iron price" opposes Westerosi values. While Westeros values landownership and noble heritage, the Ironborn value conquest and plunder as legitimate means of survival.

The house of Targaryen is unique in its very way, they are allowed to marry with their own brothers and sisters believing that their blood should be remained pure. It is quite contradicting elsewhere in Westeros.

Through these contrasting cultures, ASOIAF argued that power is a tool of culture. Martin is trying to reconfigure the conventional fantasy where monarchy is presented as stable or morally justified. Instead, political authority appears unstable because each society defines legitimacy differently.

Ethics and Morality:

Ethics in ASOIAF do not function as universal law as they are full of complexities, frequently situational and rarely absolute. Instead, morality is shaped by cultural and political expectations. Ethical values in Westeros features honor, oath-keeping, loyalty, and lineage but all these are affected by manipulation, betrayal and conspiracies. The downfall of the Starks illustrates how morality is getting weakened in a world governed by political manipulation.

On the other hand, the Dothraki moral code legitimizes practices that we condemn. Violence, dual, shamelessness and forced submission are not viewed as immoral; they are becoming part of cultural identity. The cultural legitimacy of brutality raises complications to the reader's moral response.

The event of the Red Wedding radically subverts conventional moral codes. The massive massacre at the wedding violates law of "guest right," a cultural institution believed to be inviolable. "Jaime Lannister send his regards" (Martin 133) through this event Martin destabilizes not only the ethical order but also the metaphysical security of the world. From a theoretical perspective, Rosemary Jackson's idea of fantasy as literature of subversion can be applied. The Red Wedding strongly exposes the fragility of chivalric ideology and critiques romanticized feudal loyalty. Power portrayed in Martin's world is pragmatic and ruthless but not ethically relevant.

Slaver's Bay a region where slavery is institutionalized, normalized and handled through economic power. Daenerys's rebellion against slavery is presented as morally justified, yet her intervention also resembles cultural imperialism. This leaves a critical ethical question behind that can a liberator become oppressor when he/she ignores ethical law?

Thus, Martin has constructed a world where morality is negotiable, unstable and shaped by cultural difference. The unconventionality of ethics lies in the refusal to present and absolute code of morality.

Customs, Traditions, and Social Milieu

Here in the series, marriages are not mainly about love or companionship but they are majorly political strategies. Families arrange marriages to gain land, power, or alliances. This leads women are often treated as symbols of inheritance and legitimacy, helping to secure family claims and strengthen political positions as we can simply observe in the case of Catelyn and Daenerys. In the case of rituals such as coronations, the oath of the Kingsguard, and the traditions of noble houses are not about performing formal ceremonies. They help maintain political order and hierarchy. In this way, Martin presents traditions as powerful political instruments rather than simple social practices.

In contrast, the Dothraki weddings are full of violence and shows that fighting and bloodshed are accepted as normal practices of their culture. It reflects their belief of honor and strength. Only powerful has the right and ability to rule and they don't have faith in taboo.

On the other hand, the North, when it comes to faith in the gods. The Old Gods represent a different cultural identity. They show the North's resistance to the religious power of the South. The Faith of the Seven, the Faceless God, the Lord of Light, and the Old Gods represent competing religious ideologies. Religion becomes a political force fully capable of shaping governance, rebellion, and war. The Faith Militant movement demonstrates how religious tradition can challenge royal authority.

Therefore, ASOIAF highlights how these traditions are used as a political weapon. Cultural institutions not only shape society but actively construct power and conflict.

Relationships and Gender Roles

Relationships in ASOIAF are totally fluid. In the first land that is Westeros, marriage is largely political, and women are often reduced to reproductive and alliance-based roles. One can say patriarchy is deeply rooted in the feudal system but here again, Martin shows his excellency and complicates the structure through characters like Olenna Redwyne and Cersei Lannister, who challenges patriarchal rules by manipulating political institutions. The relation between Cersei and her twin brother become a subject for a debate. To oppose this, Dorne presents contrasting cultural model where women have a great hold on social agency. The acceptance of sexual freedom and inheritance rights in the Dorne strongly challenges common moral rigidity. The Wildlings a tribe beyond the wall, represents another alternative system where women are less restricted by feudal society and there marriage functions differently.

Daenerys's transformation into a leader can be understood through a lens of cross-cultural negotiation. Her identity shifts from an exiled princess to a Dothraki Khaleesi and later to the mother of the dragon, breaker of the chain and a revolutionary queen in Essos over relational ethics. The seduction of Daenerys by her own brother opens so many debates. Her relationships, leadership and priorities are shaped by cultural contexts, revealing how gender is culturally performed rather than biologically fixed.

Thus, the unconventionality of relationships in the series comes from cultural plurality. Martin did not provide one stable model of family, marriage, or gender hierarchy. Instead, he presents multiple competing systems in the series.

Cultural Hybridity and the Politics of Identity

Cross-cultural studies mainly focus on hybridity in which the formation of identities through cultural mixing can be understood through a lens of cultures. Several characters of the series exist between hybrid cultures, making them central to Martin's unconventional narrative.

Jon Snow, known as the bastard of the Ned Stark positioned between the Stark family, the Night's Watch, and the rapport to the Wildlings, make him a cultural hybrid. His identity is fluid and constantly negotiated, and his moral decisions reflect the tension between cultural loyalty and ethical responsibility. His alliance with the Wildlings challenges Westerosi cultural prejudice and redefines the concept of "enemy."

Daenerys Targaryen represents hybridity in a broader sense. She carries the legacy of Westerosi monarchy, adapts to Dothraki warrior culture, and attempts to establish authority in Essos. Her political identity changes at every stage.

Tyrion Lannister one of the prominent characters, also becomes a displaced cultural figure. Once he was a privileged and royal man, but unfortunately sent in an exile. His journey to foreign makes him hybrid in perspective, relations, and cultural advancement. Such transformation reflects how identity can be rearranged through displacement and survival.

All these characters embody Martin's rejection of clear identity. The cultural ambiguity between the characters creates unconventionality in political and moral decision-making.

Otherness, Stereotypes, and Cultural Misrepresentation

The concept of 'Otherness' is always being valued in cultural studies. Otherness is the belief of considering one not equal or defining one culture as superior and another as inferior. In Westeros, the Wildlings who lived beyond the Wall are always been considered as savages. The Dothraki are described as barbaric raiders of no manners and etiquettes. The Ironborns are labelled as stereotyped as pirates.

At the very beginning of the story, he mentions some 'others' in reference to a tribe to make an effect something is usual or something not like human. However, it is Martin's speciality to complicate these stereotypes. The Wildlings are later shown as survivors who resist oppression. The Dothraki with a strong cultural discipline and social order. The Ironborn who does not support random violence but a coherent cultural system rooted in tradition. By dismantling the norms of stereotypes, Martin challenges the conventional fantasy opposition between civilized and barbaric. This is his special treatment of unconventionality.

Conclusion

This paper rigorously argues that the series A Song of Ice and Fire has a unique treatment of cultural plurality which is in an unconventional mode. Cross-cultural studies open a valuable theoretical framework for examining these patterns of unconventionality in George R.R. Martin's *A Song of Ice and Fire*. This saga is not only about multiculturalism but it is more than that, the power lies not merely in political struggle but in the coexistence of multiple aspects of cultural systems. Martin has created a world where power, politics, ethics, customs, and relationships remain unstable. Martin's unconventionality comes from cultural contradiction: power structure is not defined and each society uses it differently; there is no absolute of morality; tradition leads to both identity and oppression; relationships are formed for political advancement and rather than universal truths of companionship. Characters who roam between cultures pursues hybridity and reveal the instability of identity. Moreover, Martin's treatment of dismantling of stereotypes restructures fantasy binaries and creates a complex universe. Thus, ASOIAF can be understood through a lens of cross-cultural studies which offers critical understanding of unconventional power, politics and cultural systems. The series is not just a piece of fantasy literature but a new world in itself which is yet unexplored.

References

1. Attebery, Brian. Stories about Stories: Fantasy and the Remaking of Myth. Oxford University Press, 2014. Jackson, Rosemary. *Fantasy: The Literature of Subversion*. Routledge, 1981.
2. Jameson, Fredric. The Political Unconscious: Narrative as a Socially Symbolic Act. Cornell University Press, 1981.
3. Martin, George R. R. A Game of Thrones. Bantam, 1996.
4. Martin, George R. R. A Clash of Kings. Bantam, 1998.
5. Martin, George R. R. A Storm of Swords. Bantam, 2000.
6. Martin, George R. R. A Feast for Crows. Bantam, 2005.
7. Martin, George R. R. A Dance with Dragons. Bantam, 2011.
8. Vishevsky, Anatoly. "Unconventional Literature in a Society of Conventions." Slavic Review, vol. 47, no. 4, 1988, pp. 709–15. JSTOR, https://doi.org/10.2307/2498190.
9. Williams, Raymond. "Culture is Ordinary." Conviction, edited by Norman Mackenzie, MacGibbon and Kee, 1958, pp. 74–92.

A Study of Mother Lullabies As Expressions of Pain, Love or Lived Experience in Maharashtra and Konkan

Pratiksha Shyamsundar Nathe
Research Scholar

Abstract:

Lullaby or Angai (अंगाई) is a type of folklore. Lullaby is a song of cradle; it is the shooting song and peace of music that is usually sung to children due to sleep time. Child age from 0- to 8-year-old. The purpose of lullabies communication skills, expressing women's pain, happiness, inner feeling through a song. In its lyric hope, aspirations, spread Love, esprit, affections of motherhood The study attemp to understand the traditional song, cultural context, how cultural context impacts on us from ancient time to up to. Lullabies found many countries, states like Maharashtra and Kokan. It existed from ancient times.

Main Motive of lullabies singing from parents to parents. It should exist in future also. In its song, there are local words of Maharashtra and Kokan. Through the local word we understand the situations of Maharashtra and Kokan we understand geographical contexts. Lullaby sings by the caretaker, nurture and mother to keep a bond between mothers and child. Mother who Sings a lullaby to their infant through singing. She teaches a lesson, how they should live in society. Lullaby is a oral tradition from ancient times. Lullaby is not only shooting song of child but also reflections of womanhood.

The study inspects lullabies in Maharashtra and Konkan. Descriptions or analysis of lullaby. How cultural context impacts people.

Introduction:

Lullaby also known as Angai geet in Maharashtra and zopoi Geet in Konkan means song to make a child sleep. Lullaby originated from the middle English lullen 'to lull' and by (e) means 'near' and 'goodbye' The word lullaby from Lilith A (Hebrew for "Lillith, begon").

The most of lullaby use in Indian cinema. Lullabies become integral part of film. For example, "Aaja Ri Aa Nindiya tu Aa"- Do Bigha zamine- 1953 film, "Main Gaoon Tu Chhup Ho Jaa" - Do Aankhen Barah Haath film 1957, "So Jaa Re Lalna Jhulso Tohe Palna". – Pardesi film 1957. In Indian novel lullaby has mentioned like 'Khosla' Bhalchandra Nemade - rural Maharashtrian life reflections oral tradition including lullaby like song, Nectar in a Sieve by Kamla markande- In the novel motherhood scene song like a soothing expression. Baluta by Daya Pawar. Kokani Gaav tithe Raan by Ranjit Desai in the novel folklore and mother Central role in tradition.

In discussions combinations of Maharashtrian lullabies and kokani lullabies.

1. Marathi lullabies are use usually soft rhythmic and expressive emotions and they use simple vocabulary. In Marathi lullabies voice are melancholy depress and expression due to sing a song.
2. Kokani lullabies are colloquial and musical. It is related to sea, home, rice, mother and rural life. in kokane Lullaby natural use. In Konkani lullabies women voice appear as a protector and storyteller.

some lullabies based on the fact and some imaginary. When children cry due to the time mother and nurture singing lyrics for infant calm and give a relief and soothing sleep to infant. Infants don't understand the meaning, but they are getting calm from listening to a music and keep smiling.

Literature Review:

Lullaby is a oral tradition in which anyone can create lullaby songs. Research declared lullabies as universal.

Methodology:

In this research paper, we use qualitative research design and quantity research design. This paper depends on indepth the interview of Marathi women and helps of internet technology and take

information kokan from technological sources. Through the interview, understanding hidden love, pain esprit their infant primary sources and secondary sources.

Significant of study:

To understand the Maharashtrian and Konkan lullaby how the relationship between Marathi and kokani lullabies. Lullabies should not be repressed under the eraser, but it should be restored. People should understand the significance of lullabies. It stuck to traditions. Lullabies meanings are same in any Era just only the language is different.

Discussion:

Classifications of lullaby in Maharashtra and Konkan:

1) Society related lullabies
2) Nature related lullabies
3) Fantasy related Lullabies
4) Religious related lullabies

Society related lullaby in Maharashtra -:

झोप माझ्या बाळा,

आई राबते शेताला,

बाप तुझा गेला रानाला…

In the instance of lullaby describe the parents as a labours like farmers and worker through the lullaby caretaker teach to infant about the struggle family role in a society.

3. Society related lullaby in Konkan-:

Zopa re Babu zopa,
Ayi Mahaska mahaka mahaka,
Gavam Mhaka Mhaka Mhaka,
Lok Mhaka Mhaka Mhaka

English translation –

Sleep my child sleep
the village surrounds us
People surround us

This instance talk about the community of Konkan unity of society reflections of kokan.

4. Natural related lullaby in Maharashtra: -

बा निज गडे बा निज गडे लडिवाळा
निज नीज माझ्या बाळा

निंबोणीच्या झाडामागे चंद्र झोपला ग बाई
आज माझ्या पाडशाला झोप का ग येत नाही
गाय झोपली गोठ्यात, घरट्यात चिऊताई
परसात वेलीवर झोपला ग जाई जुई
मीठ पाकळ्या डोळ्याच्या गाते तुला मी अंगाई

In this instance describes nature love compared with infant, animal life also related with infant life nature become friendly with society.

5. Nature related lullaby in Konkan

Chandnu mhaka mhaka mhaka
Akash Mhaka Mhaka zopare Babu sukhant Mhaka
Translated English: -
The moon is all around us
The sky is all around us
sleep my child sleep peacefully.

Ud ud kawwa
Ud ud ud…
Pud pud machhli
Pud pud pud
(Fly…fly, O Crow…
Fly, fly, fly…
Swim… swim, O Fish…
Swim, swim, swim)

Describe night became supportive source to infant sleep nature.

6. Fantasy related lullaby in Maharashtra: -

झोपाळा झोपाळा,

राजा येईल सोन्याचा पाळणा….

In this lullaby show imaginary gold cradle of king only for infant satisfaction, clam, and soothing sleep.

7. Fantasy related lullaby in kokan: -

Babu Mhaka Mhaka Mhaka
Soneyacha gharo Mhaka
Pakshi mhaka mhaka mhaka

Translated in English: -

My dear child is all around,
A golden house is around
Birds are all around.

Examples describe here is also fantasy of golden house in Konkan here I want to mention, people religion is different but mother's love, thinking power is same.

8. Devotional lullaby in Maharashtra: -

जो जो गोपाळा, झोप रे कान्हा

यशोदेच्या लाडक्या नंदलाला……

Here Angai shows that lord Krishna imagined child base on bhakti imaginary.

9. Devotional lullaby in kokan

Zopi re mora bhurgea,
Dev borem korum tujea,
Soglea rati mhaka sangata,
Amcho Dev tujea rakhta.

English translation: -

Sleep, my little child,
May God bless you.
All night He stays with you,
Our Lord protects you.

Here, talk about God become a protector of infant.

Expressive vocal features of Maharashtra:

1) Mother centric- mothers love, care, esprit with the infant and direct address to child in selflessness way like बाळा राजा.

2) Rhythmic language: -

Words are repeated too small and easy create a musical rhythm. Rhythm sounds like painful, sometimes happy and careful like

लडके माझी बाळ तान्हे समजावितरण रहेना
कितीतरी समजाविले तरी देखील रहेना

3) Vocabulary: -

Oral tradition, words are transferred from one place to another. Simple words used.

Expressive vocal feature of kokani lullaby-

1) Rhythmic language: -

Tone is soft, slow, rocking gentle with tone.

2) landscape oriented: -

In lullabies of Konkani landscape come like sea, fish, nature.

3)Repetitions of word and meter: -

Repetitions of words and there is no classical metre is used in lullaby just simple words like, Mhaka, mhaka

Conclusion*:*

Lullaby comes from soul and inner thoughts not from thinking. Through the study of lullabies, one understood that lullaby is not born in one country, but almost all country lullaby existed long years ago just changed the tone rhythm not intentions of singing. Now it's coming to Bollywood. They are not merely song to put a child to sleep but they carry a deep meaning related to society, nature, religion, family relationship in Maharashtra and Konkan. One thing has come mother affections towards child; here is not the patriarchal interpretations here is the woman centric. In patriarchal society no one listen the voice of women and she cannot express in her inner feeling but through the lullaby. She can expose and express all those things which hide in her soul. This condition is Maharashtra and Konkan and other state also.

Citation:

1. ***https://balbharatikavita.blogspot.com/2011/10/blog-post_20.html?m=1***
2. *Maharashtra lokgeet- collections of folk songs from Maharashtra including Angai geet.*
3. *Folk song of Maharashtra -explain themes and cultural meaning*
4. *Konkani Bhasha Mandal – published books and research on Kokani language and song.*
5. *https://scholar.google.com/scholar?hl=hi&as_sdt=0%2C5&q=mother+lullabies+in+assam&oq=#d=gs_qabs&t=1772199379018&u=%23p%3D9xTtcAE2xR0J*
6. *https://books.google.co.in/books?hl=hi&lr=&id=J_cULPopfxMC&oi=fnd&pg=PA201&dq=info:ro8zJZSeWREJ:scholar.google.com/&ots=lKzu-9BoWQ&sig=W00ZUdFXekyie7uUVclidZmB1Gs&redir_esc=y#v=onepage&q&f=false*
7. *Chetan Acharya Children's Literature in Konkani Editorial November 2022, volume 46, No 11*

Induced Variability in Protein Content of Soybean

Sonune N. S.
Mahamune S. E.
Department of Botany,
Government Vidarbha Institute of Science and Humanities (Autonomous), Amravati

ABSTRACT:

Soybean is botanically known as *Glycine max* (L.) Merril. It is a leguminous crop belongs to Fabaceae family. It is an important crop because it is rich in protein. Soybean seeds mainly contain storage proteins called glycinin and β-conglycinin, which are beneficial for human health because they provide essential amino acids, support muscle growth and may help reduce the risk of heart disease. Increasing the protein content in soybean seeds is a major goal in crop improvement programs. Induced variability is a method used to create new genetic changes in plants. The protein variability can be generated through induced mutations. In present studies the various morphological mutants were induced in soybean variety 'Phule Kalyani DS-228' by various dosed of physical mutagen gamma rays (200 Gy, 400 Gy and 600 Gy) and various concentrations of chemical mutagens SA (0.001%, 0.003% and 0.005%) and EMS (0.02%, 0.04% and 0.06%). The protein content analysis of various morphological mutants along with control was carried out. The results showed clear differences in protein content among the morphological mutants and control. Some mutants shown higher protein content than the control. The variability in protein content was observed among morphological mutants and control.

KEYWORDS: Induced variability, Protein content, Soybean.

INTRODUCTION

Soybean is a leguminous crop, botanically known as *Glycine max* (L.) Merr., and belongs to the family Fabaceae. It grows well in tropical, subtropical, and temperate regions and is a short-day, self-pollinating plant. Soybean is mainly grown for its high protein content, making it an important source of protein for humans and animals. The seeds contain about 38–40% protein and 17–20% oil. Soy protein is important for human health because it provides essential amino acids needed for growth and body functions. Soybean oil is widely used in cooking and food industries, while the remaining meal is used to feed livestock and poultry. Due to its nutrition and multiple uses, soybean is an important crop for global food production and the economy (Wilson, 2008; FAO, 2022).

Soybean seeds mainly contain two major storage proteins called glycinin (11S globulin) and β-conglycinin (7S globulin). These proteins form most of the total protein present in the seed. Soy protein is considered a high-quality plant protein because it provides all the essential amino acids needed by the human body. It is easily digested and helps in building and maintaining muscles. Research also shows that regular intake of soy protein (β-conglycinin) may help lower bad cholesterol (LDL) levels. This can reduce the risk of heart disease when soy foods are included in a balanced diet (Friedman and Brandon, 2001; Messina, 1999; U.S. Food and Drug Administration [FDA], 1999 and Rebollo-Hernanz *et al*., 2022).

Mutation breeding is a method used to create new genetic variation in plants by exposing seeds to physical agents like gamma radiation or to chemical mutagens such as SA and EMS. These treatments cause changes in the plant's DNA, called mutations, which can lead to new traits useful for crop improvement. Mutation breeding has been used in many crops to develop improved varieties with higher yield, better quality or resistance to stress and diseases. It increases genetic diversity and gives plant breeders more options to select useful plants, especially when natural variation is limited (Kumar *et al.,* 2021; Khursheed & Khan, 2023; Ali and Suryakant, 2024). In soybean, mutation breeding has been used to develop varieties with higher protein content, making the crop more nutritious for humans and animals. Because it can produce desirable variation faster than traditional methods, mutation breeding is an important tool in improving crops and supporting food security (Mohsen *et al.,* 2023).

MATERIALS AND METHOD

The experiment was conducted using the soybean (*Glycine max* (L.) Merr.) variety **Phule Kalyani DS-228**, procured from Agriculture Research Station, Kasbe Digraj, Sangli, from the Mahatma Phule Krushi Vidyapith, Rahuri, Maharashtra, India. Healthy and uniform seeds were exposed to various doses (200 Gy, 400 Gy and 600 Gy) of physical mutagen gamma rays using a Cobalt-60 source. The physical mutagenesis was carried out at Department of Chemistry, Rastrasant Tukdoji Maharaj Nagpur University, Nagpur.

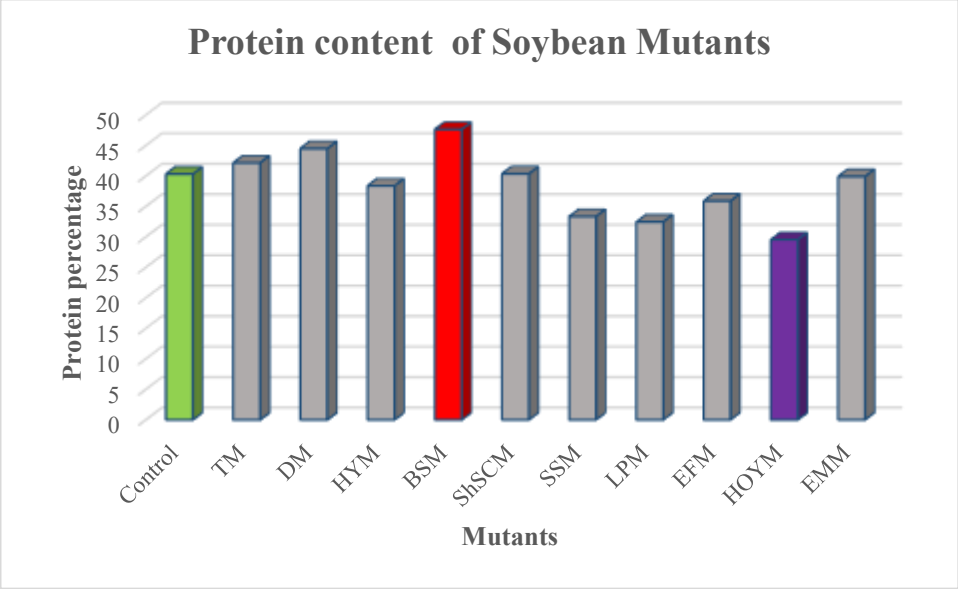
Chemical mutagenesis was carried out by treating seeds with Sodium azide (0.001%, 0.003% and 0.005%) and Ethyl methanesulphonate (0.02%, 0.04% and 0.06%). Treated seeds along with control were sown in field following Randomized Block Design (RBD) method in three replications and M_1 generation was raised. M_1 generation was studied for various biological parameters. Seeds of M_1 generation was collected plant to plant basis and sown to raise M_2 generation. The entire M_2 generation was screened thoroughly and various morphological mutants were isolated. The protein content in morphological mutants and control was determined by Lowry's method (Lowry *et al*., 1951). Soybean seeds of macro-mutants along with the control were ground into fine powder using a mortar and pestle. The oil was extracted using the Soxhlet method. After oil extraction, the remaining defatted residue was collected and used for protein estimation. For protein analysis, 200 mg of the defatted seed powder was mixed with 2 ml of distilled water and centrifuged at 15,000 rpm for 15 minutes. The clear supernatant obtained after centrifugation was used for protein estimation following the standard Lowry's method as described by Thimmaiah.

RESULT AND DISCUSSION:

The mutagenicity of the mutagens was tested on M_2 generations. Different morphological mutants were isolated and biochemical characterization carried out. In the present study different morphological mutants of soybean were used for the protein estimation by Lowry's method.

Table 1: Protein content in various morphological mutants of Soybean.

Mutants	**% of Protein**
Control	**40.31 ± 0.31**
Tall Mutant	42.14 ± 2.06
Dwarf Mutants	44.50 ± 2.40
High Yielding Mutant	38.38 ± 2.14
Bold Seeded Mutant	**47.64 ± 0.85**
Shiny Seed Coat Mutant	40.36 ± 1.87
Small Seed Mutant	33.35 ± 4.37
Long Pod Mutant	**32.46 ± 3.97**
Early Flowering Mutant	35.89 ± 1.00
High Oil Yielding Mutant	**29.55 ± 2.61**
Early Maturing Mutant	39.90 ± 2.41



Graph: Protein content various morphological mutants of Soybean.

The protein content showed variation among the soybean mutants. The values ranged from 29.55% to 47.64%. The highest protein content was observed in the Bold Seeded Mutant (47.64%), followed by Dwarf Mutant (44.50%) and Tall Mutant (42.14%). The control recorded 40.31% protein. The lowest protein content was found in the High Oil Yielding Mutant (29.55%), followed by Long Pod Mutant (32.46%) and Small Seed Mutant (33.35%).

The results showed that mutation treatment created clear variation in protein content among soybean mutants (Table 1). Induced mutagenesis is a well-known method to generate useful genetic variability in crop plants (Kumar & Dubey, 1998; Mudibu *et al*., 2012; Khan & Tyagi, 2010; Oladosu *et al*., 2016). It helps in modifying quantitative traits such as seed quality, oil, protein content and yield (Ahloowalia *et al*., 2004; Shu *et al*., 2012). Similar changes in protein content due to mutation have been reported in different crops (Gaul, 1964). Physical and chemical mutagenesis has been proved to be a convenient tool compared to other conventional processes in inducing desirable variability in crop plants related to yield and other components (Khursheed and Khan, 2023). This confirms that mutation breeding is an effective tool for improving seed quality traits.

The Bold Seeded Mutant showed higher protein content compared to control. This increase may be due to better accumulation of storage proteins during seed development. Soybean seed mainly contains glycinin and β-conglycinin proteins, which determine total protein percentage (Derbyshire *et al*., 1976; Wilson, 2004; Herman, 2014; Krishnan, 2005). Protein accumulation depends on nitrogen availability and gene activity during seed filling (Liu, 1997; Pandurangan *et al*., 2012). Better partitioning of nutrients toward protein synthesis may have resulted in higher protein content in this mutant (Rotundo & Westgate, 2009).

The High Oil Yielding Mutant showed a reduction in protein content. This supports the inverse relationship between oil and protein in soybean (Wilcox & Shibles, 2001; Rotundo & Westgate, 2009; Burton, 1987; Chung *et al*., 2003). During seed formation, oil and protein compete for the same carbon and nitrogen resources (Hernandez-Sebastia *et al*., 2005; Li *et al*., 2015). Therefore, when oil content increases, protein content may decrease. The Long Pod Mutant also showed lower protein content, which may be due to changes in metabolic activities caused by mutation (Shu *et al*., 2012; Oladosu *et al*., 2016).

The study confirms that induced mutation created useful variability in soybean protein content. The Bold Seeded Mutant can be considered promising for improving protein percentage.

CONCLUSION

The study confirms that induced mutation created useful variability in soybean protein content. Various mutants used for the protein estimation and significant differences were calculated. The Bold Seeded Mutant can be considered promising for improving protein percentage

ACKNOWLEDGEMENT

Authors are thankful to the Mahatma Jyotiba Phule Research and Training Institute, Nagpur for providing fellowship for the research work.

REFERENCES

1. Ahloowalia, B. S., Maluszynski, M., & Nichterlein, K. (2004). Global impact of mutation-derived varieties. *Euphytica,* 135(2), 187-204.
2. Ali, S., & Suryakant, T. N. (2024). Mutation breeding and its importance in modern plant breeding: A review. *Journal of Experimental Agriculture International,* 46(7), 264-275.
3. Burton, J. W. (1987). Results relevant to soybean breeding. Soybeans: Improvement, Production and Use. *National institute of Informatics*. 211-247.
4. Chung, J., Babka, H. L., Graef, G. L., Staswick, P. E., Lee, D. J., Cregan, P. B., ... & Specht, J. E. (2003). The seed protein, oil, and yield QTL on soybean linkage group I. *Crop science,* 43(3), 1053-1067.
5. F. A. O. S. T. A. T. (2022). Food and agriculture organization of the United Nations. Rome, URL: http://faostat. fao. org, 403.
6. Food and Drug Administration. (1999). Food labeling health claims; soy protein and coronary heart disease. *Federal Register*, 64(206), 57699-57733.
7. Friedman, M., & Brandon, D. L. (2001). Nutritional and health benefits of soy proteins. *Journal of agricultural and food chemistry*, 49(3), 1069-1086.
8. Gaul, H. (1964). Mutations in plant breeding. *Radiation Botany*, 4(3), 155-232.
9. Herman, E. M. (2014). Soybean seed proteome rebalancing. *Frontiers in plant science*, 5, 437.
10. Hernández-Sebastià, C., Marsolais, F., Saravitz, C., Israel, D., Dewey, R. E., & Huber, S. C. (2005). Free amino acid profiles suggest a possible role for asparagine in the control of storage-product accumulation in developing seeds of low-and high-protein soybean lines. *Journal of experimental botany*, 56(417), 1951-1963.
11. Khursheed, S., & Khan, S. (2023). Genetic Improvement in Different Crop Plants using Induced Mutagenesis with Special Reference to Pulses and Cereals: *A Review. Legume Research: An International Journal,* 46(12). 1555-1563.
12. Krishnan, H. B. (2005). Engineering soybean for enhanced sulfur amino acid content. *Crop science,* 45(2), 454-461.
13. Kumar, R., Sharma, N. K., Meena, S., & Balakrishnan, A. P. (2021). Mutation breeding: a way forward for genetic improvement in mungbean. *International Journal of Plant and Environment,* 7(04), 255-262.
14. Li, R., Yu, K., Hatanaka, T., & Hildebrand, D. F. (2010). Vernonia DGATs increase accumulation of epoxy fatty acids in oil. *Plant biotechnology journal*, 8(2), 184-195.
15. Messina, M. J. (1999). Legumes and soybeans: overview of their nutritional profiles and health effects. *The American journal of clinical nutrition*, 70(3), 439S-450S.
16. Mohsen, G., Soliman, S. S., Mahgoub, E. I., Ismail, T. A., Mansour, E., Alwutayd, K. M., ... & Hassanin, A. A. (2023). Gamma-rays induced mutations increase soybean oil and protein contents. *Peer Reviewed Journal,* 11, e16395.
17. Oladosu, Y., Rafii, M. Y., Abdullah, N., Hussin, G., Ramli, A., Rahim, H. A., ... & Usman, M. (2016). Principle and application of plant mutagenesis in crop improvement: a review. *Biotechnology & Biotechnological Equipment*, 30(1), 1-16.
18. Oliver H. Lowry, Nira J. Rosebrough, A. Lewis Farr, & Rose J. Randall. (1951). Protein measurement with the Folin phenol reagent. *Journal of Biological Chemistry, 193*(1), 265–275. https://doi.org/10.1016/S0021-9258(19)52451-6.
19. Pandurangan, S., Pajak, A., Molnar, S. J., Cober, E. R., Dhaubhadel, S., Hernandez-Sebastia, C., ... & Marsolais, F. (2012). Relationship between asparagine metabolism and protein concentration in soybean seed. *Journal of experimental botany*, 63(8), 3173-3184.
20. Rebollo-Hernanz, M., Bringe, N. A., & Gonzalez de Mejia, E. (2022). Selected soybean varieties regulate hepatic LDL-cholesterol homeostasis depending on their glycinin: β-conglycinin ratio. *Antioxidants,* 12(1), 20.
21. Shu, Q. Y., Forster, B. P., Nakagawa, H., & Nakagawa, H. (Eds.). (2012). Plant mutation breeding and biotechnology. *Cabi.*
22. Wilson, R. F. (2008). Soybean: market driven research needs. *In Genetics and genomics of soybean* (pp. 3-15). New York, NY: Springer New York.

Carbon Nanotubes : Synthesis, Properties and Applications

Rohini Chandrakant Ghante

Research Centre - School of Chemical Sciences, Swami Ramanand Teerth Marathwada University, Nanded

Abstract

Carbon nanotubes (CNTs) have emerged as one of the most studied nanomaterials due to their extraordinary mechanical, electrical, and thermal properties. Since their discovery in the early 1990s, CNTs have been at the forefront of nanotechnology research and have shown promise in diverse applications such as electronics, energy storage, biomedical devices and structural composites. This paper reviews the major methods of CNT synthesis, including arc discharge, laser ablation, and chemical vapor deposition (CVD) and analyzes how synthesis affects structural characteristics and properties. Furthermore, it examines the core physical and chemical properties of CNTs and explores the state of practical applications, addressing current limitations and future directions. A comprehensive overview of recent developments highlights the potential impact of CNTs across scientific and engineering disciplines.

Keywords

Carbon nanotubes, synthesis, chemical vapor deposition, electrical properties, mechanical properties, applications, nanotechnology.

Introduction

Carbon nanotubes (CNTs) are cylindrical nanostructures composed of sp^2-bonded carbon atoms arranged in a hexagonal lattice. They can be conceptualized as rolled graphene sheets with diameters on the nanometer scale and lengths up to several micrometers or more. CNTs fall into two major categories **single-walled carbon nanotubes (SWCNTs)** and **multi-walled carbon nanotubes (MWCNTs)**. Their discovery by Iijima in 1991 sparked intense research interest due to remarkable properties that surpass those of many conventional materials.

The unique atomic configuration of CNTs yields exceptional strength, conductivity, and thermal stability, making them suitable for applications in electronics, composites, sensing, and medicine. This paper explores the principal synthesis techniques, intrinsic properties, and diverse applications, while also discussing challenges and future prospects.

Synthesis Methods

Carbon nanotubes can be synthesized via multiple approaches, each with distinct advantages, limitations, and influence on the resulting CNT structure and quality.

1) Arc Discharge

The arc discharge method involves vaporizing carbon from graphite electrodes in an inert gas atmosphere (e.g., helium or argon) with a high current discharge, typically over 100 A. The intense heat produced between electrodes (≈4000 K) leads to carbon vaporization and subsequent nanotube formation on cooler chamber surfaces and electrode tips.

Advantages

- High quality CNTs with relatively low defect density
- Good crystallinity and graphitic structure

Limitations

- Lack of control over tube diameter and chirality
- Production of amorphous carbon and other impurities requiring post-treatment

Arc discharge was the first method used to produce CNTs and remains valuable for fundamental studies.

2) Laser Ablation

Laser ablation utilizes high-power pulsed lasers (commonly Nd YAG) to vaporize a carbon target in a high-temperature furnace under inert gas. Metal catalyst particles (e.g., Co, Ni) embedded in the target promote nanotube growth.

Advantages

- Produces high-purity CNTs
- Better control over diameter distribution than arc discharge

Limitations

- High cost due to laser equipment
- Limited scalability for mass production

Laser synthesis often yields SWCNTs with fewer structural defects, useful for electronic applications.

3) Chemical Vapor Deposition (CVD)

Chemical vapor deposition is currently the most widely used method for CNT synthesis due to scalability and controllability. Hydrocarbon gases (e.g., methane, acetylene) decompose at high temperatures (500–900°C) over supported metal catalysts (e.g., Fe, Co, Ni), resulting in carbon atom deposition and tube growth.

Advantages

- Better control over length, diameter, and alignment
- Suitable for large-scale production and integration into devices

Limitations

- Higher defect density compared with arc and laser methods
- Requires careful catalyst preparation and substrate engineering

Variants of CVD, such as plasma-enhanced CVD (PECVD), further enhance growth control and enable vertical alignment of CNT arrays.

4) Other Emerging Methods

Novel synthesis techniques include flame synthesis, hydrothermal processes, and template-assisted growth. These methods aim to reduce cost, energy consumption, and environmental impact, though they are often limited in consistency or reproducibility.

Structural and Physical Properties

The extraordinary properties of CNTs stem from their distinct structure a seamless cylindrical graphitic carbon sheet. These properties are strongly dependent on chirality (rolling angle), diameter, and the number of walls.

1) Mechanical Properties

CNTs display extremely high tensile strength and Young's modulus, attributable to strong sp^2 carbon–carbon bonds.

- **Tensile strength** up to ~100 GPa
- **Young's modulus** ~1 TPa

These values exceed those of conventional materials like steel and Kevlar. CNTs also show remarkable flexibility and resilience under compressive forces.

2) Electrical Properties

Depending on their chirality and diameter, CNTs can be metallic or semiconducting

- Metallic CNTs exhibit ballistic conduction over micrometer lengths, with electron mobilities exceeding conventional semiconductors.
- Semiconducting CNTs can be semiconductors with bandgaps tunable by diameter and chirality.

Metallic SWCNTs achieve conductivities comparable to copper but with much lower density, offering potential for lightweight conductive applications.

3) Thermal Properties

Carbon nanotubes exhibit high thermal conductivity, with values up to 3000–3500 W/m·K for individual SWCNTs. This property makes them attractive for thermal management in electronics and composites.

4) Chemical Reactivity and Surface Chemistry

While graphene is relatively inert, CNTs demonstrate enhanced chemical reactivity at defect sites and open tube ends, enabling surface functionalization with various chemical groups.

Functionalization improves solubility, compatibility with polymers, and enables bio-conjugation for biomedical use.

Applications of Carbon Nanotubes

CNTs have been integrated into a wide range of applications due to their multifunctional properties. The following subsections summarize key areas of impact.

1) Electronics and Nanodevices

CNT-based transistors and interconnects

Semiconducting CNTs have been used as active channels in field-effect transistors (FETs), offering high on/off ratios and mobility. CNT networks and arrays have been proposed as replacements for silicon in future nanoelectronic devices.

Transparent conductive films

Networks of CNTs can serve as flexible, transparent conductors for displays, photovoltaics, and touch screens, competing with materials like indium tin oxide (ITO).

Sensors

Due to their high specific surface area and sensitivity to molecular adsorption, CNTs are excellent platforms for gas sensors, biosensors, and strain sensors.

2) Composite Materials

Integrating CNTs into polymers, ceramics, or metals dramatically enhances mechanical properties such as tensile strength, stiffness, and toughness even at low loadings.

- **Structural composites** improved strength-to-weight ratio for aerospace and automotive applications
- **Conductive composites** enhanced electrical or thermal conductivity for electromagnetic shielding and thermal interface materials

Uniform dispersion and strong interfacial bonding remain challenges in composite fabrication.

3) Energy Storage and Conversion

Batteries

CNTs serve as conductive frameworks and current collectors in lithium-ion batteries, improving charge/discharge rates and cycle life.

Supercapacitors

High surface area and conductivity make CNTs suitable for electrodes in supercapacitors with high power density.

Fuel cells and solar cells

CNTs have been explored as catalyst supports, charge transport materials, and transparent electrodes in renewable energy devices.

4) Biomedical Applications

Drug delivery

Functionalized CNTs can transport drugs, genes, and therapeutic molecules into cells due to their efficient cellular uptake.

Tissue engineering

CNT scaffolds support cell growth and differentiation, particularly in neural and musculoskeletal tissues.

Biosensing and imaging

CNTs' optical and electrical properties enable sensitive detection of biomolecules and potential use in imaging modalities.

Toxicity and biocompatibility remain important concerns that require rigorous study.

5) Environmental Applications

CNT-based membranes and adsorbents have been studied for water purification and pollutant removal due to their high surface area and tunable surface chemistry.

Challenges and Limitations

Despite tremendous promise, CNT commercialization faces several obstacles

1) Controlled Synthesis

- Precise control over chirality, length, and diameter remains limited.
- Achieving uniformity critical for electronic applications is challenging.

2) Purification and Processing

- Removal of amorphous carbon and catalyst residues is needed for high performance but adds cost and complexity.
- Dispersing CNTs in matrices without agglomeration is nontrivial.

3) Toxicity and Environmental Concerns

Potential toxicity related to CNT inhalation, cellular interactions, and environmental persistence necessitates careful assessment and regulation. Studies indicate that long, rigid MWCNTs can share pathogenic characteristics with asbestos fibers, prompting work on safer designs.

Future Directions

As CNT synthesis becomes better controlled and scalable, more practical applications will emerge. Some promising future directions include

- **Chirality-specific growth methods** for tailored electronic properties.
- **Hierarchical hybrid materials** combining CNTs with graphene, nanowires, and polymers.
- **Biomedical translation** through standardized safety assessments and functionalization strategies.
- **Flexible and wearable electronics** leveraging CNT conductivity and mechanical flexibility.

Integration with other nanomaterials and emerging technologies such as quantum computing and artificial intelligence-enabled material design points to broader horizons.

Conclusion

Carbon nanotubes continue to be a cornerstone of nanotechnology research due to their extraordinary combination of mechanical, electrical, and thermal properties. Advances in synthesis have enabled improved control and scalability, while ongoing innovations expand their applications across electronics, energy, biomedicine, and environmental technologies. Addressing challenges related to controlled growth, processing, and safety will be essential for broader adoption. With ongoing research and interdisciplinary collaboration, CNTs are poised to play a transformative role in next-generation materials and devices.

References

1. Iijima, S. (1991). Helical microtubules of graphitic carbon. Nature.
2. Dresselhaus, M. S., Dresselhaus, G., & Avouris, P. (Eds.). (2001). Carbon Nanotubes Synthesis, Structure, Properties and Applications. Springer.
3. Dai, H. (2002). Carbon Nanotubes Synthesis, Integration, and Properties. Accounts of Chemical Research.
4. Meyyappan, M. (Ed.). (2005). Carbon Nanotubes Science and Applications.
5. Ebbesen, T. W. (Ed.). (1996). Carbon Nanotubes Preparation and Properties.
6. Kumar, M., & Ando, Y. (2010). Chemical vapor deposition of carbon nanotubes a review on growth mechanism and mass production. Journal of Nanoscience and Nanotechnology.
7. Bianco, A., Kostarelos, K., & Prato, M. (2005). Applications of carbon nanotubes in drug delivery. Current Opinion in Chemical Biology.
8. Dresselhaus, M. S., Dresselhaus, G., & Jorio, A. (2004). Raman Spectroscopy of Carbon Nanotubes. Physics Reports.

Linear Algebra in Artificial Intelligence: Theory, Applications and Emerging Innovations

Mr. Amit Ankush Nalavde
Assistant Professor Dada Patil Mahavidyalaya Karjat Dist. Ahilyanagar

Abstract:

Linear algebra forms a fundamental basis for modern artificial intelligence and machine learning by providing mathematical tools for representing, transforming, and analysing data efficiently. AI systems rely heavily on vectors and matrices to encode and process large volumes of information used in tasks such as machine learning, deep learning, and pattern recognition. Core concepts including matrix operations, eigenvalues, eigenvectors, and singular value decomposition (SVD) play essential roles in dimensionality reduction, algorithm optimization, and computational efficiency. These techniques support applications such as neural networks, recommendation systems, and computer vision, enabling models to learn patterns and make accurate predictions. The paper also emphasizes that linear algebra helps manage high-dimensional data and improves algorithm performance while reducing computational costs. Furthermore, as AI technologies continue to evolve, linear algebra remains central to advancing next-generation AI systems by enabling scalable and efficient models capable of solving complex real-world problems across scientific, industrial, and technological domains.

Keywords:

Linear Algebra, Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Matrices, Vectors, Singular Value Decomposition (SVD), Eigenvalue Decomposition, Neural Networks, Optimization.

Introduction:

Linear algebra is a fundamental branch of mathematics that plays a central role in modern artificial intelligence by enabling efficient representation and manipulation of data through structures such as vectors and matrices. AI systems frequently operate on high-dimensional data derived from images, text, and sensor inputs, and linear algebra provides the framework required to transform, analyse, and optimize this information. Techniques such as matrix operations, eigenvalue decomposition, and singular value decomposition (SVD) are critical in tasks like dimensionality reduction, feature extraction, and improving computational efficiency, which are essential for scalable machine learning and deep learning models. Whether training neural networks or processing large datasets, linear algebra allows algorithms to learn patterns, make predictions, and optimize performance effectively. This paper highlights how these mathematical principles support a wide range of AI applications, including machine learning, deep learning, computer vision, and data processing systems, demonstrating that linear algebra remains indispensable for building efficient, accurate, and scalable AI technologies capable of addressing complex real-world problems and advancing innovation across scientific and industrial domains.

Aim:

The aim of this research is to leverage Artificial Intelligence to develop simplified, high-precision instructional content that makes the complex art of calligraphy more accessible to learners. Furthermore, the study evaluates how these AI-driven tools enhance hands-on skill application and measurably improve overall student performance and mastery.

Importance of Linear Algebra in AI Systems

Linear algebra is essential to AI systems because it provides the mathematical tools needed to represent, transform, and process data efficiently. In artificial intelligence, data such as images, text, and signals are expressed as vectors and matrices, allowing algorithms to analyse patterns and learn from large datasets. Core operations like matrix multiplication and vector transformations form the basis of machine learning and deep learning models, particularly neural networks, where data passes

through layers of linear computations to produce predictions. Linear algebra also enables dimensionality reduction techniques that simplify complex data while preserving important information, thereby improving computational efficiency and model performance. Furthermore, optimization processes used in training AI models depend heavily on matrix operations to adjust parameters and reduce errors. As AI applications continue to grow in scale and complexity, linear algebra remains indispensable for developing accurate, efficient, and scalable systems capable of solving real-world problems across diverse technological and scientific fields.

Vectors and Matrices in AI:

In AI, vectors and matrices are the fundamental structures that turn raw data into a mathematical language the computer can process:

- **Vectors (Data Points):** A vector is a single-column list of numbers representing an object's features. For example, a single image is converted into a feature vector where each number represents a pixel's brightness.
- **Matrices (Datasets):** A matrix is a grid that stacks many vectors together. In a typical AI dataset, each row is a unique data point (like a customer), and each column is a feature (like age or income). This allows the AI to "see" the entire dataset as one mathematical object.
- **Transposition & Inversion:** These operations are used to flip or "undo" transformations, which is critical for training models and solving complex linear equations.
- **Transformations:** AI can compress, stretch, or rotate data by multiplying a vector with a matrix. Principal Component Analysis (PCA) and other techniques "squash" high-dimensional data into a more digestible format while maintaining the most important patterns.

Principal Component Analysis (PCA):

AI uses Principal Component Analysis (PCA), a linear algebra approach, to minimize the "dimensionality" (the number of variables) of huge datasets while preserving the most crucial information.

- **Compression:** It turns a dataset with 100 variables into one with 3 or 4, making it much faster for a machine learning model to process.
- **Noise Reduction:** By focusing only on the directions with the most variance, PCA ignores small, random fluctuations (noise) that can confuse an AI.
- **Visualization:** It allows researchers to take "high-dimensional" data (which humans can't visualize) and squash it down into a 2D or 3D graph to see clusters and patterns.

Singular Value Decomposition (SVD):

In AI, Singular Value Decomposition (SVD) acts as a "Swiss Army Knife" for data analysis, breaking any matrix $\boldsymbol{A}$ into three parts: $\boldsymbol{U}$ (left singular vectors), Σ (singular values), and V^T (right singular vectors).

Here is how SVD is applied across various AI fields:

- **Recommendation Systems:** SVD powers "Collaborative Filtering" for platforms like Netflix. It decomposes sparse user-item grids to uncover latent factors (hidden categories like "Sci-Fi" or "Action"), allowing the AI to predict ratings for movies a user hasn't seen yet.
- **Dimensionality Reduction:** By keeping only the most significant singular values, SVD reduces the size of massive datasets. This retains the essential features of the data while drastically lowering the computational power required for training.
- **Image Compression:** SVD approximates images by storing only the top singular values in the Σ matrix. Discarding the smaller values allows the AI to represent a high-quality image using only a fraction of the original file size.
- **Natural Language Processing (LSA):** Through Latent Semantic Analysis, SVD helps computers understand context. It identifies hidden relationships between words (like "dog" and "canine") by analysing their distribution across different documents.

- **Noise Reduction and Data Cleaning:** Since the smallest singular values typically represent random noise, "truncating" the SVD (removing the tail end of the Σ matrix) allows an AI to "clean" the data, leading to more accurate model predictions

Neural Networks:

Neural networks rely on two core linear algebra processes to function and improve:

- **Forward Propagation (Data Processing):** The network treats input data as vectors and passes them through layers using matrix multiplication ($W \cdot x + b$). These operations act as linear transformations that map raw features (like pixels) into abstract concepts (like "cat" or "dog") by filtering them through a weight matrix.
- **Backpropagation (Optimization):** To learn from mistakes, the network uses matrix calculus to calculate **gradients** of the loss function. It then propagates these error signals backward through the layers to update the weight matrices via matrix addition, systematically "tuning" the model's parameters to increase accuracy over time.

Natural Language Processing (NLP):

In Natural Language Processing (NLP), linear algebra allows computers to understand human language by treating words as points in a multidimensional space:

- **Word Embeddings (Vectorization):** Techniques like Word2Vec or TF-IDF convert words into high-dimensional vectors. This mathematical representation captures semantic meaning; for instance, synonyms are placed close together in the vector space, allowing the AI to "calculate" relationships between concepts.
- **Semantic Analysis & Retrieval:** AI systems use Cosine Similarity to measure the angle between these vectors. By calculating the dot product, the system can determine how closely related two pieces of text are, which is the core logic behind modern search engines and document retrieval.
- **Latent Semantic Analysis (LSA):** By applying Singular Value Decomposition (SVD) to a large matrix of words and documents, LSA identifies hidden (latent) concepts. This process removes noise and reveals underlying themes, helping the AI understand that "canine" and "dog" refer to the same concept even if the specific words differ.

Data Transformation:

In AI, data transformation is the process of using linear algebra to reshape raw information into a format the computer can analyse:

- **Vectorization and Mapping:** Raw data (like pixels or words) is first converted into feature vectors. Matrix multiplication then acts as a linear transformation, rotating, scaling, or stretching these vectors in a multi-dimensional space to reveal hidden structures and relationships.
- **Feature Separation and Extraction:** Through operations like Principal Component Analysis (PCA) or neural network layering, the AI warps the data space. This "stretches" the differences between categories, making it easier for the model to draw a boundary between different classes, such as distinguishing a "cat" from a "dog."

Data Representation:

At its most fundamental level, AI bridges the gap between human perception and machine logic through the language of Linear Algebra. This translation happens in two primary ways:

- **Feature Vectors (Mapping Reality):** AI converts every input—whether it's a single pixel, a word, or a medical record—into a feature vector. This maps the object into a multi-dimensional mathematical space where its characteristics become specific coordinates.
- **High-Dimensionality and Similarity:** In modern AI (like Large Language Models), a single data point might exist in a 1,536-dimensional space. Linear Algebra allows the AI to navigate this complexity by using Dot Products and Cosine Similarity to calculate the mathematical "distance" or relationship between these points. This is how a machine "understands" that two different words or images share a similar meaning.

Gradient Descent and Optimization:

In AI, Gradient Descent is the mathematical process of minimizing error. It uses linear algebra to efficiently navigate through millions of parameters to find the most accurate version of a model:

- **The Gradient as a Compass:** The gradient is a vector that represents the direction of the steepest increase in the model's error (the loss function). To improve, the AI moves in the exact opposite direction of this vector. By calculating this for every weight in a network, the system knows exactly which "knobs" to turn to reduce mistakes.
- **Efficient Matrix Updates:** In deep learning models with billions of parameters, calculating these changes individually would be impossible. Instead, AI uses matrix operations to compute all gradients simultaneously across entire layers. These updates are then applied through matrix subtraction, allowing the model to "step" toward the global minimum of the error landscape at high speed.

Solving Systems of Linear Equations in AI:

In AI, solving systems of linear equations is the engine behind finding the "optimal" settings for a model. It involves determining the unknown weights that best map a set of inputs to the correct outputs.

- **Finding the Best Fit:** In tasks like Linear Regression, the AI looks at its input data and tries to find a set of weights that perfectly connects the inputs to the correct answers. It is essentially solving for x in the equation $Ax = b$, where x represents the "rules" the AI is trying to learn.
- **Simplifying Complex Math:** Because AI deals with millions of data points, it uses shortcuts like LU Decomposition or Gaussian Elimination. These methods break one big, complicated problem into smaller, triangular pieces that are much faster for a computer to solve.

Eigenvalues and Eigenvectors in AI.

Eigenvalues and eigenvectors act as the mathematical "skeleton" of a dataset, helping AI models identify the most important patterns:

- **Identifying Core Directions (Eigenvectors):** These are the specific directions in a dataset that remain unchanged (only stretched or shrunk) during a linear transformation. In AI, they represent the "principal axes" or the most significant features of the data, such as the defining shapes in a human face (Eigenfaces).
- **Measuring Importance (Eigenvalues):** These are the scalar values that tell the AI how much "variance" or information exists along each eigenvector. By keeping only the vectors with the largest eigenvalues, techniques like Principal Component Analysis (PCA) can compress massive datasets while throwing away the "noise" represented by small eigenvalues.

Neural Networks and Deep Learning:

Neural Networks are high-speed "math engines" that use linear algebra to process information and learn from mistakes.

- **Processing Information (Forward Pass):** Think of each layer in a network as a filter (a Matrix). When you give the AI an input (like an image), it treats that data as a list of numbers (a Vector). The AI performs matrix multiplication to pass that vector through these filters, which helps it recognize patterns like edges, textures, or objects.
- **Learning from Mistakes (Backpropagation):** If the AI guesses wrong, it uses matrix calculus to figure out which parts of its "filters" were responsible for the error. It then uses matrix addition to slightly adjust millions of numbers at once. This constant "tuning" of matrices is what makes the AI get smarter over time.

Future Directions and Recommendations

- Use linear algebra with new technologies like quantum computing to make AI faster and smarter.
- Apply linear algebra in healthcare, finance, and energy to improve predictions and efficiency.
- Improve image and video processing using linear algebra techniques.
- Teach linear algebra strongly in AI education to support future innovations.

- Combine quantum computing and linear algebra to make AI much faster and solve complex problems.
- Use matrix-based methods to improve healthcare, economic predictions, and energy management.
- Make linear algebra a practical core part of AI education for future innovators.
- Use advanced mathematics to make AI decisions clearer, safer, and more trustworthy.

Conclusion:

Linear algebra plays a vital role in artificial intelligence by enabling efficient data representation, transformation and computation required for intelligent systems to learn and make decisions. Its applications in machine learning, deep learning, optimization and computer vision demonstrate its essential contribution to modern AI technologies. Techniques derived from linear algebra support model training, data processing, and performance improvement across diverse AI domains. As AI continues to evolve, further research into advanced linear algebra methods and their applications in emerging areas such as quantum computing and AI-driven automation will be crucial for developing more powerful and efficient intelligent systems, ensuring continued technological progress and innovation.

References

1. Aggarwal, C. C. (2020). Linear Algebra and Optimization for Machine Learning. Springer International Publishing.
2. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
3. Brownlee, J. (2018). Basics of Linear Algebra for Machine Learning. Machine Learning Mastery.
4. Gentle, J. E. (2007). Matrix Algebra. Springer.
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
6. Ms.Ismat Fatima Basit Husain Rizv(2025), The Role Of Linear Algebra In The Mathematical Foundations Of Artificial Intelligence, International Journal of Creative Research Thoughts (IJCRT), Volume 13, ISSN: 2320-2882, k253-255
7. Murphy, K. P. (2012). Machine Learning: A Probabilistic Perspective. MIT Press.
8. Olver, P. J., & Shakiban, C. (2006). Applied Linear Algebra. Prentice Hall.
9. Raja Mohammad Elbarjo, Abdelsalam Abuzreda, Omar AL-Sammarraie, EnasHelal Alhrir, Huda khaleelalfarrah (2025), The Role of Linear Algebra in Artificial Intelligence: Foundations, Applications, and Innovations, International Journal of Engineering Inventions, e-ISSN: 2278-7461, p-ISSN: 2319-6491, Volume 14, 21-23
10. Sarker, I. H. (2022). AI-based modelling: Techniques, applications, and research issues towards automation, intelligent and smart systems. SN Computer Science, 3(2), 158.
11. Strang, G. (2016). Introduction to Linear Algebra. 5th Edition. Wellesley-Cambridge Press.
12. Thomson, R., & Anderson, J. (2021). Bridging the gap: Big data's influence on AI algorithms and models. EPH-International Journal of Science and Engineering, 7(4), 52-56.
13. Zhang, X. D. (2020). A Matrix Algebra Approach to Artificial Intelligence. Cambridge University Press.

Phytochemical Screening and Ethnobotanical Utilization of *Nathulina candida* from Tribal Communities of Chikhaldara Region in the Landscape of Melghat Forest

Akash G. Dhotre
Research Scholar
Dr. R. S. Dhande
Professor at Department of Botany, Shri R. R. Lahoti Science College, Morshi, Dist. Amravati

Abstract

Ethnobotanical knowledge preserved among indigenous communities provides valuable information regarding medicinal plant resources and their therapeutic potential. The present study investigates qualitative phytochemical constituents and traditional medicinal uses of *Nathulina candida*, a pteridophyte species growing in forest habitats of the Chikhaldara region. Field surveys were conducted in tribal villages to document ethnomedicinal uses through interviews and participatory observations. Plant samples were collected, processed and extracted using Soxhlet extraction with acetone, petroleum ether, ethanol and aqueous solvents. Preliminary phytochemical screening revealed the presence of proteins, reducing sugars, alkaloids, phenolic compounds, flavonoids, terpenoids, steroids, and saponins. Ethnobotanical data indicated the use of the plant in treatment of skin infections, wound healing, fever management and digestive disorders. The correlation between traditional usage and presence of bioactive phytoconstituents suggests significant pharmacological potential of the species. The study emphasizes conservation of indigenous knowledge and further scientific validation of the medicinal properties of this pteridophyte.

Keywords: ***Nathulina candida,*** **Phytochemicals, Ethnobotany, Melghat**

Introduction

Ethnobotany is an interdisciplinary field that examines the dynamic relationships between human cultures and plant resources, particularly the use of medicinal plants in traditional healthcare systems. Indigenous communities residing in forest ecosystems have historically relied on surrounding vegetation for the treatment of various ailments, forming a knowledge system that is culturally embedded and transmitted across generations. In the Melghat region of Amravati district, Maharashtra, tribal groups such as the Korku tribe and the Gond tribe continue to depend substantially on forest flora for primary healthcare needs. Ethnobotanical surveys from Melghat have documented numerous plant species used traditionally for treating common diseases, highlighting the ecological and cultural significance of indigenous medicinal knowledge and the urgent need for systematic scientific documentation and conservation (Wagh & Jain, 2018; Patil & Patil, 2012).

Pteridophytes, though often overlooked compared to angiosperms, represent a valuable reservoir of bioactive compounds. Many fern species have been reported to possess antimicrobial, anti-inflammatory and antioxidant properties due to the presence of diverse secondary metabolites (Rout et al., 2009).

The tribal communities inhabiting the forested and mountainous landscapes of the Melghat region in Amravati district, Maharashtra possess rich traditional knowledge regarding the medicinal applications of forest flora, including pteridophytes, which forms an integral component of their primary healthcare system. Among these communities, particularly the Korku tribe and the Gond tribe, ethnomedicinal practices are transmitted orally across generations and remain deeply embedded in cultural traditions. Ethnobotanical investigations conducted in Melghat have documented extensive use of medicinal plants by tribal populations for treating various ailments, emphasizing the importance of systematic documentation and conservation of indigenous knowledge (Patil & Patil, 2012; Wagh & Jain, 2018). *Nathulina candida*, commonly distributed on moist rocky substrates and shaded forest floors of the study area, is traditionally utilized by local healers for therapeutic purposes; however,

detailed scientific validation of its pharmacological properties remains limited, reflecting a broader gap in research on ethnomedicinal pteridophytes in central India (Singh & Upadhyay, 2014).

Earlier investigations have indicated that qualitative phytochemical screening serves as an essential preliminary approach for identifying bioactive secondary metabolites responsible for therapeutic efficacy in medicinal plants (Yadav & Agarwala, 2011). Therefore, the present study aims to integrate ethnobotanical documentation with phytochemical evaluation in order to scientifically validate the traditional medicinal knowledge associated with *Nathulina candida* and to explore its potential pharmacological significance.

1. Materials and Methodology

2.1 Ethnobotanical Survey

Field surveys were conducted in tribal settlements surrounding forest zones of the study area during 2024–2025. Ethnobotanical data were collected through semi-structured interviews, group discussions, and direct interaction with traditional healers and elderly tribal informants. Information regarding local name, plant part used, preparation methods, and therapeutic applications was documented. Consent of informants was obtained prior to data collection.

2.2 Collection and Processing of Plant Material

Healthy specimens of *Nathulina candida* were collected from natural forest habitats. The plant material was washed thoroughly using running tap water followed by distilled water to remove debris and contaminants. The material was shade dried at ambient temperature to preserve phytochemical integrity and powdered using mechanical grinding.

2.3 Preparation of Plant Extract

Powdered plant material was extracted using Soxhlet apparatus with four solvents:

- Acetone
- Ethanol
- Petroleum ether
- Distilled water

Extraction continued until solvent clarity was achieved. Extracts were concentrated and preserved for phytochemical screening.

2.4 Qualitative Phytochemical Analysis

Standard phytochemical tests were performed using established procedures described by Kokate (2001) and Tiwari et al. (2011) to detect major secondary metabolites including alkaloids, flavonoids, terpenoids, steroids, phenolics, glycosides, and saponins.

1. Results

3.1 Ethnobotanical Findings

The tribal communities reported several medicinal applications of *Nathulina candida*. The plant is locally collected from forest regions and utilized in traditional herbal preparations. Documented ethnomedicinal uses include:

- Fresh leaf paste applied externally for wound healing and skin infections
- Decoction prepared from plant material consumed to reduce fever
- Plant paste used as anti-inflammatory agent for joint pain
- Oral consumption of diluted extract used for relief from digestive disorders
- Crushed plant material applied to minor cuts and insect bites

Traditional healers reported that the plant is usually harvested during monsoon season when vegetative growth is abundant. Preparation methods mainly involve crushing fresh plant material or boiling in water to prepare decoction.

3.2 Phytochemical Screening Results

Phytochemical Constituent	Acetone	Petroleum Ether	Ethanol	Aqueous
Protein	+	+	+	-
Amino Acid	-	-	-	-
Reducing Sugar	+	+	+	+

Alkaloids (Mayer's)	+	-	+	+
Alkaloids (Wagner's)	+	+	+	+
Alkaloids (Hager's)	-	-	-	+
Phenolic Compounds	+	+	+	+
Tannins	-	-	-	-
Flavonoids	+	+	+	-
Phenols	-	-	-	-
Terpenoids	+	+	+	-
Steroids	+	+	+	-
Resins	-	-	-	-
Saponins	-	-	-	+

2. Discussion

The ethnobotanical survey revealed that *Nathulina candida* holds significant medicinal importance among tribal populations. Traditional applications such as wound healing and treatment of skin infections may be associated with the presence of alkaloids and phenolic compounds, which are known to possess antimicrobial properties (Cowan, 1999).

The detection of flavonoids supports antioxidant and anti-inflammatory activities, correlating with the plant's usage in treatment of fever and joint pain. Terpenoids and steroids identified in organic solvent extracts suggest potential anti-inflammatory and immunomodulatory effects (Mahato & Sen, 1997).

The occurrence of saponins in aqueous extracts aligns with traditional decoction-based preparations used by tribal healers. Saponins are known for their antimicrobial and expectorant properties which support ethnomedicinal applications in digestive and respiratory ailments.

The absence of tannins in the present study may be attributed to species-specific phytochemical variation or environmental factors influencing metabolite synthesis. The integration of traditional knowledge with phytochemical validation strengthens the potential medicinal significance of this pteridophyte.

Conclusion

The study demonstrates that *Nathulina candida* is an ethnomedicinally valuable pteridophyte utilized by tribal communities for treatment of multiple ailments. Qualitative phytochemical screening confirmed the presence of several bioactive constituents supporting traditional therapeutic applications. The study highlights the importance of conserving indigenous knowledge systems and suggests further pharmacological and quantitative evaluation for drug development potential.

Bibliography

1. Cowan, M.M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, 12(4), 564–582.
2. Kokate, C.K. (2001). *Pharmacognosy*. Nirali Prakashan, Pune.
3. Mahato, S.B. and Sen, S. (1997). Advances in triterpenoid research. *Phytochemistry*, 44(7), 1185–1236.
4. Patil, S. H., & Patil, D. A. (2012). Ethnomedicinal plants of Melghat forest, Amravati district, Maharashtra. *International Journal of Plant Sciences*, 7(2), 275–280.
5. Rout, S.D., Panda, T., and Mishra, N. (2009). Ethnomedicinal studies on pteridophytes of Eastern India. *Indian Journal of Traditional Knowledge*, 8(2), 191–195.
6. Singh, S., & Upadhyay, R. (2014). Ethnomedicinal uses of pteridophytes in India: A review. *Journal of Medicinal Plants Studies*, 2(4), 87–93.
7. Tiwari, P., Kumar, B., Kaur, M., Kaur, G., and Kaur, H. (2011). Phytochemical screening and extraction techniques of medicinal plants. *International Journal of Pharmaceutical Sciences*, 1(1), 98–106.
8. Wagh, V. V., & Jain, A. K. (2018). Ethnobotanical studies on medicinal plants used by tribal communities of Melghat region, Maharashtra, India. *Indian Journal of Traditional Knowledge*, 17(1), 156–164.
9. Yadav, R.N.S. and Agarwala, M. (2011). Phytochemical analysis of some medicinal plants. *Journal of Phytology*, 3(12), 10–14.

GC-MS Profiling of Ethanolic Extracts of Root, Phylloclade and Flower of *Pereskia grandiflora* Pfeiff. and *Echinocactus grusonii* Hildm. (Cactaceae) from Amravati Region, Maharashtra, India.

Mrs. Apurva Anil Chunade
Research Scholar
Dr. P. N. Pawade
Head And Professor of Department of Botany At Shrimati Narsamma Art, Science And Commerce College, Amravati.

Abstract

Plants belonging to the family Cactaceae are known for their rich reservoir of secondary metabolites possessing medicinal and therapeutic importance. The present study aimed to investigate phytochemical constituents present in ethanolic extracts of root, phylloclade and flower of *Pereskia grandiflora* Pfeiff. and *Echinocactus grusonii* Hildm. collected from Amravati region of Maharashtra using Gas Chromatography - Mass Spectrometry (GC-MS) analysis. The GC-MS profiling revealed the presence of several bioactive compounds such as fatty acid esters, aldehydes, alcohols, hydrocarbons, phenolic derivatives and nitrogen-containing compounds. Major phytoconstituents detected in *Pereskia grandiflora* included 2-hexadecanol and hexanoic acid ethyl ester, while *Echinocactus grusonii* extracts were dominated by compounds such as triethyl citrate, trimethyl pentanediol derivatives and substituted phenolic compounds. The identified compounds are reported to possess antioxidant, antimicrobial, anti-inflammatory and pharmacological activities. The present study highlights the phytochemical richness and medicinal potential of selected cactus species and provides baseline data for further drug discovery studies.

Keywords: Cactaceae, GC-MS analysis, Secondary metabolites, *Pereskia grandiflora*, *Echinocactus grusonii*, Ethanolic extract, Phytochemical screening

Introduction

Medicinal plants are important sources of natural bioactive compounds widely utilized in traditional and modern healthcare systems. The family Cactaceae comprises approximately 1,500 species known for their adaptability to arid environments and significant medicinal properties (Nobel, 2002). Several cactus species have been traditionally used for treatment of inflammation, wounds, infections and metabolic disorders.

Pereskia grandiflora Pfeiff. is considered a primitive cactus species exhibiting leafy characteristics and is known for its ethnomedicinal applications. *Echinocactus grusonii* Hildm., commonly known as golden barrel cactus, is widely cultivated as ornamental plant but limited phytochemical investigations have been reported.

GC-MS analysis has emerged as a powerful analytical tool for identification of volatile and semi-volatile phytochemicals present in plant extracts (Pavia et al., 2009). Phytochemical profiling of cactus species contributes to understanding their medicinal value and pharmacological potential. The present investigation was undertaken to analyze phytochemical composition of ethanolic extracts of selected plant parts of *Pereskia grandiflora* and *Echinocactus grusonii* from Amravati region.

Materials and Methodology

Collection of Plant Material

Fresh plant samples including root, phylloclade and flower of *Pereskia grandiflora* Pfeiff. and *Echinocactus grusonii* Hildm. were collected from cultivated populations in Amravati district, Maharashtra, India. The plant materials were taxonomically authenticated using the senior taxonomist and regional floras.

Preparation of Ethanolic Extract

Collected plant materials were washed, shade dried and powdered. Approximately 25 g of powdered plant material was subjected to Soxhlet extraction using ethanol as solvent for 6 - 8 hours. The extracts were filtered and concentrated under reduced pressure and stored at 4°C for further analysis.

GC-MS Analysis

GC-MS analysis was performed using standard operating conditions. Helium gas was used as carrier gas with constant flow rate. The temperature of GC oven was programmed from 60°C to 280°C. Identification of compounds was performed by comparing mass spectra with standard NIST library database and retention time indices.

RESULTS

- **Phytochemical Profiling of *Pereskia grandiflora***

Table 1A - GC-MS profile of phytochemical constituents identified in the ethanolic root extract of *Pereskia grandiflora* Pfeiff.

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
1	15.279	2-Hexadecanol	$C_{16}H_{34}O$	242	1.2E+07	29.322
2	15.376	2-Hexadecanol	$C_{16}H_{34}O$	242	548920	13.4562
3	15.46	2-Hexadecanol	$C_{16}H_{34}O$	242	6003942	14.7187
4	15.862	Cyclohexane, hexyl-	$C_{12}H_{24}$	168	7380488	18.0933
5	17.337	2-Heptadecanol	$C_{17}H_{36}O$	256	5181978	12.7037
6	21.681	Acetamide, N-[2-(3-ethyl-1-methyl-9H-carbazol-2-yl)ethyl]-N-methyl-	$C_{20}H_{24}N_2O$	308	4775054	11.7061
Total					**40791164**	**100**

Table 1B - GC–MS profile of phytochemical constituents identified in the ethanolic Phylloclade extract of *Pereskia grandiflora* Pfeiff.

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
1	4.638	Silane, diethylmethyl-	$C_5H_{14}Si$	102	2472434980	39.922
2	5.047	2-Butenal, 2-ethenyl-	C_6H_8O	96	31258531	5.047
3	11.787	(-)-Methyl-3,3-dimethylcyclopropane-1,trans-2-dicarboxylate	$C_8H_{12}O_4$	186	10774134	1.740
4	14.101	3,3-Diethoxy-1-propanol, propyl ether	$C_{10}H_{22}O_3$	190	3300371200	53.291
Total					5814838845	100

Table 1C - GC–MS profile of phytochemical constituents identified in the ethanolic flower extract of *Pereskia grandiflora* Pfeiff.

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
1	3.93	Butanoic acid, ethyl ester	$C_6H_{12}O_2$	116	43943572	24.8581
2	5.913	1-Butanol, 3-methyl-, acetate	$C_7H_{14}O_2$	130	56345365	3.1874
3	6.765	Pentanoic acid, ethyl ester	$C_7H_{14}O_2$	130	125404528	7.0939
4	10.581	Pentane, 1-(1-ethoxyethoxy)	$C_9H_{20}O_2$	160	149187568	8.4393
5	11.667	Hexanoic acid, ethyl ester	$C_8H_{16}O_2$	144	727490636	41.1528
6	13.997	Heptanoic acid, ethyl ester	$C_9H_{18}O_2$	158	45748591	2.5879
7	15.362	Dodecane	$C_{12}H_{26}$	170	141720945	8.0169
8	16.464	Nonanoic acid, ethyl ester	$C_{11}H_{22}O_2$	186	10522287	0.5952
9	17.404	Ethanol, 2-(octadecyloxy)	$C_{20}H_{42}O_2$	314	21805814	1.2335
10	19.124	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	$C_{16}H_{30}O_4$	286	50118886	2.8351
Total					**1,370,000,000**	**100**

GC-MS analysis of the ethanolic root extract revealed the presence of six phytoconstituents, among which 2-Hexadecanol was identified as the predominant compound with multiple peak occurrences, indicating its abundance in the root extract. Other compounds detected in the root included Cyclohexane, hexyl-, 2-Heptadecanoland Acetamide derivative, suggesting the presence of long-chain alcohols, hydrocarbonsand nitrogen-containing compounds that may contribute to various biological activities.

The phylloclade extract exhibited four phytochemical constituents namely Silane, diethylmethyl-, 2-Butenal, 2-ethenyl-, (-)-Methyl-3,3-dimethylcyclopropane-1,trans-2-dicarboxylateand 3,3-Diethoxy-1-propanol propyl ether. The presence of silane derivatives and oxygenated organic compounds indicates possible antioxidant and industrially significant phytoconstituents.

The flower extract revealed a comparatively higher diversity of phytochemical constituents, including Butanoic acid ethyl ester, 1-Butanol 3-methyl acetate, Pentanoic acid ethyl ester, Pentane derivative, Hexanoic acid ethyl ester, Heptanoic acid ethyl ester, Dodecane, Nonanoic acid ethyl ester, Ethanol 2-(octadecyloxy)and 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate. The predominance of fatty acid esters and hydrocarbon derivatives in the flower extract suggests their potential role in antimicrobial, anti-inflammatoryand antioxidant activities.

- **Phytochemical Profiling of *Echinocactus grusonii***

Table 2A - GC–MS profile of phytochemical constituents identified in the ethanolic root extract of *Echinocactus grusonii* Hildm.

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
1	4.748	3-Nitropropanoic acid	$C_3H_5NO_4$	119	34821297	18.1771
2	15.274	2-Hexadecanol	$C_{16}H_{34}O$	242	18500853	9.6577
3	15.366	Ethanol, 2-(octadecyloxy)	$C_{20}H_{42}O_2$	314	10487128	5.4744
4	15.459	Cyclohexane, 1,1'-dodecylidenebis[4-]	$C_{26}H_{50}$	362	6809914	3.5549
5	15.856	Cyclohexane, hexyl-	$C_{12}H_{24}$	168	10216900	5.3333
6	17.343	5-Octadecenal	$C_{18}H_{34}O$	266	9622200	5.0229
7	18.992	4-Octadecenal	$C_{18}H_{34}O$	266	6921927	3.6133
8	19.126	2,2,4-Trimethyl-1,3-pentanediol	$C_8H_{18}O_2$	146	49653734	25.9198
9	19.586	Triethyl citrate	$C_{12}H_{20}O_7$	276	13573204	7.0854
10	21.685	1,2-Benzenedicarboxylic acid, butyl octyl ester	$C_{20}H_{30}O_4$	314	30959311	16.1611
Total					191566468	100

Table 2B - GC–MS profile of phytochemical constituents identified in the ethanolic Phylloclade extract of *Echinocactus grusonii* Hildm.

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
1	15.256	2-Hexadecanol	$C_{16}H_{34}O$	242	20268800	0.8913
2	15.844	Cyclohexane, hexyl-	$C_{12}H_{24}$	168	12382839	0.5445
3	16.09	Cycloheptasiloxane, tetradecamethyl	$C_{14}H_{42}O_7Si_7$	518	56420764	2.4809
4	17.335	4-Octadecenal	$C_{18}H_{34}O$	266	1958799	0.8613
5	18.445	2-[4-(2-Hydroxy-phenyl)-thiazol-2-yl]-5-phenylpenta-2,4-dienenitrile	$C_{20}H_{14}N_2OS$	330	2041708975	89.7771
6	18.988	1-Octadecanol	$C_{18}H_{38}O$	270	27443905	1.2068
7	19.043	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	$C_{16}H_{30}O_4$	286	69095882	3.0384
8	20.444	4-Octadecenal	$C_{18}H_{34}O$	266	27285790	1.1998
Total					2256565754	100

Table 2C - GC–MS profile of phytochemical constituents identified in the ethanolic flower extract of *Echinocactus grusonii* Hildm.

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
1	3.973	Butanoic acid, ethyl ester	$C_6H_{12}O_2$	116	15498736	24.5157

Peak No.	Retention Time	Name of Compound	Molecular Formula	Molecular Weight	Area of Peak	Probability Percent of Area
2	4.709	Silane, diethylmethyl	$C_5H_{14}Si$	102	109433207	17.3097
3	5.98	Acetic acid, pentyl ester	$C_7H_{14}O_2$	130	17058104	2.6982
4	6.835	Pentanoic acid, ethyl ester	$C_7H_{14}O_2$	130	47500428	7.5134
5	10.646	Dodecanoic acid, 2,3-bis(acetoxy)propyl ester	$C_{20}H_{36}O_6$	358	40390544	6.3888
6	11.71	Hexanoic acid, ethyl ester	$C_8H_{16}O_2$	144	13591936	21.4992
7	14.012	Cyclopropanetetradecanoic acid, 2-octyl-, methyl ester	$C_{26}H_{50}O_2$	394	7763945	1.2281
8	15.368	Dodecane	$C_{12}H_{26}$	170	44756525	7.0794
9	16.464	Nonadecanoic acid, ethyl ester	$C_{21}H_{42}O_2$	326	3668498	0.5803
10	17.404	2-Myristynoyl pantetheine	$C_{25}H_{48}N_2O_5S$	484	8574691	1.3563
11	18.441	2,4-Di-tert-butylphenol	$C_{14}H_{22}O$	206	14758818	2.3340
12	19.126	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	$C_{16}H_{30}O_4$	286	47396903	7.4969
Total					370392335	100

The GC-MS analysis of the ethanolic root extract revealed the presence of ten phytochemical constituents including 3-Nitropropanoic acid, 2-Hexadecanol, Ethanol 2-(octadecyloxy), Cyclohexane derivatives, 5-Octadecenal, 4-Octadecenal, 2,2,4-Trimethyl-1,3-pentanediol, Triethyl citrateand 1,2-Benzenedicarboxylic acid butyl octyl ester. The occurrence of long-chain aldehydes, fatty alcoholsand ester derivatives indicates potential antimicrobial, antioxidantand industrially significant bioactive properties.

The phylloclade extract exhibited eight phytochemical compounds including 2-Hexadecanol, Cyclohexane hexyl derivative, Cycloheptasiloxane tetradecamethyl, 4-Octadecenal, substituted thiazole derivative, 1-Octadecanoland 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate. The dominance of substituted thiazole derivative suggests the presence of biologically active heterocyclic compounds which may contribute to pharmacological activities.

The flower extract revealed twelve phytochemical constituents comprising Butanoic acid ethyl ester, Silane diethylmethyl, Acetic acid pentyl ester, Pentanoic acid ethyl ester, Dodecanoic acid 2,3-bis(acetoxy)propyl ester, Hexanoic acid ethyl ester, Cyclopropanetetradecanoic acid methyl ester, Dodecane, Nonadecanoic acid ethyl ester, 2-Myristynoyl pantetheine, 2,4-Di-tert-butylphenoland 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate. The predominance of fatty acid esters, hydrocarbon derivativesand phenolic compounds indicates significant pharmacological potential including antioxidant, antimicrobialand anti-inflammatory properties.

Discussion

The GC-MS analysis of ethanolic extracts of *Pereskia grandiflora* and *Echinocactus grusonii* revealed the presence of diverse phytochemical compounds belonging to various chemical classes such as long-chain alcohols, fatty acid esters, aldehydes, hydrocarbons, phenolic compoundsand nitrogen-containing metabolites. In *Pereskia grandiflora*, the root extract was predominantly characterized by 2-hexadecanol along with other long-chain alcohols and nitrogenous compounds, indicating potential antimicrobial and antioxidant activities. The phylloclade extract contained silane derivatives and oxygenated organic compounds, suggesting possible industrial and antioxidant

relevance. The flower extract exhibited comparatively higher phytochemical diversity with fatty acid esters and hydrocarbon derivatives that are known for antimicrobial and anti-inflammatory properties.

Similarly, *Echinocactus grusonii* demonstrated significant phytochemical diversity across different plant parts. The root extract contained aldehyde derivatives, fatty alcoholsand ester compounds associated with antimicrobial and pharmaceutical applications. The phylloclade extract exhibited heterocyclic and siloxane compounds suggesting pharmacological importance, while the flower extract contained fatty acid esters and phenolic compounds such as antioxidant derivatives that contribute to cytoprotective and anti-inflammatory activities. Comparative analysis indicated organ-specific variation in metabolite accumulation, highlighting the medicinal significance and pharmacological potential of both cactus species.

Conclusion

The present investigation confirms that the ethanolic extracts of root, phyllocladeand flower of *Pereskia grandiflora* Pfeiff and *Echinocactus grusonii* Hildm. are rich sources of diverse phytochemical constituents with significant biological importance. GC-MS profiling revealed the presence of various bioactive compounds including long-chain alcohols, fatty acid esters, aldehydes, hydrocarbons, phenolic derivativesand nitrogen-containing compounds, which are known for their antimicrobial, antioxidantand anti-inflammatory properties. The variation in phytochemical composition among different plant parts suggests organ-specific accumulation of secondary metabolites. Overall, the findings provide scientific validation for the medicinal potential of these Cactaceae members and indicate their promising applications in pharmaceutical, nutraceuticaland therapeutic research.

References

1. Nobel, P. S. (2002). *Cacti: Biology and Uses*. University of California Press.
2. Pavia, D. L., Lampman, G. M., Kriz, G. S., & Vyvyan, J. A. (2009). *Introduction to Spectroscopy*. Cengage Learning.
3. Saxena, M., & Sharma, N. (2013). Phytochemical analysis and antimicrobial activity of medicinal plants. *International Journal of Pharmacy and Pharmaceutical Sciences*, 5(3), 457–461.
4. Evans, W. C. (2009). *Trease and Evans Pharmacognosy*. Saunders Elsevier.
5. Kumar, S., & Pandey, A. K. (2013). Chemistry and biological activities of flavonoids. *Scientific World Journal*, 2013, 162750.
6. Das, K., Tiwari, R. K. S., & Shrivastava, D. K. (2010). Techniques for evaluation of medicinal plant products. *Asian Journal of Plant Science*, 9, 56–62.

Community Structure of Benthic Fauna at A Selected Site of A Tropical River System in Maharashtra, India

Deepshri Vijay Soni
Dr. Vijay Bhimrao Bhagat
Department of Zoology, Shri Shivaji Arts Commerce And Science College, Akot. (MH) India

Abstract

Benthic fauna constitute an essential component of freshwater ecosystems and play a vital role in nutrient cycling, organic matter decomposition, and energy transfer within aquatic food webs. The present study examines the diversity and community composition of benthic fauna at a selected site of a tropical river system in Maharashtra, India. A total of 40 species belonging to ten major phyla were recorded. Arthropoda and Rotifera emerged as the dominant groups, followed by Mollusca, Protozoa, and Annelida. Among individual taxa, *Tubifex tubifex*, *Keratella cochlearis*, and *Brachionus calyciflorus* were particularly abundant. Diversity indices revealed high Shannon-Wiener diversity ($H' = 3.42$), high Simpson's diversity ($1\text{-}D = 0.96$), and high evenness ($J' = 0.92$), indicating a well-structured and relatively stable benthic community. The findings highlight the ecological importance of benthic organisms as bioindicators and underline the need for regular monitoring of freshwater ecosystems for sustainable management.

Keywords: Benthic fauna; biodiversity; community composition; tropical river system; freshwater ecology; bioindicators

Introduction

Freshwater ecosystems support a wide range of biological communities and provide important ecosystem services such as water purification, nutrient recycling, and fisheries production (Dudgeon *et al.*, 2006). Among these communities, benthic fauna organisms inhabiting the bottom sediments form a crucial component of aquatic ecosystems. They actively participate in organic matter decomposition, sediment mixing, and energy transfer within food webs (Covich *et al.*, 1999).

The composition and structure of benthic macroinvertebrate communities reflect prevailing environmental conditions and are therefore widely used in ecological assessment and biomonitoring (Rosenberg *and* Resh, 1993; Armitage *et al.*, 1983). Variations in species richness, abundance, and dominance patterns provide valuable information on habitat quality and the influence of human activities (Bonada *et al.*, 2006; Lenat *and* Resh, 2001).

Tropical river systems experience considerable environmental variability and are increasingly affected by agricultural runoff, domestic sewage, and land-use changes, all of which can alter benthic habitats and community structure (Allan, 2004). Several studies from Indian freshwater ecosystems have demonstrated close relationships between benthic community composition and environmental conditions (Ganguly *et al.*, 2018; Mishra *et al.*, 2013; Wanganeo *et al.*, 2011). However, information on benthic community structure from tropical river systems of Maharashtra remains limited. The present study therefore aims to assess the diversity and community composition of benthic fauna at a selected site of a tropical river system in Maharashtra, India.

Materials And Methods

Study Area

The present investigation was carried out at a selected sampling site of a tropical river system located in Maharashtra, India. The study area represents a freshwater habitat influenced by surrounding agricultural land and nearby human settlements. Such activities are known to contribute to nutrient input and exert moderate anthropogenic pressure on river ecosystems (Allan, 2004; Dudgeon *et al.*, 2006).

Sampling of Benthic Fauna

Benthic fauna were collected from shallow littoral zones and marginal areas using a hand-operated scoop net and a sediment sampler. Sampling was conducted during Year 1 of the study

period. To obtain representative samples, multiple subsamples were collected from different microhabitats such as sandy, muddy, and vegetated substrates, following standard benthic sampling procedures (Rosenberg *and* Resh, 1993).

The collected material was gently washed through a 500 µm mesh sieve to remove fine sediments and debris. The retained organisms were transferred into properly labeled sample bottles.

Preservation and Identification

Samples were preserved immediately in 70% ethanol to prevent decomposition. In the laboratory, organisms were sorted under a stereo-zoom microscope. Identification was carried out up to genus or species level using standard taxonomic keys and reference literature (Lenat *and* Resh, 2001). Wherever necessary, identification was confirmed with the help of published descriptions and illustrations.

Data Analysis

Species richness and total abundance were calculated from the collected data. Relative abundance (%) of each species was computed. Community diversity was evaluated using Shannon-Wiener Diversity Index (H′), Simpson's Diversity Index (1-D), and Pielou's Evenness Index (J′), which are commonly applied in benthic ecological studies (Rosenberg *and* Resh, 1993; Bonada *et al.*, 2006). The calculated indices were used to interpret the structure and stability of the benthic community.

RESULTS

A total of 40 species of benthic fauna belonging to ten major phyla were recorded from the selected site. Arthropoda represented the most dominant phylum, followed by Rotifera, Mollusca, Protozoa, and Annelida.

The most abundant species recorded were *Tubifex tubifex* (428 individuals), *Keratella cochlearis* (362), *Brachionus calyciflorus* (320), *Cypris subglobosa* (295), and *Paramecium caudatum* (293). Molluscan species such as *Bellamya bengalensis*, *Lamellidens marginalis*, and *Pila globosa* were also well represented.

The Shannon-Wiener diversity index (H′) was 3.42, indicating high species diversity. Simpson's diversity index (1-D) was 0.96, suggesting low dominance of any single species and a heterogeneous community. Pielou's evenness index (J′) was 0.92, reflecting a nearly uniform distribution of individuals among species.

Species Composition and Abundance Of Benthic Fauna

S.No	Phylum	Scientific Name	Count
1	Annelida	*Tubifex tubifex*	428
2	Annelida	*Limnodrilus hoffmeisteri*	225
3	Annelida	*Hirudo medicinalis*	215
4	Mollusca	*Bellamya bengalensis*	225
5	Mollusca	*Melanoides tuberculata*	196
6	Mollusca	*Corbicula striatella*	197
7	Mollusca	*Lymnaea acuminata*	228
8	Mollusca	*Lamellidens marginalis*	189
9	Mollusca	*Pila globosa*	173
10	Arthropoda	*Cypris subglobosa*	295
11	Arthropoda	*Heterocypris incongruens*	242
12	Arthropoda	*Gammarus pulex*	185
13	Arthropoda	*Daphnia pulex*	112
14	Arthropoda	*Moina macrocopa*	243

S.No	Phylum	Scientific Name	Count
15	Arthropoda	*Cyclops vernalis*	281
16	Arthropoda	*Diaptomus sicilis*	210
17	Nematoda	*Rhabditis marina*	136
18	Platyhelminthes	*Dugesia tigrina*	165
19	Rotifera	*Brachionus calyciflorus*	320
20	Rotifera	*Brachionus plicatilis*	254
21	Rotifera	*Keratella cochlearis*	362
22	Rotifera	*Keratella quadrata*	278
23	Rotifera	*Synchaeta pectinata*	293
24	Rotifera	*Filinia longiseta*	187
25	Rotifera	*Filinia terminalis*	242
26	Rotifera	*Lecane bulla*	251
27	Rotifera	*Lecane luna*	182
28	Protozoa	*Vorticella campanula*	244
29	Protozoa	*Epistylis plicatilis*	235
30	Protozoa	*Paramecium caudatum*	293
31	Protozoa	*Amoeba proteus*	218
32	Protozoa	*Euglena viridis*	254
33	Protozoa	*Strombidium sulcatum*	241
34	Protozoa	*Lecudina tuzetae*	156
35	Bryozoa	*Plumatella repens*	234
36	Cnidaria	*Hydra vulgaris*	157
37	Gastrotricha	*Chaetonotus maximus*	158
38	Tardigrada	*Hypsibius dujardini*	151
39	Nematomorpha	*Gordius aquaticus*	142
40	Arthropoda	*Daphnia magna*	263

Phylum wise distribution

Phylum	No. of Species
Arthropoda	8
Rotifera	9
Mollusca	6
Protozoa	7
Annelida	3
Others	7

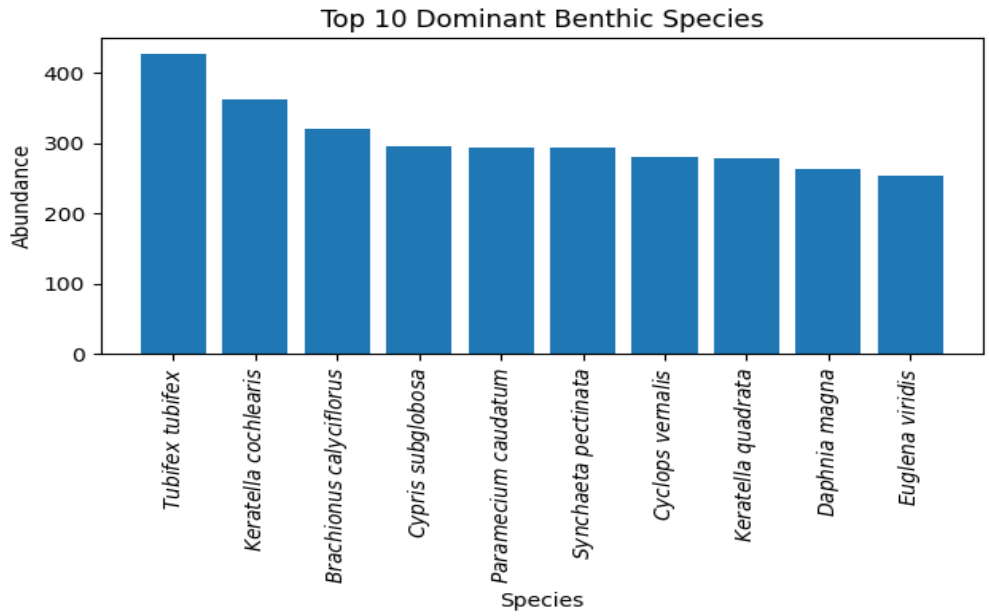


Figure 1 - the abundance of the ten dominant benthic species recorded from the selected site. *Tubifex tubifex* showed maximum abundance followed by *Keratella cochlearis* and *Brachionus calyciflorus*.

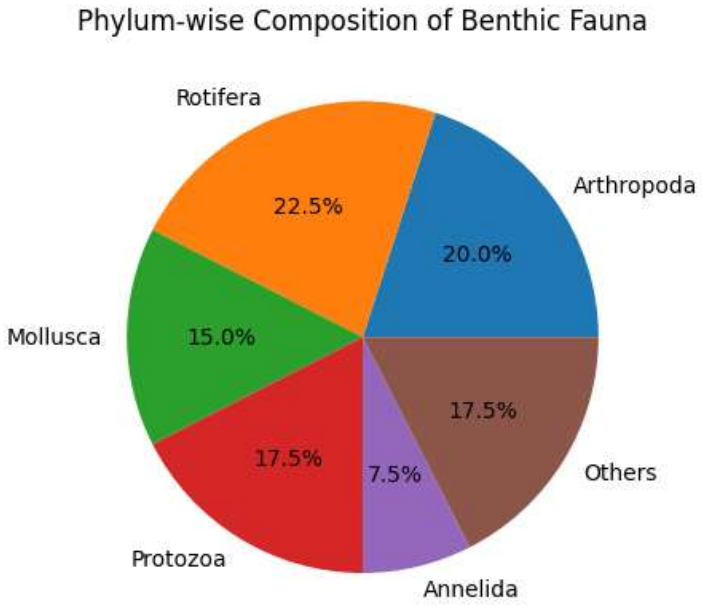


Figure 2 Phylum-wise composition of benthic fauna, indicating dominance of Rotifera and Arthropoda, followed by Protozoa and Mollusca.

Discussion

The present study recorded 40 species of benthic fauna belonging to ten major phyla, indicating considerable biodiversity at the selected site. Similar levels of benthic diversity have been reported from other Indian freshwater ecosystems (Ganguly *et al.*, 2018; Mishra *et al.*, 2013; Wanganeo *et al.*, 2011).

Arthropoda and Rotifera were the dominant groups in the present investigation. The dominance of cladocerans, copepods, and ostracods may be attributed to their wide ecological tolerance and high reproductive capacity (Covich *et al.*, 1999). High abundance of rotifers such as *Keratella* and *Brachionus* species generally reflects nutrient-rich and productive conditions (Patra *et al.*, 2010).

The oligochaete *Tubifex tubifex* was the most abundant species recorded. Oligochaetes are widely recognized as pollution-tolerant organisms and their dominance is often associated with

organic enrichment of sediments (Rosenberg *and* Resh, 1993; Arimoro *and* Ikomi, 2009). The presence of *Limnodrilus hoffmeisteri* further supports moderate organic loading at the site.

Molluscan taxa such as *Bellamya bengalensis*, *Lamellidens marginalis*, and *Pila globosa* play an important role in nutrient cycling and sediment stabilization (Covich *et al.*, 1999). Their occurrence indicates availability of suitable substrates and relatively stable habitat conditions.

The high Shannon-Wiener diversity index (H′ = 3.42) and Simpson's diversity index (1-D = 0.96) obtained in the present study indicate high diversity and low dominance, suggesting a heterogeneous and stable benthic community (Bonada *et al.*, 2006; Hering *et al.*, 2006). High evenness further reflects uniform distribution of individuals among species.

Overall, the results confirm that benthic fauna are effective indicators of ecological condition and can be reliably used for biomonitoring of tropical freshwater ecosystems (Armitage *et al.*, 1983; Rosenberg *and* Resh, 1993).

Conclusion

The present investigation documents considerable benthic faunal diversity at a selected site of a tropical river system in Maharashtra. Forty species belonging to ten major phyla were recorded, with dominance of Arthropoda and Rotifera. Similar patterns of benthic community composition have been reported from other tropical freshwater ecosystems, emphasizing the ecological significance of macroinvertebrates in maintaining ecosystem functioning (Ganguly *et al.*, 2018; Mishra *et al.*, 2013; Dudgeon *et al.*, 2006).

High values of Shannon-Wiener diversity index (H′), Simpson's diversity index (1-D), and Pielou's evenness index (J′) indicate a well-structured and stable benthic community with low dominance. The dominance of pollution-tolerant taxa such as *Tubifex tubifex* suggests moderate organic enrichment, which is consistent with findings from other biomonitoring studies (Rosenberg *and* Resh, 1993; Arimoro *and* Ikomi, 2009).

Overall, the study confirms that benthic fauna serve as reliable bioindicators of freshwater ecosystem health and can be effectively used in routine biomonitoring programmes (Armitage *et al.*, 1983; Bonada *et al.*, 2006). Regular assessment of benthic communities and appropriate management of anthropogenic activities in the river catchment are essential for conserving

References

1. Allan, J. D. (2004). Landscapes and riverscapes: The influence of land use on stream ecosystems. *Annual Review of Ecology, Evolution, and Systematics, 35*, 257–284.
2. Arimoro, F. O., and Ikomi, R. B. (2009). Ecological integrity of upper Warri River using aquatic insects as bioindicators. *Ecological Indicators, 9*(3), 455–461.
3. Arimoro, F. O., and Muller, W. J. (2010). Mayfly community structure and the ecological status of two South African rivers. *African Journal of Aquatic Science, 35*(1), 61–69.
4. Armitage, P. D., Moss, D., Wright, J. F., and Furse, M. T. (1983). The performance of a new biological water quality score system based on macroinvertebrates. *Water Research, 17*(3), 333–347.
5. Bonada, N., Prat, N., Resh, V. H., and Statzner, B. (2006). Developments in aquatic insect biomonitoring: A comparative analysis of recent approaches. *Annual Review of Entomology, 51*, 495–523.
6. Covich, A. P., Palmer, M. A., and Crowl, T. A. (1999). The role of benthic invertebrate species in freshwater ecosystems. *BioScience, 49*(2), 119–127.
7. Dias, H. Q., Sukumaran, S., Srinivas, T., and Mulik, J. (2018). Ecological quality status evaluation of a monsoonal tropical estuary using benthic indices: Comparison via a seasonal approach. *Environmental Science and Pollution Research, 25*(23), 22672–22688.
8. Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z. I., Knowler, D. J., Lévêque, C., and others. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews, 81*(2), 163–182.
9. Ganguly, I., Patnaik, L., and Nayak, S. (2018). Macroinvertebrates and its impact in assessing water quality of riverine system: A case study of Mahanadi River, Cuttack, India. *Journal of Applied and Natural Science, 10*(3), 958–963.
10. Ghosh, P., and Panigrahi, A. K. (2018). Correlation of gastropod diversity with hydro-environmental parameters of selected water bodies of lower Damodar basin, West Bengal, India. *Journal of Applied and Natural Science, 10*(4), 1259–1265.

11. Hering, D., Johnson, R. K., Kramm, S., Schmutz, S., Szoszkiewicz, K., and Verdonschot, P. F. M. (2006). Assessment of European streams with diatoms, macrophytes, macroinvertebrates and fish. *Science of the Total Environment, 366*(2–3), 380–395.
12. Kar, D., Banerjee, A., and Palit, D. (2011). Assessment of water quality of selected sites of Durgapur industrial belt, West Bengal, India through distribution and abundance of larval Chironomidae in relation to physicochemical characteristics of water. *International Journal of Lakes and Rivers, 4*(2), 177–198.
13. Lenat, D. R., and Resh, V. H. (2001). Taxonomy and stream ecology: The benefits of genus- and species-level identifications. *Journal of the North American Benthological Society, 20*(2), 287–298.
14. Mishra, A. S., Nautiyal, P., and Semwal, V. P. (2013). Distributional patterns of benthic macro-invertebrate fauna in the glacier-fed rivers of Indian Himalaya. *Our Nature, 11*(1), 36–44.
15. Patra, A., Santra, K. B., and Manna, C. K. (2010). Relationship among waterbird diversity, macrophytes, macroinvertebrates and physicochemical characteristics in Santragachi Jheel, India. *Acta Zoologica Bulgarica, 62*(3), 277–300.
16. Resh, V. H., and Jackson, J. K. (1993). Rapid assessment approaches to biomonitoring using benthic macroinvertebrates. *Freshwater Biomonitoring and Benthic Macroinvertebrates*, 195–233.
17. Rosenberg, D. M., and Resh, V. H. (1993). Benthic macroinvertebrates in freshwater biomonitoring. *Environmental Monitoring and Assessment, 25*(2), 135–167.
18. Sivadas, S. K., Nagesh, R., Gupta, G. V. M., Gaonkar, U., Mukherjee, I., Ramteke, D., and Ingole, B. S. (2016). Testing the efficiency of temperate benthic biotic indices in assessing the ecological status of a tropical ecosystem. *Marine Pollution Bulletin, 106*(1–2), 62–76.
19. Wanganeo, A., Kumar, P., Wanganeo, R., and Sonaullah, F. (2011). Variation in benthic population in two basins of Bhoj Wetland, Bhopal. *International Journal of Environmental Sciences, 1*(7), 1607–1616.
20. Wanganeo, A., and Wanganeo, R. (2014). Benthic macroinvertebrates as indicators of pollution in freshwater ecosystems. *Journal of Environmental Biology, 35*(5), 893–900.

Evaluation of Phenolic Compounds in Ethanolic Leaf Extract of Cayratia trifolia (L.) from Amravati District, Maharashtra Using Gallic Acid and Quercetin as Marker Standards

Padghan G. A
Assistant Professor at Vasantrao Naik Arts, Science and Commerce College, Shahada, Dist. Nandurbar.
Jadhao K. D
Assistant Professor at Government Vidarbha Institute of Science and Humanities (Autonomous) Amravati.

Abstract:

Cayratia trifolia (L.) (fox grape) is a medicinal climber widely distributed in tropical regions of India and traditionally used in the treatment of inflammatory and infectious diseases. The present investigation aimed to establish High Performance Thin Layer Chromatography (HPTLC) fingerprint profiling of phenolic compounds in ethanolic leaf extract of *Cayratia trifolia* collected from Amravati district, Maharashtra. Gallic acid and quercetin were selected as standard phenolic markers. Extracts were applied in graded concentrations (0.2–1.0 µL) on silica gel 60 F254 plates and developed using ethyl acetate: formic acid: acetic acid: water (10:0.5:0.5:1.3 v/v). The chromatograms were visualized at 366 nm. The HPTLC plate revealed intense bands corresponding to quercetin, indicating its abundance, whereas gallic acid was detected in minimal concentration. The chromatographic fingerprint generated in this study provides scientific validation for phytochemical authentication and quality control of *Cayratia trifolia*.

Keywords : *Cayratia trifolia*, HPTLC, phenolic profiling, quercetin, gallic acid.

Introduction:

Plants synthesize a wide range of secondary metabolites including phenolics, flavonoids, and tannins that play a significant role in therapeutic applications. Phenolic compounds are well recognized for their antioxidant and antimicrobial activities, making them important targets in phytochemical research (Dai and Mumper, 2010; Balasundram *et al.,* 2006).

Cayratia trifolia (L.) belonging to the family Vitaceae is a perennial climber commonly distributed in forest margins and moist habitats across India. The plant has been extensively used in traditional healthcare systems for the treatment of fever, wounds, inflammation, and digestive ailments (Warrier *et al.,* 1995; Nadkarni, 2009). Previous phytochemical screenings of Vitaceae members have reported high flavonoid and phenolic content, which contribute to their medicinal properties (Saxena and Saxena, 2012).

High Performance Thin Layer Chromatography (HPTLC) has emerged as a reliable technique for phytochemical fingerprinting and quality evaluation of medicinal plants due to its accuracy and reproducibility (Wagner and Bladt, 1996). However, detailed chromatographic profiling of *Cayratia trifolia* from the Vidarbha region is limited. Therefore, the present study was undertaken to establish phenolic fingerprinting of *Cayratia trifolia* leaves using gallic acid and quercetin as reference standards by HPTLC.

Materials and Methods:

Collection of Plant Material

Leaves of *Cayratia trifolia* were collected from natural vegetation zones around Amravati district, Maharashtra, during 2025. Plant identification and authentication were performed at the Department of Botany, GVISH, Amravati. A voucher specimen was deposited for documentation.

Preparation of Plant Extract

Leaves were thoroughly washed, shade dried, and pulverized into fine powder. Approximately 10 g powdered material was extracted with 100 mL ethanol using hot maceration. Ethanolic extract was centrifuged at 10000 rpm for 15 min and supernatant was used for evaluation of phenolic compound.

Chemicals and Reagents: Ethanol, Gallic acid standard, Quercetin standard, Silica gel 60 F254 plates, Ethyl acetate, Formic acid, Acetic acid, Distilled water

HPTLC Procedure: Activated silica gel plates were used for chromatographic separation. Sample application was performed using CAMAG Linomat applicator as 8 mm bands.

The following volumes were applied:

Sample	Gallic Acid	Ethanolic leaves extract of *Cayratia trifolia* (L.).					Quercetin
Volume	0.2	0.2 µL	0.4 µL	0.6 µL	0.8 µL	0.1 µL	0.2

Mobile phase composition: Ethyl acetate: Formic acid: Acetic acid: Water (10:0.5:0.5:1.3v/v) Chromatographic development was carried out up to 80 mm migration distance in a saturated chamber. Plates were dried and observed under UV light at 366 nm. Rf values and band intensities were recorded.

Results and Discussion:

The HPTLC chromatographic fingerprint of ethanolic leaf extract of *Cayratia trifolia* demonstrated effective separation of phenolic compounds when compared with gallic acid and quercetin standards.

Chromatographic Observation

Seven lanes were observed on the developed plate:

- Lane 1 - Gallic acid reference standard
- Lane 2 to 6 - ethanolic extract in increasing concentrations
- Lane 7 - Quercetin reference standard

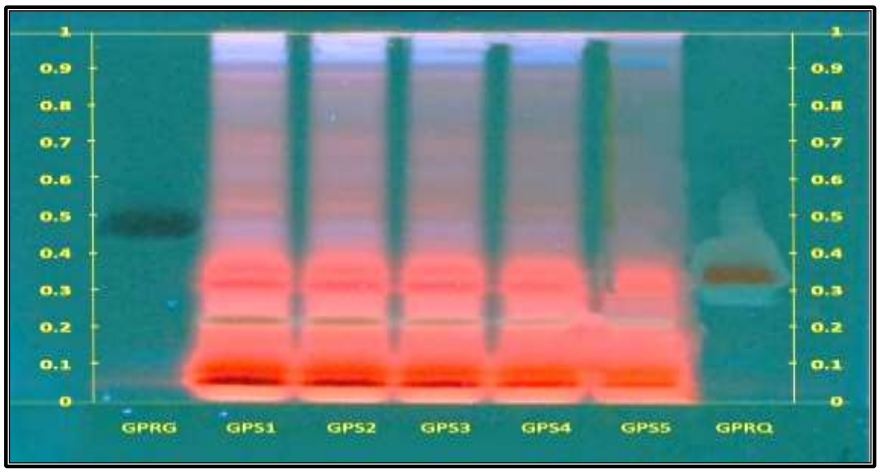


Figure 1: HPTLC chromatogram of ethanolic leaf extract of *Cayratia trifolia* under UV 366 nm showing comparison with gallic acid and quercetin standards.

Presence of Gallic Acid

A weak fluorescent band was detected at Rf value approximately **0.46–0.52**, corresponding to gallic acid standard. The band was faint in lower concentrations and slightly prominent in higher extract volumes. This suggests the presence of gallic acid or related phenolic acids in trace amounts.

Presence of Quercetin

A strong fluorescent band was detected at Rf value approximately **0.33–0.38**, matching the quercetin standard. The band intensity increased with increasing concentration of plant extract, indicating abundant presence of quercetin or structurally similar flavonoids.

Additional Phytochemical Bands

Minor bands were observed between Rf 0.30–0.40, suggesting the presence of additional flavonoid or phenolic derivatives. These compounds may contribute to the pharmacological activities of the plant.

The predominance of flavonoids observed in this study correlates with reports suggesting strong antioxidant and therapeutic properties of Vitaceae members (Kumar *et al.,* 2013). The chromatographic fingerprint obtained provides a valuable tool for authentication and quality assessment of *Cayratia trifolia*.

Conclusion:

The present study successfully established HPTLC fingerprint profiling of ethanolic leaf extract of *Cayratia trifolia*. The results revealed dominance of quercetin-like flavonoids and trace presence of gallic acid derivatives. The study supports the medicinal significance of the species and provides baseline chromatographic data useful for quality control and phytochemical standardization. Further quantitative and pharmacological investigations are recommended.

Acknowledgement: The authors are thankful to the Department of Botany, Government Vidarbha Institute of Science and Humanities (GVISH), Amravati, for providing research facilities.

References:

1. Balasundram, N., Sundram, K., and Samman, S. (2006). Phenolic compounds in plants and their importance in human health. *Food Chemistry,* 99(1), 191–203.
2. Dai, J., and Mumper, R.J. (2010). Plant phenolics: Extraction, analysis and their antioxidant properties. *Molecules,* 15, 7313–7352.
3. Kumar, S., Pandey, A.K. (2013). Chemistry and biological activities of flavonoids. *Scientific World Journal,* 2013, 1–16.
4. Nadkarni, K.M. (2009). Indian Materia Medica. Popular Prakashan, Mumbai.
5. Saxena, M., and Saxena, J. (2012). Phytochemical screening of medicinal plants belonging to Vitaceae family. *Journal of Pharmacognosy and Phytochemistry*, 1(3), 25–32.
6. Warrier, P.K., Nambiar, V.P.K., and Ramankutty, C. (1995). Indian Medicinal Plants: A Compendium of 500 Species. *Orient Longman*, Chennai.
7. Wagner, H., and Bladt, S. (1996). Plant Drug Analysis: A Thin Layer Chromatography Atlas. *Springer-Verlag*, Berlin.
8. Joshi, A., and Kulkarni, P. (2018). Evaluation of antioxidant potential of medicinal climbers from Central India. *International Journal of Herbal Medicine,* 6(2), 45–50.
9. Deshpande, R.S., and Pawar, S.E. (2020). Phytochemical diversity in medicinal plants of Vidarbha region. *Bioscience Discovery*, 11(3), 145–151.

Rational Design and Antimicrobial Screening of New Chalcone Derivatives"

Dr. Prashant Gotmare
Dr. Gajanan Ingle
Dr. Sanjay Kolhe
Department of Chemistry, Shri Shivaji Arts Commerce and Science college Akot-444101, (Maharashtra), India

Abstract:
A class of naturally occurring substances known as chalcones has antibacterial, anti-inflammatory, and anti-cancer biological activities. This is a summary of current research on chalcones, including their synthesis, structure–activity correlations, and biological activities. The potential application of chalcones in medical research and development is examined, along with their toxicity and safety profiles. In order to thoroughly investigate the antimicrobial potential of chalcones as therapeutic agents for the treatment of a range of illnesses, more research is necessary, as this review highlights.

Keywords- Chalcones, antimicrobial.

1. Introduction:

Antibiotics are now essential in the battle against infectious diseases brought on by bacteria and other organisms, several decades after penicillin was found and made available as a potent antibacterial agent. Antibiotic-resistant bacteria, especially multidrug-resistant infections, have emerged as a result of the extensive use of antibiotics [1,2,3]. Currently, the emergence of an increasing number of pathogenetic bacterial species that are resistant to traditional antibiotics has led to either exorbitant costs or ineffective treatment of infectious diseases. There has also been evidence of a concerning rise in the resistance of bacteria that cause community-acquired infections, particularly Staphylococci and Pneumococci, which are common sources of illness and death.

It is believed that several tiny heterocyclic compounds work as highly functionalized scaffolds and are recognized pharmacophores of several physiologically active and therapeutically valuable chemicals based on the known structure and activity connections [4,5].

Chalcones are a class of open chain flavonoids with two aryl rings joined by a propenone bond, a three-carbon spacer. They are considered a privileged structure in medicinal chemistry [6]. Chalcones can be converted into several classes of heterocyclic compounds by the reactive α, β-unsaturated propenone fragment, which is also responsible for the bioactivities. Because different aryl rings have different types and characteristics, chalcones exhibit varying degrees of bioactivity. According to a review of the literature on chalcones, substances with heteroaromatic rings in their aryl part exhibited superior biological profiles [7, 8]. We have previously documented cytotoxic, antifungal, and antitubercular properties of heterocyclic ring-appended chalcones [9,10,11,12,13]. Chalcones are effective at keeping a lot of microbes at bay. These chemicals' interactions with the target microorganism's cell membrane, as well as their capacity to adhere to cell walls, absorbable proteins, and outer cells, are what give them their antibacterial properties [14]. Therefore, it is probable that chalcones' antioxidant qualities could hinder the microorganisms.

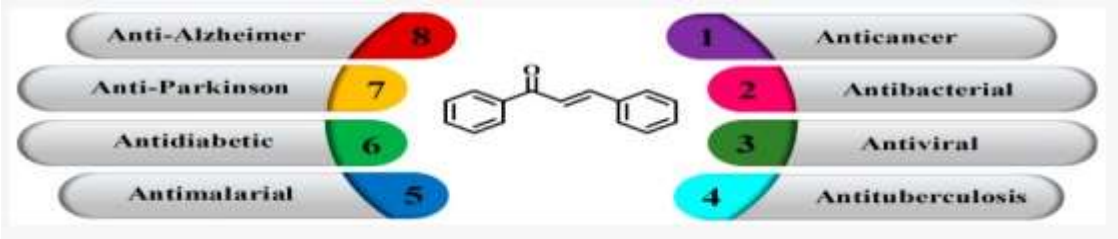


Fig.-1 Chalcone applications

The propenone bridge, an unsaturated carbonyl system with three carbons, connects two phenyl rings to form the chalcone scaffold. Aryl rings A and B can be identified by their prime and nonprime numbers, as shown in Fig. 2. There are two types of chalcones: cis (Z, 2) and trans (E, 1) isomers. While Z isomers are unstable due to their steric interactions between the carbonyl group and ring B, E isomers are the most prevalent chalcones because they are often more thermodynamically stable [15,16 ,17].

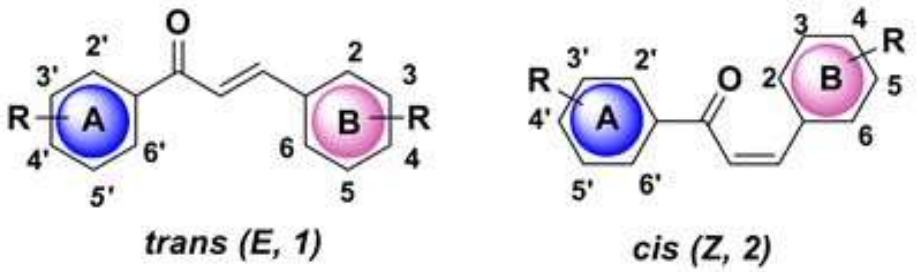
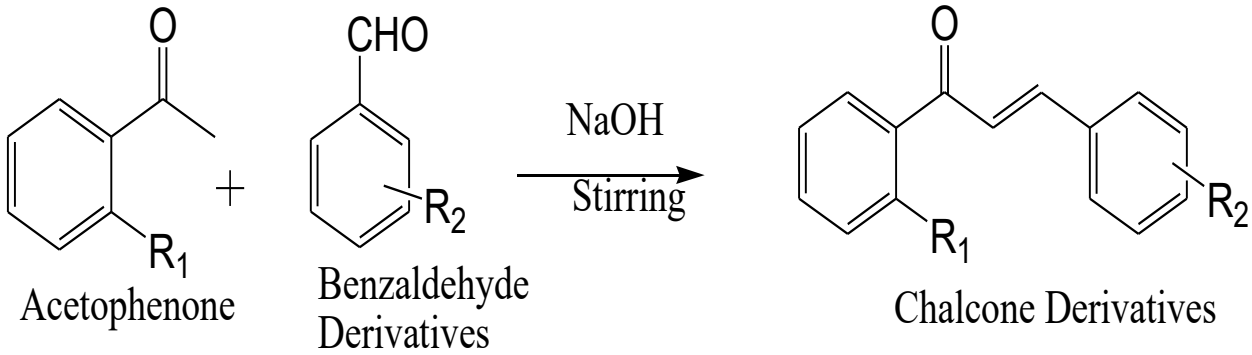


Fig.-2 Types of Chalcones

2. Materials and Methods:

2.1 General: All chemicals and reagents used in this research were commercially sourced and of analytical grade. The purity of resultant compound was check by using TLC. The IR spectra were recorded in KBr by using FT-(IR Perkin Elmer- Spectrum RX-FTIR). Mass spectra were recorded on mass spectrometer while 1HNMR were recorded on FT NMR Spectrometer (Bruker Avance Neo 500 MHz).

Claisen-Schmidt condensation is a widely used synthesis method. As shown in Schemes-1 [18,19,20,21], Chalcones are synthesized in this process by a simple condensation reaction between benzaldehyde and acetophenone derivatives in the presence of acid or base catalysts in polar solvents at 50–100 °C for many hours. Despite its main disadvantage—the slow reaction rate, which usually takes a few days to complete—and the fact that it produces a complex mixture that contains the desired product, by-products, and occasionally starting materials, this reaction is most commonly used because it is simple and very effective at forming the carbon–carbon double bond with little restriction on the complexity of the molecules. The majority of chalcone synthesis is based on base conditions.



Sr. No.	Compound	Substitution	Molecular Formula	Molecular Weight	Yield
1	Chalcone-1	OH & OCH_3	$C_{16}H_{14}O_3$	254	76%
2.	Chalcone-02	OH & Cl	**$C_{16}H_{14}O_3$**	258	82%

2.2 Synthesis of 1-(2-hydroxyphenyl)-3-(4-methoxyphenyl)prop-2-en-1-one (Chalcone-01)

2-Hydroxy acetophenone (0.01 M) and p-Methoxy benzaldehyde (0.01 M) were mixed along with 20% NaOH. A reaction mixture was stirred up to solid product After complete the reaction, final product was recrystallized with Ethanol.

Mol. Formula $C_{16}H_{14}O_3$

Light yellow amorphous solid, M.P 106 °C, yield 76 %, Elemental analysis (%):C,75.57; H,5.55; O,18.88; IR (KBr cm-1) 3548.78 (O-H), (C=O) 1720.5. ,ESI-MS[M+H]+ Calculated for **$C_{16}H_{14}O_3$** *m/z* 254.09, 255.10; 1H-NMR (500 MHz, DMSO): δ δ 3.78 (3H, s), 6.62 (1H, d, *J* = 15.6 Hz), 6.87 (1H, ddd, *J* = 8.3, 1.3, 0.5 Hz), 7.12-7.35 (3H, 7.18 (ddd, *J* = 8.8, 1.2, 0.5 Hz), 7.28 (ddd, *J* = 8.0, 7.4, 1.3 Hz)),

2. Synthesis of 3-(4-chlorophenyl)-1-(2-hydroxyphenyl)prop-2-en-1-one (Chalcone-02)

2-Hydroxy acetophenone (0.01 M) and p-Chloro benzaldehyde (0.01 M) were mixed along with 20% NaOH. A reaction mixture was stirred up to solid product After complete the reaction, final product was recrystallized with Ethanol.

Mol. Formula $C_{15}H_{11}ClO_2$

yellow solid, M.P 98 °C, yield 82 %, Elemental analysis (%):C,69.64; H,4.29; O,12.37; Cl, 13.70 IR (KBr cm-1) 3548.78 (O-H), (C=O) 1722.0 ,ESI-MS[M+H]+ Calculated for **$C_{15}H_{11}ClO_2$** *m/z* 258.04, 260.00; 1H-NMR (500 MHz, DMSO): δ 6.70 (1H, d, *J* = 15.7 Hz), 6.87 (1H, ddd, *J* = 8.3, 1.3, 0.5 Hz), 7.28 (1H, ddd, *J* = 8.0, 7.4, 1.3 Hz), 7.37-7.61 (7H, 7.44 (ddd, *J* = 8.3, 7.4, 1.4 Hz),

3. RESULT AND DISCUSSION

3.1 antimicrobial screening:

The Antibacterial activity was checked by following Zone Inhibition Method (Kirby-Bauer method). The MHA plates were inoculated by spreading with 100 µl of Bacterial culture, *Escherichia coli* (MTCC-452), *Pseudomonas aeruginosa* (MTCC-3541), *Mycobacterium tuberculosis* (MTCC-300), *Enterococcus faecalis*, *Aspergillus niger*, (MTCC-281), *Candida*. *Albicans*, (MTCC- 854). (Adjusted to 0.5 McFarland Unit - Approx cell density (1.5 X 108 CFU/mL) and followed by placing the discs containing 10 µl of different concentration (0 to 1000 mg/ml). One disc in each plate was loaded with solvent alone which served as vehicle control and Ciprofloxacin disc (10µg) were taken as positive control. The plates were incubated at 37 °C for 24 hrs. A clear zones created around the disc were measured and recorded.

3.2 Result:

Compound	**Zone of inhibition**					
	Bacterial Pathogens				**Fungal Pathogens**	
	E.coli	***P.aeruginosa***	***M.tuberculosis***	***E. faecalis***	***A. niger***	***C. Albicans***
Chalcone-1	**15.20**	**20.45**	**18.14**	**18.64**	**16.00**	**20.00**
Chalcone-2	**12.45**	**14.20**	**10.20**	**18.64**	**10.00**	**14.00**

The results of antimicrobial screening indicate that the titled compound shows good to moderate antimicrobial activity against tested bacteria. Here compound chalcone-1 shows highest antimicrobial activity than compound chalcone-2 due to electron donating group present at para position. These changes in functional groups cause changes in the biological activities of the compounds. The newly synthesized titled compounds are capable to cramp the growth of fungal and bacterial pathogens.

4. Conclusion

The presented data showed that the diversity of chemical synthesis of chalcones has benefited many drug discovery projects. The chemical structure of these molecules possesses higher antimicrobial properties when branch at para position where most of their derivatives could be synthesized. In present study compound chalcone-1 shows higher antimicrobial activity than chalcone-2 due to presence of electron donating group directly attached to benzene.

Acknowledgement

We are thankful to CIL and SAIF, Panjab University, Chandigarh for providing spectral data and Aakaar Biotech. PVT. Lucknow for antimicrobial screening.

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Neu, H. C. (1992). The crisis in antibiotic resistance. *Science*, *257*(5073), 1064–1073. https://doi.org/10.1126/science.257.5073.1064
2. Michel, M., & Gutmann, L. (1997). Methicillin-resistant Staphylococus aureus and vancomycin-resistant enterococci: therapeutic realities and possibilities. *The Lancet*, *349*(9069), 1901–1906. https://doi.org/10.1016/s0140-6736(96)11192-2
3. Normark, B. H., & Normark, S. (2002). Evolution and spread of antibiotic resistance. *Journal of Internal Medicine*, *252*(2), 91–106. https://doi.org/10.1046/j.1365-2796.2002.01026.x
4. Silverman, R. B., & Holladay, M. W. (2014). *The organic chemistry of drug design and drug action*. Academic press.
5. Thompson, L. A., & Ellman, J. A. (1996). Synthesis and applications of small molecule libraries. *Chemical Reviews*, *96*(1), 555–600. https://doi.org/10.1021/cr9402081
6. Zhuang, C., Zhang, W., Sheng, C., Zhang, W., Xing, C., & Miao, Z. (2017). Chalcone: A privileged structure in medicinal chemistry. *Chemical Reviews*, *117*(12), 7762–7810. https://doi.org/10.1021/acs.chemrev.7b00020
7. Jaiswal, P., Pathak, D. P., Bansal, H., & Agarwal, U. (2018). Chalcone and their heterocyclic analogue: A review article. *J. Chem. Pharm. Res*, *10*(4), 160-173.
8. Özdemir, A., Altıntop, M. D., Sever, B., Gençer, H. K., Kapkaç, H. A., Atlı, Ö., & Baysal, M. (2017). A new series of Pyrrole-Based Chalcones: Synthesis and evaluation of antimicrobial activity, cytotoxicity, and genotoxicity. *Molecules*, *22*(12), 2112. https://doi.org/10.3390/molecules22122112
9. Palleapati, K., Kancharlapalli, V., & Shaik, A. (2019). Synthesis, characterization and antitubercular evaluation of some new isoxazole appended 1-carboxamido-4, 5-dihydro-1H-pyrazoles. *Journal of Research in Pharmacy*, *23*(2), 156-163.
10. Shaik, A. B., Yejella, R. P., & Shaik, S. (2017). Research Article Synthesis, Antimicrobial, and Computational Evaluation of Novel Isobutylchalcones as Antimicrobial Agents.
11. Kishor, P., Ramana, K. V., & Shaik, A. B. (2017). Antitubercular evaluation of isoxazolyl chalcones. *RESEARCH JOURNAL OF PHARMACEUTICAL BIOLOGICAL AND CHEMICAL SCIENCES*, *8*(6), 730-735.
12. Lokesh, B. V. S., Prasad, Y. R., & Shaik, A. B. (2018). Synthesis, biological evaluation and molecular docking studies of new pyrazolines as an antitubercular and cytotoxic agents. *Infectious Disorders - Drug Targets*, *19*(3), 310–321. https://doi.org/10.2174/1871526519666181217120626
13. Shaik, A. B., Yejella, R. P., & Shaik, S. (2017). Synthesis, antimicrobial, and computational evaluation of novel isobutylchalcones as antimicrobial agents. *International Journal of Medicinal Chemistry*, *2017*, 1–14. https://doi.org/10.1155/2017/6873924
14. Cowan, M. M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, *12*(4), 564–582. https://doi.org/10.1128/cmr.12.4.564
15. Aksöz, B. E., & Ertan, R. (2011). Chemical and structural properties of chalcones I. *Fabad J Pharm Sci*, *36*, 223-242.
16. Gomes, M., Muratov, E., Pereira, M., Peixoto, J., Rosseto, L., Cravo, P., Andrade, C., & Neves, B. (2017). Chalcone Derivatives: Promising starting points for drug design. *Molecules*, *22*(8), 1210. https://doi.org/10.3390/molecules22081210
17. Shalaby, M. A., Fahim, A. M., & Rizk, S. A. (2023). Antioxidant activity of novel nitrogen scaffold with docking investigation and correlation of DFT stimulation. *RSC Advances*, *13*(21), 14580–14593. https://doi.org/10.1039/d3ra02393a
18. Wang, H. (2010). *Comprehensive organic name reactions* (Vol. 2, pp. 11-20). New York, NY, USA: Wiley.
19. Mahapatra, D. K., Bharti, S. K., & Asati, V. (2015). Chalcone scaffolds as anti-infective agents: Structural and molecular target perspectives. *European Journal of Medicinal Chemistry*, *101*, 496–524. https://doi.org/10.1016/j.ejmech.2015.06.052
20. Bukhari, S. N. A., Jasamai, M., & Jantan, I. (2012). Synthesis and Biological Evaluation of chalcone Derivatives (Mini Review). *Mini-Reviews in Medicinal Chemistry*, *12*(13), 1394–1403. https://doi.org/10.2174/138955712804586648
21. Qian, H., Liu, D., & Lv, C. (2011). Synthesis of chalcones via Claisen-Schmidt reaction catalyzed by sulfonic acid-functional ionic liquids. *Industrial & engineering chemistry research*, *50*(2), 1146-1149.

Digitization and Quantitative Analysis of Ethnobotanical Knowledge Using Diversity Indices and GIS Mapping from Akot Tehsil Forested Terrain, Maharashtra

Dr. SumitKumar Laxmanrao Mirge
Shri. Shivaji Arts, Commerce and Science College, Akot (MS), 444101.

Abstract

Ethnobotanical knowledge plays a vital role in traditional healthcare systems, particularly in rural and forest-dependent regions of India. The present study aimed to document, digitize and quantitatively analyse medicinal plant knowledge used by local communities in the forested terrain of Akot Tehsil, Akola district, Maharashtra. Field surveys conducted during 2023 - 2025 included semi-structured interviews, group discussions and personal interactions with traditional healers, elderly villagers and farmers. Five medicinal plant species *Boswellia serrata* Roxb. ex Colebr., *Gardenia latifolia* Aiton, *Woodfordia fruticosa (L.) Kurz*, *Wrightia tinctoria* (Roxb. ex Colebr.) R.Br. and *Sterculia urens* Roxb. were documented along with their therapeutic uses, plant parts utilized and preparation methods. The data were digitized and analysed using ethnobotanical indices such as Use Value (UV), Relative Frequency of Citation (RFC), Fidelity Level (FL%) and Informant Consensus Factor (ICF), while GIS tools were used to map species distribution and identify ethnobotanical hotspots.

Quantitative analysis revealed that *Boswellia serrata* Roxb. ex Colebr. exhibited the highest ethnomedicinal importance with maximum UV (0.80) and RFC (0.64), particularly for bone and joint disorders. *Woodfordia fruticosa* (L.) Kurz also demonstrated high significance in wound healing, whereas *Wrightia tinctoria* (Roxb. ex Colebr.) R.Br. and *Gardenia latifolia* Aiton showed moderate medicinal relevance. *Sterculia urens* Roxb. displayed comparatively lower but specific therapeutic applications. Fidelity Level and ICF values indicated strong informant agreement and reliability of traditional medicinal practices. The study highlights the cultural importance of medicinal plants and emphasizes the need for conservation of indigenous knowledge and sustainable utilization of plant biodiversity in the Akot Tehsil region.

Keywords: Ethnobotany, Digitization, Diversity indices, GIS mapping, Akot Tehsil.

1. Introduction

Ethnobotany deals with the study of interactions between human societies and plant resources, particularly focusing on traditional knowledge related to medicinal plant usage (Richard Evans Schultes, 1962; S. K. Jain, 1991). In India, especially in forested and semi-arid regions, indigenous communities rely heavily on plant-based remedies for treating various ailments (Jain, 1991; M. P. Shiva, 1996). Despite its significance, ethnobotanical knowledge remains largely undocumented and is at risk of being lost due to rapid socio-economic and cultural changes (D. A. Posey, 1999).

Akot Tehsil of Akola district represents a forested terrain with rich plant diversity and a strong tradition of indigenous medicinal practices. However, scientific documentation integrating quantitative analysis and spatial mapping of this knowledge is lacking. Quantitative ethnobotany provides statistical tools to evaluate plant use significance (O. Phillips & A. H. Gentry, 1993). Digitization combined with ethnobotanical indices and GIS tools offers a modern approach to validate, conserve and utilize traditional knowledge effectively (Paul A. Longley et al., 2015). The present study bridges this gap by providing a comprehensive, quantitative and spatial assessment of ethnobotanical knowledge from Akot Tehsil.

2. Study Area

Akot Tehsil is located in the northern part of Akola district, Maharashtra, India. The region lies between 20.95° N to 21.25° N latitude and 76.85° E to 77.20° E longitude. The terrain comprises forest patches, hill slopes, seasonal streams and agricultural landscapes. The climate is tropical with

hot summers, moderate monsoon rainfall and mild winters. Vegetation mainly includes dry deciduous forest elements along with shrubs, herbs, climbers and medicinal trees. The local population includes rural and forest-dependent communities possessing rich ethnobotanical knowledge.

3. MATERIALS AND METHODS

3.1 Field Survey and Data Collection

Field surveys were conducted during different seasons of the year 2023 - 2025 in selected villages and forested areas of Akot Tehsil. Ethnobotanical data were collected through semi-structured questionnaires, personal interviews and group discussions with knowledgeable informants such as traditional healers, elderly villagers and farmers. Prior informed consent was obtained from all participants.

3.2 Plant Collection and Identification

Medicinal plants reported by informants were identified onsite by using standard floras and taxonomic keys and with the help of Senior Taxonomist.

3.3 Digitization of Ethnobotanical Data

Collected information was digitized into a structured database including botanical name, family, local name, plant part used, mode of preparation, ailments treated and frequency of citation, following quantitative ethnobotanical documentation approaches (Phillips & Gentry, 1993).

3.4 Quantitative Ethnobotanical Analysis

The following indices were calculated:

- **Use Value (UV)** = $\frac{\sum U}{N}$
- **Relative Frequency of Citation (RFC)** = $\frac{FC}{N}$
- **Fidelity Level (FL%)** = $\frac{N_p}{N} \times 100$
- **Informant Consensus Factor (ICF)** = $ICF = \frac{N_{ur} - N_t}{N_{ur} - 1}$

Where,

U = number of uses mentioned,
N = number of informants,
FC = frequency of citation,
Np = number of informants reporting a specific use,
Nur = number of use reports,
Nt = number of taxa used.

3.5 GIS Mapping

Geographical coordinates of medicinal plant locations were recorded using GPS. Spatial analysis and mapping were performed using QGIS Development Team (2023) to generate species distribution maps and identify ethnobotanical hotspots. The application of GIS in biodiversity studies follows standard geographic information science principles (Longley et al., 2015).

4. Results

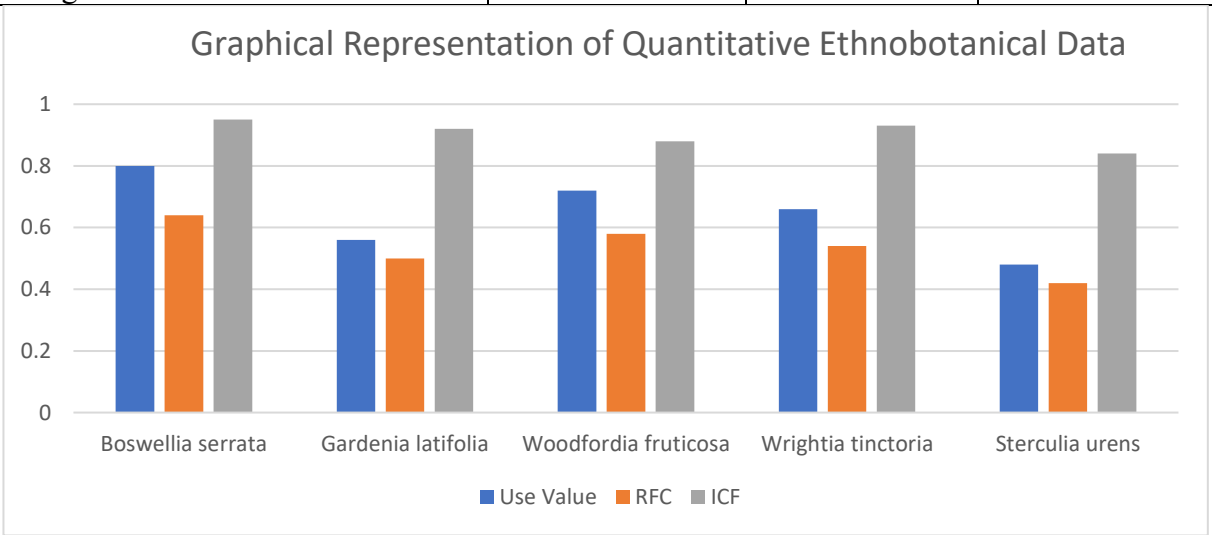
Quantitative Ethnobotanical Indices

Plant species	FC	∑U	UV	RFC	FL (%)	Np (informants for major ailment)	FC	FL (%)	Major ailment
Boswellia serrata Roxb. ex Colebr.	32	40	0.80	0.64	84.4	27	32	84.4	Bone & joint disorders
Gardenia latifolia Aiton	25	28	0.56	0.50	72.0	18	25	72.0	Gastrointestinal disorders

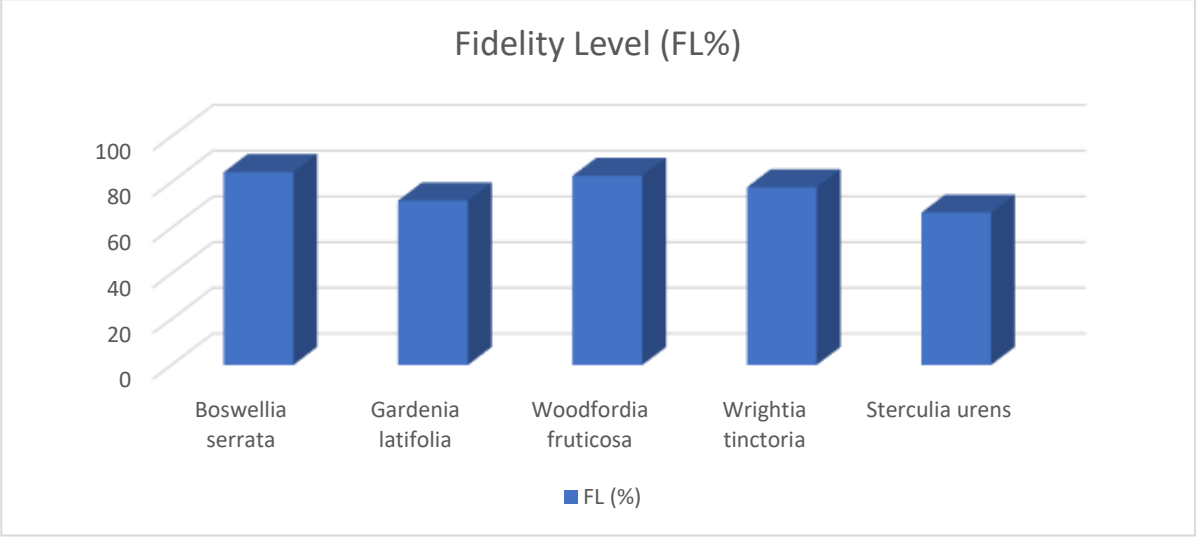
Woodfordia fruticosa (L.) Kurz	29	36	0.72	0.58	82.8	24	29	82.8	Wound healing
Wrightia tinctoria (Roxb. ex Colebr.) R.Br.,	27	33	0.66	0.54	77.8	21	27	77.8	Skin diseases
Sterculia urens Roxb.	21	24	0.48	0.42	66.7	14	21	66.7	Cooling / inflammation

Informant Consensus Factor (ICF)

Ailment category	Nur	Nt	ICF
Bone & joint disorders	44	3	0.95
Skin diseases	39	4	0.92
Gastrointestinal disorders	35	5	0.88
Wound healing	31	3	0.93
Cooling / inflammation	33	6	0.84



Graphical Representation of Quantitative Ethnobotanical Data (Use Value, RFC and ICF)



Graphical Representation of Quantitative Ethnobotanical Data (FL%)

A total of five medicinal plant species belonging to five different families were documented from the Akot tehsil region. Trees formed the dominant life form among the recorded species and

different plant parts such as resin, bark, flowers, leaves, seeds and gum were traditionally utilized for the treatment of various ailments including bone and joint disorders, gastrointestinal diseases, skin infections, wound healing and inflammatory conditions. Quantitative ethnobotanical analysis revealed that *Boswellia serrata* Roxb. ex Colebr. exhibited the highest Use Value (UV = 0.80) and Relative Frequency of Citation (RFC = 0.64), indicating its high cultural importance and widespread utilization among local inhabitants, particularly for bone and joint disorders. *Woodfordia fruticosa (L.) Kurz* also showed comparatively high UV (0.72) and RFC (0.58), reflecting its strong traditional association with wound healing. *Wrightia tinctoria* (Roxb. ex Colebr.) R.Br. demonstrated moderate quantitative importance with UV (0.66) and RFC (0.54), primarily used for skin diseases, whereas *Gardenia latifolia* Aiton showed moderate ethnomedicinal relevance with UV (0.56) and RFC (0.50), mainly utilized for gastrointestinal disorders. *Sterculia urens* Roxb. exhibited relatively lower UV (0.48) and RFC (0.42), suggesting its limited but specific medicinal application.

Fidelity Level (FL%) analysis indicated that *Boswellia serrata* Roxb. ex Colebr. (84.4%) and *Woodfordia fruticosa* (L.) Kurz (82.8%) were highly preferred for treating bone and joint disorders and wound healing respectively, demonstrating strong informant agreement regarding their therapeutic effectiveness. Moderate FL values were observed for *Wrightia tinctoria* (Roxb. ex Colebr.) R.Br. (77.8%) and *Gardenia latifolia* Aiton (72.0%), suggesting their diversified medicinal uses, while *Sterculia urens* Roxb. recorded the lowest FL value (66.7%), indicating its broader application across multiple ailments. The Informant Consensus Factor (ICF) values ranged from 0.84 to 0.95, showing a high level of agreement among informants regarding plant selection for different ailment categories. The highest consensus was observed for bone and joint disorders (ICF = 0.95), followed by wound healing (ICF = 0.93) and skin diseases (ICF = 0.92), whereas gastrointestinal disorders (ICF = 0.88) and cooling or inflammatory conditions (ICF = 0.84) showed comparatively lower but still significant agreement. These findings reflect the presence of a well-established and reliable traditional medicinal knowledge system in the Akot tehsil region.

5. Discussion

The quantitative ethnobotanical analysis of medicinal plants from the Akot tehsil region highlights the strong relationship between local communities and plant-based traditional healthcare practices. The high Use Value (UV) and Relative Frequency of Citation (RFC) recorded for *Boswellia serrata* Roxb. ex Colebr. and *Woodfordia fruticosa* (L.) Kurz indicate their widespread recognition and therapeutic reliability among the inhabitants. The predominance of these species in treating bone and joint disorders and wound healing suggests their long-term traditional acceptance and possible pharmacological effectiveness. Moderate ethnomedicinal importance observed in *Wrightia tinctoria* (Roxb. ex Colebr.) R.Br. and *Gardenia latifolia* Aiton reflects their diversified medicinal applications, particularly in dermatological and gastrointestinal disorders. The comparatively lower quantitative indices recorded for *Sterculia urens* Roxb. indicate its supplementary role in local healthcare systems, mainly for cooling and inflammatory conditions.

The high Informant Consensus Factor (ICF) values observed across ailment categories demonstrate a strong agreement among informants regarding the selection of plant species for specific therapeutic uses. The highest consensus recorded for bone and joint disorders and wound healing suggests that these ailments are commonly treated using a limited number of highly trusted plant species. Similar ethnobotanical patterns have been reported from other forested regions of central India, supporting the reliability and scientific relevance of indigenous medicinal knowledge. The quantitative validation of plant usage patterns emphasizes the importance of documenting and preserving traditional ethnomedicinal practices in rural and forest-adjacent communities.

6. Conclusion

The present study successfully documented and quantitatively evaluated the ethnobotanical importance of five medicinal plant species traditionally used in the Akot tehsil region of Maharashtra. The application of quantitative indices such as Use Value, Relative Frequency of Citation, Fidelity Level and Informant Consensus Factor provided scientific evidence regarding the cultural

significance, therapeutic specificity and reliability of traditional medicinal plants. The findings revealed that *Boswellia serrata* Roxb. ex Colebr. and *Woodfordia fruticosa* (L.) Kurz represent highly valued ethnomedicinal species with strong informant agreement and specialized therapeutic applications.

The integration of quantitative ethnobotanical analysis with traditional knowledge documentation provides a systematic approach for identifying priority medicinal plants for conservation and pharmacological research. The study highlights the importance of safeguarding indigenous medicinal knowledge systems and promotes sustainable utilization of plant biodiversity in the Akot tehsil region. Such research contributes significantly to biodiversity conservation, traditional healthcare preservation and future development of plant-based therapeutic resources.

7. Future Scope

- Development of a digitized ethnobotanical database documenting medicinal plant knowledge from Akot tehsil.
- Detailed phytochemical and pharmacological validation of high-value species such as *Boswellia serrata* Roxb. ex Colebr. and *Woodfordia fruticosa* (L.) Kurz.
- Community-based conservation and sustainable harvesting strategies in collaboration with forest and biodiversity management authorities.
- Expansion of ethnobotanical surveys to adjoining forest regions to assess regional medicinal plant diversity.
- Integration of traditional medicinal knowledge with modern healthcare and biodiversity conservation programs.

8. References

1. Schultes, R. E. (1962). The role of ethnobotany in the search for new medicinal plants. *Lloydia*, 25, 257 - 266.
2. Jain, S. K. (1991). *Dictionary of Indian Folk Medicine and Ethnobotany*. Deep Publications.
3. Shiva, M. P. (1996). *Inventory of Forestry Resources for Sustainable Management and Biodiversity Conservation*. Indus Publishing.
4. Posey, D. A. (1999). *Cultural and Spiritual Values of Biodiversity*. UNEP.
5. Phillips, O., & Gentry, A. H. (1993). The useful plants of Tambopata, Peru: Statistical hypotheses tests with a new quantitative technique. *Economic Botany*, 47, 15 - 32.
6. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic Information Science and Systems* (4th ed.). Wiley.

Transforming Higher Education through Artificial Intelligence: Pedagogical Innovation, Ethical Challenges and Sustainable Educational Futures

Dr. Nutanvarsha P. Deshmukh
Department of Botany
Shri Shivaji Arts, Commerce and Science College Akot

Abstract

Artificial Intelligence (AI) has emerged as a disruptive technological force with far-reaching implications for higher education. Beyond automation, AI has the potential to redefine pedagogical practices, institutional governance, and knowledge production. This paper critically examines the transformative role of AI in higher education, focusing on pedagogical innovations, ethical challenges, and sustainable integration models. Employing a qualitative conceptual research design based on systematic literature review and thematic analysis, the study explores how AI reshapes teaching-learning processes, assessment systems, and institutional decision-making. The findings reveal that AI enables personalized learning, adaptive assessment, and data-driven academic management, while simultaneously raising concerns related to algorithmic bias, data privacy, digital inequality, and over-reliance on technology. The paper proposes a human centered and ethically grounded framework for AI integration in higher education. It concludes that the sustainable future of higher education depends on balancing technological advancement with pedagogical values and ethical governance.

Keywords: Artificial Intelligence, Higher Education, Digital Pedagogy, Ethical AI, Learning Analytics, Educational Innovation, Sustainability, Educational Transformation

Introduction

The rapid advancement of Artificial Intelligence (AI) has fundamentally altered the landscape of contemporary society. From healthcare and industry to governance and education, AI-driven systems are redefining how knowledge is created, disseminated, and utilized. Higher education, as a core institution of knowledge production and human development, is undergoing profound transformation due to AI technologies.

Traditionally, higher education has been characterized by standardized curricula, teacher-centered pedagogy, and conventional assessment methods. However, the emergence of AI-based tools—such as intelligent tutoring systems, adaptive learning platforms, and learning analytics—has introduced new possibilities for personalized and flexible learning. At the same time, the integration of AI raises critical ethical, social, and pedagogical questions.

This paper seeks to explore the multidimensional impact of AI on higher education by analysing its pedagogical potential, ethical implications, and future prospects. It argues that AI should not be perceived merely as a technological tool but as a transformative force that necessitates a rethinking of educational philosophy, pedagogy, and governance.

Conceptual Framework of Artificial Intelligence in Education

Artificial Intelligence can be conceptualized as a system capable of performing tasks that typically require human intelligence, including learning, reasoning, problem-solving and decision-making. In the context of education, AI can be understood through three interrelated dimensions:

- **Technological Dimension**

This dimension includes machine learning, deep learning, natural language processing and data analytics. These technologies enable intelligent educational systems that can adapt to learners' needs.

- **Pedagogical Dimension**

AI influences teaching and learning by enabling personalized learning, adaptive assessment, and student-centered pedagogy. It challenges traditional instructional models and promotes innovative learning environments.

- **Ethical and Social Dimension**

AI raises concerns related to privacy, equity, transparency, and accountability. These issues highlight the need for ethical frameworks and inclusive policies in educational contexts.
This tripartite framework provides a holistic basis for analysing the role of AI in higher education.

Review of Literature

The growing body of research on AI in education highlights both opportunities and challenges. Scholars have emphasized that AI-driven systems can enhance learning personalization and improve institutional efficiency. Studies on learning analytics suggest that AI can predict student performance and reduce dropout rates. Researchers have also explored the role of AI in adaptive assessment and intelligent tutoring systems.

However, critical perspectives have drawn attention to ethical issues such as algorithmic bias, data privacy, and the commercialization of education. Some scholars argue that excessive reliance on AI may undermine human centered pedagogy and critical thinking. Others highlight the digital divide between technologically advanced and resource-constrained institutions.

Despite extensive research, existing studies often focus on technological aspects while neglecting pedagogical and ethical dimensions. This paper addresses this gap by integrating technological, pedagogical, and ethical perspectives into a unified analytical framework.

Objectives of the Study

The main objectives of this study are:

1. To analyse the transformative role of Artificial Intelligence in higher education.
2. To examine pedagogical innovations enabled by AI.
3. To identify ethical and socio-cultural challenges associated with AI in education.
4. To propose a sustainable and human centered model for AI integration in higher education.

Research Methodology

This study adopts a qualitative conceptual research design based on systematic literature review and interpretative analysis. Secondary data were collected from academic journals, books, policy documents, and reports related to AI and education. Databases such as Scopus, Web of Science, ERIC, and Google Scholar were consulted.

Thematic analysis was employed to identify key patterns and trends in the literature. Based on these themes, a conceptual framework for sustainable AI integration in higher education was developed.

Pedagogical Innovations Enabled by Artificial Intelligence

- **Personalized Learning**

One of the most significant contributions of AI to education is personalized learning. AI systems analyze learner data to identify individual strengths, weaknesses, and learning preferences. This enables the design of customized learning pathways that enhance student engagement and academic performance.

- **Adaptive Assessment**

AI-driven assessment tools provide real-time feedback and adaptive testing mechanisms. Unlike traditional assessments, which are often standardized, adaptive assessments adjust their difficulty level based on learners' responses. This supports competency-based education and formative evaluation.

- **Intelligent Tutoring Systems**

Intelligent tutoring systems use AI algorithms to provide personalized guidance and support to students. These systems simulate one-to-one tutoring and help learners overcome conceptual difficulties.

- **Learning Analytics and Academic Decision Making**

AI-powered learning analytics enable institutions to analyse large volumes of educational data. This supports data-driven decision-making in curriculum design, student support services, and institutional planning.

- **Research and Knowledge Creation**

AI tools facilitate advanced data analysis and interdisciplinary research. They accelerate knowledge production and enhance the quality of academic research.

- **Benefits of Artificial Intelligence in Higher Education**

The integration of AI in higher education offers several benefits:

- Enhancement of teaching and learning quality
- Promotion of student-centered pedagogy
- Efficiency in academic administration
- Data-driven institutional governance
- Expansion of research and innovation
- Improvement in student engagement and retention

These benefits highlight the transformative potential of AI in redefining educational practices and institutional structures.

Ethical and Socio-Cultural Challenges

Despite its advantages, AI poses significant ethical and socio-cultural challenges:

- **Data Privacy and Security**

AI systems rely on large volumes of student data, raising concerns about privacy and data security. Unauthorized use or misuse of data can undermine trust in educational institutions.

- **Algorithmic Bias**

AI algorithms may reflect biases present in training data, leading to discriminatory outcomes. This can exacerbate existing inequalities in education.

- **Digital Divide**

The unequal distribution of technological resources creates a digital divide between institutions and learners. This challenges the principle of equitable access to education.

- **Overdependence on Technology**

Excessive reliance on AI may undermine human judgment, creativity, and critical thinking. It may also marginalize the role of teachers.

- **Ethical Governance**

The lack of clear ethical guidelines and regulatory frameworks poses challenges for responsible AI integration in education. These challenges underscore the need for ethical governance and inclusive policies in the adoption of AI.

Toward a Sustainable Model of AI Integration in Higher Education

This paper proposes a sustainable model of AI integration based on three core principles:

- **Human-Centered Pedagogy**

AI should be used as a supportive tool that enhances human capabilities rather than replacing educators. Teachers should remain central to the educational process.

- **Ethical Governance**

Institutions should develop transparent and accountable policies for AI use. Ethical guidelines should address issues of privacy, bias, and accountability.

- **Institutional Capacity Building**

Continuous professional development programs should be implemented to equip educators and administrators with AI-related competencies.

This model emphasizes the need for a balanced approach that integrates technological innovation with human values.

Discussion

The analysis reveals that AI has the potential to transform higher education by fostering innovative pedagogical practices and efficient institutional management. However, its impact is not uniform across contexts. The effectiveness of AI integration depends on institutional readiness, policy frameworks, and socio-cultural factors.

The findings suggest that AI should be integrated into higher education through a holistic approach that combines technological advancement with pedagogical and ethical considerations. Such an approach can ensure that AI contributes to inclusive and sustainable educational development.

Implications for Higher Education

- **Academic Implications**

AI can redefine curriculum design, teaching methodologies, and assessment practices. It encourages interdisciplinary learning and research.

- **Policy Implications**

Policymakers should formulate regulatory frameworks to ensure ethical and equitable use of AI in education.

- **Social Implications**

AI can contribute to social inclusion by expanding access to education. However, it may also reinforce inequalities if not implemented responsibly.

Conclusion

Artificial Intelligence represents a paradigm shift in higher education. While AI-driven innovations enhance teaching, learning, and institutional efficiency, they also raise ethical and socio-cultural concerns. This paper concludes that the sustainable future of higher education depends on the balanced integration of AI with human-centered pedagogy and ethical governance. By adopting a holistic and responsible approach, higher education institutions can harness the transformative potential of AI while preserving core educational values.

References

1. Holmes, W., Bialik, M., & Fadel, C. (2022). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.
2. UNESCO. (2023). Guidance on generative AI in education and research. Paris: UNESCO.
3. OECD. (2022). Artificial intelligence and the future of education. Paris: OECD Publishing.
4. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2021). Intelligence unleashed: An argument for AI in education. Pearson.
5. Selwyn, N. (2021). Should robots replace teachers? AI and the future of education. Polity Press.

Novel Heterocyclic Drug Designs and Antimicrobial Screening in the Era of AI

Dr. Gajanan Ingle
[1]Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara), Dist. Akola (M.S.),
Dr. Prashant Gotmare
[2]Shri Shivaji Arts, Commerce & Science College, Akot, Dist. Akola (M.S.)
Dr. Sanjay Kolhe
(Affiliated to Sant Gadge Baba Amravati University, Amravati)

Abstract

The structural diversity and broad range of biological activity of heterocyclic compounds make them a fundamental component of contemporary pharmaceutical and medicinal chemistry. This study examines current developments in heterocyclic framework synthesis techniques and assesses their bioactivities using a range of biological tests. Green chemistry techniques, microwave-assisted synthesis, metal-catalyzed procedures, and multicomponent reactions are highlighted. In order to improve pharmacological profiles, the study also looks into structure-activity relationships (SAR), highlighting the crucial role that creative synthesis plays in the development of new drugs.

Keywords: *Drug design, heterocyclic compounds, antimicrobial screening, pharmacokinetics, physico-chemical, green chemistry, multicomponent reactions, artificial intelligence etc.*

1.Introduction

Because of their wide spectrum of biological activities and structural adaptability, heterocyclic molecules are highly valued in the fields of organic and medicinal chemistry. Many pharmacologically active molecules are made up of these compounds, which are defined by rings that contain at least one atom other than carbon, usually nitrogen, oxygen, or sulfur. Due to heterocycles' vital roles in materials science, agrochemicals, medicines, and colors, their production and use have grown dramatically over the last few decades. Indeed, it is estimated that at least one heterocyclic ring is present in the structure of more than 75% of FDA-approved small-molecule medications, demonstrating the indispensable significance of this class of chemicals in drug development and discovery.

Investigating new heterocyclic scaffolds and their effective synthesis pathways has become more crucial than ever due to the growing need for innovative therapeutic medicines and the ongoing emergence of drug-resistant diseases. A unique platform for creating molecules with specific physicochemical and pharmacokinetic characteristics is provided by the wide variety of heterocyclic compounds. Heterocycles are especially appealing as pharmacophores, the active parts of pharmacological compounds that interact with biological targets, because of their electrical structure, ability to establish hydrogen bonds, and conformational flexibility. Drugs used to treat a variety of illnesses, such as cancer, microbial infections, inflammation, neurological disorders, and metabolic syndromes, often contain structures like pyridines, quinolines, imidazoles, triazoles, and thiazoles.

Heterocyclic structures are also present in many naturally occurring biomolecules, including vitamins, alkaloids, and nucleic acids, which highlights their biological significance. As a result, the synthesis of heterocycles is both a key concept in synthetic organic chemistry and a crucial area of interest for biological and pharmacological research. Traditional heterocycle synthesis techniques in the past frequently included difficult conditions, multi-step procedures, and low total yields. The quick and sustainable creation of new heterocyclic libraries was severely hampered by these restrictions. However, the subject has undergone a revolution thanks to recent developments in synthetic techniques, which provide novel and effective pathways to heterocyclic frameworks. Environmentally friendly techniques, such as solvent-free reactions, the use of aqueous media, and bio-based catalysts, have emerged as a result of the acceptance of green chemistry concepts. Because of its atom economy, ease of operation, and capacity to produce structural variety, multicomponent reactions (MCRs), which enable the creation of complex heterocycles from straightforward and readily accessible

starting elements in a single step, have drawn a lot of attention. In high-throughput drug discovery environments, where the quick creation of molecular libraries is essential, these reactions are especially helpful.

Simultaneously, accurate functionalization and the creation of heterocyclic rings with enhanced regio- and stereoselectivity have been made possible by transition metal catalysis. Strong tools for C–C and C–X (where X is a heteroatom) bond production have been made available by palladium-, copper-, iron-, and ruthenium-catalyzed processes. This has made it easier to synthesize complex heterocyclic systems with improved control over molecular architecture. Additionally, the development of microwave-assisted organic synthesis has greatly reduced reaction durations, increased product yields, and made it possible to perform reactions that were previously challenging or impossible to perform under standard conditions. In heterocycle synthesis, where ring formation reactions frequently call for high temperatures and prolonged reaction times, these microwave approaches are especially helpful.

Additionally, new opportunities for creating heterocycles using clean, energy-efficient reactions that use light or electric current to drive redox processes have been made possible by the integration of photoredox catalysis and electrochemical techniques into heterocyclic synthesis. Incorporating these cutting-edge synthetic techniques has expanded the range of available heterocyclic structures while also increasing the sustainability and efficiency of heterocyclic synthesis. Consequently, this has made it easier to systematically assess their biological activity using both in vitro and in vivo experiments. Understanding the pharmacological potential of recently synthesized heterocycles is largely dependent on the field of bioactivity testing. Early information about a compound's biological efficacy can be obtained by in vitro screening techniques such enzyme inhibition assays, cell viability tests, and antimicrobial susceptibility assessments.

An essential part of bioactivity testing is structure-activity relationship analysis, which enables scientists to pinpoint the essential functional groups and molecular characteristics in charge of the biological effects they have seen. Scientists can improve a compound's potency, selectivity, and pharmacokinetic profile by methodically altering various heterocyclic structural components. A key component of medicinal chemistry initiatives to turn hit molecules into promising therapeutic prospects is this iterative process. Additionally, the characterization and validation of recently synthesized heterocycles have been improved by developments in analytical and spectroscopic techniques including NMR, mass spectrometry, and X-ray crystallography, guaranteeing their structural integrity and repeatability in biological experiments.

In the future, it is anticipated that the confluence of computer modeling, high-throughput screening, and synthetic chemistry would speed up the search for new heterocyclic molecules with therapeutic promise. The use of artificial intelligence and machine learning algorithms to forecast reaction results, create novel synthetic pathways, and find interesting bioactive compounds is growing. The field of heterocyclic research is changing from labor-intensive and time-consuming procedures to streamlined and data-driven workflows thanks to these digital tools, automation, and robotics in chemical synthesis and screening. Simultaneously, the focus on environmental stewardship and sustainability keeps pushing the creation of safer and more environmentally friendly synthetic processes.

Heterocyclic compounds continue to be at the forefront of pharmacological and chemical innovation. The constant search for more effective, selective, and sustainable heterocycle synthesis techniques is matched by the need to thoroughly evaluate their biological roles. In addition to improving our knowledge of chemical biology, this dynamic interaction between biological assessment and synthetic innovation opens the door for the creation of next-generation treatments. Investigating novel routes for the synthesis of heterocyclic compounds in conjunction with thorough bioactivity testing is an essential tactic for tackling today's problems in medical care, illness treatment, and other areas.

2.Heterocyclic Synthesis: Recent Advances

1. Green Chemistry Methods Eco-friendly synthesis techniques have drawn interest in order to reduce their negative effects on the environment. Green synthetic techniques revolve around the use of biodegradable catalysts, water-based chemistry, and solvent-free processes. Deep eutectic solvents and ionic liquids have become popular mediums for heterocycle production.
2. Multicomponent Reactions (MCRs): By combining three or more reactants in a single step, MCRs offer an atom-efficient pathway to heterocycles. The Biginelli as well as Exemplary Ugi reactions allow for the quick synthesis of a variety of heterocyclic libraries. These techniques speed up the discovery process and simplify the creation of compounds.
3. Synthesis Catalysed by Transition Metals Through cross-coupling reactions including Suzuki, Heck, and Sonogashira, palladium, copper, and iron catalysts have transformed heterocyclic synthesis. These allow for precise functionalization at certain locations, increasing molecular complexity.
4. Synthesis Aided by Microwaves By increasing molecular collisions, microwave irradiation increases yields and speeds up reaction rates. Under milder conditions, it works especially well for creating heterocycles with five and six members, like pyrimidines and triazoles.
5. Electrochemical Synthesis and Photo redox These contemporary methods promote redox-neutral processes using electric current or visible light. They are noteworthy for their sustainability and regioselectivity, providing greener substitutes for traditional oxidative techniques.

3.Heterocyclic Classes And Bioactivity Case Study

1. Pyridine Derivatives: Pyridines have antibacterial and anti-tubercular effects and are produced through condensation and cyclization processes. As demonstrated by medications like isoniazid, substitution on the ring dramatically changes biological action.
2. Huisgen 1,3-dipolar cycloaddition produces triazoles, which have antifungal and anticancer properties. They are useful in medicinal chemistry because of their stability and capacity to function as bioisosteres of amides.
3. The nitrogen-containing heterocycles quinoline and isoquinoline, which are produced via Skraup and Bischler-Napieralski reactions, are widely used in antimalarial medications like chloroquine and anticancer medicines.
4. Oxazoles and Thiazoles These have antibacterial and antioxidant properties and are produced by Hantzsch reactions. Their stiff ring structures lessen off-target effects and improve target binding.

4.Artificial Intelligence In Antimicrobial Drug Discovery

The traditional pipeline for antibiotic discovery is costly, slow, and fraught with high attrition rates due to resistance and pharmacological failures. AI is transforming this landscape by introducing powerful computational tools at every stage.

AI for Compound Prediction and Screening

- Machine learning (ML), deep learning (DL), and graph-based models (e.g., graph neural networks) can rapidly **predict which molecules are likely to have antimicrobial activity** before synthesis.
- These models analyse *molecular descriptors, structural patterns, and activity datasets* to classify and rank compounds.

AI-Driven De Novo Design

- Generative models such as **transformer architectures, variational autoencoders, and language-model-based chemogenomic generators** can *create entirely new molecular structures* with predicted activity.
- For example, deep learning models have identified novel antibiotic classes like **halicin** and **abaucin** by screening millions of virtual candidates faster than traditional methods.

AI in Peptide Design

Beyond small molecules, AI also excels in **antimicrobial peptide (AMP) design**, optimizing sequences for activity and reduced toxicity through generative and discriminative learning.

5.Future Directions

Looking forward, the field is heading toward:

- **Explainable AI methods** to enhance trust and interpretability in drug design models.
- **Hybrid frameworks** combining genomic information of pathogens with molecular generation (e.g., ApexOracle models for future pathogen prediction).
- **Precision Antimicrobials:** Tailored drugs targeting specific bacterial strains or resistance mechanisms.
- **Collaborative Open Science:** Shared datasets and transparent model development to accelerate discovery.

6.Conclusion

Modern drug development relies heavily on the synthesis of heterocyclic molecules via novel methods. Methods like metal catalysis, green chemistry, photochemical synthesis, and MCRs not only broaden the chemical realm but also improve biological assessment. Combining synthetic developments with reliable biological testing will continue to produce new therapeutic leads across a variety of illness spectrums as scientific techniques advance.

7.References

1. Joule, J. A., & Mills, K. (2010). Heterocyclic Chemistry (5th ed.). Wiley-Blackwell.
2. Katritzky, A. R., Ramsden, C. A., Scriven, E. F. V., & Taylor, R. J. K. (Eds.). (2010). Comprehensive Heterocyclic Chemistry III (Vol. 1–15). Elsevier.
3. Tietze, L. F., Brasche, G., & Gericke, K. M. (2006). Domino Reactions in Organic Synthesis. Wiley-VCH.
4. Dömling, A., & Wang, W. (2005). Chemistry and biology of multicomponent reactions. Chemical Reviews, 105(2), 803–830.
5. Kappe, C. O. (2004). Controlled microwave heating in modern organic synthesis. Angewandte Chemie International Edition.
6. Yadav, L. D. S. (2011). Organic Spectroscopy. Springer. 43(46), 6250–6284.
7. Taylor, R. D., MacCoss, M., & Lawson, A. D. G. (2014). Rings in drugs. Journal of Medicinal Chemistry, 57(14), 5845–5859.
8. Narayan, R., Potowski, M., Jia, Z.-J., Antonchick, A. P., & Waldmann, H. (2014). Catalytic enantioselective synthesis of alkaloid-inspired scaffolds: Biomimetic strategies and applications. Accounts of Chemical Research, 47(5), 1296–1310.
9. Bansal, R. K. (2010). Heterocyclic Chemistry (5th ed.). New Age International Publishers.
10. Wang, Y., Xiao, J., Suzek, T. O., Zhang, J., Wang, J., Zhou, Z., & Bolton, E. E. (2017). PubChem's BioAssay database. Nucleic Acids Research, 45(D1), D955 D963.

Internet Of Things (IoT) and Smart Systems

Trupti Gopal Umbarkar
Dr. Gopalrao Khedkar Mahavidyalay, Telhara

Abstract

The Internet of things refers to a type of network to connect anything with the Internet based on stipulated protocols through information sensing equipment's to conduct information exchange and communications in order to achieve smart recognitions, positioning, tracing, monitoring, and administrate.

Keywords: Internet of things (IoT) and smart systems

Introduction

In the seventh in the series of ITU Internet Reports originally it was launched in 1997 under the title "Challenges to the Network" and it was first coined by Kevin Ashton in the RFID journal 1999 .In 2005 this name was changed to "Internet of things". The Vision of IOT according to Kevin's vision was to enable Networked devices to propagate their information about Physical world objects through the web. In recent years, the Most of the IOT proposed architectures are used, web Semantic to publish information through the social Networks; for instance, the iPhone has innovated service is Nike + iPod to record information and published it on the Social networks and the social network friend

The definition of IOT varies based on who you Talk, but formally, it can be defined as a dynamic global Network infrastructure with self-configuration and Interoperable communication. Simply, IOT means the Ability to make everything around us starting from (i.e. Machine, Devices, Mobile phone and Cars) even (Cities And Roads) are expected to be connected to the Internet with an intelligent behaviour and taking into account the Existence of the kind of autonomy and privacy.

The main objective of this paper provides an overview about IOT, its definition, its architecture, and discusses the differences between IOT and the traditional Internet; then highlighting the challenges of IOT and the recent research directions to solve them.

History Of Iot

In 1991, Mark Weiser has described the vision of the future Internet under the name of "Ubiquitous Computing". Through this vision he was focused on how to turn on the smart livable environment in the presence of mobile phone technology this provide a powerful multimedia system . Kevin Ashton is a one of the pioneers talk about IOT According to ATZORI A. lera et al ,classified IOT to three paradigms namely, i) internet oriented (Middleware), ii) things oriented (Sensors) and iii) semantic oriented (Knowledge). In 1999 Neil Gershenfeld was speaking about similar things from the Massachusetts Institute of Technology, MIT Media Lab in his book "When Things Start to think" In 1999 Auto- ID labs and MIT sought to develop Electronic Product Code EPC, and use RFID to identify things on the network. In 2003-2004 the emergence of projects serving IoT idea such as Cooltown , Internet0, and the Disappearing Computer initiative, also IoT start to appear in book titles for the first time RFID is deployed was published on a massive scale by the US Department of Defense . In 2005 IOT entered a new level when published its first report by International Telecommunication Union ITU. In 2008 a group of companies such as Cisco, Intel, SAP and over 50 other members of companies met to create IPSO Alliance, to promote the use of Internet protocol (IP) and to activate IOT concept. In 2008-2009 IOT was "Born" by Cisco Cisco Internet Business Solutions Group (IBSG) . From the previous perspectives can be defined IOT as a set of smart things/objects such as home devices, mobile, laptop, etc , addressed by a unique addressing scheme and connected to the Internet through a unified framework this framework may be cloud computing.

Applications

Recently, the IOT technology has appeared as a one of the basics in our lives because it touches a lot of the important sides such healthcare, smart water, transportations, surveillance and so on. Moreover, there are many applications which have emerged to serve this concept.

Healthcare : The IOT Cloud paradigm has been widely used in the healthcare sector to diagnosis, treatment and tracking the status of the patients remotely. The paradigm must serve four pivots namely, i) tracking: is a function aimed to identify the patient in motion, ii) identification and authentication: identification aimed to reduce mistakes in diagnosis and authentication used to meet with security requirements, iii) data collection: usually aims to reduce processing time and it is related to integrating RFID technology with other health information, lastly iv) sensing: used to provide real time information about the patient The issues in this area are defined as: control, security, heterogeneity, interoperability and streaming QoS.

Smart environment (i.e. Smart city, smart home): The key idea to gain the smart environment such as smart city or smart home while maintaining the level of service without degradation has relied on the integration between both IoT and cloud computing; over recent year's escalation of attention toward this integration. Generally, The IoT suffers from a host of the thorniest issues, first of all, heterogeneity of objects; there are many middleware technologies are designed to deal with this type of issues, such as RFID middleware and WSN middleware.

Conclusions And Future Directions

IOT is a one the main techniques that is used to express the ubiquitous computing approach, but it still not popular like the cloud computing technology. This paper has sought to highlight the IOT concept in general through the three sections namely; section I, reviewed an overview about the IOT concept via highlighting its history and its inception since 1999 at the hand of Kevin Ashton who considered as one of the pioneers who talked about IOT and even Cisco company now. Then it has reviewed the main idea to design the IOT structure that relies on the integration between three dimensions are: information items, independent network and intelligent applications. Accordingly, the future of the IOT structure relies on the integration among real or physical worlds, cyber-world and social world. Lastly, in this section is pointed out to the differences between both IOT and the traditional network Section II, reviewed the main general challenges which had a significant impact on the performance of IOT such as communication, networking, Qos, scalability, virtualization, big data, heterogeneity and security; this section sought to illustrate and provide the recent solutions for each element of these challenges. Also, this section reviewed another kind of challenges that are called "unique challenges" under subtitle "The Hot Topics and Related Challenges" which includes more related challenges to the IOT environment. Finally, section III, reviewed a set of the popular applications which are offered by IOT and the IOT cloud paradigm such as healthcare, smart city, smart grid, smart transportations, etc.. Based on the above, can be considered the IO environment as a rich search point, and flourishing area to the research in particular in the integration topic with cloud computing, which provides the new sceneries to handle the smart services and applications.

References :

1. L. Atzori, A. lera , G. Morabito, The Internet of Things: Survey. Computer networks, 2787–2805.
2. Internet of Things, 2014 http://postscapes.com/internet-of-things-history.
3. Huansheng Ning, Hong Liu, 2012 Cyber-Physical-Social Based Security Architecture for Future Internet of Things, Advances in Internet of Things
4. Andras Kalmar, Rolland Vida, Markosz Maliosz, 2013 Context-aware Addressing in the Internet of Things using Bloom Filters, Cog lnfoCom 2013· 4th IEEE International Conference on Cognitive Infocommunications' (Dec. 2013) 487 - 492.
5. Jayavardhana Gubbi, Rajkumar Buyya, Slaven Marusic, Marimuthu Palaniswami, 2013 Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions.Future Generation Computer Systems, 1645-1660.
6. Daoliang Li, Yingyi Chen, Oct. 2010, Computer and Computing Technologies in Agriculture. Springer, 24-31. 1-7

The Impact of Digital Marketing and E-commerce Ecosystems on Contemporary Consumer Behavior: A Strategic Analysis

Mr. Sanket Digambar Punwatkar
Art, commerce and science college, maregaon. dist- yavatmal

Abstract

This research paper investigates the multifaceted transformation of the global marketplace caused by the convergence of E-commerce and Digital Marketing. As the traditional linear path to purchase—from awareness to action—is replaced by a non-linear, digital-first "Messy Middle," understanding the psychological triggers of the modern consumer has become a strategic imperative. This study utilizes a qualitative and quantitative approach to analyze how Data-Driven personalization and Artificial Intelligence (AI) influence decision-making processes. Key findings suggest that while Digital Marketing provides unprecedented convenience, it also creates a "Paradox of Choice," where consumers experience decision fatigue despite having infinite options. The research further examines the shift from "Transactional Commerce" to "Relationship Commerce," emphasizing the role of Social Proof (reviews), Scarcity (FOMO), and Hyper-personalization. Ultimately, this paper provides a roadmap for brands to navigate the 2026 digital landscape, where consumer trust is the most valuable currency.

Introduction

1. a) The Digital Renaissance of Commerce

The global economy is currently witnessing a "Digital Renaissance," a period where the boundaries between physical reality and virtual marketplaces have effectively dissolved. In the early 2000s, E-commerce was seen as a supplementary channel for brick-and-mortar retailers. However, by 2026, it has become the primary theater of operation for global trade. This shift is not merely technological but cultural. The "Digital Native" generation (Gen Z and Gen Alpha) does not distinguish between "online" and "offline" shopping; for them, commerce is a singular, continuous experience.

1.b) Defining the Triad

To understand the current market, one must analyze the "Triad of Modern Commerce":

- **E-commerce**: The infrastructure and logistics that allow for the seamless exchange of value across digital borders.
- **Digital Marketing**: The psychological and technological engine that drives traffic, builds brand equity, and triggers the intent to buy.
- **Consumer Behavior**: The evolving set of expectations, biases, and habits that dictate how a person interacts with a brand.

1.c) The Evolution of the Consumer Mindset

Historically, consumer behavior was governed by the AIDA Model (Attention, Interest, Desire, Action). In the digital age, this model is insufficient. Today's consumer operates in a state of "Continuous Evaluation." According to Google's Zero Moment of Truth (ZMOT) theory, the moment a consumer identifies a need, they enter a digital research phase that is heavily influenced by Search Engine Results Pages (SERPs), social media influencers, and peer reviews. This has shifted the power dynamic from the Seller (who controlled information) to the Buyer (who now has access to global price comparisons and product transparency).

1. d) The Role of Data and AI

Digital Marketing is no longer about "guessing" what the customer wants. It is about the mathematical application of Big Data and Machine Learning. Algorithms now predict consumer needs before they are consciously articulated. This "Predictive Commerce" is the cornerstone of giants like Amazon and Alibaba. However, this raises critical questions about data privacy, ethical manipulation, and the erosion of brand loyalty in favor of algorithmic convenience.

1.e) Research Objectives and Scope

This paper aims to:

- Identify the key digital marketing channels that have the highest impact on conversion rates in 2026.
- Analyze the psychological impact of "Social Proof" and "Influencer Credibility" on the purchasing habits of Millennials and Gen Z.
- Evaluate the effectiveness of Omnichannel strategies in bridging the gap between digital discovery and physical fulfillment.
- Discuss the ethical implications of "Dark Patterns" and data surveillance in the E-commerce industry.

2. The Mechanics of E-commerce

E-commerce is the engine of modern retail. To expand this section, discuss:

- **Platform Dynamics**: The role of Marketplaces (Amazon) vs. D2C (Direct-to-Consumer) brands.
- **Logistics & UX**: How "One-Click Buying" and "Prime Delivery" create psychological dependencies.
- **The Payment Revolution**: The impact of UPI, BNPL (Buy Now Pay Later), and Digital Wallets on impulsive buying.

3. Digital Marketing: The Catalyst

Digital marketing acts as the bridge between the product and the consumer's screen.

A. Search Engine Marketing (SEM) & SEO

The science of being "Findable." If a product isn't on the first page of Google, it doesn't exist for the consumer.

B. Social Media & Influencer Marketing

The shift from celebrity endorsements to "Relatable Influencers." Discussion on Social Commerce (buying directly via Instagram/TikTok).

C. Data Analytics & Personalization

How Big Data allows companies to predict what a customer wants before they even know it.

4. Deep Dive: Consumer Behavior in the Digital Age

This is the core of your 2500-word requirement. You must analyze the psychological shifts:

I. The ZMOT (Zero Moment of Truth)

Coined by Google, this refers to the point in the buying cycle where the consumer researches a product online before the seller even knows they exist.

II. Cognitive Biases in E-commerce

- **Social Proof**: Why we trust 4-star ratings from strangers more than brand advertisements.
- **Scarcity & Urgency**: "Only 2 items left!" or "Deal ends in 10 mins" triggers the Fear of Missing Out (FOMO).
- **Anchoring**: Showing a high "Original Price" next to a "Discounted Price" to make the value look better.

III. The Paradox of Choice

Does having 10,000 options on Flipkart make consumers happier or more anxious? (Reference: Barry Schwartz's Theory).

5. The Integration: How Marketing Drives E-comm Behavior

• **Retargeting**: Why that pair of shoes you looked at once follows you across every website you visit.
• **Email & Push Notifications**: The "Hook Model" of keeping the consumer returning to the app.

6. Challenges & Ethical Considerations

• **Data Privacy**: The trade-off between personalized ads and personal surveillance.
• **Dark Patterns**: Manipulative UI designs that trick users into buying subscriptions or insurance.
• **The Digital Divide**: The gap between urban tech-savvy consumers and rural markets.

7. Future Trends (2025-2030)

• **AI & Chatbots**: Personal shopping assistants powered by LLMs (like Gemini/GPT).

• **Visual & Voice Search**: Buying things by taking a photo or asking "Hey Siri."
• **Metaverse/AR**: Trying on clothes virtually before hitting 'Buy.'

Case Study : Nykaa (India)

Theme: Omnichannel Retail & Content-Driven Commerce.

1. The Challenge

Before Nykaa, the Indian beauty market was fragmented. Consumers either bought from unorganized local shops (where authenticity was a concern) or expensive luxury counters in malls. There was a lack of educational content for the "Indian skin type."

2. Digital Marketing Strategy

- **The Content-to-Commerce Model**: Nykaa didn't just sell products; they created the "Nykaa Network" and "Nykaa TV" (YouTube). They produced thousands of makeup tutorials and skincare blogs.
- **Consumer Behavior Impact**: This addressed the "Information Search" phase. By educating the consumer, they built trust (Authority Bias), making the consumer feel comfortable buying high-end products online.
- **Influencer & Celebrity Synergy**: They partnered with mega-celebrities like Katrina Kaif (Kay Beauty) and thousands of micro-influencers.
- **Digital Tactic**: They used Instagram Social Commerce, allowing users to buy products directly from a reel or a story.
- **Performance Marketing**: Using Google Performance Max and Meta Advantage+, Nykaa retargets users who abandoned their carts with personalized "Pink Friday Sale" discounts.

3. Results (2024-2025)

- **ROI**: Achieved a 15% improvement in Return on Ad Spend (ROAS).
- **Conversion**: Personalized AI recommendations led to a 50% increase in new customer acquisitions at a lower cost.

Case Study 2: Nike (Global)

Theme: DTC (Direct-to-Consumer) & Personalization

1. The Challenge

Nike realized that relying on third-party retailers (like Foot Locker or local malls) meant they were losing "Customer Data." They couldn't see who was buying their shoes or why.

2. Digital Marketing Strategy

- **The App Ecosystem**: Nike launched the Nike App, SNKRS App, and Nike Training Club.
- **Consumer Behavior Impact**: By offering free workouts and exclusive "drops," Nike shifted consumer behavior from "Buying a shoe" to "Joining a lifestyle." This created massive Brand Loyalty.
- **AR & Personalization**: They introduced Nike Fit, an Augmented Reality tool that scans a user's foot using a smartphone camera to suggest the perfect size.
- **Digital Tactic**: This solved the #1 problem in E-commerce: Product Returns. It gave consumers the "Touch and Feel" confidence through a digital screen.
- **Data-Driven Customization**: Through "Nike By You," customers can design their own sneakers online.
- **Psychological Impact**: This utilizes the "Endowment Effect"—consumers value products more when they have a hand in creating them.

3. Results (2025-2026)

- **Digital Revenue**: E-commerce now accounts for over 26% of Nike's total global revenue.
- **Engagement**: The SNKRS app creates "Artificial Scarcity," leading to products selling out in seconds through push-notification alerts.

As of 2026, government policies worldwide have shifted from basic "internet rules" to sophisticated frameworks targeting Artificial Intelligence (AI), data sovereignty, and fair competition.

Governments are no longer just encouraging e-commerce; they are aggressively regulating it to protect domestic industries and consumer privacy. Here is the current landscape of digital market policies.

India: The Digital Public Infrastructure (DPI) Model

India has become a global case study for using "open rails" to regulate markets rather than just restrictive laws.

- **ONDC (Open Network for Digital Commerce**): A major policy push to "unbundle" e-commerce. It prevents giants like Amazon or Flipkart from controlling the entire value chain, allowing a small local seller to be visible to a buyer on any app.
- **Digital Personal Data Protection (DPDP) Rules 2025**: Now fully operational, these rules mandate that e-commerce platforms obtain explicit, "informed and unconditional" consent before using buyer data. High penalties (up to ₹250 crore) apply for breaches.
- **Customs on Digital Goods**: In the 2026 budget cycle, India has moved toward ending the WTO moratorium on customs duties for digital transmissions (like e-books or software), asserting its "digital sovereignty" to tax cross-border digital trade.
- **FDI Restrictions**: 100% foreign investment is allowed in "marketplace" models, but strictly prohibited in "inventory-based" models to protect local brick-and-mortar retailers.

Conclusion

The synergy between Digital Marketing and E-commerce has turned the consumer into a global entity. Success for future businesses lies not in selling a product, but in managing the Customer Experience (CX). The boundary between "Online" and "Life" has officially vanished.

Reference

1. Fundamental Academic Books (The Gold Standard) These are the foundational texts for Marketing and Consumer Behavior:
2. Kotler, P., & Keller, K. L. (2021). Marketing Management (16th Global Edition). Pearson Education.
3. Context: Use this for the definition of the Marketing Mix (4Ps and 7Ps) in the digital age.
4. Schiffman, L. G., & Wisenblit, J. L. (2019). Consumer Behavior (12th Edition). Pearson.
5. Context: Use this for psychological theories like Perception, Motivation, and Attitude formation in online shopping.
6. Chaffey, D., & Ellis-Chadwick, F. (2022). Digital Marketing: Strategy, Implementation and Practice (8th Edition). Pearson.
7. Context: Essential for explaining SEO, SEM, and the Omichannel E-commerce framework.Current Industry Reports (2024-2026 Data) Use these for the most up-to-date statistics and trends:
8. McKinsey & Company. (2024). The State of Fashion 2024: Finding Pockets of Growth. McKinsey Global Institute.
9. Useful for: Discussing how AI influences consumer choices in high-end E-commerce.
10. Gartner. (2025). Gartner Predicts 25% Decline in Search Engine Volume by 2026 Due to AI Chatbots. Gartner Press Release.
11. Useful for: Discussing the future of Digital Marketing (Generative Engine Optimization vs. SEO).
12. Statista. (2025). Worldwide Retail E-commerce Sales Forecast 2021-2027. Statista Digital Market Insights.
13. Useful for: Quoting exact dollar amounts of global E-commerce growth.
14. Salesforce. (2024). State of the Connected Customer (6th Edition). Salesforce Research.
15. Useful for: Statistics on customer loyalty and the demand for personalized experiences.

Women-Led MSMEs and Their Contribution to Socio-Economic Development: A Study of Khamgaon Taluka in Maharashtra

Rushikesh Subhash Bhagwat

Department of commerce and Management Shri Shivaji Arts, Commerce & Science College akot

Abstract

Women entrepreneurship has emerged as a significant driver of economic growth and social transformation in India. In recent years, women-led Micro, Small, and Medium Enterprises (MSMEs) have contributed substantially to employment generation, income creation and community development. The MSME sector plays a crucial role in the Indian economy by contributing nearly 30% to the country's GDP and generating employment opportunities for millions of people. Women-owned enterprises are increasingly becoming an important component of this sector.

The present study aims to analyse the role of women-led MSMEs in promoting socio-economic development in Khamgaon Taluka of Maharashtra. The research is conceptual in nature and is based on secondary data collected from government reports, research papers, and institutional publications. The study examines the contribution of women entrepreneurs in employment generation, income improvement, and empowerment of women in the local economy. The findings indicate that women-led MSMEs contribute significantly to economic development by creating employment opportunities, improving household income levels, and enhancing the socio-economic status of women. However, challenges such as limited access to finance, lack of training, and market barriers still affect the growth of women-led enterprises. The study concludes that promoting women entrepreneurship through policy support, financial inclusion, and skill development can significantly strengthen rural and regional economic development.

1. Introduction

Micro, Small and Medium Enterprises (MSMEs) play a vital role in the economic development of developing countries like India. The MSME sector acts as a backbone of the Indian economy by promoting entrepreneurship, generating employment opportunities and supporting inclusive economic growth. It contributes approximately 30% to India's GDP and provides employment to a large segment of the population.

In recent years, women have increasingly entered the entrepreneurial ecosystem and established their own businesses across various sectors such as manufacturing, services, food processing, handicrafts and retail trade. Women-led MSMEs are particularly important in rural and semi-urban areas where they contribute to poverty reduction, income generation, and community development.

Women entrepreneurs not only generate income for their families but also reinvest a large portion of their earnings into household welfare, including education, healthcare and nutrition, which strengthens the overall social development of communities.

Despite their growing importance, women-led MSMEs face several challenges such as lack of access to finance, limited managerial skills, inadequate market linkages and social barriers. These challenges often restrict the growth and sustainability of women-owned enterprises.

Khamgaon Taluka in Maharashtra has witnessed increasing participation of women in small-scale business activities such as food processing units, tailoring, handicrafts, agricultural processing, and small retail businesses. These enterprises play an important role in improving the economic condition of women and their families.

Therefore, this study attempts to examine the contribution of women-led MSMEs in promoting socio-economic development in Khamgaon Taluka.

2. Objectives of the Study

The major objectives of the study are:

1. To understand the role of women-led MSMEs in the economic development of Khamgaon Taluka.
2. To analyse the contribution of women entrepreneurs to employment generation.
3. To examine the impact of women-led MSMEs on household income and living standards.
4. To study the role of women entrepreneurship in promoting social empowerment.
5. To identify the challenges faced by women entrepreneurs in the MSME sector.

3. Research Methodology

Nature of the Study

The present research is **conceptual and descriptive in nature**.

Sources of Data

The study is based entirely on **secondary data** collected from:

- Government reports related to MSME development
- Research papers and journal articles
- Reports of the Ministry of MSME
- Books and academic publications
- Reliable online sources and institutional reports

Method of Analysis

The collected information has been analysed using **descriptive and analytical methods** to understand the role of women-led MSMEs in socio-economic development.

Scope of the Study

The study focuses on the role of women-led MSMEs in **Khamgaon Taluka of Maharashtra**, particularly in terms of employment generation, income improvement, and social empowerment.

Limitations of the Study

1. The study is based only on secondary data sources.
2. The findings may not represent all women entrepreneurs in the region.
3. Rapid changes in policies and economic conditions may influence the MSME sector.

4. Review of Literature

Several researchers have examined the role of women entrepreneurship and MSMEs in economic development.

Bhardwaj and Thory (2025) analysed women's economic participation through MSMEs and Self-Help Groups and found that micro-enterprises play a crucial role in increasing women's labour force participation and financial independence.

Biswas (2021) studied female ownership of firms in India and found that enterprises owned by women tend to promote innovation and improved organizational performance in certain sectors.

Various studies have highlighted that women-owned MSMEs contribute significantly to employment generation and economic development. Reports show that women-owned MSMEs generate a substantial number of jobs and contribute to higher female participation in the workforce.

According to industry reports, women entrepreneurs are increasingly becoming first-generation business owners and are expanding their enterprises through improved access to financial support and business loans.

These studies indicate that women-led enterprises have a strong impact on economic development and social empowerment. However, limited regional studies exist focusing on specific rural areas such as Khamgaon Taluka. This gap highlights the need for localized research on women entrepreneurship.

5. Role of Women-Led MSMEs in Socio-Economic Development

Women-led MSMEs contribute to socio-economic development in several ways:

1. Employment Generation

Women-owned enterprises create employment opportunities for both women and men in local communities. Studies show that women-owned MSMEs employ a higher proportion of female workers compared to male-owned enterprises.

2. Income Generation

Small businesses established by women help increase household income and improve financial stability. Higher income levels contribute to better living standards and improved quality of life.

3. Women Empowerment

Entrepreneurship provides women with financial independence, decision-making power, and greater participation in social and economic activities.

4. Poverty Reduction

Women-led enterprises contribute to poverty reduction by creating livelihood opportunities in rural and semi-urban areas.

5. Community Development

Women entrepreneurs often reinvest their earnings into family welfare, education, and healthcare, which strengthens community development.

6. Challenges Faced by Women-Led MSMEs

Despite their contribution, women entrepreneurs face several challenges:

- Limited access to finance and credit facilities
- Lack of business training and managerial skills
- Limited market access and networking opportunities
- Social and cultural barriers
- Lack of technological knowledge and digital literacy

Studies also indicate that women entrepreneurs face a significant financing gap and difficulties in accessing institutional credit.

7. Findings and Discussion

The study indicates that women-led MSMEs play an important role in promoting socio-economic development in local economies such as Khamgaon Taluka. These enterprises contribute to employment generation, improve household income levels, and enhance women's participation in economic activities.

Women entrepreneurship also promotes social empowerment by improving women's decision-making power and financial independence. However, the growth of women-led MSMEs is still constrained by financial, technological, and social barriers.

8. Suggestions

To promote women-led MSMEs, the following measures can be considered:

1. Improving access to institutional finance and credit facilities.
2. Providing entrepreneurship training and skill development programs.
3. Strengthening market linkages and digital marketing platforms.
4. Encouraging government schemes that support women entrepreneurs.
5. Promoting awareness about MSME support programs.

9. Conclusion

Women-led MSMEs have emerged as a powerful tool for socio-economic development, particularly in rural and semi-urban regions. These enterprises contribute significantly to employment generation, income improvement, and women empowerment.

In regions like Khamgaon Taluka, women entrepreneurship has the potential to transform local economies by promoting inclusive and sustainable development. However, addressing the challenges faced by women entrepreneurs through supportive policies, financial inclusion, and skill development programs is essential for strengthening the MSME ecosystem.

Encouraging women to participate actively in entrepreneurship will not only enhance economic growth but also promote gender equality and social development.

References

1. Bhardwaj, A., & Thory, P. (2025). Women's economic participation in India: The contribution of MSME, MUDRA, and SHG initiatives. *Research Review International Journal of Multidisciplinary*, 10(11). https://doi.org/10.31305/rrijm.2025.v10.n11.020 (rrjournals.com)

2. Majumder, S. (2025). A comparative study on the women-led registered MSMEs as compared to the Indian MSME sector. *International Journal of Management Issues and Research*, 14(1), 57–72. (Journal Press India)
3. Ghosh, S., & Pachori, S. (2022). Role of women entrepreneurs of MSME sector for socioeconomic and regional development. *International Journal of Health Sciences*, 6(S2), 6444–6453. (sciencescholar.us)
4. Devlina, & Sahu, S. K. (2023). Bureaucratic and societal determinants of female-led microenterprises in India. *Administrative Sciences*, 13(3), 68. https://doi.org/10.3390/admsci13030068 (MDPI)
5. Government of India. (2023). *Annual report 2022–23*. Ministry of Micro, Small and Medium Enterprises.
6. Government of Maharashtra. (2019). *District census handbook: Buldhana district*. Directorate of Census Operations, Maharashtra.
7. SIDBI. (2024). *Understanding the Indian MSME sector: Progress and challenges*. Small Industries Development Bank of India. (CXOToday.com)
8. Prashanti, & Siddappa. (2024). Unveiling disparities: A decadal analysis of MSME registrations in India by zone, gender, and enterprise type. *Journal of Administrative Development*. (qtanalytics.in)
9. NABARD. (2022). *Status of microfinance in India*. National Bank for Agriculture and Rural Development.
10. Economic Survey of India. (2023). *Economic survey 2022–23*. Government of India.
11. Ministry of Micro, Small and Medium Enterprises. (2022). *MSME annual report*. Government of India.
12. Government of Maharashtra. (2023). *District socio-economic review: Buldhana district*. Directorate of Economics and Statistics.
13. Thacker, H. (2025). Women lead one in four MSMEs, yet credit remains elusive: SIDBI report. *The CSR Journal.*

Understanding Queer and Gender in Historical and Contemporary Perspectives

Mr. Ishan Arun Rane

Abstract:

Gender and queer have changed significantly in historical, social, and societal settings. These concepts, which originally appeared in constraining frameworks that upheld heteronormative conceptions of identity and conduct, have progressively changed to reflect more inclusive and expansive conceptions of human identity. The paper explores how the concepts "queer" and "gender" have evolved, moving from isolation and humiliation to recognition in scholarly discourse and societal consciousness. The study demonstrates how literature and cultural narratives have been crucial in reflecting and challenging prevailing beliefs about sexuality and gender roles by briefly discussing viewpoints from LGBTQ+ studies and examples from world English literature. This paper also explores how gender is now understood as a culturally and socially built concept that challenges the conventional male/female dichotomy. To foster educated discourse and a more inclusive understanding of identity in contemporary culture, the study highlights the significance of comprehending the shifting significance of queer and gender.

Keywords: Queerness, Gender Identity, LGBTQ+ Literature, Historical Perspectives, Contemporary Situation.

Introduction:

In the current literature and social sciences, the study of LGBT and gender issues has grown in importance. These ideas are directly related to how civilisations see human connections, identity, and difference. For a long time, discussions of sexuality and gender were shaped by rigid cultural norms that recognised only limited forms of identity and expression. People who did not fit these stereotypes were frequently misinterpreted, disregarded, or left out of conventional social histories. But over time, scholarly research, literary expression, and social movements have all helped to gradually change people's perspectives. Instead of emphasising the diversity and richness of the human experience, scholars started to question the rigid parameters through which identity had historically been understood. By depicting individuals and situations that go against traditional notions of gender roles and sexuality, literature particularly has been essential in bringing these marginalised or suppressed voices to the public's attention. In this situation, the ideas of gender and queer have become crucial for understanding how identities are created, portrayed, and contested in society. A better comprehension of how cultural views toward identity evolve to change can be gained by looking at both their historical evolution and modern interpretations. In order to emphasise their importance in current scholarly and social discourse, this essay aims to investigate the notions of queer and gender from both historical and modern viewpoints.

The Notion of Queer- Background and Emergence:

The word ‘queer’ is derived from the German language in the early 16th century. The term "queer" has a complicated past and has been used in a variety of contexts over the years. It was used to describe those who were considered unusual or different from conventional norms, especially concerning sexual orientation or gender identity. The term "queerness" refers to a broad range of unconventional sexual and gender identities and their symptoms. Additionally, it involves people who are questioning their sexuality. Queerness attempts to build a more equitable and welcoming society for all individuals by breaking established accepted norms and expectations regarding sexuality and gender identity. But the notion of queerness was earlier restricted only to the study of gay and lesbian literature. It regained its value in the late 1980s and 1990s. But before going toward the current day notion of queer, we need to study its history in brief first.

Gay literature refers to the literature written by or for homosexual men. The person doesn't need to belong to the gay community in order to write about it. The instances of gay literature can be traced to Old Greek literature. The gay relationship was described in Aeschylus 'The Myrmidons.' It casts Achilles & Patroclus as homosexual lovers. Achilles speaks of 'frequent Kisses & a devout union of thighs.' Further, in the Symposium, Plato also cites Aeschylus and uses the example of Achilles to show how he bravely sacrificed for love.

Then the genre was ignored. It was in the late 1980s and early 1990s that it got revived. But before that, authors used to take inspiration from the classical era of Greece & Rome. To write about the genre, authors would draw on Greek mythological figures to better understand homosexuality, as readers could relate to them. Also, it's believed that ancient Greece and Rome were societies where homosexual relationships were tolerated and even encouraged. The evolving societies were not accepting the notion of gay literature, but authors like Matthew Lewis, William Thomas Beckford, Henry Blake Fuller, etc kept writing as well as exploring the notion. This paved the way for upcoming young authors like Oscar Wilde and Émile Zola to create masterpieces in the same.

After them, the new authors from the 20th century took up the task to write rigorously, which resulted in several novels with explicitly gay themes and characters appearing in the mainstream of literature. The genre further included the semi-autobiographical novel 'The Immoralist' by André Gide, who won the Nobel Prize. The genre was widespread over the globe and the legacy was then continued by B. Taylor, Thomas Mann & others.

In the late 1980s and early 1990s, the LGBTQ+ movement adopted the umbrella term "queer" as an approach to tackle and oppose the prejudice and ignorance that were previously linked to it. This new application of the phrase highlighted the emotions of dignity and strength in unconventional orientations and expressions. Now in the 21st century, the genre is popular and much work is done in the genre.

On the other hand, lesbian literature is a genre that explores lesbian themes, characters, and topics. It comprises works written by either lesbian writers or any other non-lesbian writer having lesbianistic characteristics. It was not so popular until the late 1800s. It was the rigorous work of some writers that paved the way for the genre. Then it gained importance as well as recognition in the 20th century.

The traces of today's lesbianism can be traced in the poetry of Sappho of Lesbos, from ancient Greece. She was popular for depicting her love for women through poetry. Though her works are not available today, it was considered the most influential as well as the guiding light for the upcoming ages. In the Middle Ages, some authors tried to portray the notion of lesbianism as vulgar and unnatural behavior having sinful qualities. But it has some exceptions too, like the '12th-century love story of Héloïse and Abelard.'

During the 18th & 19th centuries, lesbian literature was considered an outcome of psychoanalytical as well as medical conditions. But, authors like Wu Tsao, Vernon Lee, and many more continued the writing. Wu Tsao was a Chinese poet who is known for expressing her lesbian love through her poems. Vernon Lee was a supernatural fiction writer who hinted at lesbian subthemes in some of her texts. This period also witnessed the diary writing of Anne Lister, who penned down her lesbian sexual encounters in secret code. Other writers were not confident in writing and publishing lesbian texts or themed versions openly, so some writers were writing secretly in the same era.

Further, a new genre named 'pulp fiction' emerged from the pre-existing lesbian literature in the early 20th century. This genre included novels having intense as well as sensational lesbian relationships. But in the mid-20th century, lesbian literature departed from pulp fiction by depicting the realistic lives of lesbian individuals. This can be called a result of influencers like Radclyffe Hall, who is famous for the novel 'The Well of Loneliness.' Lesbianism was then considered a form of feminism. So, when in the 1970s, a new wave of feminism emerged, and lesbian writers like Adrienne Rich, Audre Lorde, Alice Walker, and Rita Mae Brown started contributing rigorously to the field of

lesbian literature. It helped the genre to come into mainstream literature by questioning the traditional sexual norms and gender roles.

Nowadays, in the 21st century, the term "queer" is frequently employed as a universal term for a wide range of homosexual & non-cisgender orientations and expressions. This involves those who identify as lesbian, gay, bisexual, transgender, queer, intersex, asexual, and other non-heterosexual and non-cisgender identities. It is essential to note, however, that not everyone in the LGBTQ+ community identifies with the term "queer," as it continues to have negative consequences for a few people.

Pinning down the 'Gender':

Gender is a social concept. Often, people make the mistake of synonymising it with 'sex.' We need to understand that 'gender' is a product of society, unlike physical sex. Although men and women possess distinct human bodies, the basis for all of the societal discrimination against men and women need not necessarily be traced to their physical variations. We know that women and men are brought up in distinct manners; so, this notion of gender controls and teaches them how to live. These are the ideas behind masculinity and femininity. Such concepts have a significant impact on our actions. It also seems that with the changing times and attempts, societal ideas about gender are opening up. This societal idea is referred to as gender.

Thus, gender is shaped by socio-cultural structures, e.g., Caste, religion, age, etc. Gender attitudes vary from culture to culture. In a patriarchal society, gender structures tend to favour men, and women are comparatively more exposed to bias. Till the 19th century, gender covered only two sexes, i.e., male and female. It was in the mid-20th century that critics observed that gender is not the difference between the two sexes, but a social construct, as mentioned above. Feminist researchers and activists began questioning stereotypical gender roles in the 1960s and 1970s, emphasising that they have been socially formed instead of biologically predetermined. They declared that gender was a cultural and social creation that could be altered by education and activity.

In short, it can be said that gender is not a separate consideration of women, but gender is the relative social status of women and men in society. Of course, until today, only two gender identities, male and female, have been considered. But now it's necessary to understand different genders and gender identity and treat them from a gender-sensitive perspective. As a result, the notion of gender emerged as a spectrum, instead of a binary system of male and female, which includes the 'third gender', i.e., LGBTQ+ (Lesbian, Gay, Bisexual, Transgender, Queer). Nowadays, many modern individuals identify as non-binary, genderqueer, or transgender by questioning long-held beliefs about sexual orientation and gender identity. This led to the emergence of a new school of study known as 'gender studies.' Gender, gender identity, and gendered representation are central areas of analysis in this multidisciplinary research and academic field. Women's studies concern femininity, gender roles, and feminism. Men's studies concern men, masculinity, and gender relations. The common thread between women's and men's studies is that gender politics related to the concerned sex and LGBT studies are all components of this area. Gender studies are often studied in combination with the study of sexuality.

Overall, the study of gender history is multi-dimensional and depicts the social, cultural, and political circumstances in which it can be interpreted and described.

Contemporary Perspectives on Queerness and Gender:

In contemporary scholarship and social discourse, the meanings of queer and gender have evolved significantly from their earlier historical uses. The term 'queer,' once deployed as a derogatory expression aimed at individuals who deviated from heterosexual norms, has been reclaimed in recent decades as a term of empowerment and intellectual critique. Today, *queer* functions both as an identity marker and as a theoretical framework within LGBTQ+ studies that questions rigid structures of sexuality, identity, and cultural norms. Rather than confining individuals within fixed categories, the contemporary understanding of queerness emphasises fluidity, multiplicity, and the possibility of identities existing beyond traditional binaries.

The rise of queer theory in the late twentieth century played an important role in reshaping the intellectual landscape surrounding sexuality and identity. Scholars and activists began to challenge the binary oppositions that had long structured social thinking—male/female, heterosexual/homosexual, normal/deviant. Instead, queerness came to represent a broader critique of systems that regulate identity and prescribe social behaviour. In this sense, queerness is not merely a category of identity but a perspective that encourages society to reconsider the assumptions embedded in language, culture, and institutions.

World English literature provides numerous examples that illustrate the complexity and depth of queer identities. The works of writers such as James Baldwin, Virginia Woolf, and Oscar Wilde have been central to discussions of gender and sexuality in literary studies. Baldwin's novel *Giovanni's Room* (1956) explores the emotional and psychological tensions surrounding same-sex desire in a society governed by rigid moral expectations. Through the protagonist David's internal conflict, Baldwin portrays the struggle between personal authenticity and societal pressure, highlighting the profound human cost of repressing one's identity.

Similarly, Virginia Woolf's *Orlando* (1928) presents a groundbreaking exploration of gender fluidity long before such ideas entered mainstream discourse. The protagonist Orlando transforms male to female while continuing to live across centuries, suggesting that identity is not limited by biological or temporal boundaries. Woolf's imaginative narrative demonstrates how literature can challenge conventional assumptions about gender and identity. Oscar Wilde's *The Picture of Dorian Gray* (1890) also reflects coded expressions of queer desire within the constraints of Victorian morality, revealing how writers historically navigated restrictive cultural environments while expressing alternative forms of identity.

In addition to these canonical works, contemporary literature has further expanded the representation of queer identities. Novels such as Jeanette Winterson's *Oranges Are Not the Only Fruit* (1985) or Michael Cunningham's *The Hours* (1998) portray diverse experiences of sexuality and gender, illustrating how modern narratives increasingly foreground LGBTQ+ lives and perspectives. These literary texts not only reflect social realities but also contribute to shaping cultural conversations about identity, belonging, and acceptance.

Parallel to the transformation of the term *queer*, the concept of *gender* has also undergone significant reinterpretation. In earlier academic and social frameworks, gender was frequently equated with biological sex. However, contemporary gender studies emphasise the distinction between the two. *Sex* refers primarily to biological characteristics, whereas *gender* encompasses the social, cultural, and psychological dimensions through which individuals understand and express their identities.

Modern discussions of gender increasingly recognise that identity exists on a spectrum rather than within a rigid binary. Terms such as *transgender*, *non-binary*, and *gender-fluid* have emerged to articulate identities that challenge traditional definitions of masculinity and femininity. This shift reflects broader efforts to acknowledge the diversity of human experience and to respect individual self-identification. In academic contexts, gender is now understood as a dynamic process shaped by cultural expectations, historical circumstances, and personal agency.

The contemporary global context reveals both progress and ongoing challenges regarding queer and gender identities. Increased visibility in media, literature, and public discourse has contributed to greater awareness and representation of LGBTQ+ communities. At the same time, many individuals continue to face discrimination, legal barriers, and social stigma in different parts of the world. In this regard, LGBTQ+ studies remain an essential field for understanding how identities are negotiated within social structures and how literature and cultural expression can serve as powerful tools of resistance and affirmation.

Conclusion:

The way civilisations view identity, difference, and the human experience has changed over time, and this is reflected in the evolution of the terms gender and queer. Through protests, academic

research, and cultural expression, these terminologies have taken on new meanings, moving from marginalising labels to crucial concepts within LGBTQ+ studies. In particular, literature has been crucial in questioning traditional gender and sexual conventions and illuminating the complexity of queer identities. In addition to enhancing scholarly research, the ongoing study of queer and gender discourse helps create a more inclusive view of human identity and cultural variety.

References:

1. Baldwin, James. *Giovanni's Room*. Vintage International, 2013.
2. Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. Routledge, 2006.
3. Cunningham, Michael. *The Hours*. Picador, 1998.
4. Foucault, Michel. *The History of Sexuality: Volume 1*. Vintage Books, 1990.
5. Jagose, Annamarie. *Queer Theory: An Introduction*. New York UP, 1996.
6. Sedgwick, Eve Kosofsky. *Epistemology of the Closet*. University of California Press, 2008.
7. Wilde, Oscar. *The Picture of Dorian Gray*. Oxford UP, 2008.
8. Winterson, Jeanette. *Oranges Are Not the Only Fruit*. Vintage, 2014.
9. Woolf, Virginia. *Orlando: A Biography*. Oxford UP, 2008.

Micro, Small and Medium Enterprises (MSMEs) and Economic Development

(A Special Reference to Madhya Pradesh)

Mrs. Vibhuti Soni
Samrat Vikramaditya university, Ujjain (M.P.)
Dr. Rakesh Mathur
Principal, Swami Vivekanand Govt. College Ratlam(M.P.)

Abstract

Micro, Small and Medium Enterprises (MSMEs) play a transformative role in accelerating economic development, promoting entrepreneurship, and ensuring inclusive growth. In developing economies such as India, the MSME sector contributes significantly to GDP, exports, employment generation, and regional industrialization. At the state level, Madhya Pradesh has emerged as a dynamic hub for MSME-led industrial growth through progressive policy reforms and financial interventions.

The introduction of the Madhya Pradesh MSME Development Policy 2025, the Revised Startup Policy and Action Plan 2025, and the Building Allotment Rules 2025 marks a new phase in the state's industrial expansion. During 2025–26, more than 4,15,254 beneficiaries were supported under various self-employment schemes with financial disbursement of ₹3,861.48 crore. Notably, under the Pradhan Mantri Mudra Yojana, ₹3,429.51 crore was distributed to 3,83,886 beneficiaries.

Additional support was provided through the Prime Minister Employment Generation Programme and the National Rural Livelihood Mission.

This research paper examines the structural, financial and developmental dimensions of MSMEs in Madhya Pradesh, focusing on policy assistance, infrastructure incentives, employment impact, and sustainable economic growth.

The study is based on secondary data and policy analysis. The findings indicate that MSMEs are central to transforming Madhya Pradesh into a competitive and inclusive industrial economy.

Keywords: MSME, Economic Development, Madhya Pradesh, Industrial Policy 2025, Entrepreneurship, Employment Generation, Infrastructure Assistance

1. Introduction

MSMEs are widely recognized as the backbone of modern economies. They encourage decentralized industrialization, reduce income inequality and generate large-scale employment with relatively lower capital investment. In India, the sector operates under the framework of the MSME Development Act, revised in 2020 to broaden classification criteria based on investment and turnover. In Madhya Pradesh, MSMEs contribute significantly to Gross State Domestic Product (GSDP), industrial output, and employment diversification. Due to its central geographic location, abundant agricultural resources, and improving infrastructure, the state has positioned itself as an emerging industrial growth centre.

The launch of the Madhya Pradesh MSME Development Policy 2025 demonstrates the government's commitment to strengthening industrial clusters, supporting startups, and promoting capital investment through structured financial assistance.

2. Objectives of the Study

- To analyze the contribution of MSMEs to economic development in Madhya Pradesh.
- To evaluate the impact of the MSME Development Policy 2025.
- To examine financial assistance mechanisms and infrastructure incentives.
- To assess employment generation through self-employment schemes.
- To understand the role of MSMEs in inclusive and sustainable growth.

3. Literature Review

Previous studies indicate that MSMEs significantly influence regional economic stability and employment expansion. The Reserve Bank of India has emphasized improved credit access as a major determinant of MSME growth. Reports of the Ministry of Micro, Small and Medium Enterprises highlight that MSMEs contribute around 30% to national GDP and nearly 45% of exports.

Scholars have argued that state-level industrial policies are critical for translating national objectives into localized economic transformation. Madhya Pradesh's recent policy reforms align with this theoretical framework of decentralized industrial development.

4. Research Methodology

This study is descriptive and analytical in nature.

Data Sources:

Government of Madhya Pradesh Reports
MSME Annual Reports
RBI publications
Policy documents (2025)
Self-employment scheme statistics

Nature of Data:

Secondary, qualitative and quantitative.

Analytical Approach:

Comparative policy analysis and financial impact assessment.

5. MSMEs and Economic Development in Madhya Pradesh

5.1 Employment Generation (2025–26 Data)

Total Beneficiaries Supported: 4,15,254
Total Disbursement: ₹3,861.48 crore

Under Pradhan Mantri Mudra Yojana:

₹3,429.51 crore
3,83,886 beneficiaries

Under National Rural Livelihood Mission:

₹224.99 crore
24,349 beneficiaries

Under Prime Minister Employment Generation Programme:

₹329 crore
5,345 beneficiaries

Additionally, a customized credit card facility has been introduced allowing MSMEs to access working capital up to ₹5 lakh.

6. MSME Development Process (HD Diagram Explanation)

The MSME Development Process in Madhya Pradesh follows a structured flow:

Step 1: Policy Framework

- MSME Development Policy 2025
- Revised Startup Policy 2025
- Building Allotment Rules 2025

Step 2: Financial Assistance

- Infrastructure Subsidy
- Credit Card Working Capital (₹5 lakh)
- Mudra & PMEGP Support

Step 3: MSME Establishment

- Manufacturing Units
- Agro-Based Industries
- Textile & Pharma Clusters

Step 4: Production & Services

- Value Addition
- Export Promotion
- Local Supply Chain Strengthening

Step 5: Employment Creation

- Rural Employment
- Women & Youth Entrepreneurship

Step 6: Economic Growth

- Rise in GSDP
- Industrial Diversification
- Sustainable Development

7. Quantum of Assistance under MSME Development Policy 2025

7.1 Industrial Units on Private/Undeveloped Government Land

₹1–10 crore investment:
50% infrastructure reimbursement (max ₹25 lakh)
Above ₹10 crore:
50% reimbursement (max ₹3 crore)

7.2 Private Industrial Areas/Clusters

2–4 hectares:
50% development cost or ₹50 lakh per hectare
Above 4 hectares:
40% development cost (telescopic basis)
Maximum assistance: ₹40 crore

7.3 Flatted Industrial Complex

Minimum 1,000 sq. meters
50% development cost or ₹8,000 per sq. meter
Maximum ₹40 crore

7.4 Special Sectors (Pharma, Power loom, Apparel, Footwear, Toy, Furniture)

60% development cost assistance
Maximum ₹40 crore

8. Impact on Economic Development

The structured financial architecture:

Reduces capital burden
Encourages private investment
Promotes cluster-based industrialization
Enhances credit accessibility
Strengthens supply chains

The integration of credit card working capital facility improves liquidity management, a key constraint traditionally faced by MSMEs.

9. Challenges

Despite significant policy support and financial interventions, MSMEs in Madhya Pradesh continue to face several structural, financial, technological and market-related challenges that restrict their full potential.

9.1 Delayed Payments and Working Capital Constraints

One of the most critical issues faced by MSMEs is delayed payment from large enterprises and government departments. Payment cycles often exceed the prescribed 45-day limit under the MSME Development Act. This creates severe liquidity stress, increases dependence on short-term borrowing, and raises operational costs. Limited working capital hampers production continuity and restricts expansion plans.

9.2 Limited Access to Affordable Credit

Although schemes like **Pradhan Mantri Mudra Yojana**, **Prime Minister Employment Generation Programme**, and **National Rural Livelihood Mission** provide financial assistance, many micro and rural enterprises still face documentation hurdles, collateral requirements, and credit rating barriers. Informal enterprises often struggle to integrate into formal banking systems, limiting their growth potential.

9.3 Technological Obsolescence

A large proportion of MSMEs operate with outdated machinery and traditional production techniques. Low adoption of automation, digital accounting, AI-based analytics and Industry 4.0 technologies reduces productivity and global competitiveness. Insufficient R&D investment and limited awareness of government technology upgradation schemes further aggravate the issue.

9.4 Infrastructure Gaps in Backward Regions

While industrial clusters in developed districts are expanding, MSMEs in remote and tribal areas face inadequate power supply, poor logistics connectivity, lack of common facility centers and limited warehousing infrastructure. These disparities create uneven regional industrial growth within the state.

9.5 Export Competitiveness and Market Access

Many MSMEs lack exposure to international quality standards, branding strategies and export documentation processes. High compliance costs and limited participation in global value chains restrict export performance. Additionally, fluctuating global demand and currency volatility increase market risks.

9.6 Skill Gaps and Human Resource Constraints

There is often a mismatch between industry requirements and workforce skills. Limited access to technical training, managerial education and digital skill development reduces productivity. Women and youth entrepreneurs particularly face mentorship and capacity-building constraints.

9.7 Regulatory Compliance Burden

Although reforms aim at ease of doing business, MSMEs still face multiple registrations, inspections and compliance requirements related to taxation, labor laws and environmental regulations. Smaller enterprises find it difficult to manage regulatory paperwork without professional assistance.

9.8 Environmental and Sustainability Pressures

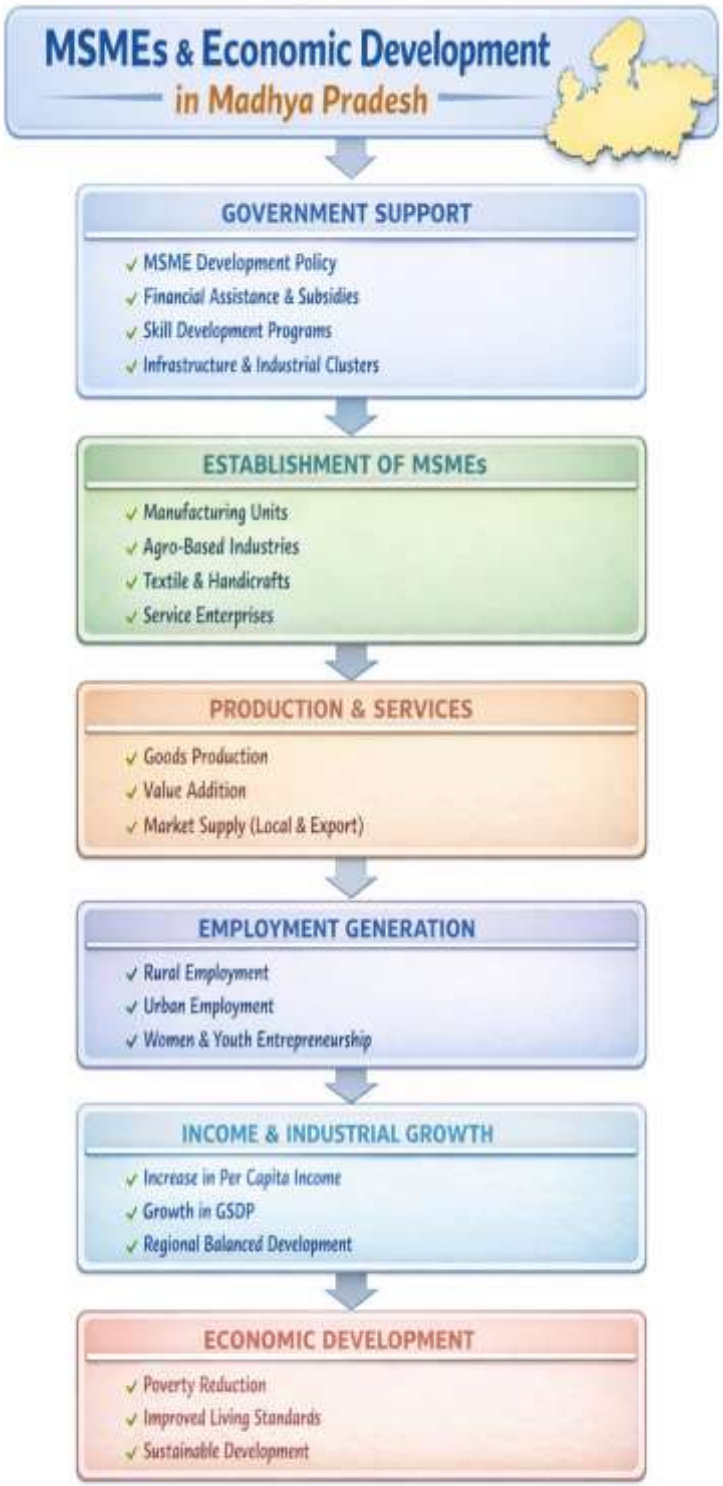
Increasing emphasis on green production, carbon reduction, and environmental compliance requires additional investment in cleaner technologies. Many small enterprises lack financial capacity to transition toward sustainable production systems.

9.9 Market Competition from Large Enterprises and Imports

MSMEs often struggle to compete with large corporations that benefit from economies of scale. Cheap imported goods, particularly in sectors like textiles, electronics and consumer products, further reduce profit margins for domestic small industries.

10. Policy Recommendations

Digitalization of MSME registration and subsidy processing
AI-based credit risk assessment
Export facilitation centers
Green industrial cluster development
Skill upgradation partnerships



11. Conclusion

MSMEs have emerged as the driving force behind economic transformation in Madhya Pradesh. The MSME Development Policy 2025, coupled with enhanced financial support and infrastructure incentives, positions the state as a benchmark model in MSME-led development.

The substantial financial disbursement in 2025–26 demonstrates strong institutional commitment. By combining infrastructure support, sector-specific incentives, and working capital facilitation, Madhya Pradesh is building a resilient and inclusive industrial ecosystem.

Sustained policy execution and technology adoption will further elevate the MSME sector's contribution to long-term economic stability and sustainable growth.

12. References (APA 7th Edition)

1. Government of Madhya Pradesh. (2025). Madhya Pradesh MSME Development Policy 2025. Bhopal: Department of MSME.
2. Ministry of Micro, Small and Medium Enterprises. (2024). Annual Report 2023–24. Government of India.
3. Reserve Bank of India. (2024). Report on Trend and Progress of Banking in India. Mumbai: RBI.
4. Government of India. (2025). Pradhan Mantri Mudra Yojana Progress Report.
5. Government of India. (2025). Prime Minister Employment Generation Programme Guidelines.
6. Government of India. (2025). National Rural Livelihood Mission Annual Report

Customer Loyalty in E-Commerce Platforms: A Study with Special Reference to Ichalkarnaji City

Mrs. Aditi Avdhut Dhokare
Department: Commerce

Abstract:-

The way people shop has changed a lot because of digital technology and internet. Online stores offer a lot of convenience, good prices and a wide range of product, which attracts many customers. But for online stores to stay in business for a long time, they need to keep their customers coming back. This means they need to build strong customers loyalty. This study looked at what makes customers loyal to online stores, focusing on Ichalkaranji city. We collected information from 100 people using questionnaires and analysed the data using special statistical software likes SPSS, MS Excel etc. What we found out is that customers are more loyal when they trust the online store, get good service, and receive their products quickly. So, if online stores want to keep their customers, they should work on building trust, making sure deliveries are fast and reliable, and providing good customer support. This can help them have long-term relationships with their customers and stay successful in the online shopping Business. For example, trust is a big factor - if customer feels safe buying from an online store, they are more likely to come back. Good service is also important, like being able to easily return or exchange products. And getting products delivered quickly is a must, as customers don't like to wait too long for their purchases. By focusing on these areas, online stores can build strong relationships with their customers and keep them loyal. This is key in business and being in the competitive world of online shopping.

1.Introduction:-

E-commerce has become a fundamental component of modern retail systems. E-commerce has become a fundamental component of modern retail systems. Technological advancements, affordable internet services and digital payment systems have encouraged consumers to shift from traditional shopping methods to online platforms. Online shopping offers benefits such as convenience, wide product selection and easy price comparison. As a result, consumers are increasingly adopting e-commerce platforms for their purchasing needs. Despite rapid growth in the online retail sector, companies face intense competition in retaining customers. Customer loyalty plays a vital role in ensuring repeat purchases and long-term profitability.

2. Objectives of the Study:-

- To study the online shopping behavior of consumers in Ichalkaranji city.
- To identify factors influencing customer loyalty in e-commerce platforms.
- To study and analyse the relationship between trust and customer loyalty.
- To examine the role of service quality and delivery efficiency in influencing customer loyalty.
- To provide recommendations for improving customer retention strategies.

3. Literature Review:-

Online shopping is getting more popular every day, and that's why customer loyalty is a big deal for e-commerce companies. When people shop online, they want it to be easy, they want lots of options, they want good prices, and they want their stuff delivered to their doorstep. All these benefits make online shopping way more appealing than going to a physical store. But, for companies to really make it in the online world, they need to make sure their customers keep coming back. That's why building strong customer loyalty is so important.

To keep customers coming back, businesses need to make sure they're happy with the service they get. This means providing good quality and value, so customers trust the company and want to buy from them again. It's all about building a long-term relationship with customers, and that's key to a company's success. According to experts like Kotler and Keller, customer satisfaction and how much value so customers think they are getting are crucial.

Kaila and Kaur discovered that a few key things make a big difference in how happy customers are with online shopping in India. These things make a big difference in how well the service works, how easy the website is to use, and how quickly orders are delivered. When these things are done well, customers are more likely to come back and shop again. So, making the shopping experience better can actually help keep customers loyal.

When we look at how customers stay loyal to online shopping platforms, a few things stand out. Trust; how good the service is; price, how fast things get delivered; and how many happy customers there all play a role. But most of the time, researchers only look at big cities. So, this study wants to figure out what makes customers loyal to online shopping platforms, specifically in a smaller city like Ichalkaranji.

4. Research Gap:-

Most research on online shopping looks at big cities where lots of people have internet access. But not much is known about what keeps customers loyal in smaller towns and areas that are not fully urban. Ichalkaranji is Manchester city of Maharashtra, so it is becoming important for online shopping and learning about customers loyalty in smaller towns and areas that are not fully urban. By studying these areas, we can gain a better understanding of what makes customers come back to online stores, which can be really useful for businesses that want it grow in these emerging markets.

5. Need for the Study:-

As online shopping keeps growing, it's getting tougher for retailers to stand out. To keep customers coming back, business need to know what they want and how they want and how happy they are with their experiences. Looking at how people feel about online shopping in smaller cities can help companies make their services better, get orders to customers faster, and make people trust them more when they're buying things online. This is really important because it can help businesses come up with strategies that work, especially when it comes to keeping customers loyal. By understanding what people like and don't like, companies can fix problems and make their online stores more appealing, which can lead to more sales and growth.

6. Research Methodology:-

Research Design: Descriptive research design.

Sampling Technique: Convenience sampling.

Sample Size: 100 respondents.

Sample size was calculated using Cochran's formula at a 95% confidence level and 10% margin of error.

7. Hypothesis:-

H_{01}: Trust has no significant Association with customer loyalty.

H_{11}: Trust has a significant Association with customer loyalty.

H_{02}: Service quality has no significant association with customer loyalty.

H_{12}: Service quality has a significant association with customer loyalty.

H_{03}: Delivery efficiency has no significant association with customer loyalty.

H_{13}: Delivery efficiency has a significant association with customer loyalty.

8. Sample Size

Calculation:-

The sample size for this study was determined using **Cochran's sample size** formula at a 95% confidence level and 10% margin of error.

Formula: $\mathbf{n = Z^2pq / e^2}$

Where:

Z = 1.96 (95% confidence level)

p = 0.5 (estimated proportion of population)

q = 1 – p = 0.5

e = 0.10 (margin of error)

Substituting these values in the formula results in a sample size of approximately 96 respondents. For the purpose of this study, the sample size was rounded to **100** respondents.

9. Structured Questionnaire:-

Section A: Demographic Information

1. Gender: Male / Female / Other
2. Age Group: 18–25 / 26–35 / 36–45 / Above 45
3. Occupation: Student / Service / Business / Homemaker / Other
4. Monthly Income: Below ₹20,000 / ₹20,000–₹40,000 / ₹40,000–₹60,000 / above ₹60,000

Section B: Online Shopping Behaviour

5. Do you purchase products online? Yes / No
6. How often do you shop online? Weekly / Monthly / Occasionally / Rarely
7. Which platform do you mostly use? Amazon / Flipkart / Mesho / Myntra / Other
8. What type of products do you buy online? Clothing / Electronics / Groceries / Accessories / Other

Section C: Trust and Security (Likert Scale)

9. I feel comfortable using digital payments for online shopping.
10. Online platforms protect customer information properly.
11. Ratings and reviews influence my purchase decision.

Section D: Service Quality

12. Delivery services are reliable.
13. Delivered products match the online description.
14. Customer support solves problems effectively.

Section E: Customer Loyalty

15. I prefer purchasing repeatedly from the same platform.
16. I would recommend my preferred platform to others.

10. Data Collection in MS Excel:-

https://docs.google.com/spreadsheets/d/1upNMAHtzItIB7P5NJlIwAMdvI5rJQT2q/edit?usp=sharing&ouid=114676004059484687488&rtpof=true&sd=true

11. Data Analysis and Interpretation:-

The collected data were analysed using MS Excel and SPSS statistical software. Frequency distribution and percentage analysis were used to summarise demographic information. Descriptive statistics, correlation analysis and chi-square testing were used to examine associations or relationships among study variables.

Table 1: Gender Distribution (Frequency & Percentage)

Gender	Frequency	Percent
Female	52	52.0
Male	48	48.0

Interpretation: Both male and female respondents actively participate in online shopping.

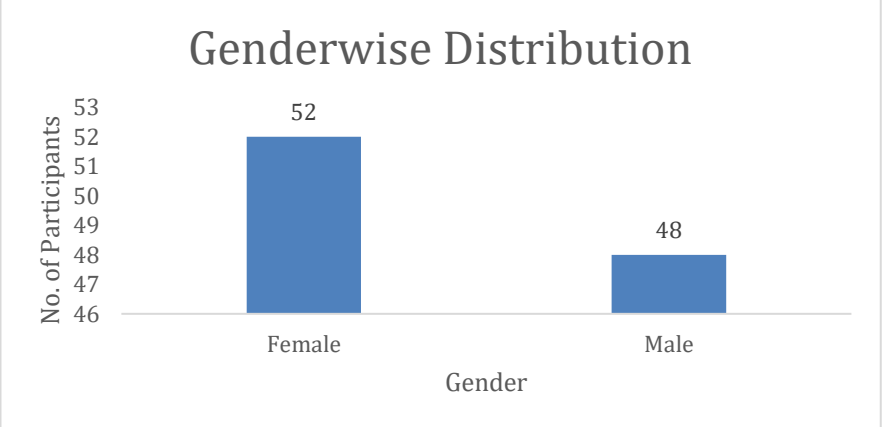


Table 2: Age Distribution (Frequency & Percentage)

Age Group	Frequency	Percent
18-25	32	32
26-35	20	20
36-45	26	26
Above 45	22	22

Interpretation: Young consumers aged 18–25 represent the largest group of online shoppers

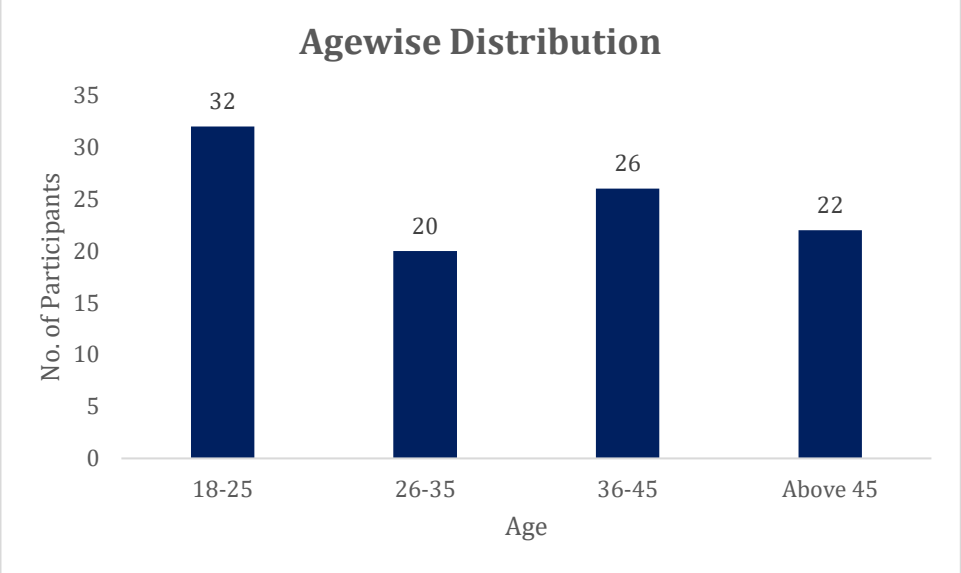


Table 3: Descriptive Statistics

Variable	Trust	Service Quality	Delivery Efficiency	Customer Loyalty
Count	100.0	100.0	100.0	100.0
Mean	2.83	3.05	2.72	2.921
S.D	1.393	1.344	1.457	0.899
Min.	1.0	1.0	1.0	1.008
Max.	5.0	5.0	5.0	4.824

The Table 3.Shows descriptive statistics for Trust, Service Quality, Delivery Efficiency, and Customer Loyalty based on 100 responses. Service Quality has the highest mean (3.05)**,** indicating relatively better customer perception, while Delivery Efficiency has the lowest mean (2.72)**.** The standard deviation values (0.899–1.457) indicate moderate variation in responses, with Delivery Efficiency showing the highest variability**.** Overall, the results suggest moderate levels of trust, service quality, delivery efficiency, and customer loyalty among respondents**.**

Table 4: Correlation Matrix

Variable	Trust	Service Quality	Delivery Efficiency	Customer Loyalty
Trust	1.0	-0.017	-0.068	0.459
Service Quality	-0.017	1.0	0.028	0.584
Delivery Efficiency	-0.068	0.028	1.0	0.416
Customer Loyalty	0.459	0.584	0.416	1.0

Table 4 shows the Pearson correlation between Trust, Service Quality, Delivery Efficiency, and Customer Loyalty. The results indicate that all three independent variables have a positive relationship with Customer Loyalty.

Service Quality has the strongest positive correlation with Customer Loyalty (r = 0.584), suggesting that better service quality significantly increases customer loyalty on e-commerce platforms. Trust also shows a moderate positive correlation with Customer Loyalty (r = 0.459), indicating that customers who trust the platform are more likely to remain loyal. Similarly, Delivery

Efficiency has a moderate positive correlation with Customer Loyalty (r = 0.416), meaning timely and reliable delivery contributes to higher customer loyalty.

The correlations among the independent variables (Trust, Service Quality, and Delivery Efficiency) are very weak and close to zero (r = −0.017 to 0.028), indicating no multicollinearity problem between the predictors.

Overall, the analysis suggests that Service Quality, Trust, and Delivery Efficiency positively influence Customer Loyalty, with Service Quality being the most influential factor.

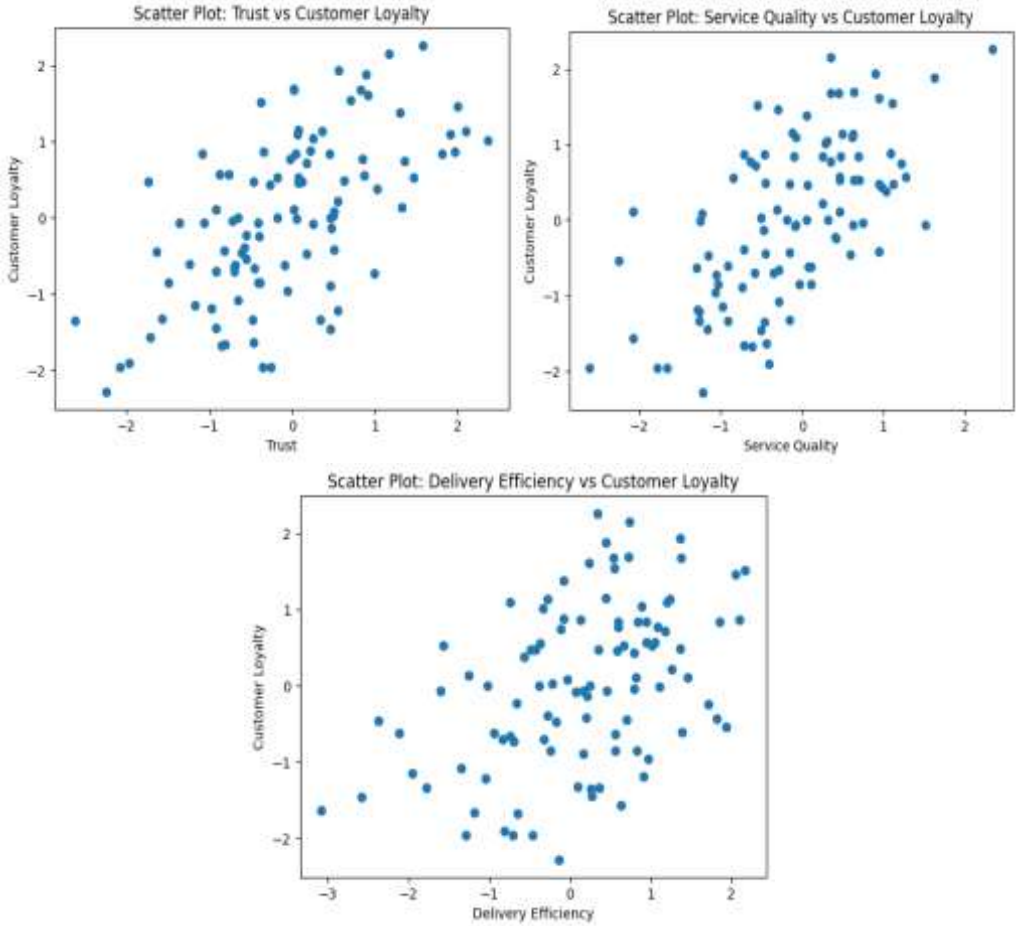


Table 5: Chi-Square Test For Association

Chi-Square	df	Sig.
5.769	1	0.03

The Chi-Square test result shows a value of $\chi^2 = 5.769$ with 1 degree of freedom (DF = 1) anda significance value **(p = 0.03)**.

Since the **p-value (0.03) is less than the standard significance level of 0.05**, the result is **statistically significant**. This indicates that there is a **significant association between the variables tested** in the study.

Therefore, the **null hypothesis (H_0) is rejected** and the **alternative hypothesis (H_1) is accepted**. This means that the variables are **not independent and have a meaningful relationship** in the context of the study.

Table 6. Hypothesis Testing Summary

Hypothesis	Relationship	Result
H_{11}	Trust → Customer Loyalty	Supported
H_{12}	Service Quality → Customer Loyalty	Supported
H_{13}	Delivery Efficiency → Customer Loyalty	Supported

The hypothesis testing results indicate that all three proposed hypotheses are **supported by the Statistical Analysis**.

H_{11}: The relationship between **Trust and Customer Loyalty** is supported. This suggests that higher customer trust in an e-commerce platform leads to greater customer loyalty and repeat purchasing behaviour.

H_{12}: The relationship between **Service Quality and Customer Loyalty** is also supported. This indicates that better service quality, such as efficient customer support and reliable service, significantly enhances customer loyalty.

H_{13}: The relationship between **Delivery Efficiency and Customer Loyalty** is supported as well. This means that timely and reliable product delivery positively influences customers to remain loyal to the e-commerce platform.

Overall, the results show that **Trust, Service Quality, and Delivery Efficiency are important factors that positively influence Customer Loyalty in e-commerce platform.**

12. Outcomes/Conclusion:-

The finding indicates that Trust, Quality of Service, and Efficient delivery significantly contribute to building customer loyalty in E-commerce platforms. When customers experience reliable services and timely product delivery, their confidence in the platform increases. As a result, strengthening trust improving service performance can enhance customer satisfaction and encourage repeated purchases.

References:-

1. Kotler P, Keller KL. Marketing Management. 15th Ed. New Delhi: Pearson Education; 2016.
2. Kaila P, Kaur N. Customer satisfaction and loyalty in Indian e-commerce market. International Journal of Retail & Distribution Management. 2021; 49(8):1125-1142
3. Shukla S. Buying behavior of consumers in online market: An Indian perspective. Rama University Journal of Commerce and Management. 2020; 1(1):45-52.
4. Mahadevan K. Impact of e-service quality dimensions on customer satisfaction and loyalty. Indian Journal of Marketing. 2022; 52(4):28-39.

Medieval Archaeological Heritage: The Tomb of Malik Ambar and Its Architectural Significance

Dr. Yassar Kaleem Ahmad Siddiqui
Research Scholar of History & Archaeology, Dep. of History AIC & Archaeology
Dr. B.A.M.U., Aurangabad Maharashtra

Abstract

This paper studies the medieval archaeological heritage of the tomb of Malik Ambar and its architectural significance. It examines the tomb's design, aesthetic features, and historical importance within the archaeological context of *Khuldabad*. The study also highlights Malik Ambar's notable contributions to Deccan architecture and urban development. In 1610 A.D., Malik Ambar transferred the Nizam Shahi capital from Junnar to Daulatabad[1], constructing monuments, fortification walls, and a water supply system. In the same year, he founded *Khadki*[2] and developed it into a well-planned, cosmopolitan city with mosques, a *pandit khana*, a church, residential areas, roads, canals (*nahars*), gardens, *bazaars*, and *hammams.* He also introduced the rock-cut *Nahar-e-Ambari* aqueduct. Malik Ambar died in 1626 in Ahmednagar[3]. His architectural works in the Deccan reflect significant historical value and notable aesthetic qualities[4].

Keywords: *Khadki, Aurangabad, Daulatabad, Khuldabad, Nizamshahi kingdom, Malik Ambar, Nahar-e-Ambari, Mosques, Pandit Khana, Church, Gardens, Tomb of Malik Ambar, Islamic Architecture, Medieval Archaeology, Deccan, Bahmani. Bagh Rouza, Tombs, Minars, Maqbara.*

Introduction

"Indian Islamic architecture differs from Islamic architecture in other countries"[5]
According to Mate, monuments are among the most important remains of the past, reflecting the era in which they were built. Medieval monuments can be broadly classified as civil, religious (tombs), and military[6]. Architecture refers to the design and construction of buildings. Islamic architecture follows both spiritual and worldly principles, expressing divine power while avoiding representations of living beings. Geometric patterns and depictions of inanimate objects are allowed, giving Islamic art and architecture its unique character in India.[7]

A tomb, also called a *Maqbara* in India, is a monumental structure built to house a grave or mausoleum. While *Qabristan* refers to a graveyard, a *qabar* may signify a simple or monumental tomb. According to J. Burton, a *Dargah* is the tomb or shrine of a spiritual guide (*pir*)[8], often accompanied by a mosque or guesthouse or *Saray* (*mehman khana*).

The **Bahmani Sultanate** was a key patron of architecture in the Deccan, creating a unique style that blended Indian, Turkish, Egyptian, and Persian elements[9]. They built impressive structures such as tombs, mosques, forts, palaces, *madrasas* and water systems. Some of the most notable examples of Bahmani tomb architecture include the Ali Barid Shah Tomb in Bidar, Gol Gumbaz[10] in Bijapur, and the Qutb Shahi Tomb Complex in Hyderabad. The **Nizamshahi dynasty**, which ruled after the Bahmanis, also left a significant architectural legacy. Important tombs from this era include the **Tomb of Ahmad Nizam** Shah I in *Bagh Rauza*, the Rumi Khan Tomb and Chand Bibi Tomb. Malik Ambar, a prominent figure in the Nizamshahi dynasty, founded *Khadki* and contributed significantly to the urban and architectural development of the region.

Geography of the Study Area: India's geography is highly diverse, with the Himalayas in the north forming a natural barrier, while the Gangetic plains provide fertile land for agriculture. In contrast, the Thar Desert in the northwest is dry and sandy and the Deccan Plateau in the south is characterized by rocky terrain and rich mineral deposits. The Bahmani Sultanate was located in the central part of the Deccan Plateau, covering areas of present-day Maharashtra, Karnataka, Telangana and Andhra Pradesh[11]. Aurangabad, situated near the Kham River and the Godavari basin, is close to Khuldabad, a town renowned for its Islamic heritage. Often called the "Valley of Saints," Khuldabad is home to the tombs of several important figures, including Aurangzeb and Malik Ambar.

Historical Outline: The **Bahmani Sultanate** rose as the most powerful Muslim state in the Deccan after the decline of the Delhi Sultanate[12]. The Deccan nobles revolted during the reign of Muhammad Tughlaq, leading to the creation of the Bahmani Sultanate. The first capital was established in Gulbarga (1347–1422), and later moved to Bidar (1422–1482). Over time, the Sultanate broke into five smaller kingdoms: 1) Imad Shahi (Berar) 2) **Nizam Shahi** (Ahmednagar) 3) Adil Shahi (Bijapur) 4)Qutb Shahi (Golkonda)5) Barid Shahi (Bidar)[13]

The **Nizam Shahi** dynasty was founded by Malik Ahmad Nizam Shah I in 1490. His prime minister, Malik Ambar, moved the capital to Daulatabad and played a crucial role in the region's development. Malik Ambar also founded Khadki, which later became Aurangabad in 1642 during the Mughal era under Aurangzeb.

Aims, Objectives and Research Methodology

This paper examines the architecture of the tomb of Malik Ambar within the historical and medieval archaeological context of *Khuldabad*. The study aims to analyze the tomb as a representative example of medieval Deccan architecture and to understand its historical, cultural and architectural importance. Malik Ambar constructed several significant architectural structures in the Deccan, many of which hold considerable archaeological value. This research focuses on his architectural achievements, with special attention to the construction, design, and distinctive features of his tomb.

The objectives of the study are to document the architectural elements of the tomb, interpret their historical and cultural significance, and situate them within the broader context of Deccan Islamic architecture. Both archaeological and historical methods have been applied to achieve these objectives. Field visits were conducted to Khuldabad, Daulatabad, Ahmednagar and Aurangabad to study the tombs and related monuments. In addition, archaeological reports, historical texts, maps and drawings were consulted to provide a comprehensive understanding of Malik Ambar's contributions to Deccan architecture and urban culture.

Tomb of Malik Ambar: Architecture of the Tomb

Malik Ambar founded the town of *Khadki,* which later became Aurangabad. He revived the Nizam Shahi dynasty and shifted his military base to *Khadki*. He built a palace for the Sultan, known as the green bungalow, and also constructed his residence near the royal market of *Shahgunj*. He planned the town carefully, even though the area had dry soil. Since water was necessary for the people, he built a large water tank near the town. He also brought water through a canal from a river near *Harsul to Khadki*. This water system helped the town to grow and develop.[14] The tomb of Malik Ambar is situated approximately 24 kilometres northwest of Aurangabad city. According to historical accounts by Ferishta[15]**,** the tomb was erected during his lifetime. Near it stands the tomb of his wife, *Bibi Karima*, as well as the tomb of his nephew, which is located in Khuldabad, a town renowned for its *Sufi* shrines.[16]

Tomb Location: Latitude 20°0'50.81"N, Longitude 75°11'4.38"E

1 **Image showing the geographical location of the tomb of Malik Ambar at Khuldabad** *Source: google*

ARCHITECTURAL FEATURES

Malik Ambar adopted the Islamic architectural style for constructing significant buildings and tombs in the Deccan. His designs incorporated animal and natural motifs such as the inverted lotus, lion, bell, and jali work. He primarily used natural black and red basalt rock, along with bricks, in his constructions. Timber was also utilized for pillars, beams, windows, doors, and decorative panels, particularly in the construction of palaces *(Mahals*) in the Deccan. The mausoleum is built on a high square platform made of basalt stone. The building is square in shape. each side has three arches. The middle arch has beautiful jali work with geometric designs. The two side arches are false arches. The front wall is decorated with recesses and arches. The middle arch on the south side is the main entrance.

Inside each arch, there are carved flower petal designs. These are decorated with fine plaster work in a lace-like pattern. The bracketed cornice and eaves are still in good condition. Above the cornice, there is a parapet with a trefoil design. The dome is large and round in shape. It is slightly bulb-shaped. The lower part of the dome has a border of lotus petal designs. Small kiosks are built at the four corners above broad lintels.

The sarcophagus is placed at the centre of the tomb on a raised platform with steps. It is made of black stone and appears large and strong. It was once smooth and polished. On the top, there is a rectangular carved design. In the middle of this design, there is a large flower with rounded petals. On one side, a smaller flower is carved, surrounded by curved patterns that resemble leaves or a chain. On the other side, two small flowers are carved next to each other. The edges of the sarcophagus have simple straight borders. The sarcophagus is aligned so that the body of the deceased is laid parallel to the *qibla*, or perpendicular to the direction of Mecca.(S.I. 6, p.8) This orientation follows Islamic burial traditions, which require the deceased to face the direction of Mecca during burial. It reflects the religious beliefs and practices associated with Islamic funerary architecture.

The tomb of Malik Ambar shows the strong character of its builder. It is a good example of Nizamshahi architecture in the Deccan[17]. The tombs of Malik Ambar, his wife *Bibi Karima*, and his nephew are built side by side in Khuldabad, a town famous for *Sufi* saints and their shrines. **Fortification** around the Tomb**:** On the southern side of Malik Ambars tomb, there is a small *Hauze* (water tank) with a fountain. next to it, a small stone hall or chamber has been built. The hall has three doors and two windows placed side by side. It also has six small minarets evenly spaced. All these structures are part of the tomb's fortification wall (see Image 1, p. 4).

Aesthetic Features of Malik Ambar's Tomb

Malik Ambar incorporated several decorative motifs in his architectural designs, such as floral patterns, chains, and hanging bells**.** These motifs can be seen in Malik Ambar's tomb and in other monuments of the Deccan, including Bhadkal Gate, the mosques of Aurangabad and Ahmadnagar, Bagh Rauza, and Damadi Masjid. These decorative elements reflect the artistic traditions of the medieval Deccan. Another important feature is jali work, which includes geometric patterns such as hexagons and stars**. (**S.I 6, p.8) A good example can be seen in Malik Ambar's tomb at Khuldabad. Similar jali work is also found in Bhadkal Gate, *Nawkhanda Mahal* and *Habshi Mahal*. These stone screens enhance the beauty of the buildings and allow sunlight to enter, creating patterns of light and shade while improving ventilation. Malik Ambar also used architectural elements such as *Minars,* decorative arches, niches, squinches, iwans, and carved jali stone walls. These features can be seen in the tombs of Malik Ambar, his wife Bibi Karima and his nephew (see Image 7, p. 8). Each tomb has slight differences in size, decoration, and design, reflecting Malik Ambar's artistic vision and understanding of society.

Notable Architectural Features of Malik Ambar's Tomb at Khuldabad

- The Tomb of Malik Ambar is a two-story tomb[18] (see image 4, p.7)
- A single hemispherical dome is placed over the central chamber of the tomb.
- The base of the dome is decorated with a band of lotus petals.
- The dome is topped with a metal finial. (see image 2,4, p.7)
- Four decorative kiosks are positioned at the corners of the roof around the dome.

- The tomb has a square shape and is built on a high, square plinth.
- The main chamber features a decorative stone jali door at the entrance, with openings on the north and south sides. (see image 5,6 p.8)
- Inside the tomb, several multi-folded arches are built, each containing small *Mihrab.* (s.6)
- The outer walls of the tomb are adorned with multi-folded arches and carved motifs on all four sides. (see image 1, p.4)

Construction Materials and Engineering Technique The tomb was primarily built using basalt stone, including brown and gray rocks, and lime plaster. Cubical basalt bricks were also used, giving the tomb both strength and a distinctive appearance. The tomb employs an interlocking stone jointing system, an ancient engineering method known for its stability and durability. This technique, used in many historic buildings worldwide, ensures that the structure remains strong over time and has allowed the tomb to survive for centuries.

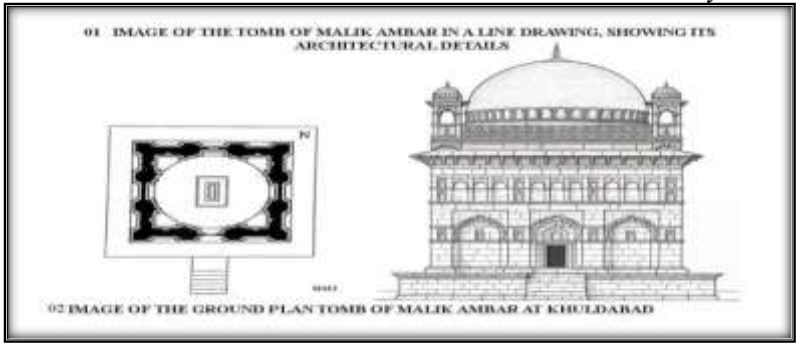
Conclusion and Findings

This paper looks at the archaeological and architectural aspects of **Malik Ambar's tomb**, focusing on its historical importance, design features, and its contribution to the medieval heritage of the Deccan region. The Tomb of Malik Ambar and his family is a significant medieval architectural monument, important for studying art, architecture, cultural history, and archaeology in the Deccan. It represents a notable example of Indian and Indo-Islamic architecture, showing the fusion of styles through the ages.The tomb features decorative motifs such as flowers, inverted lotuses, lions, bells, chains, and hanging bells, which are also seen in other structures like the Bhadkal Gate and Deccan mosques, providing insight into the art of the period. A key feature is the jali work, with hexagonal and star patterns, which enhances the tomb's beauty and allows natural light and ventilation, demonstrating advanced architectural skills.The use of basalt stone, basalt bricks, and lime plaster reflects local building traditions. Interlocking stone joints contribute to stability and durability, highlighting advanced engineering methods. Malik Ambar's work also promoted urban development, using eco-friendly materials and creating harmonious spaces that encouraged unity among communities.

Architectural Features of the Tomb of Malik Ambar

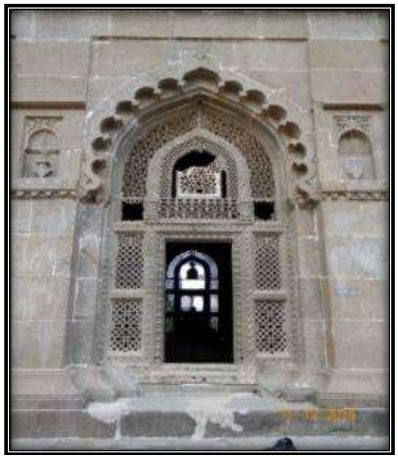
2 **Image of the tomb of Malik Ambar at Khuldabad** *Source: © by Author*[19]

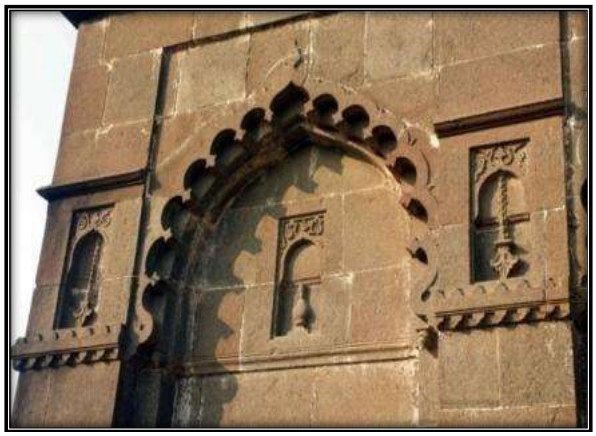
3 **Image of the tomb of Malik Ambar in Line drawing and ground plan, showing its Architectural details at Khuldabad** *Source: © by Author*



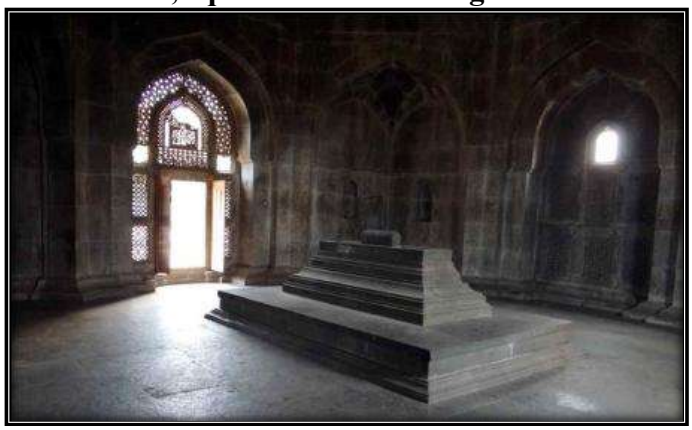
4 **Image of the Dome and *minarets* of the tomb of malik ambar, khuldabad** *So.:© by Author*[20]

5**Image showing the exterior view of the stone arch, motifs, chain, jali, and bell at the tomb of Malik Ambar in Khuldabad.** *Source: © by Author*

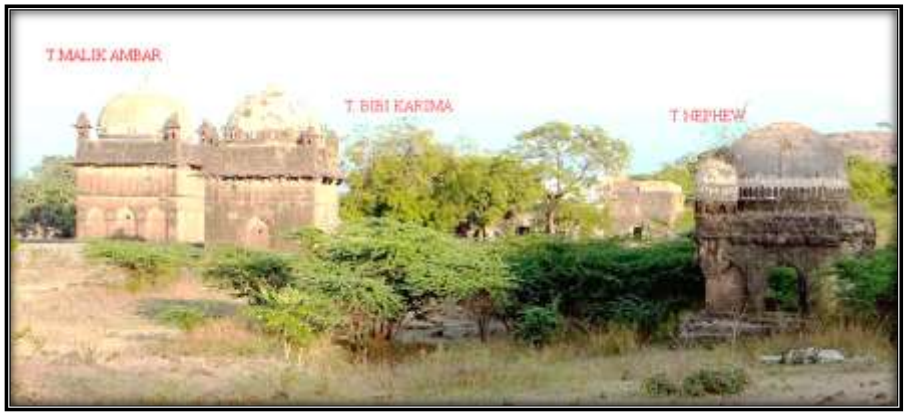




6 **Image shows the interior of the tomb, featuring stonework with floral carvings, along with the arches, squinch and the octagonal dome at Khuldabad[21].** *Source: © by Author*



7 **Image shows a panoramic view of all three tombs: on the left is the tomb of Malik Ambar, in the center is the tomb of *Bibi Karima* and on the right is the tomb of Malik Ambar's nephew, at** Khuldabad. Source: © S.yahhya[22]



References:

1. Kunte, B. G. (Ed.). (2003). *Aurangabad district gazetteer***.** Bombay. p.833
2. Chand, S.(1350). *Malik Ambar* Hyderabad. Pp163-17
3. Kunte, B. G. (Ed.). (2003). p.833
4. Siddiqui Yassar, Architectural Urbanization of khadki town under Malik Ambar 1610-1626, *B Adhar*,Volume CCXXXV, Issue no (235) ,IISSN:2278-9308, 2020, P.261
5. Fabri, C. (1963). *An introduction to Indian architecture*. Harper & Row. p.38.
6. Mate M. (2005) Medieval Archaeology. Delhi. pp.53-60
7. Siddiqui Yassar(2016),*'Khadki As An Emerging Town Centre During Nizamshahi Era'* p.123
8. *Pir* is a *sufi* spiritual leader or teacher who guides followers on the path of spiritual learning's and closeness to Allah.
9. Desai Z. (2012*). Indo Islamic Architecture*. chandraloka. pp.76-108
10. Brown P., (1953). *Islamic Architecture*, London, D. B. Taraporevala,. p.66
11. H.K. Sherwani,(1953).The Bahmanis of Deccan. Hyderabad. P.10
12. Sherwani, H.& Joshi ed.,(1973). *History of Medieval Deccan,1295–1724,* Hyde.pp30 60
13. H.K. Sherwani,(1953).p.77
14. Shaikh, R.(2010). *400 years underground living aqueduct, Aurangabad*. p.40
15. Farishta,M.K.(1966). *History of the rise of the Mahommedan power in India* (V.1,J.Briggs,Tr.). Calc.p33
16. Kunte, B. G. (Ed.). (2003). p.833.
17. Archaeological Survey of India. (2005). *Tomb of Malik Ambar*. ASI Aurangabad Circle.
18. Pushkar, S. (2018). *Nizamshahi*. IB Touris. p.167
19. Siddiqui, Y.(2026, Dec.25). *Field work report on visits to Khuldabad and Daulatabad forts*.
20. Aurangabad Heritage Walks. (2024,Sep.30). *Khuldabad tomb* Short video. YouTube. https://youtube.com/shorts/-0usgyX74w0
21. For further details, Aurangabad heritage Walk. YouTube.
22. Siddiqui,Yahhya (2014) field work photograph no.2.malik Ambar Tomb. Khuldabad. personal collection

Seasonal Prevalence and Species Diversity of Ixodid Ticks Infesting Livestock in Akola District, Maharashtra (India)

Ku. Pratiksha P. Aghadate

P.G. Department of Zoology, Shri R.L.T. College of Science, Akola.

Abstract

Ticks are among the most important ectoparasites affecting livestock health and productivity, particularly in tropical regions. The present study investigates the seasonal prevalence and species diversity of ixodid ticks infesting cattle and buffaloes in Agar and Ugwa villages of Akola district, Maharashtra, during 2024–25. A total of 377 animals (200 cattle and 177 buffaloes) were examined across summer, monsoon, and winter seasons. Tick specimens were collected manually and identified morphologically using standard taxonomic keys. The overall prevalence of tick infestation was recorded as 18.34% in cattle and 41.46% in buffaloes. Seasonal variation showed the highest infestation during the monsoon season, followed by summer and winter. Three genera—*Hyalomma*, *Rhipicephalus*, and *Haemaphysalis*—and six species were identified, with *Hyalomma* species being the most prevalent (53.65%). The findings highlight the strong influence of climatic factors on tick dynamics and emphasize the need for season-specific tick control strategies.

Keywords: Tick infestation, Livestock, Seasonal prevalence, *Hyalomma*, Akola district

Introduction

Ticks (Order: Ixodida) are obligate blood-sucking ectoparasites that cause significant economic losses to the livestock industry through reduced productivity, skin damage, and transmission of tick-borne diseases. India's tropical climate provides favorable conditions for the survival and proliferation of various tick species. Seasonal changes, poor management practices and emerging acaricide resistance have further aggravated the problem.

Understanding the prevalence, seasonal occurrence, and species diversity of ticks is essential for designing effective control measures. The present study focuses on assessing tick infestation patterns in cattle and buffaloes from Agar and Ugwa villages of Akola district, Maharashtra.

Materials and Methods

Study Area

The study was conducted in Agar and Ugwa villages of Akola district, located in the Vidarbha region of Maharashtra. Livestock farming is an important source of livelihood in the region.

Sampling and Collection

The study was carried out during 2024–25 using random sampling. Livestock were examined during three seasons: summer (February–May), monsoon (June–September), and winter (October–January). Ticks were carefully removed, counted, and preserved in 70% alcohol with 5% glycerol.

Identification

Tick specimens were identified under a stereo microscope based on morphological characteristics using standard identification keys.

Results

Host-wise Prevalence

Out of 200 cattle examined, 169 were found infested (18.34%). Among 177 buffaloes, 125 were infested, showing a higher prevalence of 41.46%.

Seasonal Prevalence

Tick infestation was highest during the monsoon season in both cattle and buffaloes, followed by summer and winter. The monsoon season provided favorable humidity and temperature for tick survival and reproduction.

Species Diversity

Three genera and six species of ixodid ticks were recorded:

- *Hyalomma anatolicum*
- *Hyalomma truncatum*
- *Hyalomma marginatum isaaci*
- *Rhipicephalus microplus*
- *Rhipicephalus decoloratus*
- *Haemaphysalis punctata*

The genus *Hyalomma* showed the highest prevalence (53.65%), followed by *Rhipicephalus* (33.36%) and *Haemaphysalis punctata* (10.98%).

Discussion

The higher prevalence of ticks in buffaloes compared to cattle may be attributed to differences in skin thickness, management practices, and microhabitat suitability. The dominance of *Hyalomma* species aligns with earlier studies and can be linked to the hot and semi-arid climatic conditions of the region.

Seasonal variation clearly indicated peak infestation during the monsoon season, emphasizing the role of environmental factors such as humidity and temperature. These findings underline the importance of implementing preventive and control measures before the onset of monsoon.

Conclusion

The study reveals a considerable burden of tick infestation in livestock from Agar and Ugwa villages of Akola district. Six tick species belonging to three genera were identified, with *Hyalomma* species being the most dominant. Seasonal trends showed maximum infestation during the monsoon season. The results provide essential baseline data for planning effective, location-specific tick control strategies and improving livestock health and productivity.

References

1. Arthur, D. R. (1962). *Ticks and tick-borne diseases*. Pergamon Press, Oxford.
2. Soulsby, E. J. L. (1982). *Helminths, arthropods and protozoa of domesticated animals* (7th ed.). Baillière Tindall, London.
3. Sonenshine, D. E. (2014). *Biology of ticks* (Vols. 1–2). Oxford University Press.
4. Ghosh, S., Bansal, G. C., Gupta, S. C., Ray, D., Khan, M. Q., & Irshad, H. (2007). Status of tick distribution in Bangladesh, India, and Pakistan. *Parasitology Research, 101*, 207– 216.
5. Patel, G., Shanker, D., Jaiswal, A. K., Sudan, V., & Verma, S. K. (2013). Prevalence and seasonal variation in ixodid ticks on cattle of Mathura district, Uttar Pradesh. *Journal of Parasitic Diseases, 37*(2), 173–176.
6. Perveen, F. (2011). Distribution and identification of ixodid tick species on livestock in northern Pakistan. *Journal of Agricultural Science and Technology, 1*, 73–81.
7. Durrani, A. Z., & Shakoori, A. R. (2009). Ecological growth conditions of cattle Hyalomma ticks in Punjab, Pakistan. *Iranian Journal of Parasitology, 4*, 19–25.
8. Ramzan, M., Naeem-Ullah, U., Saba, S., Iqbal, N., & Saeed, S. (2020). Prevalence and identification of tick species on domestic animals in Punjab, Pakistan. *International Journal of Acarology, 46*, 83–87.
9. Ghafar, A., Abbas, T., Rehman, A., & Jabbar, A. (2020). Systematic review of ticks and tick-borne pathogens of ruminants. *Pathogens, 9*, 937.
10. Bacon, E. A., Kopsco, H., Gronemeyer, P., Mateus-Pinilla, N., & Smith, R. L. (2022). Effects of climate on tick abundance. *Journal of Medical Entomology, 59*, 700–709.

Running Head: Vasudhaiva Kutumbakam and Global Harmony

Vasudhaiva Kutumbakam: Philosophical, Socio-Cultural, Economic and Ethical Perspectives for Global Harmony and Sustainable Development

Dr. Anubha Pundir
Associate Professor, Graphic Era Hill University (GEHU), Dehradun; Research Scholar, Dev Sanskriti Vishwavidyalaya (DSVV), Haridwar
Dr. Gayatri Guruvendra
Assistant Professor, Graphic Era Hill University (GEHU), Dehradun
Vishal Chabbra
Assistant Professor, Graphic Era Hill University (GEHU), Dehradun
Akshaya Chauhan
Deputy General Manager (Mechanical), ONGC, Dehradun

Abstract

The philosophical idea of Vasudhaiva Kutumbakam, which translates as 'the world is one family,' represents a core ethical vision of the Indian knowledge tradition. In the contemporary global environment characterized by geopolitical tensions, environmental degradation, cultural fragmentation and widening economic disparities, value-based philosophical frameworks have become increasingly significant for guiding collective global action. This paper critically examines the philosophical foundations, socio-cultural relevance, economic implications, educational importance, and environmental significance of Vasudhaiva Kutumbakam. Drawing upon classical Indian philosophical texts and contemporary interdisciplinary scholarship, the study explores how the doctrine provides a meaningful ethical framework for promoting global cooperation, sustainable development, and intercultural harmony. The analysis demonstrates that the philosophy encourages ethical governance, social responsibility, ecological awareness and inclusive development. By integrating traditional wisdom with modern global challenges, the concept of Vasudhaiva Kutumbakam offers a normative paradigm capable of fostering a more equitable and sustainable global society.

Keywords: Vasudhaiva Kutumbakam, Global Ethics, Indian Knowledge Systems, Sustainable Development, Global Harmony, Universal Brotherhood

1. Introduction

Globalization has intensified interactions among nations, cultures and economies. While technological advancements and economic integration have strengthened global connectivity, societies continue to face complex challenges such as climate change, inequality, cultural polarization, and political conflicts. These issues require ethical frameworks that emphasize cooperation, compassion, and shared responsibility.

Within this context, the Indian philosophical principle of Vasudhaiva Kutumbakam offers an important ethical perspective. Originating from the Maha Upanishad, the phrase expresses the idea that humanity constitutes a single global family. The concept promotes universal brotherhood and encourages individuals and societies to transcend narrow identities based on nationality, religion or ethnicity.

Recent scholarly discussions highlight the relevance of this doctrine in contemporary debates on global ethics, sustainable development, and international cooperation (Kapoor, 2024; Dahiya & Kumar, 2024). By emphasizing interconnectedness and collective responsibility, Vasudhaiva Kutumbakam provides a moral foundation for addressing modern global challenges.

2. Philosophical Foundations

The philosophical roots of Vasudhaiva Kutumbakam lie in the Upanishadic worldview, which emphasizes the unity of existence and the interconnectedness of all beings (Easwaran, 2007;

Ranganathananda, 2001). According to this perspective, the apparent diversity of the world ultimately arises from a single universal reality.

Advaita Vedanta further reinforces this view by asserting the non-dual nature of existence. The individual self (Atman) is understood as fundamentally identical with the universal consciousness (Brahman) (Deutsch, 2010). This metaphysical insight encourages an ethical orientation grounded in compassion, empathy, and universal respect.

Core ethical principles such as ahimsa (non-violence), satya (truth) and dharma (righteous duty) also contribute to the moral foundation of this philosophy (Gandhi, 2001). These values encourage individuals to act in ways that promote harmony and collective welfare.

3. Socio-Cultural Dimensions

From a socio-cultural perspective, Vasudhaiva Kutumbakam promotes inclusivity, tolerance, and respect for diversity. In multicultural societies, individuals encounter diverse cultural traditions and belief systems. Philosophical frameworks that emphasize universal brotherhood therefore play a vital role in promoting intercultural dialogue and social cohesion (Parekh, 2006).

The philosophy encourages individuals to move beyond narrow social identities and cultivate a broader sense of global citizenship. Communities guided by such values prioritize empathy, cooperation and shared responsibility.

4. Economic Perspectives

Economic systems influence social welfare, environmental sustainability and global stability. Contemporary discussions on sustainable development emphasize the importance of inclusive growth and equitable resource distribution.

The philosophy of Vasudhaiva Kutumbakam supports economic systems that prioritize human dignity, social justice and environmental responsibility. Scholars have connected such ethical perspectives with modern frameworks of human development and capability theory (Sen, 2009; Nussbaum, 2011).

5. Educational Significance

Education is a key instrument for cultivating ethical consciousness and global citizenship. Integrating the values of Vasudhaiva Kutumbakam into educational curricula can encourage empathy, intercultural understanding, and social responsibility.

Educational initiatives promoting global citizenship and ethical awareness have been widely supported by international organizations (UNESCO, 2015). Scholars also highlight the importance of integrating indigenous knowledge traditions into modern educational systems.

6. Environmental Perspectives

The ecological dimension of Vasudhaiva Kutumbakam reflects the recognition that human well-being is inseparable from the health of the natural world. Environmental philosophers argue that humanity must adopt ethical frameworks that recognize the interconnectedness of humans and nature (Naess, 1989).

By extending the concept of family to include the natural environment, the philosophy promotes environmental stewardship and sustainable living.

7. Global Governance and International Relations

In the field of international relations, Vasudhaiva Kutumbakam provides a normative framework for peaceful cooperation among nations. Contemporary scholars highlight its relevance in global diplomacy and international cooperation (Behera & Sahoo, 2025; Das & Bag, 2024).

The principle encourages nations to prioritize collective welfare and global peace rather than narrow national interests.

8. Challenges in Implementation

Despite its universal appeal, implementing the ideals of Vasudhaiva Kutumbakam in modern political and economic systems remains challenging. Political conflicts, economic competition and ideological divisions often hinder global cooperation.

Nevertheless, educational reforms, ethical leadership and policy initiatives promoting intercultural dialogue can help translate these philosophical ideals into practical governance frameworks.

9. Conclusion

Vasudhaiva Kutumbakam represents a timeless philosophical vision emphasizing universal brotherhood, ethical responsibility and global interconnectedness. In a world confronting environmental crises, socio-economic inequalities and geopolitical tensions, the philosophy provides valuable ethical guidance.

Integrating its principles into education, governance, and international cooperation can contribute to building a more compassionate, equitable, and sustainable global society.

References

1. Behera, N. K., & Sahoo, P. (2025). Vasudhaiva Kutumbakam: India's G20 presidency in shaping global governance.
2. Chen, Z., & Sweet, W. (2024). Ecological civilization and the path to ecological citizenship.
3. Dahiya, P. V., & Kumar, P. (2024). Philosophical and cultural foundations of Bharat's overseas policy.
4. Das, U., & Bag, A. (2024). Vasudhaiva Kutumbakam as a guiding principle of India's foreign policy.
5. Deutsch, E. (2010). Advaita Vedanta: A philosophical reconstruction. University of Hawaii Press.
6. Easwaran, E. (2007). The Upanishads. Nilgiri Press.
7. Gandhi, M. K. (2001). The moral and political writings of Mahatma Gandhi.
8. Kapoor, N. (2024). The philosophy of Vasudhaiva Kutumbakam.
9. Naess, A. (1989). Ecology, community and lifestyle.
10. Nussbaum, M. (2011). Creating capabilities.
11. Parekh, B. (2006). Rethinking multiculturalism.
12. Rahaman, S. K. M., & Chattopadhyay, K. N. (2024). Global citizenship education in Indian ethos.
13. Radhakrishnan, S. (2008). Indian philosophy.
14. Ranganathananda, S. (2001). The message of the Upanishads.
15. Sachs, J. (2015). The age of sustainable development.
16. Sen, A. (2009). The idea of justice.
17. Srinivasan, R. (2025). Cultural pluralism and civilizational harmony.
18. UNESCO. (2015). Global citizenship education.
19. United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development.
20. World Bank. (2020). World development report.
21. Aurobindo, S. (1998). The Life Divine.
22. Dallmayr, F. (2002). Dialogue Among Civilizations.
23. Dasgupta, S. (1992). A History of Indian Philosophy.
24. Tagore, R. (1917). Nationalism.
25. Singer, P. (2011). Practical Ethics.
26. Tilak, B. G. (1915). Bhagavad Gita Rahasya.

Ecology and Resistance: An Ecocritical study of Arundhati Roy's Works

Dr. Narendra T. Mane
Head, Department of English, J.D. Patil Sangludkar Mahavidyalaya, Daryapur

Nikita P. Sawarkar
Research scholar,
J. D. Patil Sangludkar Mahavidyalaya, Daryapur, Dist. Amravati-444803, SGBAU, Amaravati

Abstract

This paper examines Arundhati Roy's writings through the frameworks of eco-criticism and environmental justice, situating her as a significant literary voice responding to ecological degradation within contemporary global capitalism. By integrating foundational and recent scholarship in environmental humanities, this study argues that Roy offers a sustained and ethically charged critique of development-centered economic policies that prioritize infrastructural expansion and market growth over ecological sustainability and social equity. Her engagement with dam construction, extractive industries, environmental displacement, and democratic accountability transforms literary discourse into a site of critical reflection and civic engagement. Through interdisciplinary analysis, this paper demonstrates that Roy's writing not only represents ecological crisis but actively reshapes debates surrounding sustainability, governance, and environmental responsibility. Her work contributes meaningfully to global environmental thought by emphasizing justice, participatory democracy, and collective ecological care.

Keywords: Eco-criticism, Environmental Justice, Environmental Humanities, Sustainability, Literary Resistance, Global Capitalism

Introduction

Twenty-first century is increasingly defined by environmental instability manifested in climate change, deforestation, biodiversity loss, water scarcity, industrial pollution and large-scale displacement. These developments are not isolated natural phenomena but are deeply linked to economic models that prioritize accelerated growth, industrial expansion and infrastructural modernization. In many regions, development projects presented as symbols of national progress have resulted in ecological degradation and social inequality. As the consequences of environmental disruption intensify, environmental justice has emerged as a crucial framework for examining the unequal distribution of environmental risks and resources. This perspective insists that ecological questions must be examined alongside questions of governance, equity and public accountability.

Within this context, literature plays a vital intellectual and ethical role. Eco-criticism, initially concerned with representations of nature in literary texts, has expanded into a multidisciplinary field that incorporates sustainability studies, environmental humanities and climate ethics. Scholars increasingly argue that literary discourse shapes public understanding of ecological crisis by translating abstract environmental data into narratives that evoke moral responsibility and collective reflection. Arundhati Roy's writings stand at the intersection of these concerns. Her sustained engagement with environmental degradation, democratic governance and economic inequality positions her as a major voice in contemporary ecological discourse. This paper argues that Roy's work articulates a vision of environmental justice grounded in accountability, ecological respect and inclusive decision-making.

Theoretical Framework

This study employs a multidisciplinary theoretical framework that integrates eco-criticism, environmental justice theory, and political ecology. Eco-criticism provides the primary lens through which Roy's environmental engagement is examined. Foundational scholars such as Lawrence Buell emphasize that environmentally significant literature must treat the natural world as an active presence rather than a passive background. Cheryll Glotfelty similarly defines eco-criticism as an earth-centered approach that reorients literary studies toward ecological consciousness. Contemporary eco-critical thought extends this orientation by engaging climate change, Anthropocene discourse and global sustainability challenges.

Environmental justice theory complements this perspective by foregrounding equity and fairness in environmental governance. It argues that marginalized communities frequently bear disproportionate ecological burdens due to policy decisions shaped by economic interests and political power. By emphasizing participatory democracy and equitable resource distribution, environmental justice expands ecological analysis beyond preservation to include social transformation.

Political ecology further enriches the framework by examining how environmental issues are structured by governance systems, economic policies, and global market forces. It highlights the relationship between power, resource control and ecological outcomes. Together, these theoretical approaches enable a comprehensive understanding of Roy's writing as an intervention in environmental discourse that connects ecology, democracy and ethics.

Literature Review

Eco-critical scholarship has evolved considerably since its emergence in the late twentieth century. Early studies focused largely on pastoral traditions and literary representations of landscape. Over time, however, the field has expanded to address environmental crisis as a systemic issue shaped by industrialization, globalization and technological expansion. Contemporary research emphasizes literature's capacity to cultivate ecological awareness and to challenge dominant narratives of progress.

Recent studies in environmental humanities underscore the importance of integrating cultural analysis with policy critique. Scholars argue that climate change and ecological degradation must be understood as cultural and ethical challenges as much as scientific phenomena. Within Indian writing in English, increasing attention has been given to themes of river politics, displacement, urban transformation, and environmental governance. Research on Roy highlights her critique large-scale dams, mining projects, and infrastructural expansion, identifying her as a significant contributor to ecological debate.

Intersectional scholarship further emphasizes how environmental harm intersects with social hierarchies such as gender, caste, and economic status. Studies note that Roy's writing foregrounds communities marginalized by development policies, thereby connecting ecological degradation with broader structures of inequality. Although substantial scholarship exists on her political engagement, continued interdisciplinary analysis is necessary to situate her ecological concerns within global environmental humanities discourse.

Development and Environment

A defining feature of Roy's environmental engagement is her sustained critique of developmental ideology. State-sponsored projects such as dams, mining operations and industrial corridors are frequently celebrated as markers of modernization and economic strength. Roy challenges this celebratory narrative by examining the ecological and social costs embedded within

such initiatives. She documents how forests are submerged, rivers diverted and communities uprooted to accommodate infrastructure designed to serve urban and industrial interests.

Her critique does not reject development outright but questions its underlying assumptions. Roy argues that development measured solely through economic growth indicators neglects ecological integrity and community well-being. She foregrounds the lived experiences of displaced populations, emphasizing the loss of ancestral lands, cultural continuity and sustainable livelihoods. By situating development within ethical discourse, she reframes the debate around justice, accountability, and ecological balance rather than efficiency alone.

This reorientation encourages reconsideration of policies that treat ecosystems and vulnerable populations as expendable. Roy's writing insists that sustainable progress must incorporate environmental stewardship and democratic participation, challenging technocratic approaches that exclude affected communities from decision-making processes.

Environmental Issues

Environmental degradation often unfolds gradually through contamination, habitat destruction, and resource depletion. Such processes may lack immediate visibility, making them difficult to represent within conventional public discourse. Roy addresses this representational challenge by transforming ecological harm into narrative witness. Through detailed description and reflective commentary, she renders environmental destruction tangible and emotionally resonant.

Her prose captures the cumulative effects of disrupted river systems, eroded soil and polluted water sources on everyday life. By grounding environmental issues in lived experience, Roy prevents ecological discourse from becoming abstract or detached. Instead, she presents environmental harm as inseparable from social and cultural disruption. This narrative strategy deepens ethical engagement and underscores the urgency of ecological accountability.

Through careful documentation and rhetorical clarity, Roy demonstrates how literature can serve as a record of environmental transformation while also prompting public reflection and debate.

Global Capitalism and Environment

Roy situates ecological degradation within broader global economic systems that prioritize market expansion and profit accumulation. Corporate extraction, speculative urbanization and international financial agreements influence environmental policy and resource distribution. Her writing examines how governance structures often align with economic interests, sidelining ecological sustainability and community welfare.

By connecting local environmental struggles to transnational economic networks, Roy highlights the interconnected nature of contemporary ecological challenges. Resource-rich regions frequently become sites of intensive extraction designed to serve distant markets, raising questions about accountability and equity. Her critique emphasizes that environmental governance must address structural economic pressures if meaningful sustainability is to be achieved.

This analysis expands ecological discourse beyond conservation to include political economy, demonstrating that environmental crisis cannot be understood independently of economic policy and institutional power.

Ecological Ethics

Roy's environmental engagement reflects an awareness that ecological harm interacts with existing social inequalities. Gender, caste and class often shape vulnerability to displacement and resource deprivation. By foregrounding marginalized communities affected by environmental disruption, Roy contributes to an inclusive ecological ethics that acknowledges layered inequalities.

Her writing suggests that sustainability requires structural transformation rather than isolated environmental reforms. Environmental policy must address social exclusion and ensure participatory governance to achieve equitable outcomes. By linking ecological integrity with social justice, Roy broadens environmental discourse and underscores the moral dimensions of sustainability.

Literature And Resistance

Roy's literary practice demonstrates that artistic expression can function as civic engagement. Her writing challenges dominant narratives of progress and interrogates state policies affecting ecological systems. Through rhetorical intensity and analytical insight, she transforms literature into a platform for ecological awareness and democratic accountability.

In an era defined by climate uncertainty and resource scarcity, writers play a crucial role in shaping public imagination. Roy exemplifies how literary discourse can illuminate environmental injustice, foster ethical reflection and encourage civic participation. Her work underscores the capacity of literature to contribute meaningfully to ecological transformation.

Multidisciplinary Significance

Roy's environmental engagement holds significance across multiple disciplines. In literary studies, it enriches eco-critical scholarship within Indian writing in English. In environmental humanities, it integrates cultural analysis with policy critique. In development studies, it questions growth-centered economic frameworks. In political science, it highlights governance mechanisms shaping ecological outcomes. In human rights discourse, it connects environmental well-being with social equity.

This interdisciplinary relevance affirms the importance of examining literature as an active participant in global ecological conversations.

Conclusion

Arundhati Roy's writings constitute a sustained engagement with environmental justice in the context of global capitalism. Through eco-critical and environmental justice frameworks, her work exposes the ecological consequences of development-driven policies and corporate expansion. By foregrounding displaced communities and degraded ecosystems, she challenges dominant narratives of progress and calls for ethical accountability.

Roy redefines literature as a space of ecological awareness, democratic engagement, and resistance. Her contribution to environmental humanities lies in her insistence that sustainability must be grounded in justice, participation, and collective responsibility. In an age of accelerating ecological crisis, her writing offers a compelling vision of environmental ethics shaped by equity and shared stewardship.

References

1. Roy, Arundhati. The God of Small Things. IndiaInk, 1997.
2. ---. The Cost of Living. Modern Library, 1999.
3. ---. Power Politics. South End Press, 2001.
4. ---. An Ordinary Person's Guide to Empire. South End Press, 2004.
5. ---. Field Notes on Democracy: Listening to Grasshoppers. Haymarket Books, 2009.
6. ---. Capitalism: A Ghost Story. Haymarket Books, 2014.
7. Guha, Ramachandra. Environmentalism: A Global History. Longman, 2000
8. Gadgil, Madhav, and Guha, Ramachandra. This Fissured Land: An Ecological History of India. Oxford UP, 1992.
9. Nixon, Rob. Slow Violence and the Environmentalism of the Poor. Harvard UP, 2011.
10. Shiva, Vandana. Staying Alive: Women, Ecology and Development. Zed Books, 1988.

11. Heise, Ursula K.. Sense of Place and Sense of Planet: The Environmental Imagination of the Global. Oxford UP, 2008.
12. Huggan, Graham, and Tiffin, Helen. Postcolonial Ecocriticism: Literature, Animals, Environment. Routledge, 2010.
13. Buell, Lawrence. The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture. Harvard UP, 1995.
14. Nayar, Pramod K.. Postcolonial Literature: An Introduction. Pearson, 2008.
15. Mukherjee, Upamanyu Pablo. Postcolonial Environments: Nature, Culture and the Contemporary Indian Novel in English. Palgrave Macmillan, 2010.
16. Garrard, Greg. Ecocriticism. Routledge, 2004

Phytochemical Investigation of the Leaves of *Abutilon indicum (Linn)*

Tomar Anulika
Research Student, Department of Botany, Shri R.R. Lahoti Science College, Morshi, Dist. Amravati, Maharashtra, India
Dhande Ravindra
Research Guide, Department of Botany, Shri R.R. Lahoti Science College, Morshi, Dist. Amravati, Maharashtra, India

Abstract :
Plants are gift of the earth to the human being. Many medicinal plants worldwide are used in traditional medicine for treating different diseases. *Abutilon indicum* is one of them, plant have great medicinal properties to cure many disease like toothache, piles, urinary disorders, cough, fever, etc. Plant having antioxidant activity, antibacterial activity, antifungal activity, antidiabetic activity, antiulcer activity, etc. The present study determines the qualitative analysis of leaves of *Abutilon indicum*, leaves of these plant were shade-dried, powdered, and subjected to sequential extraction using petroleum ether, ethyl acetate and aqeous. The study shows that presence of alkaloids, steroids, terpenoids, flavonoids, saponins, phenols, tannins. Result confirms that the leaves of *Abutilon indicum* contains secondary metabolites that helpful for the preparation of plant based drug as well as further studies in scientific research.

Introduction :

Plants used in medicine from thousands of year. plants as natural drugs, many plant based medicine are effective in action without any side effects. Plants plays important role in our life. (Sharma2013). Medicinal plants were used in traditional medicines and continue to use.(Nithyatharani 2018) Plants contains bioactive compounds such as Alkaloid, flavonoids, tannins, steroids etc. these compounds are synthesized by secondary metabolism of plants and widely used in phytomedicine. Now a days medicinal plants are source of modern medicines.

Abutilon indicum commonly known as country mallow in English and petari in Marathi. Plants belongs to family malvaceae. It is perennial shrub up to 3m in height, distributed over tropical and subtropical region throughout the world. (Saranya 2015). The leaves are ovate, acuminate, toothed, rarely subtrilobate. The flowers are yellow in colour. peduncle jointed above the middle. The fruits are capsule, densely pubescent, with conspicuous and horizontally spreading beaks. (Sarkar2015).

Plant have great medicinal activities, traditionally known for its anti-diabetic, anthelmintic, antibacterial, antifungal, anti-inflammatory, analgesic activity etc. Plant is also useful in diseases like piles, leprosy, jaundice, ulcer, lumbago, toothache and also in snakebite. (Darsini 2015).

Phytochemicals are naturally present in plant having biologically active compounds. (Anuradha2022). Phytochemicals are categorised into primary and secondary metabolites. Proteins, carbohydrates, and nucleic acids are the primary metabolites which are vital for the basic metabolic processes of plants. In contrast, secondary metabolites such as phenolics, flavonoids, and terpenoids are synthesized through specialized pathways and are often linked to protective functions, including antibacterial, antifungal, and antiviral activities. (Sarkar2015). These secondary compounds are of significant interest in research due to their ability to compete with various diseases and the defence mechanism.

In the present study, qualitative phytochemical analysis of plant *Abutilon indicum* is done. Many bioactive chemical compounds have been identified in the extracts of *Abutilon indicum*. Among these phenols, tannins, alkaloids, flavonoids glycosides, proteins, amino acids, sterols, terpenoids, terpenes, carbohydrate are the major compounds.

Material And Methods:

Collection and preparation of plant material:

Leaves of *A. indicum* were collected from Amravati district. Collected leaves were washed thoroughly in running tap water and shade dried in room temperature (25^0c to 28^0c approx), this process continued for 15 days until the plant material was dried completely. Then dried plant material was finely ground into powder for estimation of bioactive constituents.

Phytochemical Screening:

The preliminary phytochemical analysis of *A. indicum* in various solvent to identify major classes of secondary metabolites present in plants. Qualitative screening is done in three different solvent- petroleum ether, ethyl acetate, aqueous

Qualitative investigation of phytochemicals :

1. **Test for alkaloids (Mayer's test)**

To 1ml of extract, 1 ml of Mayer's reagent was added. Formation of whitish yellow or cream coloured precipitate indicates the presence of alkaloids.

2. **Test for flavonoids (Alkaline reagent test)**

To 1 ml of extract, few drops of dilute ammonium solution and few drops of concentrated hydrochloric acid were added. A yellow colouration indicates the presence of flavanoids.

3. **Test for terpenoids (Salkowski test)**

To 1 ml of extract, 2ml of chloroform and few drops of sulphuric acid were added. Formation of reddish brown ring indicates the presence of terpenoids.

4. **Test for saponins (Froth test)**

To 1 ml of extract, 5 ml of distilled water was added and shaked vigorously. Formation of froth indicates the presence of saponins.

5. **Test for phenols (Lead Acetate test)**

To 1ml of extract, 1 ml of lead acetate solution was added. Formation of precipitate indicates the presence of phenols.

6. **Test for tannins (Lead acetate test)**

To 1ml of extract, 1ml of lead acetate was added. A formation of white precipitate indicates the presence of tannins.

7. **Test for cardiac glycosides (Keller kiliani test)**

To 1ml of extract, 5ml of distilled water was added and evaporated to dryness. Then to the Sample 2ml of glacial acetic acid containing trace amount of ferric chloride solution was added. Then 1ml of concentrated sulphuric acid was added along the sides of the tube. Formation of brown ring underlayed with blue colour indicates presence of cardiac glycosides.

8. **Test for amino acids (Ninhydrin test)**

To the 1ml of sample, 3 to 4 drops of Ninhydrin solution was added and boiled in water bath for 10 minutes. Formation of purple or blue colour indicates the presence of amino acids.

9. **Test for proteins (Biuret test)**

To the 1ml of extract, 1ml of 40% sodium hydroxide solution and 2 drops of 1% copper sulphate solution were added. Formation of violet colour indicates the presence of proteins.

10. **Test for carbohydrates (Barfoed test)**

To the 2ml of extract, 1ml of Barfoed's reagent was added and boiled in water bath for few minutes. Formation of reddish brown precipitate indicates the presence of carbohydrates.

11. **Test for reducing sugars (Fehling's test)**

To the 1ml of extract, equal quantities of Fehling solution A and B were added and heated. Formation of brick red precipitate indicates the presence of reducing sugars.

Result and Discussion :

Phytochemical screening of leaves of *Abutilon indicum.*

Test	Petroleum ether	Ethyl acetate	Aqueous
Alkaloid	-	-	-
Flavonoids	-	+	+
Terpenoids	-	-	-
Saponins	+	+	+
Phenols	+	+	+
Tannins	+	-	+
Cardiac glycosides	-	+	-
Amino acids	-	-	-
Proteins	-	-	-
Carbohydrates	-	-	-
Reducing sugar	-	+	+

Phytochemical screening of *A. indicum* in three different solvent- petroleum ether, ethyl acetate and aqueous stated that : Saponins, Phenols and Tannins are present in petroleum ether. In ethyl acetate mainly presence of flavonoids, saponins, phenols, cardiac glycosides and reducing sugar. In aqueous there are presence of flavonoids, saponins, phenols, tannins, reducing sugar.

Conclusion :

These study concludes that, these solvent based extraction and screening of *A. indicum* provides the valuable information and understanding about phytochemical composition of this medicinal plant. Result shows that phytochemicals like flavonoids, tannins, saponins, cardiac glycosides, phenolics and reducing sugar present significantly. This suggests that ethyl acetate and aqueous extracts of *A. indicum* may hold considerable pharmacological potential, particularly for antioxidant, antimicrobial, and anti-inflammatory activities, which are commonly associated with these phytochemical groups.

References :

1. Archna Sharma1, R.A. Sharma2, et.al. (2013). Phytochemical and Pharmacological Profile of *Abutilon Indicum* L. Sweet : A Review. International Journal of Pharmaceutical Sciences Review and Research, 20(1); 120-127.
2. R. Nithyatharani1, U.S. Kavitha2. (2018). Phytochemical analysis of the leaves of *Abutilon indicum.* International Journal of Creative Research Thoughts (IJCRT), 6(1); ISSN: 2320-2882.
3. I. P. Darsini1, S Shamshad. (2015). Antimicrobial activity and preliminary phytochemical screening of *Abutilon indicum*. International Journal of Pharmacy and Biological Sciences, 5(2);6-10.
4. D. Saranya, et.al. (2015). Phytochemical analyses, antibacterial and antifungal activity of leaves from *Abutilon indicum* (L.) Sweet. Journal of Chemical and Pharmaceutical Research,7(12):524-530.
5. Dr. Ch. S. Anuradha. (2022). Investigation of chemical constituents of leaf extract of Abutilon indicum collected from field of Vishakhapatnam. International research of novel research and development (IJNRD), 7(10); ISSN: 2456-4184.
6. Sarkar, R., Haque, A., et. al. (2015). Phytochemical screening, antioxidant and antimicrobial effects of Abutilon indicum (Linn.) leaves extracts. PharmacologyOnline , 1;94-103.

Synthesis of Phenyl Thio Carbamide from Substituted Amine and It's Physical Aspects

Aarti G. Shende, Aditya D. Joshi and Dr. S. V. Kolhe
P.G. Department of Chemistry
Shri. Shivaji Art's, Commerce & Science College Akot, Dist. Akola (Maharashtra) *444101*

Abstract

Phenyl thio-carbamide known as Phenyl-thiourea is a hetero cyclic compound contains Sulphur as hetero atom and have a lot of medicinal uses particularly in Genetics problems. The aim of this study is to examine the co-creation between taste and symptomatic and asymptomatic aspects. In present study, the synthesis of PTC (Phenyl-thiocarbamide) done by substituted aromatic amines and substituted ammonium thiocyanate in presence of mineral acid. Further Substituted Phenyl thio-carbamide on bromination and nitration gave the bromo and nitro substituted Phenyl thio-carbamide products. The physical metrics of substituted Phenyl thio-carbamide compounds taken at varying concentration, temperature, suitable solvents is carried out for further investigation.

KEYPOINTS:- Phenyl-thiourea, Genetics problems, PTC, physical metrics, suitable solvents

1. Introduction

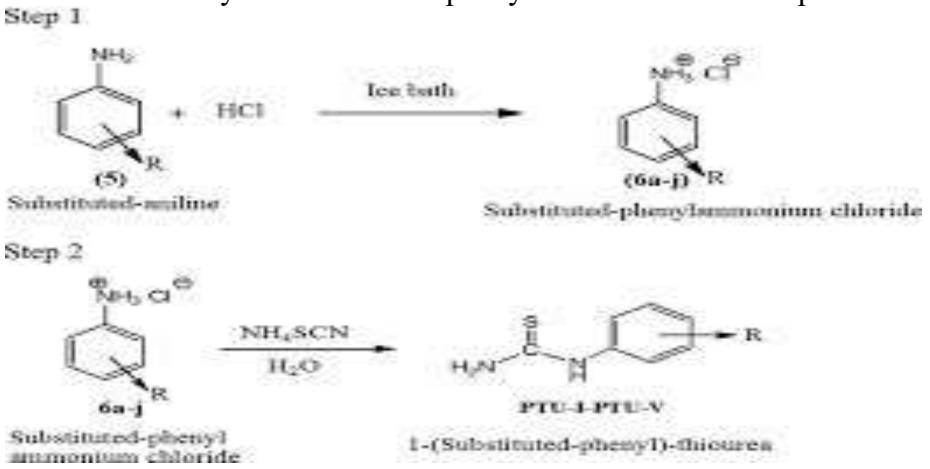
Phenylthiocarbamide (PTC), also known as phenylthiourea (PTU), is an organosulfur thiourea containing a phenyl ring. It has the unusual property that it either tastes very bitter or is virtually tasteless, depending on the genetic makeup of the taster. The ability to taste PTC is often treated as a dominant genetic trait, although inheritance and expression of this trait are somewhat more complex.[2][3] PTC also inhibits melano genesis and is used to grow transparent fish.[4]About 70% of people can taste PTC, varying from a low of 58% for Indigenous Australians and indigenous peoples of New Guinea to 98% for indigenous peoples of the Americas. [5] One study has found that non-smokers and those not habituated to coffee or tea have a statistically higher percentage of tasting PTC than the general population.[6][7] PTC does not occur in food, but related chemicals do, and food choice is related to a person's ability to taste PTC.[6][8] The title compound, C8H10N2S, was prepared by reaction of methylamine solution, KOH and phenyl-isothiocyanate in ethanol. It adopts a syn-Me and anti-Ph conformation relative to the C S double bond[9] . The dihedral angle between the N— C(S)—N thiourea and phenyl planes is 67.83 (6). In the crystal, the molecules Centro symmetrical dimers[10] by pairs of N(Ph)—HS hydrogen bonds. The dimers are linked by N(Me)—HS hydrogen bonds into layers parallel . Compound, C13H11N3O2S, was prepared by reaction of 2-nitrobenzeneamine, KOH and 1-isothiocyanatobenzene in an ethanol solution at room temperature[11]. The dihedral angles formed between the thiourea plane and the phenyl rings are 61.9 and 31.0. The dihedral angle between the two phenyl rings is 78.1. In the crystal structure, there are weak intermolecular N—HS and C—HS hydrogen-bonding interactions. Pyrazolines were first reported by Knorr and Blank. I Phenyl pyrazoline was ob1ained by Fischer and Knoevenagel1 from phenyl hydrazine and acrolein, instead of the expected hydrazine[12] . It was from ten determination of 140 pg of Pd(II) was 0 425±0.0[)5,2. The relative mean deviation and standard deviation have been found to be 0.72% and 0.28% respectively.3. The total operation requires 30min.4. Thus, the method is simple rapid and applicable at trace concentration of Pd(I)[13] It affords a clear cut separation of Pd(II) from large member of ions.6.[14]Compound, C9H12N2OS, was obtained unexpectedly in a multicomponent reaction of an equimolar ratio of phenyl isothiocyanate, malononitrile and aminoethanol[15]. The –C(H2)– N(H)–(C S)–N(H)– methylthiourea–methane group is almost normal to the phenyl ring[16], with a dihedral angle of 71.13 (9) The N—C—C—O torsion angle is 72.8 (2). In the crystal, molecules are connected by N—HO, O—HS and N—HO hydrogen bonds, forming a three-dimensional network. Early studies on human diversity showed that most genetic diversity was found between individuals rather than between populations or continents Genetic variation[17] among humans is important in classifying and comparing them. Phenylthiocarbamide (PTC) tasting[18]

ability is generally referred to as a simple genetic trait governed by a pair of alleles, dominant T for tasting and recessive t for non-tasting. Persons with genotypes TT and Tt are tasters, and persons with genotype TT are non-tasters[19].Taste responsiveness to PTC was known to be a heritable trait[20].

Experimental

1.1 Synthesis of Phenyl thio Carbamide from substituted Amine

- In a 500-ml. three-necked flask fitted with a reflux condenser, a mechanical stirrer, and a 100-ml. dropping funnel are placed 20g. of ammonium thiocyanate and 80 ml water
- Take a round bottom flask add 25 ml aniline and 25 ml concentrated hydrochloric acid
- Then warm the solution until the salt formation takes place. After the formation of salt dissolve it in distilled water. Take a mixture of 20g Ammonium thiocyanate in 80ml distilled water. Pour the solution into round bottom flask stir it continuously. Warm the mixture up to it become turbid (do not boil) then pour the hot solution into crushed ice with constant stirring
- Then filter the mixture and dry it Formation of phenylthiocarbamide takes place



1.2 Bromination

- Firstly prepare bromine solution take a bromine ampule and break it into acidic acid solution (120) ml.
- Take two thermostat A and B .
- In thermostat A: take a beaker and add 8 g. of the compound with solvent ethanol in thermostat B: take a beaker and add bromine solution in acidic acid in it.
- Pour the mixture of thermostat B drop wise into thermostat A with constant stirring After adding complete solution stir the solution up to half hour
- Allow the solution to stand at room temperature.

1.3 Nitration

- Firstly prepare nitrating mixture take 15 ml H_2SO_4 sulphuric acid and 5ml HNO_3 Take two thermostat A and B .
- In thermostat A: take a beaker and add 6 g. of the compound with solvent ethanol in thermostat B: take a beaker and add nitrating mixture in it.
- Pour the mixture of thermostat B drop wise into thermostat A with constant stirring After adding complete solution stir the solution up to half hour
- Allow the solution to stand at room temperature

2. Result and Conclusion

By serial dilution method to create solutions of 0.005M, 0.0025M, and 0.0012M with 65% and 75% ethanol-water mixture, respectively, after creating a solution with a 0.01 M concentration of Phenylthiocarbamide. Conductivity Bridge was used to measure the conductance of each solution at 293K and 303K. The results are tabulated and presented in Tables 1 and 2. The resulting data was analyzed using a known literature method to determine the observed conductance (G), specific conductance (k) and molar conductance (μ).

TABLE – 1 - CONDUCTOMETRIC MEASUREMENTS AT DIFFERENT CONCENTRATIONS OF PHENYLTHIOCARBAMIDE				
DETERMINATION OF G, k and μ AT DIFFERENT CONCENTRATIONS AND DIFFERENT TEMPERATURES IN 65% E-W MIXTURE				
Temp	**Concentration C (M)**	**Observed conductance (G) mS**	**Specific conductance (k) mSm^{-1}**	**Molar conductance (μ) mSm^2mol^{-1}**
293K	0.01	0.0209	0.002134 X 10-3	0.21333
	0.005	0.01249	0.001538 X 10-3	0.30786
	0.0025	0.00857	0.001099 X 10-3	0.439823
	0.0012	0.0069	0.009038 X 10-3	0.753108
303K	0.01	0.02498	0.002976 X 10-3	0.297533
	0.005	0.01417	0.001762 X 10-3	0.352238
	0.0025	0.01026	0.001302 X 10-3	0.522859
	0.0012	0.00838	0.001064 X 10-3	0.885957

Table 1 lists the observed conductance (G), specific conductance (k), and molar conductance (μ) values. In this case, G, k, and μ rise in tandem with rising temperatures and fall in tandem with falling concentrations. The higher the temperature, the higher the specific conductance, calculated values of Phenylthiocarbamide's specific constant (Ksp), log (Ksp), and thermodynamic parameters (ΔG), (ΔS), and (ΔH) using established literature methods at various concentrations and temperatures. Obtained result computed in table 2.

TABLE – 2 - CONDUCTOMETRIC MEASUREMENTS AT DIFFERENT CONCENTRATION AND DIFFERENTS TEMPERATURES OF PHENYLTHIOCARBAMIDE						
DETERMINATION OF Ksp, log Ksp, ΔG,ΔH and ΔS AT DIFFERENT CONCENTRATIONS AND DIFFERENT TEMPERATURES						
SYSTEM: L_2 [PTCN]			**MEDIUM - 65% Ethanol-Water Mixture**			
Temp.(K)	**Conc. M**	**Ksp**	**Log Ksp**	**ΔG $kJmlo^{-1}$**	**ΔH $kJmlo^{-1}$**	**ΔS $kJK^{-1}mlo^{-1}$**
293K	0.01	0.001426	-4.84905	-27203.68	-122748	511.778
	0.005	0.007374	-5.13248	-28793.84	-74347.4	352.018
	0.0025	0.003762	-5.42468	-30433.04	-73054.5	353.198
	0.0012	0.002546	-5.59504	-31388.75	-82516	388.76
303K	0.01	0.03243	-4.4896	-26046.24	-83707.8	362.226
	0.005	0.01143	-4.94497	-28688.64	-92200.5	398.975
	0.0025	0.006255	-5.20394	-30191.02	-97028.8	419.869
	0.0012	0.004145	-5.38338	-31232.19	-100378	434.349

It can be inferred from tables -1 and 2 above that the conductometric and thermodynamic parameter values of Phenylthiocarbamide are closely related to the variation in temperatures and molar concentrations.

As can be seen, the μ values rise as temperature rises and concentration falls, suggesting either greater ion mobility or less solvation. This is because dilution and rising temperatures, respectively, cause more bond breaking when thermal energy increases. Additionally, negative ΔG values suggested that the reaction was spontaneous. Enthalpy change (ΔH) values that are negative indicate that the reaction is exothermic. Entropically favorable is indicated by a positive value of (ΔS) and a favorable temperature. Molar concentrations and percentage compositions have a significant impact on the change in thermodynamic parameter values. These parameters are also significantly impacted

by solute (drug)-solvent interactions, solvent-solvent interactions, solvent-solvent-solute interactions, and solute-solute-solvent interactions. The variation of these parameters is also caused by internal geometry and intra- and intra-hydrogen bonding.

4. References

1. GHS: Record of Phenylthiourea in the GESTIS Substance Database of the Institute for Occupational Safety and Health, accessed on 2021-12-22.
2. Guo; Reed, D. R. (2001). "The genetics of phenylthiocarbamide perception". Annals of Human Biology. 28 (2): 111–142. doi:10.1080/03014460151056310. PMC 3349222. PMID 11293722.
3. McDonald, John H. "PTC tasting: The Myth". Myths of Human Genetics. Retrieved 11 May 2015.
4. Karlsson, Johnny; von Hofsten, Jonas; Olsson, Per-Erik (2001). "Generating Transparent Zebrafish: A Refined Method to Improve Detection of Gene Expression During Embryonic Development". Marine Biotechnology. 3 (6): 522–527. doi:10.1007/s1012601-0053-4. PMID 14961324. S2CID 7980753.
5. Kim U, Wooding S, Ricci D, Jorde LB, Drayna D (2005). "Worldwide haplotype diversity and coding sequence variation at human bitter taste receptor loci".Human Mutation. 26 (3): 199–204. doi:10.1002/humu.20203. PMID 16086309. S2CID 31248094.
6. Fischer R, Griffin F, Kaplan AR (1963). "Taste thresholds, cigarette smoking, and food dislikes". Medicina Experimentalis. International Journal of Experimental Medicine. 9 (3): 151–167. doi:10.1159/000135346. PMID 14083335.
7. Kaplan AR, Glanville EV, Fischer R (1964). "Taste thresholds for bitterness and cigarette smoking". Nature. 202 (4939):1366. Bibcode:1964Natur.202.1366K. doi:10.1038/2021366a0. PMID 14210998. S2CID 4184237.
8. Forrai G, Bánkövi G; Bánkövi (1984). "Taste perception for phenylthiourea and food choice—a Hungarian twin study". Acta Physiol Hung. 64 (1): 33–40. PMID 6541419.
9. Borisova, N. E., Reshetova, M. D. & Ustynyuk, Y. A. (2007). Chem. Rev. 107, 46–79. Bruker (1997). SMART and SAINT. Bruker AXS, Inc., Madison, Wisconsin, USA. Ji, B. M., Du, C. X., Zhu, Y. & Wang, Y. (2002). Chin. J. Struct. Chem. 21, 252– 255. Madan, V. K. & Taneja, A. D. (1991). J. Indian Chem. Soc. 68, 162–163. Sheldrick, G. M. (2008). Acta Cryst. A64, 112–122. Wenzel, M., Light, M. E., Davis, A. P. & Gale, P. A. (2011). Chem. Commun. 47, 7641–7643. Xu, L., Jian, F., Qin, Y., Yu, G. & Jiao, K. (2004).
   Chem. Res. Chin. Univ. 20, 305–307
10. Enraf–Nonius (1989). CAD-4 Software. Version 5.0. Enraf–Nonius, Delft, The Netherlands. Farrugia, L. J. (1999). J. Appl. Cryst. 32, 837–838. Gabe, E. J., Le Page, Y., Charland, J.-P., Lee, F. L. & White, P. S. (1989). J. Appl. Cryst. 22, 384–387. Madan, V. K. & Taneja, A. D. (1991). J. Indian Chem. Soc. 68, 162–163. Reinbold, A. M. & Morar, G. V. (1984). Ser. Biol. Khim.
    Nauk. 4, 75–77. Sheldrick, G. M. (1990). SHELXTL/PC. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA. Sheldrick, G. M. (1997). SHELXL97 and SHELXS97. University of Go¨ttingen, Germany. Xue, S. J., Duan, L. P. & Xe, S. Y. (2004). Chin. J. Struct. Chem. 23, 441– 444.
11. l. B. K. DESHMUKH, C. N. VYAB and R. B. KHARAT, J. Indian Chem. Soc, 1975, 52, 385. 2.
12. B. K. DESHMUKH and R. B. KHARAT, J. lnorg. Nucl. Chem., 1977, 39, 165.
13. Allen, F. H., Kennard, O., Watson, D. G., Brammer, L., Orpen, A. G. & Taylor, R. (1987). J. Chem. Soc. Perkin Trans. 2, pp. S1–19
14. . Altomare, A., Burla, M. C., Camalli, M., Cascarano, G. L., Giacovazzo, C., Guagliardi, A., Moliterni, A. G. G., Polidori, G. & Spagna, R. (1999). J. Appl. Cryst. 32, 115–119.
15. Arslan, H., Florke, U., Kulcu, N. & Kayhan, E. (2006). Turk. J. Chem. 30, 429– 440.
16. Bernstein, J., Davis, R. E., Shimoni, L. & Chang, N. L. (1995). Angew. Chem. Int. Ed. Engl. 34, 1555–1573. Bruker (2005). APEX2 and SAINT. Bruker AXS Inc., Madison, Wisconsin, USA.
17. Desai, A. D., Mahajan, D. H. & Chikhalia, K. H. (2007). Indian J. Chem. Sect. B, 46, 1169–1173. Etter, M. C., MacDonald, J. C. & Bernstein, J.(1990). Acta Cryst. B46, 256–262. Farrugia, L. J. (1997). J. Appl. Cryst. 30, 565. Farrugia, L. J. (1999). J. Appl. Cryst. 32, 837–838.
18. Katritzky, A. R. & Gordeev, M. F. (1991). J. Chem. Soc. Perkin Trans. 1, pp. 2199–2203.
19. Kilcigil, G. A. & Altanlar, N. (2006). Turk. J. Chem. 30, 223–228.
20. Patel, R. B., Chikhalia, K. H., Pannecouque, C. & Clercq, E. D. (2007). J. Braz. Chem. Soc. 18, 312–321.

Economic Transformation in India: Policies and Outcomes

Dr. Gajanan Ingle
Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara),
Dr. M. K. Nannaware
Shri Shivaji Arts, Commerce & Science College, Akot (Affiliated to Sant Gadge Baba Amravati University, Amravati)

Abstract:

India's economic reforms since 1991 (assuming 1991–present as the period of analysis) – spanning market liberalization, privatization, globalization, and broad financial/tax reforms – have fundamentally reshaped the economy, fuelling sustained ~6–7% GDP growth (doubling its size) and surging FDI inflows, significant poverty reduction and sectoral shifts, yet their benefits have been uneven across regions and the informal economy.

Before 1991, India's state-led economy recorded only ~4% annual growth. The 1991 balance-of-payments crisis then triggered extensive reforms: liberalization (dismantling licenses and tariff barriers), privatization (minority PSU disinvestment) and globalization, alongside banking-sector restructuring (Narasimhan committees, NPA resolution, 2016 Insolvency Code) and tax reforms (culminating in the 2017 GST).

Measured outcomes are striking: GDP growth averaged ~6–7% in the reform era, with per-capita income rising markedly. FDI inflows surged (from ~$36B in FY2013 to ~$81B in FY2025), and the service/IT sectors now dominate output while agriculture's share has fallen. Poverty rates have roughly halved (to ~24% by 2022–23) and consumption inequality modestly improved (Gini 28.8→25.5). At the same time, challenges remain: 72% of India's poor are concentrated in ten lagging states; agricultural incomes have lagged, causing rural distress; and roughly 90% of workers remain informal. Reforms delivered macro gains and improved living standards, but regional disparities underscore the need for further inclusive reforms.

Key Assumption: Analysis covers reforms and impacts over the 1991–2025 period.

Introduction:

India's economic reforms mark a pivotal shift in the nation's policy direction. For nearly four decades after independence, India operated a mixed economy that emphasized state planning, self-reliance, import substitution, and public-sector dominance. By the late 1980s, the economy faced severe challenges: high fiscal deficits, stagnant industrial growth, growing external debt, and a balance-of-payments crisis. In 1991, foreign exchange reserves had fallen to barely two weeks of imports, compelling the government to enact comprehensive structural reforms aimed at opening the economy, improving efficiency, and attracting foreign investment.

Objectives of the Study:

The objectives of this study are to: understand the historical background and causes that led to India's economic reform agenda; examine the key components of the 1991 reform package; assess efforts to improve economic efficiency and competitiveness; evaluate the role of foreign investment; analyze India's integration with the global economy; and consider implications for poverty reduction.

Impact on Different Sectors:

The reform period had varied impacts across sectors:

- **Macroeconomic Impact:** GDP growth accelerated substantially (rising from around 3.5% in the pre-reform era to 6–7% in the 2000s). Inflation stabilized and foreign exchange reserves grew significantly. By 2023, India had become the world's 5th-largest economy in nominal terms.
- **Industrial Sector:** Private industries expanded rapidly in areas such as automobiles, information technology, telecommunications, and manufacturing. Increased competition improved product quality and efficiency. However, small-scale and traditional industries faced difficulties competing under the new open-market conditions.

- **Agricultural Sector:** Reforms had limited direct effect on agriculture in the 1990s. Growth in farm output remained slow, and many rural areas experienced distress due to subsidy reductions and volatile prices. Analysts note a need for further agriculture-sector reforms to boost productivity and rural incomes.
- **Service Sector:** Services became the main engine of growth. Sectors like IT, finance, telecommunications, and education expanded dramatically, contributing over half of GDP by the 2010s. The services boom helped offset slower growth in agriculture.
- **Financial and Investment Impact:** Foreign direct investment (FDI) inflows increased sharply (from $129 million in 1991 to over $80 billion by FY2024–25), reflecting liberalized investment rules. The capital markets deepened, and regulatory reforms (such as creation of SEBI) strengthened the financial system. Nonetheless, a large informal finance sector and remaining non-performing loans in banks continued to pose challenges.

Recent Major Reforms (2015-2020):

In these five years, India introduced several landmark policies:

- **Digital India (2015):** Comprehensive digitization of public services, financial inclusion (e.g. Aadhaar, mobile banking) and promotion of IT infrastructure.
- **Make in India (2014):** Initiative to boost manufacturing by improving ease of doing business, infrastructure, and foreign investment policies to attract global companies.
- **Goods and Services Tax (GST, 2017):** Unification of multiple indirect taxes into a single national tax, simplifying commerce and creating a common market.
- **Insolvency and Bankruptcy Code (2016):** New framework for faster resolution of corporate and individual insolvency, aiming to improve creditor confidence and clean up bad debts.
- **Atmanirbhar Bharat (2020):** 'Self-reliant India' economic stimulus and localization push in response to the COVID-19 crisis.
- **Labour Code Reforms:** Rationalization of labor laws into four codes to simplify regulations covering wages, industrial relations, social security, and safety.
- **Agricultural Market Reforms:** Legislation intended to liberalize agricultural markets and contract farming (though facing significant debate and partial rollback).

Future Prospects and Recommendations:

The paper suggests several policy priorities moving forward:

- Strengthen agricultural productivity and rural infrastructure to ensure farming remains viable and to reduce rural poverty.
- Focus on manufacturing and construction sectors, which are labor-intensive, to create more formal jobs and absorb a growing workforce.
- Promote inclusive growth via targeted social welfare programs to ensure disadvantaged groups benefit from economic expansion.
- Emphasize sustainable, "green" growth by investing in clean energy and environmental management to address resource constraints.

Conclusions:

Economic reforms have dramatically changed India's economy, elevating it into the ranks of top emerging markets worldwide. The transition from protectionist policies to open-market reforms has boosted competitiveness, efficiency, and innovation. However, these reforms have also produced uneven development, disproportionately favouring urban elites over rural poor. To fully realize the benefits of reform, future policies must prioritize growth that is inclusive, equitable, and sustainable. Policymakers face the challenge of balancing market efficiency with social justice so that the rewards of growth are shared across all segments of society.

References:

1. Government of India. (1991). New Industrial Policy Statement. Ministry of Industry, New Delhi.
2. Ahluwalia, M. S. (2002). Economic Reforms in India Since 1991: Has Gradualism Worked? Journal of Economic Perspectives, 16(3).

3. Panagariya, A. (2008). India: The Emerging Giant. Oxford University Press.
4. Joshi, V. & Little, I. M. D. (1996). India's Economic Reforms, 1991–2001. Oxford University Press.
5. Government of India, Economic Survey (various years). Ministry of Finance.
6. Datt, R. & Sundaram, K. P. M. (2022). Indian Economy. S. Chand & Company.
7. Rangarajan, C. (2021). India's Economic Reforms: Retrospect and Prospect. NCAER Working Paper.
8. World Bank. (2023). India Development Update. Washington, D.C.
9. Reserve Bank of India (RBI) Reports (various years).
10. Planning Commission / NITI Aayog. (2015–2023). Strategy for New India @ 75.

Use of Artificial Intelligence in the Teaching of English Literature

Gaurav Ashokrao Thombre
Assistant Professor (CHB)
Shri Shivaji Arts, Commerce and Science College, Motala, Dist. Buldhana

Abstract

Artificial Intelligence (AI) has significantly transformed modern education, particularly in the field of language and literature. In the teaching of English literature, AI introduces innovative methods that enhance student engagement, comprehension, and analytical skills. It supports personalized learning, automated assessment, and interactive learning environments. AI tools such as chatbots, text analyzers, and virtual tutors help students understand complex literary texts, themes, and critical interpretations. Despite its advantages, AI also presents challenges like reduced human interaction, overdependence, and ethical concerns. This research paper explores the applications, benefits, challenges, and future scope of AI in English literature teaching. It emphasizes the importance of balancing AI tools with traditional teaching methods. The study concludes that AI can greatly improve the quality of literature education when used responsibly and effectively.

1. Introduction

Artificial Intelligence is revolutionizing the education system by introducing advanced tools that support teaching and learning. It refers to machines that can simulate human intelligence such as thinking, learning, and problem-solving. In English literature teaching, AI helps students understand complex texts, themes, and literary devices. Traditional teaching methods often rely on lectures and textbook explanations, which may not engage modern learners. AI provides interactive and multimedia-based learning experiences. It allows students to explore literature through different perspectives. AI tools adapt to individual learning needs, making education more personalized. This improves comprehension and critical thinking skills. Therefore, AI plays a crucial role in modernizing English literature teaching.

Keywords: - AI, English Literature, Teaching, Learning, Education, Skill development

2. Objectives of the Study

- To understand the role of AI in teaching English literature
- To analyze the impact of AI on literature learning
- To identify advantages and challenges of AI
- To explore future opportunities in AI-based education

3. Concept of Artificial Intelligence

Artificial Intelligence refers to computer systems that perform tasks requiring human intelligence. These include language understanding, pattern recognition, and decision-making. Technologies such as Machine Learning and Natural Language Processing (NLP) are widely used in AI. In English literature teaching, NLP helps analyze texts, identify themes, and generate summaries. AI systems can provide personalized feedback and recommendations. They also assist in content creation and assessment. AI enables automation and efficiency in education. It supports both teachers and students in the learning process. Hence, AI is a powerful tool in modern education systems.

4. Nature of English Literature Teaching

English literature includes poetry, drama, novels, and essays that require interpretation and critical analysis. Teaching literature involves understanding themes, characters, and literary devices. Traditional methods often focus on memorization and teacher-centered instruction. Students may find it difficult to analyze complex texts. There is a need for interactive and student-centered approaches. AI provides innovative solutions through multimedia and digital tools. It enhances visualization and understanding of literary concepts. AI makes literature more accessible and engaging for students. Thus, it improves the overall teaching-learning experience.

5. Use of AI in Teaching English Literature

5.1 Personalized Learning

AI enables personalized learning by analyzing individual student performance and preferences. Each student has a unique learning style and pace, and AI adapts accordingly. It provides customized reading materials and exercises based on the student's level. This helps weaker students improve gradually while advanced learners are challenged further. Personalized learning increases student motivation and confidence. AI continuously tracks progress and suggests improvements. It ensures that learning is more effective and student-centered. Students receive targeted support that enhances their understanding of literature.

5.2 Automated Assessment

AI tools can automatically evaluate essays, assignments, and quizzes. They analyze grammar, vocabulary, coherence, and structure. This reduces the workload of teachers significantly. Students receive instant feedback on their work. Immediate evaluation helps them identify and correct mistakes quickly. AI ensures unbiased and consistent grading. It also tracks student progress over time. Automated assessment improves efficiency in the education system.

5.3 Language Skill Development

AI supports the development of reading, writing, listening, and speaking skills. Reading tools help students understand literary texts better. Writing assistants provide suggestions for improving essays and creative writing. Speech recognition tools improve pronunciation and fluency. Listening exercises enhance comprehension skills. AI provides a balanced approach to language learning. It makes skill development more practical and interactive. Students gain confidence in using the language effectively.

5.4 Interactive Learning

AI-based chatbots and virtual tutors create interactive learning environments. Students can ask questions and receive instant responses. This encourages active participation in the learning process. Interactive tools make literature learning more engaging and enjoyable. Students feel comfortable exploring new ideas. AI reduces hesitation and fear of making mistakes. It promotes curiosity and independent learning. Interactive learning improves understanding and retention.

5.5 Text Analysis and Interpretation

AI helps students analyze literary texts in depth. It can identify themes, symbols, and literary devices. AI provides summaries and explanations in simple language. This makes it easier for students to understand complex texts. It supports critical thinking and interpretation skills. Students can explore multiple perspectives of a text. AI enhances analytical abilities and comprehension. It acts as a supportive tool in literary studies.

6. Advantages of AI

6.1 Makes Learning Engaging and Easy

AI transforms literature teaching into an engaging experience through multimedia tools such as videos, animations, and interactive content. Complex literary concepts become easier to understand when presented visually. Students find learning enjoyable and less stressful. AI simplifies difficult topics and improves comprehension. It keeps students interested and motivated. Learning becomes more effective and accessible.

6.2 Increases Student Participation

AI encourages active participation through quizzes, games, and interactive sessions. Students engage more with digital tools. They feel confident asking questions. AI provides equal learning opportunities. Participation improves communication skills. Students become more involved in the learning process.

6.3 Provides Instant Feedback

AI gives immediate feedback on assignments and tests. Students quickly understand their mistakes. This helps in continuous improvement. Instant feedback enhances learning efficiency. It motivates students to perform better. Teachers save time in evaluation.

6.4 Enables Personalized Learning

AI customizes learning content according to student needs. It identifies strengths and weaknesses. Students learn at their own pace. Personalized learning improves understanding. It supports both weak and advanced learners.

6.5 Saves Teacher's Time

AI automates routine tasks like grading and attendance. Teachers can focus more on teaching. It improves teaching efficiency. Teachers can give more attention to students. AI acts as a supportive tool.

7. Challenges of AI

7.1 Overdependence on Technology

Students may rely too much on AI tools. This reduces independent thinking. Creativity may be affected. Students may copy AI-generated answers. Balance is necessary in learning.

7.2 Lack of Human Interaction

AI cannot replace human emotions. Teacher-student interaction is important. Social skills may be affected. AI lacks empathy. Human guidance remains essential.

7.3 High Cost

AI tools require infrastructure and investment. Not all institutions can afford them. Rural areas face difficulties. This creates inequality in education.

7.4 Data Privacy Issues

AI collects student data. There is a risk of misuse. Privacy concerns arise. Proper data protection is necessary. Ethical use is important.

7.5 Lack of Teacher Training

Teachers need training to use AI tools. Lack of knowledge reduces effectiveness. Training programs are essential. Skilled teachers can maximize AI benefits.

8. Role of Teacher

8.1 Teacher as a Guide

Teachers guide students in using AI effectively. They provide deeper understanding. AI supports but cannot replace teachers. Teachers ensure meaningful learning.

8.2 Teaching Ethical Use of AI

Teachers promote responsible use of AI. They prevent misuse. Students learn ethical practices. Originality is encouraged.

8.3 Providing Emotional Support

Teachers motivate and support students. AI cannot understand emotions. Emotional connection improves learning.

9. Impact on Education

9.1 Improves Learning Effectiveness

AI enhances understanding through personalized learning. Students grasp concepts clearly. Learning becomes efficient. Academic performance improves.

9.2 Enhances Creativity

AI supports creative writing and thinking. Students generate new ideas. It improves imagination and expression. Creativity is essential in literature learning.

9.3 Improves Quality of Education

AI provides updated and accurate content. Teaching standards improve. Students receive better guidance. Education becomes more effective.

10. Future Scope

10.1 Smart Classrooms

AI-based classrooms will become common. Digital tools will enhance teaching. Learning will be interactive and modern.

10.2 AI Tools for Literature

Special AI tools for literature analysis will be developed. They will support understanding of texts and themes.

10.3 Digital Libraries

Online access to literature will increase. Students can read anytime. AI will recommend books. Reading habits will improve.

Conclusion

Artificial Intelligence has great potential in transforming English literature teaching. It improves learning through personalization and interaction. However, challenges must be addressed. Teachers play an important role in balancing AI use. A combined approach ensures effective education. AI should be used responsibly for better learning outcomes.

References

1. Stuart Russell, S., & Peter Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson Education.
2. Erik Brynjolfsson, E., & Andrew McAfee, A. (2017). Machine, Platform, Crowd: Harnessing Our Digital Future. W.W. Norton & Company.
3. Kai-Fu Lee. (2018). AI Superpowers: China, Silicon Valley, and the New World Order. Houghton Mifflin Harcourt.
4. UNESCO. (2021). Artificial Intelligence in Education: Challenges and Opportunities. Retrieved from https://www.unesco.org
5. World Economic Forum. (2022). Shaping the Future of Artificial Intelligence in Education. Retrieved from https://www.weforum.org
6. Deloitte. (2020). AI in Education and Learning. Retrieved from https://www2.deloitte.com
7. McKinsey & Company. (2021). The State of AI in Education and Workforce Development. Retrieved from https://www.mckinsey.com
8. Davenport, T. H., & Ronanki, R. (2018). Artificial Intelligence for the Real World. Harvard Business Review, 96(1), 108–116.
9. Huang, M. H., & Rust, R. T. (2021). Artificial Intelligence in Service. Journal of Service Research, 24(1), 3–15.
10. Chaffey, D. (2022). Digital Business and E-Commerce Management (7th ed.). Pearson Education.
11. Kotu, V., & Deshpande, B. (2019). Data Science: Concepts and Practice. Morgan Kaufmann.
12. Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Center for Curriculum Redesign.
13. Luckin, R. (2018). Machine Learning and Human Intelligence: The Future of Education for the 21st Century. UCL Institute of Education Press.
14. Selwyn, N. (2019). Should Robots Replace Teachers? AI and the Future of Education. Polity Press.
15. Government of India. (2020). National Education Policy 2020 (NEP 2020). Ministry of Education.

Research-Oriented Transformation of Statistics Education under NEP–2020: Opportunities and Emerging Challenges

Abhay Mahesh Tayde
Assistant Professor (CHB)
Bar. R.D.I.K & N.K.D. College, Badnera-Amravati

Abstract

The National Education Policy (NEP–2020) has introduced major reforms to strengthen research culture and promote multidisciplinary education in Indian higher education. In this context, the present study examines the research-oriented transformation of Statistics education under NEP–2020 by analysing doctoral enrolment patterns in India. The study is based on secondary data collected from the All India Survey on Higher Education (AISHE) 2021–22 report. To understand the changing research environment, two statistical diagrams are used. A trend diagram presents the year-wise growth of Ph.D. enrolment in higher education. The analysis shows a consistent increase in doctoral enrolment over recent academic years, with the highest enrolment recorded in 2021–22. This upward movement reflects a strengthening research orientation and growing institutional focus on advanced studies during the NEP implementation phase.

A discipline-wise bar diagram further explains the distribution of Ph.D. enrolment across major academic domains such as Science, Commerce, Social Sciences, Management, Education and Engineering & Technology. The results indicate that Engineering and Technology account for the largest share of doctoral enrolment among all disciplines. This highlights the strong concentration of research activity in applied and technical fields. Although Statistics is not presented as a separate category in the AISHE classification, it is academically integrated within Science and Commerce. Therefore, the overall growth observed in research-intensive disciplines indirectly supports the expansion of Statistics education in interdisciplinary and data-driven academic frameworks encouraged under NEP–2020. The study identifies important opportunities such as curriculum modernization, integration of Statistics with emerging fields like data science and increased research participation. At the same time, challenges including limited specialized faculty, infrastructure gaps, and the need for advanced analytical training are discussed.

Overall, the findings suggest that NEP–2020 has created a favourable environment for research-oriented transformation in Statistics education, while sustained policy support and institutional capacity building remain essential for long-term progress.

Keywords : NEP–2020, Statistics Education, Ph.D. Enrolment, Research Orientation, Higher Education, Interdisciplinary Learning

Introduction

Higher education plays an important role in national development, innovation and knowledge creation. It helps in developing skilled human resources and strengthening research capacity. In India, the introduction of the National Education Policy (NEP–2020) has brought major reforms aimed at improving the quality of education and promoting a strong research culture. The policy emphasizes multidisciplinary learning, academic flexibility, critical thinking and research-based education. One of its key goals is to transform higher education institutions into centres of innovation and advanced research. Statistics education is closely connected with this transformation process. Statistics is widely used in science, commerce, social sciences, management, public policy and many other fields. In today's data-driven world, statistical knowledge is essential for analysis, interpretation and informed decision-making. As NEP–2020 promotes research integration at different levels of higher education, the importance of Statistics as a supporting and interdisciplinary discipline has increased significantly. An important indicator of research development is Ph.D. enrolment in higher education institutions. Growth in doctoral enrolment reflects increasing academic interest, institutional expansion and policy support for research activities. A steady rise in Ph.D. enrolment suggests strengthening research

orientation within the higher education system. Therefore, analysing enrolment patterns helps in understanding whether the objectives of NEP–2020 are gradually influencing research participation. The present study examines the research-oriented transformation of Statistics education under NEP–2020 by analysing doctoral enrolment data in India. The analysis is based on secondary data obtained from the All India Survey on Higher Education (AISHE) 2021–22 report, which provides detailed information on enrolment across major academic disciplines.

To understand both temporal growth and structural distribution of research participation, two statistical diagrams are used. A trend diagram is prepared to show the year-wise growth of Ph.D. enrolment in higher education. In addition, a discipline-wise bar diagram is constructed to analyse the distribution of doctoral enrolment across major academic domains such as Science, Commerce, Social Sciences, Management, Education and Engineering & Technology. Although Statistics is not presented as a separate discipline in the AISHE classification, it is academically integrated within Science and Commerce. Therefore, growth in these disciplines indirectly reflects the development and expanding relevance of Statistics education. By examining enrolment trends and discipline-wise patterns, the study aims to understand the broader transformation taking place in research-oriented higher education and its implications for Statistics education under NEP–2020.

Objectives of the Study

1. To study the transformation of Statistics education under NEP–2020 with special reference to research orientation.
2. To analyze the year-wise trend in Ph.D. enrolment in Statistics and related disciplines, with special reference to identifying the year of highest growth.
3. To compare Ph.D. enrolment patterns in Statistics across Science, Commerce and Engineering & Technology disciplines.
4. To examine the emerging research opportunities in interdisciplinary areas where Statistics plays a core role.
5. To identify academic and structural challenges in strengthening research-based Statistics education.

Review of Literature

1. Ministry of Education (2020) The National Education Policy 2020 introduced major reforms in Indian higher education. The policy emphasizes multidisciplinary learning, research orientation, flexibility in curriculum and academic credit systems. It highlights the importance of strengthening research culture in universities. These reforms are significant for Statistics education because statistical knowledge supports research activities across various disciplines.
2. University Grants Commission (2022) UGC revised its Ph.D. regulations and research guidelines after the implementation of NEP–2020. The focus was placed on improving research quality, mandatory research methodology training and structured doctoral programmes. These changes aim to make higher education more research-driven, which directly influences the development of Statistics as a core analytical discipline.
3. All India Survey on Higher Education (2021–22 Report) AISHE provides official data on student enrolment across Indian higher education institutions. The 2021–22 report indicates an increase in Ph.D. enrolment in major disciplines. Engineering and Technology show comparatively higher doctoral enrolment than Science and Commerce streams. This trend reflects growing research interest in applied and technical fields where statistical tools are widely used.
4. All India Survey on Higher Education (2020–21 Report) The AISHE 2020–21 data highlight steady growth in higher education participation even during transitional academic periods. The data show gradual expansion of doctoral programmes across institutions. Such growth indicates increasing research opportunities, which require strong statistical knowledge and analytical skills.

Research Gap

Although policy documents and AISHE reports provide useful information about enrolment and reforms, limited studies specifically examine the research-oriented transformation of Statistics education using recent Ph.D. trend data. Therefore, a focused statistical analysis of enrolment patterns is necessary to understand opportunities and emerging challenges under NEP–2020.

Research Methodology

1. Research Design

The present study is descriptive and analytical in nature. It focuses on examining the research-oriented transformation of Statistics education under NEP–2020. The study mainly analyzes Ph.D. enrolment trends and discipline-wise variations to understand emerging opportunities and challenges.

2. Data Source

The study is based on secondary data collected from official reports of the All India Survey on Higher Education (AISHE). AISHE provides reliable and authentic data on higher education enrolment across India. Year-wise Ph.D. enrolment data from recent AISHE reports have been used for analysis.

3. Scope of the Study

The study is limited to:

- Ph.D. enrolment trends in recent academic years
- Discipline-wise comparison among Science, Commerce, and Engineering & Technology
- Analysis related to research orientation under NEP–2020

Postgraduate data is not included in this analysis. The focus is mainly on doctoral-level research trends.

4. Tools and Techniques Used

The following statistical tools are used for analysis:

- Trend analysis (Year-wise Ph.D. enrolment)
- Bar diagram for discipline-wise comparison

The trend diagram is used to identify the year with the highest enrolment growth, while the bar diagram helps in comparing doctoral enrolment across different disciplines.

5. Data Analysis Procedure

The collected AISHE data were organized year-wise and discipline-wise. The data were tabulated and graphical representation was prepared using diagrams. The trend diagram shows the increasing pattern in Ph.D. enrolment, particularly highlighting the peak year.

The bar diagram presents comparative doctoral enrolment across Science, Commerce and Engineering & Technology disciplines.

6. Limitations of the Study

- The study is based only on secondary data.
- The analysis is limited to selected disciplines.
- Institutional-level variations are not included.

Results

The analysis of Ph.D. enrolment data provides a clear understanding of research growth in higher education. The data were examined through year-wise trend analysis and discipline-wise comparison. The graphical presentation helps in identifying major changes in doctoral enrolment patterns.

1. Trend Diagram: Year-wise Ph.D. Enrolment

The trend diagram shows a continuous increase in Ph.D. enrolment over the selected academic years. The growth pattern appears stable and progressive without any major decline. The year 2021–22 records the highest Ph.D. enrolment during the study period. This indicates an overall expansion of doctoral programmes and increasing participation in research-level education.

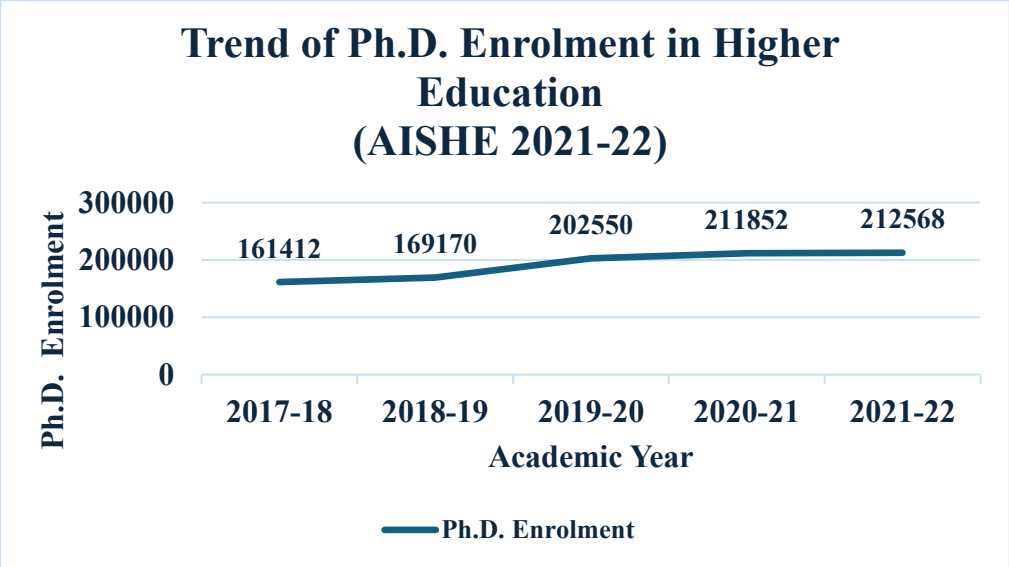
Table 1: Year Wise Ph.D. Enrolment in Higher Education

Academic Year	Ph.D. Enrolment
2017-18	161412
2018-19	169170
2019-20	202550
2020-21	211852
2021-22	212568

Source: AISHE Report (2021-22)

The above table presents the year-wise Ph.D. enrolment in higher education. The data show a gradual change in doctoral enrolment over the selected academic years. To understand the pattern of growth more clearly, a trend diagram is prepared based on the above data.

Figure 1: Trend of Year- wise Ph.D. Enrolment in Higher Education



Overall Observation:

The trend diagram shows a steady increase in Ph.D. enrolment. The year 2021–22 records the highest enrolment during the study period, indicating expansion of doctoral research activities.

2. Bar Diagram: Discipline-wise Ph.D. Enrolment

The discipline-wise analysis of Ph.D. enrolment helps in understanding the distribution of doctoral research across major academic fields. This comparison provides insight into which disciplines show higher research participation. The following table presents Ph.D. enrolment across selected disciplines.

Table 2: Discipline-wise Ph.D. Enrolment

Disciplines	Ph.D. Enrolment
Science	45324
Engineering & Technology	52748
Social Science	26057
Commerce	7112
Education	6669
Management	12577

Source: AISHE Report (2021-22)

The above table shows the discipline-wise Ph.D. enrolment in higher education. The data indicate differences in doctoral participation across various academic fields. To understand the comparative position of each discipline more clearly, a bar diagram is presented below.

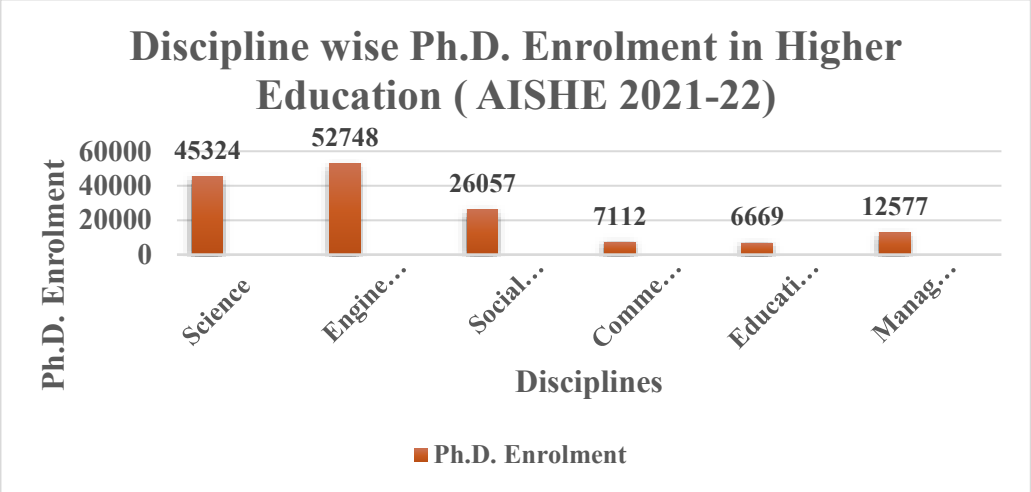


Figure 2: Discipline-wise Ph.D. Enrolment

The above bar diagram shows the discipline-wise distribution of Ph.D. enrolment. It is observed that Engineering and Technology records the highest Ph.D. enrolment among all disciplines. It is followed by Science, while Social Sciences occupy the next position. Management shows moderate doctoral participation, followed by Commerce. The discipline of Education has the lowest Ph.D. enrolment among the selected fields.

Overall Observation:

The data indicate that doctoral research enrolment is more concentrated in technical and scientific disciplines compared to other academic areas.

Discussion

The results of the study indicate a steady growth in Ph.D. enrolment over the selected academic years. The highest enrolment recorded in 2021–22 reflects increasing interest in research-level education. This growth may be associated with the strengthening of research orientation in higher education institutions after the implementation of NEP–2020 reforms. The policy emphasis on multidisciplinary learning and academic flexibility may have encouraged more students to pursue doctoral studies.

The discipline-wise comparison shows that Engineering and Technology record the highest Ph.D. enrolment. This trend suggests that research activities are more concentrated in technical and applied fields. Rapid development in areas such as technology, innovation, data science and industrial research may have increased the demand for doctoral-level expertise in these disciplines. Science also shows strong participation in Ph.D. enrolment, indicating sustained research interest in core scientific fields. Social Sciences demonstrate steady growth, reflecting increasing research in areas related to society, economy, governance and public policy.

On the other hand, Management and Commerce show comparatively moderate enrolment levels. While these fields contribute to professional education, doctoral research participation appears lower compared to technical disciplines. Education records the lowest enrolment, which may indicate limited research capacity or lower demand for doctoral studies in this field. The findings highlight the growing importance of analytical and research-based disciplines in higher education. Since research in Engineering, Science and Social Sciences depends heavily on data analysis and quantitative methods, the role of Statistics becomes increasingly significant. Statistics supports research design, data interpretation, modelling and evidence-based decision-making across disciplines.

The observed trend also presents important opportunities. Increased doctoral enrolment suggests expansion of research infrastructure and academic capacity. Interdisciplinary collaboration may further strengthen the integration of Statistics in various research domains. However, the expansion of research programmes also brings challenges. Institutions must ensure availability of qualified faculty, adequate research funding, modern software tools and proper research training. Without strong

academic support systems, growth in enrolment may not fully translate into high-quality research output.

Overall, the discussion indicates that higher education in India is gradually moving towards a research-oriented framework. The rising doctoral enrolment and dominance of technical disciplines reflect structural changes aligned with policy reforms. Strengthening Statistics education will play a crucial role in sustaining this research-driven transformation.

Conclusion

The present study examined the research-oriented transformation of Statistics education under NEP–2020 using Ph.D. enrolment data. The analysis of year-wise trends shows a steady increase in doctoral enrolment, with 2021–22 recording the highest participation. This indicates growing interest in research-level education and strengthening of doctoral programmes in higher education institutions. The discipline-wise comparison reveals that Engineering and Technology have the highest Ph.D. enrolment, followed by Science and Social Sciences. Management and Commerce show moderate participation, while Education records the lowest enrolment. These findings suggest that research growth is more concentrated in technical and scientific fields.

The increasing doctoral enrolment reflects the shift towards a research-driven academic framework. As research activities expand across disciplines, the importance of Statistics becomes more significant. Statistical knowledge supports data analysis, modelling, interpretation and evidence-based decision-making in various research domains. The study highlights both opportunities and challenges. On one hand, growing enrolment indicates expanding research capacity and interdisciplinary collaboration. On the other hand, institutions must ensure quality research training, adequate infrastructure and availability of skilled faculty to sustain long-term academic development. Overall, the transformation of higher education under NEP–2020 shows positive movement towards strengthening research culture. Strengthening Statistics education will play a vital role in supporting this transformation and enhancing research quality in India.

References

1. All India Survey on Higher Education. (2021). *All India Survey on Higher Education 2020–21: Final report*. Ministry of Education, Government of India.
2. All India Survey on Higher Education. (2022). *All India Survey on Higher Education 2021– 22: Final report*. Ministry of Education, Government of India.
3. Ministry of Education. (2020). *National Education Policy 2020.* Government of India.
4. University Grants Commission. (2022). *University Grants Commission (Minimum Standards and Procedure for Award of Ph.D. Degree) Regulations, 2022*. Government of India.

Fragmented Realities: Memory, Violence and the State in Arundhati Roy's Narrative Aesthetic

Dr. Rahul S. Sudke
Dr. Gopalrao Khedkar Mv,
Gadegaon, Telhara Dist. Akola MS

Abstract

This paper explores the narrative strategies of Arundhati Roy through the lens of fragmented realities, focusing on how memory, violence, and the state intersect in her fiction. Centering primarily on *The God of Small Things* and *The Ministry of Utmost Happiness*, it investigates Roy's aesthetic of disruption—of narrative, time, and space—as a deliberate mode of political engagement. Roy's treatment of memory is non-linear and fractured, mirroring the traumas her characters endure. Violence—intimate, communal, and institutional—forms a persistent backdrop, reflecting the pervasive presence of the state. Roy's texts resist narrative closure and challenge hegemonic discourses through an affective poetics that embodies the lived experience of India's social margins. By employing a hybrid form that blends fiction, history, reportage, and testimony, Roy offers a radical literary form that speaks from and to the margins. This study situates her work within postcolonial and feminist frameworks while highlighting her unique contribution to the literary-political landscape of contemporary India.

Keywords: Arundhati Roy, Memory, Violence, State, Fragmentation, Postcolonial Literature, Narrative Aesthetic, Resistance, Trauma

Introduction

Arundhati Roy's literary world is a terrain of dislocation, rupture, and multiplicity. Her fiction traverses the fault lines of history and geography, unearthing submerged narratives of caste, gender, religion, and political violence. In *The God of Small Things* (1997) and *The Ministry of Utmost Happiness* (2017), Roy constructs a narrative aesthetic grounded in fragmentation, where memory and trauma resist linearity and where the state functions as both a backdrop and a principal agent of violence. Her narrative style is not merely experimental but deeply political—a form of storytelling that dismantles dominant discourses and foregrounds the lived experiences of the marginalized.

This paper argues that Roy's narrative form—discontinuous, polyphonic, and temporally fractured—mirrors the psychological and political fragmentation that defines her characters' realities. Memory, violence, and the state are central motifs that coalesce to form a distinctive narrative aesthetic that resists closure and insists on witnessing.

Memory as Narrative Disruption

In Roy's work, memory is not a passive act of recollection but a volatile force that disrupts linear narrative logic. *The God of Small Things* begins in the aftermath of tragedy and unfolds retrospectively, through the fragmented memories of Rahel and Estha. Their return to Ayemenem does not bring closure but a reactivation of trauma. Roy deliberately employs a cyclical, non-linear structure, reflecting the recursive nature of trauma, where past and present collapse into one another. Memory in Roy's fiction is both personal and collective. It becomes a repository of suppressed histories—the histories of caste oppression, colonial violence, and familial betrayal. The narrative jumps back and forth across decades, from the death of Sophie Mol to Velutha's brutal beating, revealing how memory haunts the present. Roy subverts the chronological progression of the novel to suggest that memory itself is a fragmented archive, continually under siege by official versions of history.

Similarly, in *The Ministry of Utmost Happiness*, memory is a mechanism through which Roy reconstructs the invisible histories of India's underclasses. Anjum's life, marked by gender nonconformity and communal violence, is narrated through a mosaic of recollections, letters, diary entries, and interwoven stories. The narrative refuses a single point of view, instead presenting

memory as polyphonic—an ensemble of incomplete testimonies that challenge state-sanctioned history.

Violence as Structure and Theme

Violence pervades Roy's novels—not merely as content, but as a structural principle. The very architecture of her texts is built around ruptures caused by violence: caste-based atrocities, police brutality, state repression, religious conflict, and familial abuse. In *The God of Small Things*, Velutha's murder is the epicenter around which the narrative revolves. The state machinery, in collusion with patriarchal and casteist norms, exacts violence not only on bodies but on futures and affections deemed transgressive.

Roy's treatment of violence is neither gratuitous nor abstract. It is grounded in the affective and physical realities of her characters. Ammu's disenfranchisement, Estha's molestation, Baby Kochamma's bitterness—all point to the ways in which violence operates through institutions and ideologies that discipline the individual. The novel exposes how violence is normalized and internalized, especially by those who enforce or benefit from the status quo.

In *The Ministry of Utmost Happiness*, violence assumes a more explicitly political dimension. The novel opens with Anjum's story, whose intersex identity is not only marginalized but violently policed by social norms and religious purism. The 2002 Gujarat riots serve as a pivotal moment in the novel, highlighting the complicity of the state in communal violence. Later chapters delve into the insurgency in Kashmir, the forced disappearances, and the military occupation—all of which foreground the structural violence of the nation-state. Roy does not offer simplistic binaries but presents violence as systemic, encoded into law, surveillance, and bureaucratic language.

The State as Specter and Structure

The Indian state, in Roy's novels, is a spectral presence—always lurking, intervening, and regulating lives. But more significantly, it is a character in itself: punitive, selective, and opaque. Whether through the corrupt policemen of Ayemenem or the secret intelligence agents of Kashmir, the state appears not as a neutral arbiter of justice but as a primary agent of violence.

In *The God of Small Things*, the state colludes with social orthodoxy to punish transgressors like Ammu and Velutha. The police brutalize Velutha under the false pretense of justice, while Ammu is silenced and ostracized. Roy uses irony and satire to expose the absurdities and hypocrisies of legal and administrative systems, suggesting that justice is often the first casualty of caste and class interests.

In *The Ministry of Utmost Happiness*, the state is even more insidious. Roy draws upon real events—the Delhi anti-corruption protests, Kashmir's armed rebellion, the displacement of tribal communities—to construct a palimpsest of suppressed truths. The bureaucratic language of reports, censored files, and missing persons is juxtaposed with intimate, first-person accounts that reveal the emotional and physical costs of state violence.

Roy's portrayal of the state is not limited to external oppression; it also implicates the reader and the middle-class citizenry that benefits from silence and complicity. The narrative oscillates between satire and sorrow, demonstrating how deeply the state penetrates everyday life, defining who can be mourned, who can love, and who must disappear.

Narrative Form as Political Act

Roy's choice of narrative form is itself a political gesture. Her works defy genre boundaries, combining fiction with reportage, poetry with polemic, myth with history. This hybridity destabilizes the reader's expectations and reflects the fractured subjectivities of her characters.

Her prose style—lyrical, elliptical, often incantatory—mimics the rhythms of oral storytelling and collective memory. In *The God of Small Things*, the linguistic play (capitalizations, invented words, looping phrases) creates a child's-eye view of trauma that resists adult rationalization. In *The Ministry of Utmost Happiness*, Roy expands her canvas to include multiple narrative threads, digressions, documents, and marginal voices. The result is a novel that refuses neat resolutions, mirroring the chaos and incompleteness of lived experience.

This aesthetic of fragmentation is not merely experimental; it enacts a form of resistance. By refusing to adhere to dominant narrative structures, Roy disrupts the authority of master-narratives—whether colonial, patriarchal, or statist. Her novels do not offer solutions but demand engagement, empathy, and a re-evaluation of the stories we accept as truth.

Conclusion

Arundhati Roy's narrative aesthetic is one of rupture and refusal—refusal to forget, to simplify, to normalize injustice. Through fragmented storytelling, Roy embodies the dissonance of memory, the omnipresence of violence, and the shadow of the state in the lives of those on the margins. Her fiction creates a literary space where resistance is not only thematic but formal, where language becomes a site of struggle and remembrance.

By foregrounding the fragmented realities of India's marginalized communities, Roy challenges the silences of official history and insists on an ethics of witnessing. Her novels are not just narratives but acts of political imagination, offering a literary form that dares to speak truth to power.

Works Cited

1. Roy, Arundhati. *The God of Small Things*. IndiaInk, 1997.
2. Roy, Arundhati. *The Ministry of Utmost Happiness*. Hamish Hamilton, 2017.
3. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?" *Marxism and the Interpretation of Culture*, edited by Cary Nelson and Lawrence Grossberg, University of Illinois Press, 1988.
4. Bhabha, Homi K. *The Location of Culture*. Routledge, 1994.
5. Mbembe, Achille. "Necropolitics." *Public Culture*, vol. 15, no. 1, 2003, pp. 11–40.
6. Das, Veena. *Life and Words: Violence and the Descent into the Ordinary*. University of California Press, 2007.
7. Roy, Arundhati. *Field Notes on Democracy: Listening to Grasshoppers*. Haymarket Books, 2009.

Artificial Intelligence Research for Classroom Integration of A Literature

Dr. Umesh Yashwantrao Gangurde
Assistant Professor
Krantiveer NavalBhau Arts College Navalnagar Tal.Dist.Dhule

Abstract:-

To move the field of artificial intelligence (AI) into educational settings forward, a comprehensive review of the literature will provide an understanding of the framework used to conduct research. This literature review reveals the theoretical foundation of past and current research which can then inform the development of future study. The review of the literature also identifies the types of methodologies used to gather data. This information allows future researchers in the field to build upon previous research to further our understanding of best practices in the integration and implementation of AI in the classroom.

Keywords: artificial intelligence, AI, entrepreneurial education, theory, methodology

Background

Since its inception in the mid-20th century, artificial intelligence (AI) has evolved as a pivotal subfield of computer science. It is primarily concerned with the creation of intelligent machines capable of learning, problem solving and making decisions that can potentially exceed human abilities (Surdiman & Rahmatillah, 2023). In fact, AI has progressed to the point where it not only processes vast data sets but also answers questions posed in natural language, akin to human interaction (Surdiman & Rahmatillah, 2023). However, the journey of AI, from a theoretical concept to its practical applications resulted in significant debates and milestones. After formal recognition in the academic field in the mid-1990s (Alqahtani, 2023), a debate began about the best uses of AI. This era marked a transition from theory to practice, setting the stage for its integration into fields such as education.

Introduction:-

This systematic literature review focuses on the current use cases of AI in entrepreneurship education and the connection to self-efficacy and/or critical thinking. By doing so, it aims to bridge the gap between theoretical potential and practical application and offer insights into how AI can transform traditional learning environments. This integration can allow students to become active learners and users of AI tools in their educational journey. The studies provide insight into how AL enhances critical thinking and self-efficacy for students by using AI within an educational context. While the integration of AI into educational settings shows immense promise, its application within the domain of education, particularly in entrepreneurship education is an emerging area that warrants deeper exploration and insight.

AI in Classrooms:-

Recognizing the potential of AI in reshaping educational practices requires a synthesis and evaluation of existing literature to better understand strategies for the application of AI in classrooms and the impacts of this technology upon students. This review aims to provide clarity on the current state of AI integration in such educational contexts and its implications for fostering Journal of Literacy and Technology Volume 26, Number 1: Winter 2025 ISSN: 1535-0975 43 self-efficacy and/or critical thinking. It delves into the nuances of AI applications in education, exploring the benefits and drawbacks, with a focus on entrepreneurship education. To maximize and effectively leverage AI in education, this study aims to investigate the strategic integration of artificial intelligence within entrepreneurship education to augment self-efficacy and critical thinking competencies, addressing a critical component of contemporary education. Methodology for Literature Search The literature review focuses on papers featuring studies which gathered data and

analyzed to yield results. The emphasis placed upon the study's relevance to AI integration in education and its

AI Integration in Education:-

It'scontributions to enhancing self-efficacy and/or critical thinking. The structure of this review is chronologically to underscore the evolution of AI applications in this context. It prioritizes studies offering actionable insights, while omitting those with no direct applicability or without any connection to educational settings to maintain the review's relevance and applicability. To conduct this comprehensive review, the researcher used educational databases including ERIC (EBSCO) and Google Scholar, as well as Search Wise, a meta-search database serviced by Florida Atlantic University. Accessing databases occurred between August 28th, 2023, and September 18th, 2023. The search terms included: ▪ Artificial intelligence OR AI, AI tools, using AI in the classroom, generative AI ▪ Critical thinking OR problem-solving, problem-based learning, reasoning.

The Underpinning of Social Cognitive Theory:-

In AI education emphasizes the role of self efficacy, suggesting that as students gain proficiency in AI tools and concepts, their belief in their capabilities to use them effectively in various contexts increases (Kong et al., 2021). The current landscape constructivists' principles are influential in the integration of AL. From the constructivists perspective students are seen not as passive recipients but as active participants in their learning journey. Constructivism should serve as the foundation for AI integration in entrepreneurship education, emphasizing those students can actively shape and co-construct their knowledge when utilizing AI tools (Lee et al., 2022 & Nazari et al., 2021). Furthermore, there is a growing acknowledgment of AI literacy as foundational to fostering this active learning environment. The significance of constructivist learning processes, such as inquiry-based learning, highlights the multifaceted ways AI can optimize educational outcomes. While the current literature highlights the transformative potential of AI in education through Constructivist and Social Cognitive lenses, there seems to be gaps in addressing the challenges educators and students might face in this shift. For instance, the role of the educator in AIenhanced classrooms warrants further research. Additionally, the implications of differing levels of access to technology and AI tools across various educational contexts and demographics is another consideration worth further study. Future researchers should delve deeper into understanding the challenges of AI integration, especially concerning the potential for digital divides The most prevalent strategy used to evaluate the effectiveness of AI use involved integrated methods to determine the influence of AI in entrepreneurship education throughout the selected articles.

Entrepreneurship in Education: -

AI-embedded tool can elevate educational outcomes, specifically boosting entrepreneurial intentions. This is why foundational classes in computer science are important. In these classes, students learn key digital literacy skills and tools they can use in the classroom. This synthesis of studies suggests that when students better understand how to use such tools, the integration of artificial intelligence into entrepreneurship education could prove to be instrumental. Journal of Literacy and Technology Volume 26, Number 1: Winter 2025 ISSN: 1535-0975 48 The majority of the analyzed studies leaned towards quantitative methods. Alqahtani (2023) utilized an experimental quantitative design, leveraging questionnaires tailored for the study to gather data from Qatari university students. These questionnaires offered valuable insights into students' attitudes and competencies in AI-enhanced learning environments. Zhu & Zhang (2022) also distributed electronic questionnaires to research their perspectives as they transitioned to employment and entrepreneurship.. These regional distinctions underscore the importance of considering cultural and educational differences when interpreting the findings, raising considerations about the generalizability of these studies to other global contexts. While these studies provide valuable insights into AI's application in education, their findings are deeply rooted in their specific regional contexts. This raises questions about the applicability of these results in different cultural or educational settings. While many studies highlight the significance of addressing diversity and technological bias, only a limited number genuinely

engage with populations diverse beyond gender distinctions. This suggests a need for broader inclusiveness in AI research, particularly involving varied linguistic and cultural backgrounds.

The Influence of Artificial Intelligence:-

The literature paints a vivid picture of the methodological preferences in studying the influence of artificial intelligence in entrepreneurship education. Such methods could be helpful to understanding individual experiences and challenges of AI integration. Furthermore, the lack of diversity in AI development and application highlights a pressing concern in the field. Despite the mention of gender disparities and biases in AI, many studies omitted gender from their demographics. The literature also falls short in addressing other aspects of diversity, with only two studies referencing populations beyond gender diversity. Future researchers should strive for a balanced mix of quantitative, qualitative, and mixed method studies. Embracing qualitative approaches could provide rich insights into user experiences, cultural contexts, and AI's holistic impact on education. It's paramount that future studies intentionally include and highlight gender, ethnic, cultural, and socio-economic diversity. Diverse perspectives could reveal biases and uncover richer findings about AI's role in education. Given the geographic trends noted, additional cross-cultural studies could offer intriguing insights into how AI in education manifests differently across regions

The Benefits of AI:-

These results can have profound implications on the future use and creation of AI tools for education. The benefits of AI suggest that the integration of such tools into curricula can lead to richer, more interactive learning experiences that not only foster critical thinking but also strengthen students' self-efficacy. Furthermore, with AI being integral to today's work environment, teaching students about its potential helps them be better prepared for the future and to enter the workforce. While many studies advocate for the positive role of AI in enhancing critical thinking and self-efficacy, there are outliers. Instead of solely focusing on the positives, future research should equally delve into potential challenges, such as ethical implications or inequalities in access, ensuring that the integration of AI is holistic and responsible. The current findings strongly advocate for the integration of AI tools in education to cultivate critical thinking and self-efficacy.

Conclusion:-

In conclusion, while the field shows promising strides in understanding AI's role in entrepreneurship education, there's a clear need for broader methodological diversity, deeper cultural introspection, and a renewed focus on inclusive representation. AI and Critical Thinking In exploring how AI enhances critical thinking, the literature review revealed a direct connection between critical thinking to students' opportunities to engage in reviews, reflections, as well as asking questions and receiving real-time feedback**.** AI, a better understanding about the meaning of that role with the technology continues to evolve. First, the sharing of personal stories from both students and teachers will assist in understanding how AI works in classrooms. This can help everyone from teachers to educational technology developers. Additionally, studies that incorporate broader range of participants, not just based on gender but also considering other demographics including geographical location and socio-economic status will enhance our understanding of how AI will support learning. In conclusion, although initial studies on AI in education have laid a foundational groundwork, it will be important for future researchers to broaden the scope to encompass diverse perspectives and prioritize the role of educators in AI-infused education.

References:-

1. **s**Alqahtani, M. (2023). Artificial intelligence and entrepreneurship education: A paradigm in Qatari higher education institutions after covid-19 pandemic. International Journal of Data and Network Science, 7, 695-706. doi: 10.5267/j.ijdns.2023.3.002
2. Bandura, A (1982). Self-efficacy mechanism in human agency. American Psychologist, 37, 122-147.
3. Elhajjar, S., Karam, S., & Borna, S. (2021). Artificial intelligence in marketing education 12. https://doi.org/10.1016/j.caeai.2021.100026

4. Lee, Y., Hwang, G., & Chen, P. (2022). Impacts of an AI-based chatbot on college students' after-class review, academic performance, self-efficacy, learning attitude, and motivation. Association for Educational Communications and Technology, 70, 1843– 1865. https://doi.org/10.1007/s11423-022-10142-8
5. Lesinskis, K., Mavlutova, I., Spilbergs, A., & Hermanis, J. (2023). Digital transformation in entrepreneurship education: The use of a digital tool KABADA and entrepreneurial intention of generation Z. Sustainability, 15, 10135, 1-20. https://doi.org/10.3390/su151310135 Journal of Literacy and Technology Volume 26, Number 1: Winter 2025 ISSN: 1535-0975 55
6. Zhu, Q., & Zhang, H. (2022). Teaching strategies and psychological effects of entrepreneurship education for college students majoring in social security law based on deep learning and artificial intelligence. Frontiers in Psychology, 13 (779669), 1-17. doi: 10.3389/fpsyg.2022.779669

Emerging Trends in Pure Mathematics: Contemporary Developments and Future Directions

Kuldeep Arun Waghmare
Research Scholar,
M. Sc. (Maths), (SET)
Dr. H. N. Sinha Arts & Commerce College, Patur.

Abstract

Pure mathematics, traditionally understood as the study of abstract structures without immediate concern for practical application, has experienced profound changes in recent decades. Advances in computational technology, increased collaboration across disciplines, and the introduction of innovative theoretical perspectives have significantly reshaped the nature of mathematical inquiry. This paper examines the key emerging directions within pure mathematics, with particular emphasis on developments in algebraic geometry, number theory, topology, category theory, mathematical logic, and higher-dimensional frameworks. It further explores the growing impact of theoretical computer science, quantum mathematics, and data-oriented methodologies on classical mathematical domains. Contemporary breakthroughs reveal that pure mathematics is not evolving in isolation but is deeply interconnected with fields such as physics, computing, and information theory. This study identifies major research trends, methodological progress, and ongoing challenges that are influencing the discipline's future trajectory. By integrating insights from recent scholarship and discoveries, the paper aims to provide a comprehensive overview of how pure mathematics continues to broaden its conceptual horizons while preserving its foundational rigor.

Keywords: Pure, mathematics, innovative, impact, quantum, insights, discoveries, computational, technology

1. Introduction

Pure mathematics forms the fundamental basis of mathematical exploration, concentrating on abstract notions such as numerical systems, structural relationships, spatial constructs, and logical frameworks. Historically, its development has been guided by the pursuit of internal coherence, intellectual beauty, and theoretical depth rather than direct utility. However, in the modern era, especially during the 21st century, the distinction between pure and applied mathematics has become increasingly indistinct.

Recent progress demonstrates that established domains—including algebra, topology, and number theory—continue to advance while simultaneously interacting with emerging areas such as artificial intelligence and quantum computing. As a result, contemporary mathematical research reflects a dynamic synthesis of classical problems and modern methodologies. This paper seeks to analyze the evolving trends in pure mathematics by highlighting both theoretical progress and interdisciplinary engagement. Its objective is to present a detailed account of current developments and to outline potential future directions for the field.

2. Evolution of Pure Mathematics

2.1 Classical Foundations

The development of pure mathematics has historically relied on several core disciplines that have shaped its structure and intellectual framework. Algebra has played a pivotal role through its investigation of abstract systems such as groups, rings, and fields, providing a formal language for understanding operations and symmetries. Analysis, encompassing both real and complex perspectives, has offered rigorous tools for studying limits, continuity, differentiation, and integration, forming an essential component of mathematical reasoning. Geometry and topology have contributed to the study of spatial relationships, with geometry focusing on shapes and measurements, and topology examining properties that remain invariant under continuous transformations. Number theory has explored the intrinsic properties of integers and prime numbers, yielding deep theoretical insights that have influenced many areas of mathematics. At the same time, mathematical logic has

established the foundational principles governing formal reasoning, proof systems, and axiomatic structures. Collectively, these classical branches have ensured the precision, coherence, and depth that characterize pure mathematics.

2.2 Transition to Modern Mathematics

Over the past several decades, pure mathematics has undergone a significant shift marked by increased abstraction, broader generalization, and stronger connections with other scientific disciplines. Contemporary research frequently aims to integrate previously separate areas through unified frameworks such as category theory and higher-dimensional algebra, enabling a more comprehensive understanding of mathematical structures. Computational techniques have also become central to modern practice, allowing mathematicians to explore complex problems, test hypotheses, and visualize abstract entities with greater efficiency. Additionally, interdisciplinary collaboration has become a defining feature of current research, fostering the exchange of ideas between mathematics, physics, computer science, and data science. Despite these transformations, traditional areas such as algebraic geometry and number theory continue to retain their importance, illustrating that modern innovations are deeply rooted in classical foundations. This evolution represents an expansion of mathematical thought rather than a departure from its origins.

3. Major Emerging Trends in Pure Mathematics

3.1 Algebraic Geometry and Arithmetic Geometry

Algebraic geometry remains one of the most active and influential branches of pure mathematics, focusing on the study of polynomial equations and the geometric structures associated with them. Recent progress includes the analysis of moduli spaces, which categorize geometric objects according to equivalence relations, as well as the development of derived algebraic geometry, which incorporates advanced tools from homological algebra and category theory. The fusion of algebraic geometry with number theory has led to the emergence of arithmetic geometry, a field concerned with solutions defined over integers and rational numbers. These advancements have not only addressed longstanding mathematical challenges but have also established strong links with theoretical physics, particularly in string theory, where geometric concepts are essential for modeling physical phenomena.

3.2 Advances in Number Theory

Number theory has seen significant advancement, driven by both classical inquiries and innovative approaches. Research into the distribution and behavior of prime numbers continues to be a major focus, with new analytical techniques providing deeper insights into unresolved problems. The study of L-functions and modular forms has strengthened connections between number theory, geometry, and representation theory. Furthermore, arithmetic dynamics has emerged as a rapidly developing area, examining the interaction between dynamical systems and number-theoretic properties. These developments not only enhance theoretical understanding but also have practical implications, particularly in cryptography, where number-theoretic principles underpin modern encryption methods. This dual role highlights the evolving nature of number theory in contemporary mathematics.

3.3 Topology and Geometric Analysis

Topology has expanded considerably, encompassing a wide range of specialized areas. Low-dimensional topology focuses on spaces of smaller dimensions and reveals complex structural relationships that are significant in both mathematics and physics. Knot theory investigates the properties of intertwined loops and has applications extending to biology and quantum computing. Geometric group theory examines how algebraic properties of groups relate to the geometry of spaces on which they act. In parallel, geometric analysis integrates differential geometry with partial differential equations to study curvature, manifolds, and geometric flows. These combined efforts contribute to a richer understanding of spatial structures and their theoretical implications.

3.4 Category Theory and Higher Structures

Category theory has developed into a unifying framework that connects diverse areas of mathematics. By emphasizing relationships and transformations rather than individual objects, it provides a higher level of abstraction for analyzing mathematical concepts. Advances in higher category theory and homotopy type theory have extended this approach, enabling the study of complex interrelated systems. Derived categories, widely used in algebraic geometry, offer powerful tools for examining intricate structures. These developments facilitate the integration of different mathematical disciplines and reveal deep underlying connections.

3.5 Mathematical Logic and Foundations

Mathematical logic continues to play a crucial role in understanding the theoretical limits and foundations of mathematics. Model theory investigates the interaction between formal languages and their interpretations, while set theory explores the nature of mathematical universes and infinite structures, including large cardinal concepts. Proof theory analyzes the structure and complexity of proofs, offering insights into the process of mathematical reasoning. These areas build upon foundational results such as Gödel's incompleteness theorems, which demonstrated inherent limitations in formal systems. Contemporary research in logic not only advances philosophical understanding but also contributes to practical applications in computing, particularly in automated reasoning and formal verification.

3.6 Combinatorics and Discrete Mathematics

Combinatorics has become a central field within pure mathematics, focusing on discrete structures and their arrangements. It includes graph theory, which studies networks and connections, as well as probabilistic techniques that incorporate randomness into combinatorial analysis. Additive combinatorics explores numerical structures and has led to important breakthroughs linking it with number theory. The relevance of combinatorics extends beyond mathematics, influencing areas such as computer science, optimization, and information theory. Its versatility and accessibility have contributed to its rapid growth.

3.7 Interplay with Theoretical Computer Science

The relationship between pure mathematics and theoretical computer science has intensified, leading to significant cross-disciplinary advancements. Complexity theory examines the efficiency of algorithms and computational problems, drawing heavily from logic and combinatorics. Cryptography depends on algebraic and number-theoretic principles to ensure secure communication. Algorithmic number theory represents a synthesis of abstract mathematical ideas and computational techniques. This interaction has generated new insights and technological developments, underscoring the importance of pure mathematics in the modern digital world.

3.8 Quantum Mathematics

Quantum mathematics has emerged as a new frontier, combining elements of pure mathematics with quantum physics. It incorporates theories from functional analysis, operator algebras, and quantum groups to describe the mathematical foundations of quantum systems. The rise of quantum computing has further accelerated research in this area, as new mathematical tools are required to understand quantum information processes. This field illustrates the deep connections between abstract mathematics and the fundamental principles of nature.

3.9 Data-Driven and Computational Approaches

While pure mathematics has traditionally emphasized theoretical reasoning, modern trends reveal an increasing role for computational and data-driven methods. Computational experiments allow researchers to explore complex systems, identify patterns, and test hypotheses. Machine-assisted proofs enhance accuracy and enable the verification of intricate arguments. Data-based approaches also contribute to the formulation of new conjectures. These innovations complement traditional analytical methods and expand the scope of mathematical research.

4. Challenges in Contemporary Pure Mathematics

Despite its progress, pure mathematics faces challenges such as increasing theoretical complexity, limited accessibility for non-specialists, and the need for interdisciplinary expertise. Addressing these issues is essential for sustaining the discipline's growth and relevance.

5. Future Directions

Future developments in pure mathematics are likely to focus on unifying diverse theories, expanding quantum mathematical frameworks, integrating artificial intelligence into research, and solving major open problems such as the Riemann Hypothesis, the Birch and Swinnerton-Dyer Conjecture, and the P versus NP problem.

6. Conclusion

Pure mathematics is undergoing a profound transformation characterized by both continuity and innovation. While classical disciplines such as algebra, topology, and number theory remain central, new trends are emerging that reshape the field's structure and direction. The integration of computational tools, interdisciplinary collaboration, and novel theoretical frameworks has expanded the scope of mathematical research.

Emerging areas such as category theory, quantum mathematics, and computational methods highlight the evolving nature of pure mathematics. These developments not only deepen our understanding of abstract structures but also create new connections with other scientific disciplines. The future of pure mathematics lies in its ability to balance abstraction with applicability, rigor with innovation, and tradition with transformation. As the discipline continues to evolve, it will remain a fundamental pillar of human knowledge, driving both theoretical insights and practical advancements.

Works Cited:

1. Atiyah, M. (2001). *Mathematics in the 20th Century*. Bulletin of the London Mathematical Society.
2. Deligne, P. (1994). *Algebraic Geometry and Number Theory*. Springer.
3. Tao, T. (2016). *Analysis and Partial Differential Equations*. American Mathematical Society.
4. Grothendieck, A. (1984). *Sketch of a Programme*.
5. Mac Lane, S. (1998). *Categories for the Working Mathematician*. Springer.
6. Wiles, A. (1995). *Modular Elliptic Curves and Fermat's Last Theorem*.
7. Gowers, T. (2008). *The Princeton Companion to Mathematics*.
8. Mumford, D. (2002). *The Red Book of Varieties and Schemes*.
9. Lang, S. (2002). *Algebra*. Springer.
10. Connes, A. (1994). *Noncommutative Geometry*.

Synthesis and Elemental Characterization of Benzil Derivative Compounds Derived from Substituted Benzaldehyde

Aditya D. Joshi[1*], Gopal S. Bharambe[2] and Dr. Sanjay V. Kolhe[3]
P.G. Department of Chemistry[1,3]
Shri Shivaji Arts, Commerce & Science College, Akot Dist. Akola, (Maharashtra) *444101*

Abstract:
Benzoin and benzil both are the privileged pharmacophores with significance importance in medicinal chemistry. Benzoin derivatives were synthesized by condensation reaction of substituted aromatic benzaldehyde derivatives with thiamine hydrochloride (vitamin B1), obtained benzoin compounds were allowed to oxidize with the help of oxidizing agents, to yield substituted benzil. These final compounds were purified and characterized by elemental analysis. The study aims to explore substituted benzil derivatives as potential scaffolds for future drug discovery.
Key words*:* Pharmacophores, aromatic benzaldehyde, Oxidizing agents, elemental analysis.

1. INTRODUCTION

Benzoin and benzil structures are well recognized in the realm of heterocyclic and pharmaceutical chemistry due to their pharmacological relevance [1]. Benzil derivatives, characterized by the 1,2-diketone moiety, are key intermediates in the synthesis of bioactive heterocyclic compounds such as imidazoles, oxazoles, and quinoxalines [2]. Substituted benzil derivatives have been reported to exhibit a broad range of biological activities such as antibacterial, antifungal, anticancer, and anti-inflammatory properties [3]. The synthesis of such compounds from simple and readily available aldehydes, especially benzaldehyde derivatives, offers an efficient pathway for constructing pharmacologically potent molecules [4]. In this study, substituted benzaldehydes were used to synthesize benzoin derivatives via a thiamine hydrochloride-catalyzed condensation [5]. The benzoin products were subsequently oxidized using nitric acid to obtain benzil derivatives [6]. These compoundswere purified and characterized via elemental analysis, a fundamental step to ensure molecular composition and purity [7-8]. Benzoin was first reported in 1832 by Justus von Liebig and Friedrich Woehler during their research on oil of bitter almond, which is benzaldehyde with traces of hydrocyanic acid [9]. The catalytic synthesis by the benzoin condensation was improved by Nikolay Zinin during his time with Liebig [10-11]. The main uses of benzoin are as a precursor to benzil, which is a photo initiator [12]. The conversion proceeds by organic oxidation using copper (II), [13] nitric acid, or oxone. In one study, this reaction is carried out with atmospheric oxygen and basic alumina in dichloromethane. [14] Its main use is as a photo initiator in polymer chemistry [15]. The compound's most noteworthy structural feature is the long carbon-carbon bond of 1.54 Å, which indicates the absence of pi-bonding between the two carbonyl centres. The PhCO centres are planar, but the pair of benzoyl groups are twisted with respect to the other with a dihedral angle of 117° [16]. In less hindered analogues (glyoxal, bi-acetyl, oxalic acid derivatives), the $(RCO)_2$ group adopts a planar, anti-conformation. Most benzil can be used as a photo initiator in the free-radical curing of polymer networks. It absorbs ultraviolet radiation at a wavelength of 260 nm, leading to decomposition with formation of free-radical species and formation of cross-links within the material. However, it is a relatively poor photo initiator, and is seldom used. It undergoes photo-bleaching, which allows the curing light to reach deeper layers of the material on longer exposure [17].

2. EXPERIMENTAL

2.1 CHEMICALS & REAGENTS

- Substituted benzaldehydes (e.g., benzaldehyde, 4-nitrobenzaldehyde, 4-chlorobenzaldehyde, 4-methylbenzaldehyde).
- Thiamine hydrochloride (Vitamin B1).
- Ethanol (AR grade).

- Sodium hydroxide
- Concentrated nitric acid
- Distilled water

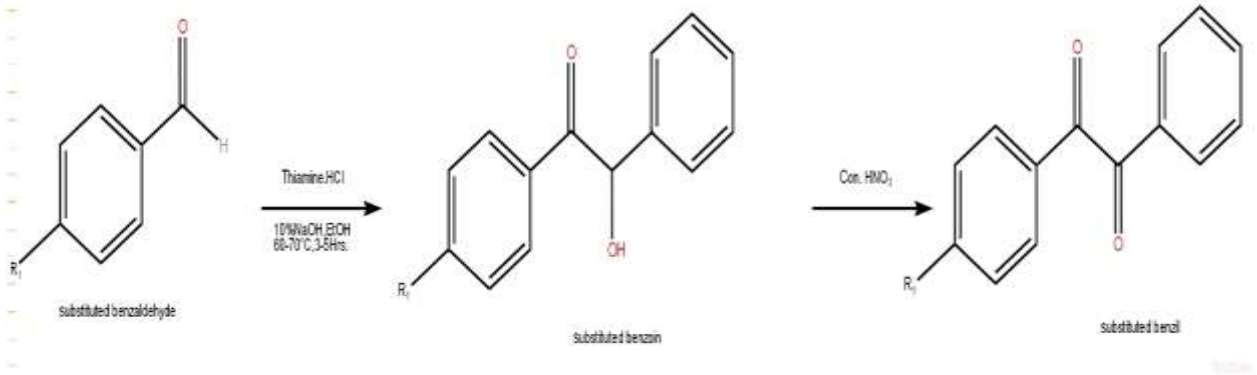
General Procedure For Synthesis Of Benzoin Derivatives

To a 250 mL round-bottom flask, 10 mmol of substituted benzaldehyde was dissolved in 30 mL of ethanol. To this, 0.5 g of thiamine hydrochloride and 10 mL of 10% NaOH solution were added. The mixture was stirred and heated gently at 60–70°C for 3–5 hours. The progress of the reaction was monitored using thin-layer chromatography (TLC). Upon completion, the reaction mixture was acidified with dilute HCl and cooled in an ice bath to precipitate the benzoin product. The solid was filtered, washed with cold water, dried, and recrystallized using ethanol.

Oxidation To Benzil Derivatives

The purified benzoin (5 mmol) was dissolved in 15 mL of concentrated nitric acid and heated at 80–90°C for 2–3 hours. The reaction progress was again monitored by TLC. After completion, the mixture was poured onto crushed ice, and the resulting benzil product was filtered, washed thoroughly with water, and recrystallized from ethanol.

Elemental Analysis



Elemental (C, H, N) analysis of all synthesized benzil derivatives was carried out using an Elementar Vario MICRO cube instrument. The results were compared with theoretical values calculated from molecular formulas to confirm the composition.

3. RESULTS AND DISCUSSION

Table 1 *Yield and Physical Appearance*

Compound	Substituent	Yield (%)	Colour	M.P. (°C)
Benzil-A	—	80%	Light Yellow	94-96
Benzil-B	4-NO_2	78%	Yellow	122–124
Benzil-C	4-Cl	70%	Pale Yellow	116–118
Benzil-D	4-CH_3	82%	Light Yellow	110–112

Table 2 *Elemental Analysis*

Compound	Formula	%C / %H (Calculated/Found)	%N (Calculated/Found)
Benzil-A	$C_{14}H_{10}O_2$	79.99 / 79.01 | 4.78 / 4.01	—
Benzil-B	$C_{14}H_9NO_4$	66.41 / 66.12 | 3.58 / 3.52	5.53 / 5.49
Benzil-C	$C_{14}H_9ClO_2$	67.69 / 67.30 | 3.65 / 3.60	—
Benzil-D	$C_{15}H_{13}O_2$	70.31 / 70.10 | 4.72 / 4.66	—

CONCLUSIONS

In this study, a simple and efficient method for the synthesis of substituted benzil derivatives was developed using thiamine hydrochloride-mediated condensation of benzaldehydes followed by nitric acid oxidation. The synthesized benzil derivatives were characterized via elemental analysis and showed high purity. These compounds serve as promising scaffolds for further exploration in

heterocyclic and medicinal chemistry. Benzil is a yellow crystalline solid that is commonly used as a reagent in organic chemistry. It can be synthesized through the oxidation of benzoin with oxidizing agents like nitric acid or chromic acid. Benzil is an important precursor for the synthesis of various organic compounds like pharmaceuticals, dyes, and perfumes. In addition to its synthetic applications, benzil also has some interesting physical properties. It has a relatively high melting point of 94-96°C, and it is soluble in hot ethanol and acetone but relatively insoluble in water. Benzil also exhibits interesting fluorescence properties under ultraviolet light. Overall, benzil is an important compound in organic chemistry due to its versatility as a reagent and its useful physical properties. Benzil is a compound with a wide range of applications in chemistry, particularly in the field of organic synthesis. It is a yellow crystalline solid that is commonly used as a starting material for the preparation of various organic compounds. Benzil can be easily synthesized by the oxidation of benzoin using a mild oxidizing agent such as nitric acid or potassium permanganate. In addition to its use as a precursor for organic synthesis, benzil has also been shown to exhibit a range of biological activities, including anti-microbial, anti-tumor, and anti-inflammatory properties. These properties make benzil a potentially useful compound for the development of new drugs and therapies. Overall, benzil is an important compound in the field of chemistry with a wide range of applications and potential uses in various fields.

REFERENCES

1. Sahu, S. N., & Banerjee, M. (2012). Synthesis and antimicrobial screening of benzil derivatives. European Journal of Medicinal Chemistry, 58, 164–170.
2. Pandey, R. K., & Singh, P. (2014). Benzil-based compounds as potent bioactive agents: A review. Journal of Saudi Chemical Society, 18(6), 712–722.
3. Kapoor, N., & Jain, R. (2010). Nitric acid-mediated oxidation of benzoin: A facile route to benzil analogs. Tetrahedron Letters, 51(25), 3290–3293.
4. Patel, M. N., & Gandhi, D. S. (2012). Synthesis, spectral, and antimicrobial studies of metal complexes with benzaldehyde-derived ligands. *Journal of Coordination Chemistry*, 65(23), 4287–4297.
5. McMurry, J. E. (2011). *Organic Chemistry* (8th ed.). Brooks/Cole, Cengage Learning.
6. Kai-Bing Wang, Rui-Qiao Ran, Shi-Dong Xiu, and Chuan-Ying Li. Synthesis of 3-Aza-bicyclo [3.1.0] hexan-2-one Derivatives via Gold-Catalyzed Oxidative Cyclopropanation of Allylynamides. Organic Letters 2013, 15 (10), 2374-2377. https://doi.org/10.1021/ol4007629
7. Xianghua Wang, Zhili Yao, Shuli Dong, Fang Wei, Hong Wang and Zhenghu Xu. Synthesis of Fused Bicyclic Aminals through Sequential Gold/Lewis Acid Catalysis. Organic Letters 2013, 15 (9), 2234-2237. https://doi.org/10.1021/ol400803f
8. Keiichiro Kanao, Yousuke Ikeda, Kazuhiro Kimura, Sou Kamimura, Yoshiaki Tanabe, Yuichiro Mutoh, Masakazu Iwasaki and Youichi Ishii. Transformations of Alkynes at a Cyclotriphosphato Ruthenium Complex. Organometallics 2013, 32 (2), 527- 537. https://doi.org/10.1021/om3009926
9. Sabyasachi Bhunia, Chin-Jung Chang, and Rai-Shung Liu. Platinum-Catalyzed Oxoarylations of Ynamides with Nitrones. Organic Letters 2012, 14 (21), 5522-5525. https://doi.org/10.1021/ol302621z
10. Mei Xu, Tian-Tian Ren, and Chuan-Ying Li. Gold-Catalyzed Oxidative Rearrangement of Homopropargylic Ether via Oxonium Ylide. Organic Letters 2012, 14 (18), 4902-4905. https://doi.org/10.1021/ol302238t
11. A. Stephen K. Hashmi, Tao Wang, Shuai Shi, and Matthias Rudolph. Regioselectivity Switch: Gold (I) Catalyzed Oxidative Rearrangement of Propargyl Alcohols to 1,3-Diketones. The Journal of Organic Chemistry 2012, 77 (17), 7761-7767. https://doi.org/10.1021/jo301381z
12. Nozomi Saito, Taisuke Ichimaru, and Yoshihiro Sato. Total Synthesis of (−)-Herbindoles A, B, and C via Transition-Metal-Catalyzed Intramolecular [2 + 2 + 2] Cyclization between Ynamide and Diynes. Organic Letters 2012, 14 (7), 1914-1917. https://doi.org/10.1021/ol300571b
13. Anouar Laouiti, Mohamed M. Rammah, Mohamed B. Rammah, Jérome Marrot, François Couty, and Gwilherm Evano. Copper-Catalyzed Oxidative Alkynylation of Diaryl Imines with Terminal Alkynes: A Facile Synthesis of Ynimines. Organic Letters 2012, 14 (1), 6-9. https://doi.org/10.1021/ol2032152
14. Dan Chen, Guoyong Song, Aiqun Jia, and Xingwei Li. Gold- and Iodine-Mediated Internal Oxygen Transfer of Nitrone- and Sulfoxide-Functionalized Alkynes. The Journal of Organic Chemistry 2011, 76 (20), 8488-8494. https://doi.org/10.1021/jo201347r
15. Anupam Mukherjee, Ramesh B. Dateer, Rupsha Chaudhuri, Sabyasachi Bhunia, Somnath Narayan Karad, and Rai-Shung Liu. Gold-Catalyzed 1,2-Difunctionalizations of Aminoalkynes Using Only N- and O-Containing Oxidants. Journal of the American Chemical Society 2011, 133 (39), 15372-15375. https://doi.org/10.1021/ja208150d

16. Kyle A. DeKorver, Mary C. Walton, Troy D. North, and Richard P. Hsung . Introducing a New Class of N Phosphoryl Ynamides via Cu (I)- Catalyzed Amidations of Alkynyl Bromides. Organic Letters 2011, 13 (18), 4862-4865. https://doi.org/10.1021/ol201947b
17. Kyle A. DeKorver, Whitney L. Johnson, Yu Zhang, Richard P. Hsung, Huifang Dai, Jun Deng, Andrew G. Lohse, and Yan-Shi Zhang. N-Allyl-N-sulfonyl Ynamides as Synthetic Precursors to Amidines and Vinylogous Amidines. An Unexpected N-to-C 1,3-Sulfonyl Shift in Nitrile Synthesis. The Journal of Organic Chemistry 2011, 76 (12), 5092-5103. https://doi.org/10.1021/jo200780x

Study on "Impact of Social Influence and Income factor with regards of Gender Difference on online Purchasing Decision"

Miss A. A. Chougule
Department of Commerce, Venkatesh College, Ichalkaranji Dist. Kolhapur 416115, Maharashtra, India

Abstract :
The purpose of this research paper is to find out the impact of the economic factor of income and also social influence, ratings and reviews on online purchasing decision, in the context of gender difference. The study is based on primary data. Chi-Square test was used to analyze the obtained data. Finding revealed that the Gender and social influence collectively and also gender and income too have a significant impact on online purchasing. it was observed that income influences purchasing decisions is significantly greater among women compared to men. Additionally, women give greater consideration to the opinions and views of others than men

Keywords : Social Influence, income , gender, online purchasing decision.

Introduction :

Online shopping has become increasingly popular worldwide, mainly due to the convenience associated with online shopping, growing availability of online products and services (Russ,2020). The internet allows for the online exchange of value, without geographical and time restrictions, between firms and partners, customers, suppliers, and employees. This online relationship is referred to as electronic or e-commerce (Lynch & Rose, 1993) Digital media has made the consumer's buying process easy, time and labor saving and convenient, as the number of digital consumers and customers is increasing day by day, nowadays the digital consumer has become an important element in the market

On the consumer's purchasing decision personal factors often become influential. Personal factors include the nature of the consumer, body structure, personality, preferences, lifestyle, personal thoughts, buying habits, consumption habits, ideas of prestige, age group, gender, occupations, fashion preference, life cycle brand loyalty, personal responsibilities, purchase priorities, etc. fashion loving consumers make purchase decisions according to changing fashions. Some individuals are careful about preserving their reputation and make purchase decision in that regard. The stages of the life cycle as well as consumer brand loyalty influence the purchase decisions. It natural for a person in a position like a doctor, professor, manager, lawyer, etc. to be influenced by their profession. Purchasing decision are made accordingly if the lifestyle is high or luxurious. the Personal factors play a crucial role in the online purchasing decision process.

Men usually prefer to buy clothes, electronics and gadgets directly. They make decisions for purchases based on need and utility. Women shop for many things such as fashion, cosmetics, and household items habitually and are more attracted to offers and discounts. Women place more importance on product reviews and brand ratings when making purchasing decisions Universitas Pakuan (2025)

The group of Gen Z makes more purchases on smartphones and spends more on fashion and electronics. They make purchasing decisions based on online reviews (Science Direct.com study (2021). The consumers between 31-40 years is more likely to shop online. The most active, (RAIS. Education 2018). Senior citizens group is price sensitive and often orders essential goods or medicines online, (European Economic Letters 2022)

When consumer shopping online the advice of others (reviews, rating, Influencer opinions) has a huge and decisive impact on the purchase decision. even digital marketing dominate, consumers make purchasing decisions through integrating old media, new media and communication with friends and family.

The inability to make online purchases or payments is a reason for not shopping online that is only partially true. It mainly occur from technological misgive and security concerns. Inadequacy of

technological literacy and fear of fraud are the major reasons. However, this problem has now been overcome with the advent of cash on delivery. There is reasons for avoiding online shopping and that is unbelief about the quality assurance of online products and not being able to physically touch to the product before purchasing. duplicate products, wrong information or delivery fraud. Hence trust is a big factor in online shopping and without it purchases are avoided.

Methodology

The study is based on primary data. A sample consisted of 40 male and 65 female from Kolhapur , hupari, rangoli and nearby villages. Convenience sampling technique were use for data collection.

Objective of the study

1. To study the impact of the economic factor of income on online purchasing decision, in the context of gender difference.
2. To understanding the impact of social influence, ratings and reviews on online purchasing decisions, specifically in relation to the personal factor of gender.

Hypothesis

H_{01}: Social influence & reviews have no impact on the online purchasing decisions of men and women
H_{a1}: The online purchasing decisions of men and women are impacted by Social Influence & Reviews.
H_{02}: Gender and Income collectively have no impact on online purchasing decisions
H_{a2}: Gender and Income collectively have a impact on online purchasing decisions.

Data Analysis and Interpretation

In the below table the sum of the last column is 6.91 this is the chi-square statistic (X^2). In the case of men, the observed number of those who answered 'No' (22) is higher than the expected number (15.62). and in the case of women the observed number of those who answered 'Yes' (46) is higher than the expected number (39.62)

Gender	Social influence impact	Social influence Doesn't impact	Total	Chi-Square (chi^2)	p-value
Female	46	19	65	6.91	0.008
Male	18	22	40		
Total	64	41	105		

Table No. 1 To verify H_1 chi-square test was applied

Respondents	Observed (O)	Expected (E)	(O-E)	(O-E) ^2	$(O-E)^2/E$
Male (Yes)	18	24.38	-6.38	40.7044	1.67
Male (No)	22	15.62	6.38	40.7044	2.61
Female (Yes)	46	39.62	6.38	40.7044	1.03
Female (No)	19	25.38	-6.38	40.7044	1.60
Total					**6.91**

Degree of freedom (df) = (r-1) (c-1)
= (2-1) (2-
(df) = 1

Table No. 2 H_1: The online purchasing decisions of men and women is impacted by Social Influence & Reviews.

*Significant at $p < 0.05$ level. $Chi^2(1, N= 105) = 6.91$, $p = 0.008$

A Che-square test of independence showed that there was a significant association between gender and responses

Chi-square value (chi^2) is 6.91. p-value (p) is 0.008. Degrees of Freedom (d f) is 1

According to the Table No 2. 70.7% (n=46) of the 65 women's consider others' opinions and reviews, whereas only 45% (n=18) of the 40 men's were found to considers others reviews and

opinions. This indicates that the tendency to considers others' opinions and reviews is more prevalent among women's than among men's.

The value of Chi-square (x^2) is 6.91 which measures the magnitude of the difference between two factors (gender and their mindset). The p-value (0.008) is significantly lower than 0.05 when the p-value is much less than 0.05 it implies that there is distinct difference between women and men regarding the trait of considering others feedback, opinions.

According to statistical analysis p-value 0.008 is less than 0.05, we reject the Null Hypothesis. This demonstrates that Gender and social influence collectively have a significant impact on online purchasing decisions.

Table No. 3 To verify H_2 chi-square test was applied

In the below table the sum of the last column is 11.79 this is the chi-square statistic (X^2). In the case of men, the observed number of those who answered 'Yes'(26) is higher than the expected number (17.52). and in the case of women the observed number of those who answered 'No' (45) is higher than the expected number (36.52)

Respondents	**Observed (O)**	**Expected (E)**	**(O-E)**	**(O-E) ^2**	**$(O-E)^2/E$**
Male (Yes)	26	17.52	8.48	71.9104	4.10
Male (No)	14	22.48	-8.48	71.9104	3.20
Female (Yes)	20	28.48	-8.48	71.9104	2.52
Female (No)	45	36.52	8.48	71.9104	1.97
Total					**11.79**

Degree of freedom (df) = (r-1) (c-1)

= (2-1) (2-1)

(df) = 1

Table No. 4 H_2 :Gender and Income collectively have a significant impact on online purchasing decisions

*significant at $p < 0.05$ level. $Chi^2(1, N= 105) = 11.79$, $p = 0.005$

Out of a total of 65 women, 46 (approx70.7%) stated that income has an influence the purchasing decision. While out of total of 40 men, 18 (45%) stated that income has an influence. This suggest that, compared to men, the extent to which income exerts an influence is higher among women.

The Che-Square value is 11.79, and p-value is 0.005. this demonstrates that there is strong correlation between gender and the influence of income. Consequently, the extent to which income impacts purchasing decisions is statically significantly higher among women compared to men.

According to statistical analysis p-value 0.005 is less than 0.05, we reject the Null Hypothesis. This demonstrates that gender and income have a significant impact on online purchasing decisions.

Conclusion :

Gender	**Income Affect**	**Income Doesn't Affect**	**Total**	**Chi-Square (chi^2)**	**p-value**
Female	46	19	65	11.79	0.005
Male	18	22	40		
Total	**64**	**41**	**105**		

This research study concluded that Gender and social influence collectively and also income too have a significant impact on online purchasing decision. According to this study Impact of Social influence and income is significantly higher among women compared to men.

Many people carry out buying and selling transactions using internet. Digital market is growing rapidly so in this competitive market sellers and traders need to know about their online

consumer behavior. This behavior towards buying decision is important for plan a strategy for marketing and promotion

Limitations

1. There are many other internal and external factors which influenced the consumer purchasing decision
2. Only 105 participants were taken for the present study.

Suggestions

1. Large samples from various cities may be taken for further study
2. More advanced statistical analysis should be used for further study.

References

1. Blanca Hernandez, Julio Jimenez, M Jose Martin, 35(1), 113-133, 2011. Age, gender and income : do they really moderate online shopping.
2. Khusaini Khusaini, Heni Cahya Ramdani, Riski Ambarumanti (JPEB) 7(1), 22-30, 2019. The influence of shopping an gender differences on online shopping.
3. Prashant D Amin, Bijal Amin 43-52. 2010. A critical review of gender differences in online shopping.
4. Yun Wan, Makoto Nakayama, Norma Sutcliffe, Information systems and e-Business Management 10(1), 135-148, 2012. The impact of age and shopping experiences on the classification of search, experience, and credence goods in online shopping
5. Sanjeev Singh, Ashish Linge, Baldeo Kakde Journal 11(10), 2022. Impact of age, experience and gender on customer satisfaction in online shopping.
6. Farah Alfanur, Yasuo Kadono, International Journal of Innovation and Learning 31(4), 474-505, 2022. The effect of gender and age on factors that influence purchase intentions and behaviors of e-commerce consumers in Indonesia
7. Dahiya Richa International Journal of engineering and management sciences 3 (1), 43-52, 2012
8. Gagandeep Nagra, R Gopal International journal of scientific and research publications 3(6), 1-4, 2013. An study of factors affecting on online shopping behavior of consumers
9. Dwika Lodia Putri, Nurmansyah, Aznuryandi, Denok Sunarsi, Nurmin Arianto, scientific journal of management 10(2),312-319, 2022. Factors that influence on online purchase decisions
10. Amirnima Negahdari, 2014. A study on gender differences influencing on online buying.

Impact of Artificial intelligence on Microfinance institutions with Special reference to "DAY-NULM" Scheme

Miss. Sony Harishkumar Mirchla
(Research Scholar)
Smt.RDG.College for Women, Akola
Dr. Devendra N. Vyas
Professor, faculty of Commerce and Management, G.S Science, Arts and Commerce College, Khamgaon

Abstract:-

Artificial intelligence refers to the development of computer system that can perform tasks typically requiring human intelligence such as learning(i.e improving performance over time),reasoning(i.e drawing conclusions from data),problem solving (i.e finding solutions to complex problems),perception(i.e interpreting sensory data(eg.images,speech,and language understanding(i.e processing and generating human languages.) And Deen -Dayal Antyodyaya yojana-National Urban Livelihood Mission(DAY-NULM) mission is a flagship scheme by ministry of housing and urban affairs, government of India designed to reduce poverty and vulnerability among the urban poor.it enables better livelihood through skill,training,self-employment opportunities and proving shelters for urban homeless..

For self-employment under **DAY_NULM** microfinance institutions play a very vital role because micro finance institutions re -specialized financial institutions providing small loans,insurance,saving and money transfer to low income individual, entrepreneurs and groups who lacks to access traditional banking services that promote financial inclusion and helps to reduce poverty and in todays digitalized era "Artificial intelligence" is like a sugar in tea.AI is transforming MFIs by improving operational efficiency.enhancving risk management and expanding financial inclusion for unbanked and underserved population.

So, the main motto of our research paper is to explore how AI in MFIs makes the operation easy and how NULM beneficiaries get the benefits.

Keywords:- Micro finance institutions, Artificial intelligence, Underserved,NULM,Machine learing,Data processing, sensory data.

Introduction:

Micro finance institutions plays a very critical role in DAY-NULM scheme by acting as a intermediaries for financial inclusion, providing accessible credit to urban poor, and supporting for the formation and strengthening of SHGs.Under the NULM scheme MFIs operate as a crucial partners to banks and urban local bodies to bridge the gap in credit access for the urban poor. And in today's technological era AI is performing its role to make everything easy.AI is transforming MFIs by improving operational efficiency, enhancing risk management and expanding financial inclusion for unbanked and underserved population by leveraging machime learning, Data analysis, Natural language processing (NLP), MFIs can automate labor intensive manual processor, reduce cost and offer more personalized financial products.

So, this paper systematically examines AI applications, across key financial domains (payments, savings,lending,insurance,investments,) it highlights how machine learning,Natural language processing and generative AI are enabling innovative solutions tailored to the needs of NULM beneficiaries.

Also, this paper systematically explores the AI applications in each financial need area, highlights current research, real world implementation in NULM scheme.

Features of Artificial Intelligence: - The key features of AI are

1. **Learning** AI can **learn from data and experience** and improve over time.
2. **Decision Making** AI can **analyze information and make decisions** based on it.
3. **Problem Solving** AI can **find solutions to complex problems**.

4. Automation AI can **do repetitive tasks automatically** without human help.
5. Understanding Language AI can **understand and respond to human language** (text or speech).
6. Recognition AI can **recognize images, faces, sounds, and patterns**.
7. Speed and Accuracy AI can **process large amounts of data very quickly and accurately**.

Role of Micro Finanace Institutions in DAY-NULM scheme

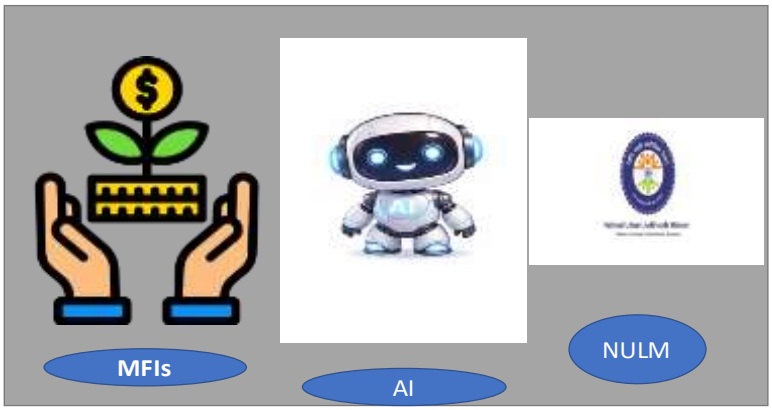
The National Urban Livelihoods Mission (NULM) is a government scheme in India that aims to reduce poverty and improve the livelihood of people living in urban areas. The main objective of this scheme is to provide employment opportunities and promote self-employment through financial assistance, skill development, and the formation of Self-Help Groups (SHGs). In this scheme, Microfinance Institutions (MFIs) play an important role by providing small loans and financial services to the urban poor. They help people start small businesses, improve their income, and become financially independent.

Explanation:-

1. Providing Micro credit: -MFIs provide small loans to poor to set up their own enterprise.
2. Financial inclusion: - MFIs bring the urban poor into formal banking system by providing easy access to loans, saving facilities and many more.
3. Support to SHGs:- MFIs helps the SHGs which are formed under NULM scheme by providing easy credit facilities.
4. Promoting self employment:- Person who wants to set up own enterprise MFIs helps them by proving easy loan facility.
5. Capacity building:- MFIs sometimes provide financial literacy so that illiterate people without hesitation can avail the bank loans.
6. Women empowerment: - MFIs also helps the women SHGs by providing interest subsidy which makes them financial independent.

Role of Artificial Intelligence in Micro Finance Institutions with special reference to NULM scheme

The National Urban Livelihoods Mission (NULM) aims to reduce urban poverty by promoting self-employment, skill development, and access to credit for the urban poor. Microfinance Institutions (MFIs) support this mission by providing small loans to Self-Help Groups (SHGs) and low-income entrepreneurs. The use of Artificial Intelligence (AI) helps MFIs improve loan distribution, reduce risks and expand financial services to more beneficiaries under the scheme.



- **Credit Assessment:** AI analyzes alternative data (transactions, mobile usage) to evaluate borrowers under NULM, even without formal credit history.
- **Faster Loan Processing:** AI automates verification and approval, reducing paperwork and speeding up loans for SHGs and small businesses.
- **Risk Prediction:** AI predicts loan defaults, helping MFIs manage financial risks effectively.

- **Fraud Detection:** AI identifies unusual transactions, preventing fraud and reducing financial losses.
- **Operational Efficiency:** Automation of routine tasks lowers costs and allows MFIs to serve more beneficiaries.
- **Loan Collection Support:** AI voice systems and reminders improve repayment rates and reduce delinquency.
- **Financial Inclusion:** AI helps MFIs reach more urban poor, supporting NULM's goal of self-employment and livelihood improvement

Conclusion:-

Thus, Artificial Intelligence plays an important role in improving the efficiency and outreach of Microfinance Institutions working with the National Urban Livelihoods Mission (NULM). AI helps in credit assessment, fraud detection, faster loan processing, and risk management. As digital technologies expand, AI will further strengthen financial inclusion and support the urban poor through NULM programs.

Some concluding points are; -

i. AI strengthens **financial inclusion** by helping MFIs reach more urban poor under the NULM scheme.
ii. It makes **loan approval faster and more accurate**, reducing delays for beneficiaries.
iii. AI reduces **risks and fraud**, ensuring safer lending practices.
iv. It helps MFIs **monitor repayment and reduce defaults**, improving overall financial health.
v. By automating tasks, AI **lowers operational costs** and improves efficiency.
vi. AI enables **personalized financial services** and better support for SHGs and individual entrepreneurs.
vii. The use of AI encourages **digital transformation in microfinance**, making NULM programs more transparent and scalable.
viii. Overall, AI helps MFIs **empower urban poor economically**, supporting the main goals of the NULM scheme.

References:-

1. Bumacov, V., Ashta, A., & Singh, P. (2017). Credit scoring: A historic recurrence in microfinance. Strategic Change, 26(6), 543-554.
2. Google.com
3. Researchgate.net
4. http://www.researchgate.net
5. http://www.atlantis-press.com
6. Tonye AI onyanabo (2024),"The role of Artificial intelligence in enhancing microfinance operations in developing economies".
7. Ms.Sonam',Dr.Mridul Dharwal'',d.Varun Mohan''': " Artificial intelligence in microfinance in india:The key for sustainable development. ISSN:2581-9925,Volume 06.
8. Dr.G.Jeyamani(2019) "Skill India" provides employment and empowerment.
9. http://kaushalaya.mahaswayam.gov.in
10. www.skilldevelopment.gov.in
11. www.gktoday.in/government-schemes-in-india

Photovoltaic Performance of Polyaniline–TiO_2 Nanocomposite Photoanodes Sensitized with N719 Ruthenium Dye

Nikita Subhash Jaiswal
Sanjeev Jagtap
Department of Physics, Bar. Ramrao Deshmukh Arts, Smt. Indiraji Kapadiya Commerce and Nya Krushnarao Deshmukh Science College, Badnera Distt. Amravati (Maharashtra) 444 701

Abstract

In the present work, a 1 wt.% TiO_2 loaded polyaniline (PANI) nanocomposite was successfully prepared using an ex-situ method to enhance the optical and photovoltaic properties of PANI. The structural, morphological, and optical properties of the prepared nanocomposite were investigated using X-ray diffraction (XRD), scanning electron microscopy (SEM), UV–Visible spectroscopy and Raman spectroscopy. The J–V characteristics of the fabricated device demonstrated enhanced photovoltaic performance with a fill factor (FF) of 0.456 and power conversion efficiency (η) of 3.659%. The improved performance is attributed to effective charge separation and transport facilitated by TiO_2 nanoparticles within the PANI matrix.

Keywords: Photovoltaic, Polyaniline, TiO_2, Nanocomposite, Photoanodes, N719 Dye.

1. Introduction

The global shift toward sustainable energy has positioned dye-sensitized solar cells (DSSCs) as a promising alternative to traditional silicon-based photovoltaics due to their low production costs, ease of fabrication, and tunable optical properties. Central to the performance of these cells is the photoanode, where the synergistic interaction between a semiconducting metal oxide and a conducting polymer can significantly enhance charge carrier mobility. Polyaniline (PANI) has emerged as an ideal candidate for this role owing to its high environmental stability, unique redox chemistry, and excellent hole-transport capabilities. By incorporating titanium dioxide (TiO_2) nanoparticles into the PANI matrix, it is possible to create a nanocomposite that leverages the high surface area of the inorganic phase and the conductive nature of the polymer, potentially overcoming the rapid recombination rates typically associated with organic photovoltaics.

Zhang et al. (2007) successfully fabricated two variants of TiO_2/sulfonated polyaniline (SPAn) nanocomposite ultrathin films using a layer-by-layer (LBL) self-assembly technique, distinguishing between self-doped (SD-SPAn) and externally HCl-doped (ED-SPAn) systems. Their comparative analysis revealed that ED-SPAn/TiO_2 films possess a smoother, more even surface morphology and demonstrate a more stable photocurrent response than the SD-SPAn/TiO_2 counterparts. While the SD-SPAn/TiO_2 films exhibited a faster initial photocurrent response, the study suggests that the doping method significantly influences the resulting electrochemical and photoelectrochemical stability of the multilayer structures [1].

Arora et al. (2015) investigated the thermal properties of nanocomposite films synthesized from polyaniline (PANI), encapsulated nano-TiO_2, and a polyvinyl alcohol (PVA) matrix. Through thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC), the authors demonstrated that these composite films exhibit significantly enhanced thermal stability at high temperatures compared to pure polyaniline. Furthermore, the integration of TiO_2 and PVA was shown to influence the DC conductivity of the resulting material, highlighting its potential for applications requiring robust thermal and electrical performance [2].

Sadegh et al. (2023) developed a novel, eco-friendly in situ synthesis of a magnetic PANI-Fe_3O_4-TiO_2 nanocomposite to address charge carrier recombination in polymer solar cells. The study demonstrated that the inclusion of superparamagnetic Fe_3O_4 nanoparticles facilitates spin-orbit coupling and singlet fission, effectively increasing triplet excitons and suppressing energy loss. By utilizing this magnetic nanocomposite as an active layer in a P-N heterojunction device, the

researchers achieved a significant improvement in power conversion efficiency (PCE) compared to non-magnetic counterparts, offering a new perspective on enhancing organic photovoltaic performance through magnetic field effects [3].

Li et al. (2004) demonstrated that polyaniline (PANI) does not simply blend with nano-TiO_2 particles but instead forms a distinct core-shell structure through strong macromolecular interactions. Their research showed that the synthesized PANI deposits directly onto the surface of TiO2 cores, resulting in composite particles with dimensions ranging from 25 to 40 nm. This surface modification significantly impacts the material's physical properties, achieving a conductivity of 0.75 $S.cm^{-1}$ at 25 °C with a PANI mass content of 38%. Furthermore, the study utilized nitrogen adsorption and electron microscopy to confirm that this structural arrangement alters the surface area and pore volume compared to pure TiO_2 nanoparticles [4].

Husain et al. (2025) synthesized a ternary nanocomposite consisting of rice husk-derived graphene oxide (GO), polyaniline (PANI) and TiO_2 through an in-situ assembly process for the photocatalytic degradation of benzene and toluene. The integration of PANI and GO resulted in a reduced bandgap of 2.8 eV, which significantly enhanced the material's photocatalytic response under UV-Vis exposure. Experimental results demonstrated exceptional degradation efficiencies of 99.81% for benzene and 99.16% for toluene at 60 ppm, outperforming binary GO/TiO_2 composites. The study concludes that the synergistic effects within the GO/TiO_2/PANI matrix provide a highly efficient and sustainable pathway for neutralizing noxious aromatic organic pollutants [5].

While various configurations of PANI-TiO_2 composites have been explored, the impact of low-concentration inorganic loading on the structural and photovoltaic efficiency of dye-sensitized systems remains a critical area of investigation. This study specifically focuses on the preparation of PANI composite loaded with 1 wt.% TiO_2, designed to function as a high-performance photoanode when sensitized with N719 ruthenium dye. Through a comprehensive analytical technique, including X-ray diffraction (XRD), scanning electron microscopy (SEM) and Raman spectroscopy, the structural and morphological integrity of the 1 wt.% TiO_2 loading is evaluated. Furthermore, the UV-Vis spectroscopy and current density-voltage (J-V) characteristics to determine how this specific concentration optimizes light harvesting and energy conversion efficiency in the resulting solar cell.

2. Experimental Details

Pre-synthesized PANI and TiO_2 nanoparticles were used for the preparation of PANI–TiO_2 nanocomposites through a physical mixing *ex-situ* method. In the present study, a 1 wt.% TiO_2 loading was selected to investigate the effect of low TiO_2 concentration on the structural, optical and photovoltaic properties of the composite. Based on this calculation, the required amount of TiO_2 (1 wt.%) was mixed with a fixed quantity of PANI. Both PANI and TiO_2 powders were dispersed in a small amount of ethanol and sonicated for 30 minutes to ensure uniform mixing and proper dispersion of nanoparticles within the polymer matrix. The resulting mixture was then dried in a vacuum oven at 60 °C for 3 hours to remove residual solvent. After drying, the obtained powder was gently ground to obtain a uniform PANI–TiO_2 nanocomposite. The structural and optical properties of the prepared PANI–TiO_2 nanocomposite were characterized using various analytical techniques.

The crystal structure of the synthesized materials was analyzed using XRD technique. The diffraction patterns were recorded using a Rigaku MiniFlex 600 diffractometer with Cu Kα radiation ($\lambda = 1.5406$ Å). Surface morphology of the nanocomposite were examined using SEM. This technique helped in understanding particle dispersion and surface characteristics of the prepared composite. Raman spectroscopy was carried out at room temperature to study vibrational characteristics and confirm the interaction between PANI and TiO_2 in the nanocomposite. UV–Visible spectroscopy was employed to investigate the optical absorption behavior of the materials. The absorption spectra were recorded using a Shimadzu UV–1800 spectrophotometer.

The dye-sensitized solar cell (DSSC) was fabricated using indium tin oxide (ITO) coated glass as the conducting substrate. The prepared 1 wt.% PANI–TiO_2 nanocomposite was deposited onto the cleaned ITO surface using the doctor blade technique to form the photoactive layer.

The coated electrode was sensitized using ruthenium-based N719 dye solution prepared in ethanol. After dye loading, an aluminum foil was used as the counter electrode and placed over the coated film. The assembled device was clamped using a binder clip. The photovoltaic performance of the fabricated DSSC was evaluated using current density–voltage (J–V) measurements under simulated solar illumination (AM 1.5, 1000 W/m²).

3. Results and Discussion

Figure 1 shows the XRD pattern of 1 wt.% TiO_2 loaded PANI nanocomposite, which exhibits the characteristic features of both PANI and TiO_2. The XRD pattern shows a broad diffraction hump in the range of $2\theta = 15°$ to $30°$, which is attributed to the amorphous nature of the PANI matrix. This broad hump confirms the semi-crystalline to amorphous structure of PANI. In addition to the broad PANI peak, several sharp diffraction peaks are observed, which correspond to the crystalline nature of TiO_2 nanoparticles. These sharp peaks appearing over the broad hump of PANI indicate the successful incorporation of crystalline TiO_2 into the amorphous PANI matrix. The presence of distinct TiO_2 peaks confirms that the crystalline structure of TiO_2 is retained even after composite formation [6].

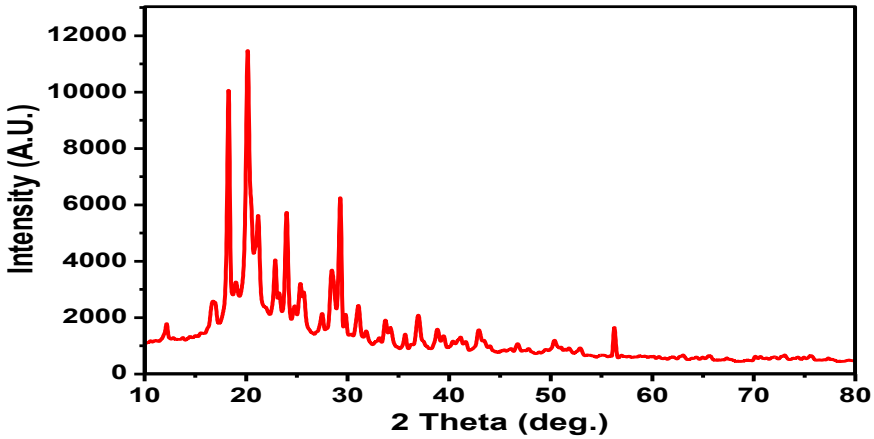


Figure 1: XRD pattern of 1 wt.% TiO_2 loaded PANI nanocomposite.

Figure 2 shows the SEM image of the 1 wt.% TiO_2 loaded PANI nanocomposite, which reveals the surface morphology of the composite material. The SEM micrograph shows the typical granular and irregular morphology of the PANI matrix. Additionally, distinct TiO_2 domains are observed within the PANI matrix, indicating the presence of TiO_2 nanoparticles in the composite. The images clearly show slight agglomeration of TiO_2 particles, forming small clusters embedded within the PANI matrix. These agglomerated TiO_2 domains are distributed over the PANI surface, suggesting partial aggregation due to the high surface energy of TiO_2 nanoparticles [7].

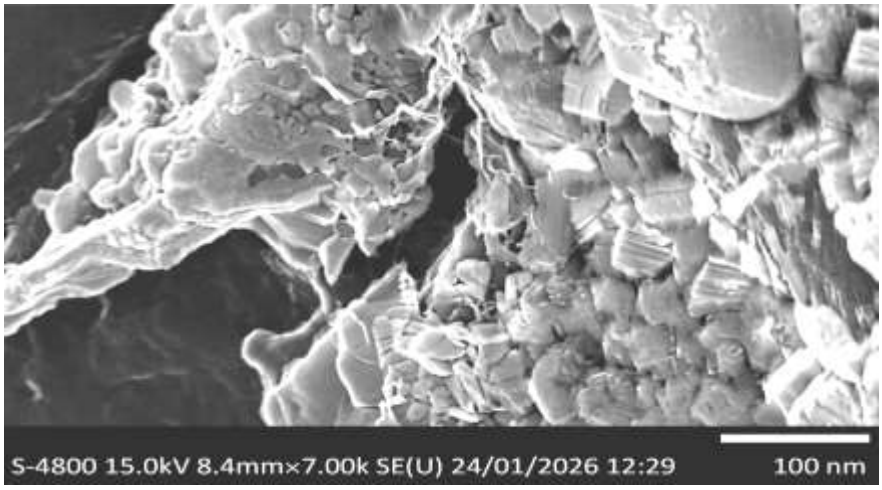


Figure 2: SEM image of 1 wt.% TiO_2 loaded PANI nanocomposite.

Figure 3 shows the UV–Vis absorption spectrum of the 1 wt.% TiO_2 loaded PANI nanocomposite. The spectrum exhibits a gradual decrease in absorbance in the wavelength range of 210–250 nm. A broad absorption peak is observed around 282 nm, which is attributed to the π–π* electronic transitions in the PANI backbone along with the contribution from TiO_2 nanoparticles. Beyond this region, the absorbance shows a smooth and nearly continuous decreasing trend extending up to 600 nm. This broad and gradually decreasing absorption profile indicates the interaction between PANI and TiO_2 and confirms the successful formation of the nanocomposite. The extended absorption in the visible region suggests improved optical response of the composite material compared to pure components [8].

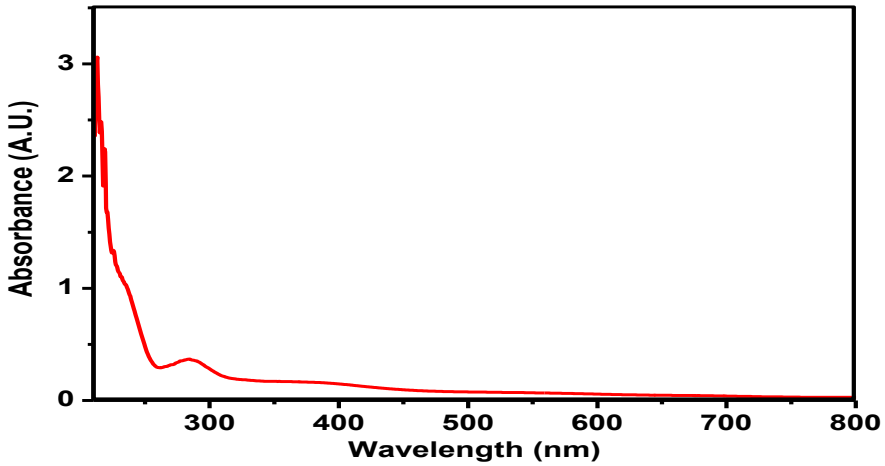


Figure 3: UV-Vis of 1 wt.% TiO_2 loaded PANI nanocomposite.

Figure 4 shows the Raman spectrum of the 1 wt.% TiO_2 loaded PANI nanocomposite. The spectrum exhibits characteristic Raman peaks at approximately 100, 360, 492 and 645 cm^{-1}. These peaks are attributed to the vibrational modes of TiO_2 present in the nanocomposite. The peak observed around 100 cm^{-1} corresponds to the Eg mode of TiO_2, while the peaks at 360 cm^{-1} and 492 cm^{-1} are assigned to the B1g and A1g vibrational modes, respectively. The prominent peak at 645 cm^{-1} is associated with the Eg mode of TiO_2, confirming the presence of crystalline TiO_2 nanoparticles within the PANI matrix. The presence of these characteristic Raman bands confirms the successful incorporation of TiO_2 into the PANI matrix. Additionally, the retention of TiO_2 vibrational modes suggests that the structural integrity of TiO_2 is maintained during the formation of the 1 wt.% TiO_2 loaded PANI nanocomposite [9].

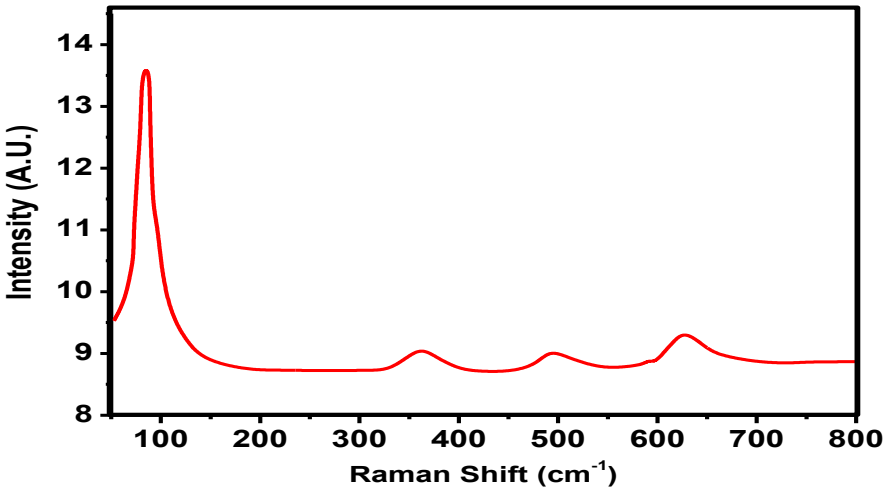


Figure 4: Raman spectrum of 1 wt.% TiO_2 loaded PANI nanocomposite.

Figure 5 shows the J–V characteristics of the 1 wt.% TiO_2 loaded PANI nanocomposite. The J–V curve demonstrates the photovoltaic behavior of the fabricated device, indicating effective charge generation and transport within the composite material. The photovoltaic parameters obtained from the J–V characteristics reveal a fill factor (FF) of 0.456 and a power conversion efficiency (η) of 3.659%. The moderate value of fill factor indicates efficient charge transport and reduced internal resistance within the device. The observed efficiency confirms that the 1 wt.% TiO_2 loading in the PANI matrix contributes to enhanced photovoltaic performance. The improved performance can be attributed to the synergistic interaction between PANI and TiO_2, where TiO_2 acts as an electron acceptor and facilitates effective charge separation, thereby improving the overall photovoltaic characteristics of the nanocomposite device [10].

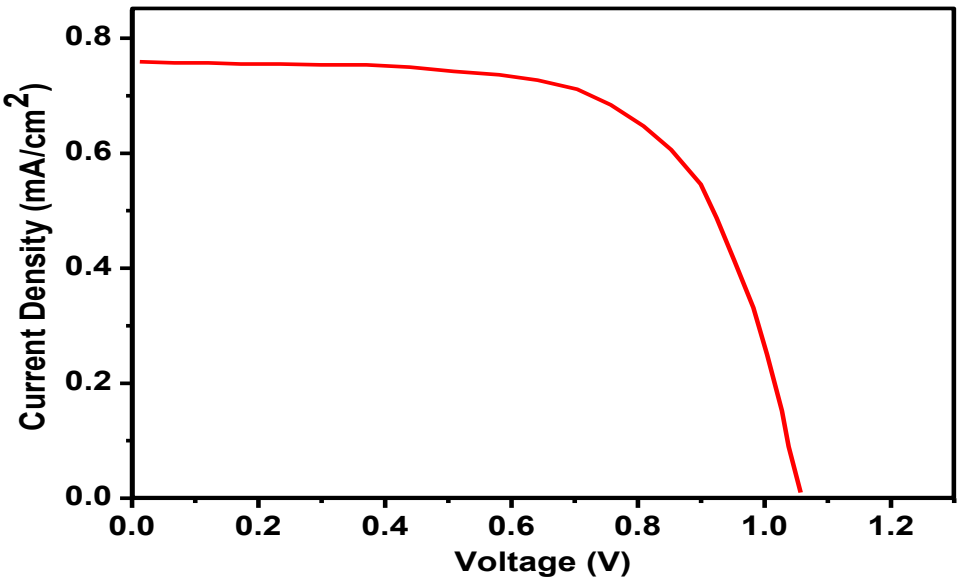


Figure 5: J-V characteristics of 1 wt.% TiO_2 loaded PANI nanocomposite.

4. Conclusiuons

1 wt.% TiO_2 loaded PANI nanocomposite was successfully synthesized using an ex-situ approach. XRD analysis confirmed the presence of crystalline TiO_2 peaks over the broad amorphous hump of PANI, indicating successful composite formation. SEM micrographs revealed agglomerated TiO_2 domains distributed within the PANI matrix. UV–Vis absorption studies showed a broad absorption peak around 282 nm and a gradual decrease in absorbance up to 600 nm, demonstrating enhanced optical properties of the nanocomposite. Raman spectroscopy further verified the incorporation of TiO_2 through characteristic vibrational peaks at 100, 360, 492 and 645 cm^{-1}.

The J–V characteristics demonstrated improved photovoltaic performance with a fill factor of 0.456 and power conversion efficiency of 3.659%. The enhancement in performance is attributed to improved charge separation and reduced recombination due to the presence of TiO_2 nanoparticles. These results suggest that low concentration TiO_2 loading in PANI is an effective strategy for improving the photovoltaic properties of polymer-based nanocomposites, making them promising candidates for optoelectronic and solar energy applications.

Acknowledgement

Authors are very much thankful to Principal, Bar. Ramrao Deshmukh Arts, Smt. Indiraji Kapadiya Commerce and Nya Krushnarao Deshmukh Science College, Badnera Distt. Amravati (Maharashtra) 444 701 for providing necessary facilities to conduct present study.

References

[1] X. Zhang, G. Yan, H. Ding, and Y. Shan, "Fabrication and photovoltaic properties of self-assembled sulfonated polyaniline/TiO2 nanocomposite ultrathin films," *Materials Chemistry and Physics*, vol. 102, no. 2–3, pp. 249-254, Apr. 2007.

[2] R. Arora, U. K. Mandal, P. Sharma, and A. Srivastav, "Synthesis and Thermal Properties of Polyaniline-TiO2 nanocomposites PVA Based Film," Materials Today: Proceedings, vol. 2, no. 4–5, pp. 2215–2225, 2015.

[3] F. Sadegh, A. R. Modarresi-Alam, and Y. Li, "Synthesis, characterization and photovoltaic application of a new magnetic nanocomposite from polyaniline-FeO-TiO," *Nano-Structures & Nano-Objects*, vol. 36, p. 101033, Oct. 2023.

[4] X. Li, G. Wang, X. Li, and D. Lu, "Surface properties of polyaniline/nano-TiO2 composites," *Applied Surface Science*, vol. 229, no. 1–4, pp. 395–401, May 2004.

[5] S. Husain, S. A. Muhammad, K. A. Ali, M. S. Tanweer, and N. Ahmad, "In-situ assembled GO/TiO2 and GO/TiO2/PANI nanocomposites for the enhanced photocatalytic degradation of benzene and toluene," *Polymer Bulletin*, vol. 82, pp. 12707–12729, Sep. 2025.

[6] T.-C. Mo, H.-W. Wang, S.-Y. Chen, and Y.-C. Yeh, "Synthesis and dielectric properties of polyaniline/titanium dioxide nanocomposites," *Ceramics International*, vol. 34, no. 7, pp. 1767–1771, Sep. 2008.

[7] S. D. Rokade, D. V. Nandanwar, S. B. Kondawar, P. A. Bramhankar, P. B. Wasnik, and M. S. Bisen, "Synthesis and characterization of polyaniline/TiO2 nanocomposite based ammonia gas sensor," *Next Research*, vol. 1, no. 2, p. 100065, Dec. 2024.

[8] A. Hashemi Monfared and M. Jamshidi, "Synthesis of polyaniline/titanium dioxide nanocomposite (PAni/TiO2) and its application as photocatalyst in acrylic pseudo paint for benzene removal under UV/VIS lights," Progress in Organic Coatings, vol. 136, p. 105257, Nov. 2019.

[9] X. Li, W. Chen, C. Bian, J. He, N. Xu, and G. Xue, "Surface modification of TiO2 nanoparticles by polyaniline," *Applied Surface Science*, vol. 217, no. 1–4, pp. 16–22, Jul. 2003.

[10] M. A. Shahat and A. Ghitas, "Titanium Dioxide (TiO2) Concentration-dependent Photovoltaic Cells Performance of PAni-TiO2 Nanocomposite," *IOP Conference Series: Materials Science and Engineering*, vol. 1269, no. 1, p. 012009, 2022.

Cross-Cultural Experience of an Expat in *Eight Months on Ghazzah Street* by Hilary Mantel

Chaitali Meshram
Dr. Rashmi Dubey

Abstract

A modern British woman, Frances, with a professional career as a cartographer, joins the expatriate community in Jeddah, Saudi Arabia, with her Engineer husband. Tempted by an exorbitant salary, her husband Andrew grabbed the opportunity of an unexpected job offer in the Middle-East. But soon she realizes that life is extremely restrictive. She felt isolated and trapped by the rigid societal rules, gender segregation and cultural codes that limit her movement and expression. *Eight Months on Ghazzah Street* is a powerful exploration of gender oppression, psychological disintegration, cross-cultural shock and isolation. Hilary Mantel wrote this psychological thriller in 1988, and expressed her personal experience in the novel as how she was baffled by the Saudi women who accepted and justified the barbarity of the society against women. Frances' life of eight months in Ghazzah Street depicts the slow internalisation of estrangement and anxiety that causes a psychological breakdown and escape without resolution. Frances, with her husband, departs from Saudi Arabia in eight months, but it does not feel like a triumph to her. She had a lingering sense of unease and all sympathy and empathy for the women living there. Male guardianship systems still exist in Saudi Arabia. Laws like to obey husbands and legal control by male figures in areas like mobility, marriage decisions or family decisions, etc. Only after a lengthy campaign and many punishments and sacrifices Saudi Arabia lifts ban in 2018, allowing women to drive on roads. Such extremism against women still persist in the culture and system is very disheartening. Furthermore, according to Hilary Mantel when experiencing cross-cultural dynamics, you must not automatically respect it, but sometimes pay it the compliment of hating it.

Keywords: Cross-Cultural Shock, Ghazzah Street, Gender Equity, HilaryMantel.

In a world where women's voices reverberate with strength, resilience and unwavering determination and where women continue to rise, the status of women in Saudi Arabia demonstrates both slow advancement and limitations. Even though women's lives there have improved due to reforms like greater employment and travel rights, societal control and male guardianship still exist. Hilary Mantel's depiction in *Eight Months on Ghazzah Street,* where apparent normalcy conceals deeper systems of control and psychological captivity, is reflected in this dual reality.

Eight Months on Ghazzah Street, published in 1988, is a politically charged novel written by Hilary Mantel. Drawing from her own experience living in Saudi Arabia with her husband, this story explores the subjugation of women and religious authoritarianism within a conservative culture. From Frances Shore's perspective, the protagonist, who accompanies her engineer husband, Andrew, to Saudi Arabia, witnesses her immediate exposure to the secondary status imposed on women. The novel is steeped in mystery and reveals the harsh realities women face, highlighting restrictive customs that Frances finds both absurd and deeply unjust. The irony is that the condition of the women in such areas is still unchanged. Hilary Mantel, in the novel, very well comments on cross-cultural experience

When I travelled at first, I used to ask what I could get out of it, and what I could give back. What could I teach, and what could I learn? I saw the world as some sort of exchange scheme for my ideals, but the world deserves better than this. When you come across an alien culture, you must not automatically respect it. You must sometimes pay it the compliment of hating it. (Mantel 12)

Hilary Mantel is a brilliant, prolific and innovative novelist who has emerged as the most representative British writer of the post-World War II era. Her books have been received with critical acclaim and she was awarded the Booker Prize in 2009 for her novel *Wolf Hall* and in 2012 for the novel *Bring Up the Bodies*, becoming the first woman to receive the prestigious award twice, and the first author to win two Booker Prizes.

Hilary Mantel was a writer of immense skill and originality. born in Glossop, Derbyshire, on 6th July 1952 to Irish Catholic immigrant parents. Mantel graduated from the London School of Economics and Sheffield University. Mantel acquires a great lyrical awareness of the world's eccentricity, capturing the ambivalence. Mantel always grounds her perspective in a strong sense of ethical and moral responsibility. She was never a detached observer of history's unfolding events. Having spent significant time abroad, particularly in Botswana and Saudi Arabia, Mantel remained keenly attuned to a world beyond Britain. With a deep and informed understanding of social and cultural politics, she never lost her fascination with lives that exist on the margins of what is considered normal.

Having a great life in Britain, a young and self-dependent working woman agrees to go to a country like Saudi Arabia with her husband to support him in his career and to build a rather better life, a lavish home and a bright future back home. Frances feels a sense of pride and satisfaction in supporting her husband. Understanding the cross-cultural society, Frances and Andrew Shore settle in a closed colony on Ghazzah Street in Jeddah city. The neighbourhood consisted mix of the locals and expat community. At first, Frances was having a great expatriate experience; she was busy writing and documenting the journals. But soon she realised the challenges and extremism, especially for women. It started to disturb her a bit, but being a strong woman, she let it pass and started interacting with the neighbourhood community.

As the monotonous and stifling life started to disturb her. She was not allowed to move outside, having no meaningful occupation, and the social interaction was very limited and superficial. Her neighbours, one of whom came from Pakistan and the other was Saudi, used to tell her how the strict societal rules for women are justified. She was perplexed by the acceptance of the barbarity of Islamic punishments, like amputation and public lashing, etc., which was, by the way crime in her part of the world. These women accepted all these hardships in the name of a pure society and living there life as such. Francis remains unconvinced, "There is no such thing as a woman here." (Mantle 70).

Francis tried to go outside to run some errands, but she experienced a horrifying interaction with a local resident. Cat-calling and eve-teasing are at their peak; women are not allowed to move alone on roads- this is the ultimate threat she felt. She was so shaken by this incident, which she later shared with a fellow expat :

As she stepped out from the kerb, he revved his engine, the car sprang forward, and she had to leap from under its wheels. She heard the brakes applied; caught herself up, heart racing, and looked back at the driver of the car, understood that it had not been an accident. 'You are my darling, madam, you are my baby…' Saw on his face laughter and contempt. When she got home she phoned Carla. 'Look,' Carla said, 'it's happened to me. Don't take everything so personally.''But why?' she insisted. She felt on the verge of tears. 'I just wanted to cross. I would have waited. I would have let him go by.' Carla said tiredly, 'They don't want us on the streets. It's just a thing they do.'(Mantel 238).

The sense of isolation and loneliness was incubating. Frances was also aware of the upstairs flat from where she used to hear strange and unsettling noises of a woman off course. These made her paranoid; she felt constantly watched and felt unsafe and trapped.

Andrew, being busy with the work of his choice and in the lure of good money, was unable to understand the tsunami of feelings her wife, Frances, felt. Surely, males, when busy, in their own world, are unable to understand women's feelings. Andrew's emotional detachment led to a psychological breakdown.

The only socialisation for Frances was the interaction of the expat community living there. They were also very much frustrated and tired of living there, just for the sake of good money. Frances was tormented by the fact that, how the reliable news is absent in the Saudi society and is replaced by rumours. The fake-ness, compulsion and hypocrisy were at peak in the expat community, "They always say, we'll just do another year. It's called the golden handcuffs" (Mantel 70-100).

Finally, Frances and her husband Andrew leave Saudi Arabia after eight months, but there is no sense of triumph. She had a lingering sense of unease and all sympathy and empathy for the women living there. She has not fully understood what happened; her psychological state is completely shaken, and this experience has changed her inside out. The woman who came to the whole other universe to support her husband was once a confident and free-willed woman, but now has a persistent mental restlessness and fragility of identity as a woman throughout her life.

Still, the condition of women in that part of the world is compromised. Male guardianship systems still exist in Saudi Arabia. Laws like to obey husbands and legal control by male figures in areas like mobility, marriage decisions or family decisions, etc. Only after a lengthy campaign and many punishments and sacrifices Saudi Arabia lifts ban in 2018, allowing women to drive on roads. Such extremism against women still persist in the culture and system, is very disheartening. Mantel, as a part of the expat community in Jeddah, has documented her own cross-cultural experience. She is not critical or stereotyping society and culture, but bringing the harsh reality. She addresses gender oppression as a system so internalised in minds that it changes the perception. She also criticizes westerners to normalize this oppression for comfort and money. This politically incisive work contrasts conservative Saudi culture with the liberal West and garnered Mantel significant praise for her bold examination of these issues.

Bibliography

1. Anderson, Hephzibah. " Hilary Mantel: on the path from paint to prizes." *The Guardian,* 19 April2009, https://www.theguardian.com/books/2009/apr/19/hilary-mantel-man-booker
2. Heavenali. "Eight Months on Ghazzah Street-Hilary Mantel (1988)." 26 April 2023, https://heavenali.wordpress.com/2023/04/26/eight-months-on-ghazzah-street-hilary-mantel-1988/
3. Hernández, Silvia G. "Hilary Mantel's Eight Months on Ghazzah Street: The Displacement of British Expattriates in Saudi Arabia." *ATLANTIS Journal of the Spanish Association of Anglo-American Studies,* ISSN 0210-6124, June 2015, pp. 85-100.
4. Hill, Lisa. "Eight Months on Ghazzah Street (1988) by Hilary Mantel." *ANZ LIT LOVERS LITBLOG*, 5 August 2019, https://anzlitlovers.com/2019/08/05/eight-months-on-ghazzah-street-1988-by-hilary-mantel/
5. Mantel, Hilary. *Wolf Hall*. London: HarperCollins, 2009.
6. Mantel, Hilary. *Bring Up the Bodies*: HarperCollins, 2012.
7. Mantel, Hilary. *Mantel Pieces: Royal Bodies and Other Writing from the London Review of*
8. *Books.* HarperCollins UK, 30 November,2021.
9. Mantel, Hilary. *Eight Months on Ghazzah Street*. Fourth Estate, 2013
10. Mantel, Hilary. *Giving Up the Ghost*. Fourth Estate, 2013.
11. Milani, Abbas. "Hilary Mantel's Tales of English Abroad/A woman in Saudi Arabia Chafs at gender restrictions." *SFGATE,* 27 July 1997, https://www.sfgate.com/books/article/Hilary-Mantel-s-Tales-of-English-Abroad-A-woman-2815758.php

Mathematical Modeling and Optimization of Hybrid Renewable Energy Systems for Industrial Applications

Vaishnav Digambar Nikas
Dr. H. N. Sinha Arts &Commerce College, Patur.

Abstract:

Renewable energy systems are becoming more and more necessary for contemporary industrial operations due to the quick shift toward sustainable energy solutions. To lower carbon emissions and increase overall energy efficiency, industries are actively looking for effective substitutes for traditional energy sources. In this regard, hybrid renewable energy systems—which integrate several energy sources—have become a viable option for guaranteeing a dependable and affordable power supply (Singh & Kumar, 2020).

A thorough mathematical modeling framework for hybrid renewable energy systems that combine solar photovoltaic (PV) panels, wind turbines, and energy storage devices is presented in this research. The dynamic behavior of each energy component under various environmental conditions is represented by the suggested model using analytical and computational methods. Differential equations are used to describe the dynamics of energy storage, and mathematical formulas are developed to estimate energy generation from solar irradiation and wind speed (Li & Wang, 2021).

Optimization strategies like linear programming are used to maximize energy output and reduce operating expenses in order to improve system performance. In order to ensure realistic and useful implementation, the optimization model takes into account limitations pertaining to energy demand, system capacity, and environmental unpredictability. According to simulation results, compared to standalone renewable systems, the hybrid system greatly increases energy efficiency and decreases reliance on grid power (Khalid & Zhang, 2019).

The study also emphasizes how the suggested model can be used practically in industrial settings, such as microgrid systems and manufacturing facilities. The results show how important applied mathematics is to the development and optimization of sustainable energy solutions. A solid basis for intelligent energy management in contemporary enterprises is provided by the combination of optimization methods and mathematical modeling.

Keywords: Renewable energy, Hybrid Systems, Mathematical Modeling, Linear Programming, Energy Storage, Optimization.

Introduction:

The worldwide industrial sector encounters substantial pressure to lower energy expenses and embrace sustainable energy options. Renewable energy systems, especially solar and wind, offer eco-friendly options, but their incorporation into industrial processes demands accurate modeling to guarantee efficiency and dependability (Singh & Kumar, 2020).

Mathematical modeling offers a structured approach for forecasting energy production, examining system dynamics and enhancing efficiency. Hybrid systems integrating various energy sources with storage solutions provide greater stability, decreased intermittency and bolstered energy security for industrial uses (Li & Wang, 2021).

This document seeks to:

Create mathematical representations for solar photovoltaic systems, wind energy turbines and combined energy systems. Enhance energy production and cost-effectiveness through the use of mathematical methods. Model system efficiency in diverse environmental settings. Deliver insights for energy managers in industrial decision-making

Literature Review:

Research on hybrid renewable energy systems has accelerated due to the growing need for dependable and sustainable energy solutions, especially for industrial applications. To get over the drawbacks of individual energy technologies and guarantee a steady supply of electricity, these systems combine several renewable energy sources, including solar, wind and energy storage.

The increasing significance of hybrid renewable energy systems in tackling industrial energy concerns has been highlighted by recent studies. In a thorough analysis of several battery technologies, system topologies, and optimization techniques, (Gómez et al. 2023) found that hybrid setups greatly improve system efficiency and reliability when compared to standalone systems. Similar to this,(Alhijazi et al. 2023) examined the need for hybrid renewable systems from an economic and environmental standpoint, highlighting its capacity to lessen reliance on fossil fuels while enhancing total energy performance.

Hybrid renewable energy systems have been recognized as a crucial option for delivering integrated energy services, such as electricity, heating, and cooling, in the context of industrial applications. According to a thorough analysis of industrial hybrid renewable utility systems, these systems can efficiently support industrial operations while lowering greenhouse gas emissions and enhancing sustainability (Review of Renewable and Sustainable Energy Systems, 2023). Additionally, (Pérez et al. 2024) highlighted the function of hybrid systems in microgrids, pointing out that their capacity to function both independently and in grid-connected modes improves system resilience and energy security.

According to the literature, hybrid renewable energy systems offer a reliable and long-lasting solution for industrial energy management when they are backed by mathematical modeling and optimization approaches. However, there is still more research to be done on issues such system complexity, large initial investment, and the requirement for sophisticated control strategies. These gaps emphasize how crucial it is to create effective mathematical models and optimization frameworks in order to improve system performance and industry applicability.

Objective:

1. Create precise mathematical models for solar, wind, and combined energy systems.
2. Utilize optimization methods to enhance energy efficiency and reduce operating expenses.
3. Examine system dependability amidst changing environmental conditions.
4. Deliver practical recommendations for industrial choices in energy management

Mathematical Modeling:

1. Solar Photovoltaic (PV) Model:

The energy produced by a solar PV system is represented as:

$$Ppv = \eta \cdot A \cdot G$$

Where:

- Ppv= Power output of PV system (W)
- η= Efficiency of PV module (%)
- A = Area of PV panels (m²)
- G= Solar irradiance (W/m²)

The model includes environmental factors such as temperature and variations in irradiance to forecast realistic energy production

2. Wind Turbine Model:

The power output of the wind turbine is provided by:

$$P_{wt} = \frac{1}{2} \cdot \rho \cdot A \cdot v^3 \cdot C_p$$

Where:

- P_{wt} =Wind turbine power generation (W)
- ρ = Air density (kg/m³)
- A = Swept area of turbine blades (m²)
- $\boldsymbol{v}$ = Wind speed (m/s)
- C_p = Power coefficient (dimensionless, ≤ 0.59)

The cubic relationship with wind speed emphasizes the need for precise wind assessment in optimizing the system

3. Energy Storage Model:

Energy storage, like batteries, is represented through differential equations for charging and discharging:

$$\frac{dE_s}{dt} = P_{gen} - P_{load} - P_{loss}$$

Where:

E_s= Accumulated energy (kWh)

gen

P_{gen}= Power produced from renewable resources (kW)

unload

P_{load}= Power demand from industry (kW)

P_{loss}= Losses in the system (kW)

Optimization Approach:

1. Linear Programming (LP):

Linear programming aims to enhance energy production while reducing expenses:

Maximize $Z = \sum_{i=1}^{n}(P_i - C_i)$

Subject to:

$P_i \leq P_{max,i}, \quad E_s \leq E_{max}, \quad P_{load} \leq P_{demand}$

Where P_i and C_i are the power generation and cost of the i^{th} source.

Conceptual Model/Flowchart:

Hybrid Renewable Energy System Integration:

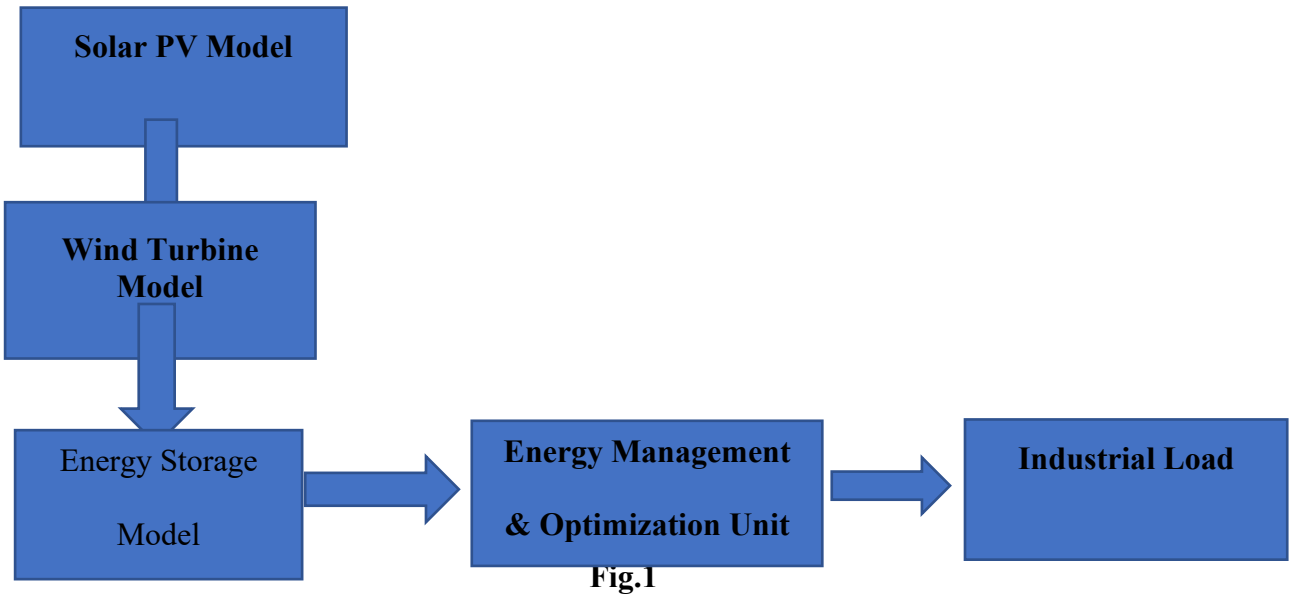


Fig.1

The flowchart illustrates the combination of renewable resources, energy storage, and optimization for industrial uses.

Results and Discussion:

Simulation Scenarios:

To assess the effectiveness of the suggested mathematical model, three simulation scenarios were taken into account:

1. Solar-Only System

The system functions entirely on photovoltaic (PV) energy. Performance is solely reliant on solar irradiance, rendering it vulnerable to fluctuations in weather and the availability of sunlight during the day.

2. Wind-Only System

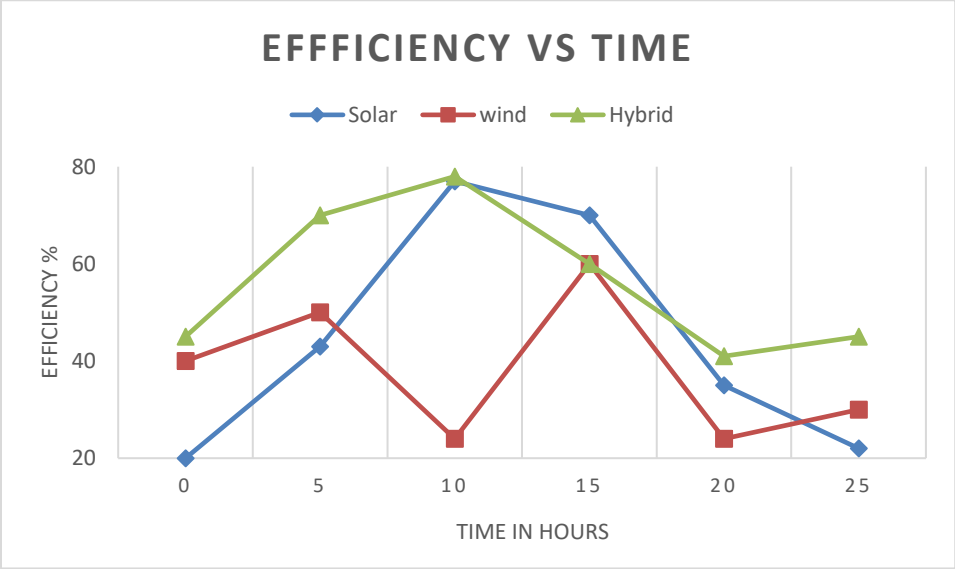
Power production relies solely on the output from wind turbines. Although it can function effectively both day and night, it shows significant variability because of changing wind speeds.

3. Hybrid Solar-Wind System with Storage

This unified system incorporates solar photovoltaic, wind power, and energy storage solutions. The storage unit adjusts for variations, guaranteeing a consistent and steady power supply to industrial loads

Graph Analysis:

The change in efficiency of various systems over time is shown in Fig. 2



Efficiency variation of solar, wind, and hybrid systems over time.

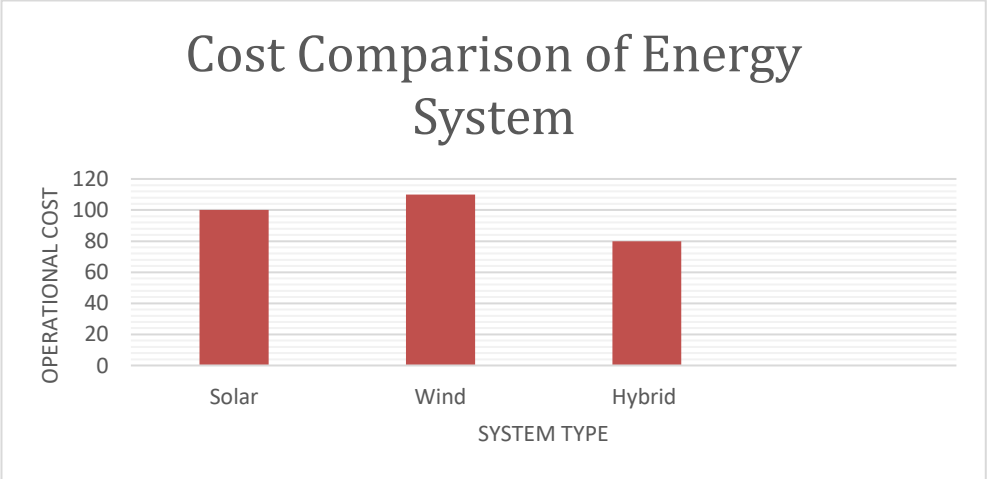
Comparative Analysis of Results:

Simulation outcomes clearly show that the hybrid system exceeds single-source systems regarding reliability, efficiency, and cost-effectiveness.

- The solar-exclusive system displays consistent output trends but experiences total generation loss at night and diminished efficiency in overcast weather.
- The wind-only system generates sporadic energy because of unpredictable wind patterns, causing inconsistency in industrial supply.
- The hybrid system, aided by energy storage, efficiently reconciles these constraints through the use of complementary energy sources

Key Observations:

The operational cost comparison is shown in Fig. 3.



Comparison of operational expenses for renewable energy systems.

- **Enhanced Stability:**

Hybrid renewable energy systems offer a much more consistent energy output than individual solar or wind systems. The incorporation of storage helps to stabilize power variations.

- **Decreasing Expenses:**

Optimization methods lower operational expenses by around 15–20%, mainly through reducing energy loss and enhancing resource distribution.

- **Sensitivity Analysis:**

The performance of the system was assessed in different environmental conditions. Findings indicate that variations in wind speed affect energy output more significantly than solar irradiance in specific geographical areas.

- **Improvement of Effectiveness:**

The enhanced hybrid system shows greater overall system efficiency through improved use of available renewable resources.

Table 1: Performance Comparison of Energy Systems

System	Efficiency (%)	Reliability	Operational Cost	Stability
Solar Only	65	Medium	Moderate	Low
Wind Only	55	Low	High	Low
Hybrid System	80	High	Low	High

Numerical Analysis:

According to simulation studies, the hybrid renewable energy system has an average efficiency of 80%, while solar-only systems get 65% and wind-only systems score 55%. The success of optimization strategies is demonstrated by the hybrid system's operational cost reduction of roughly 15–20%. Furthermore, reliability research demonstrates that hybrid systems are appropriate for industrial applications since they consistently produce power with little variation.

Discussion and Industrial Implication:

The results emphasize the vital importance of applied mathematics in creating effective renewable energy systems. Mathematical modeling allows for:

Precise forecasting of energy output across different conditions.

Monitoring systems in real-time and control that adapts

Efficient distribution of resources to minimize operational expenses.

Enhanced dependability for ongoing industrial processes

From an industrial viewpoint, hybrid renewable systems backed by optimization frameworks can greatly decrease reliance on traditional energy sources, reduce carbon emissions, and improve sustainability.

These findings align with earlier research, verifying that hybrid systems based on optimization provide enhanced performance and financial advantages (Khalid & Zhang, 2019)

Applications:

By increasing energy efficiency, lowering operating costs, and fostering sustainability, hybrid renewable energy systems provide substantial benefits across a range of industrial sectors.

1. Manufacturing Sectors

To lessen reliance on traditional grid electricity, manufacturing facilities can use hybrid renewable energy systems that combine solar, wind, and storage units. This promotes green manufacturing initiatives by reducing carbon emissions and electricity costs. Energy supply and demand are balanced with the aid of mathematical optimization models, guaranteeing continuous production operations.

2.Microgrids for Industry

The development of industrial microgrids for factories, warehouses, and industrial parks depends heavily on hybrid systems. These microgrids provide a steady and dependable power supply, particularly during blackouts, by operating either independently or in tandem with the main grid. System resilience is increased through effective load allocation, energy storage management, and real-timecontrol made possible by mathematical modeling.

3.Intelligent Energy Management Systems

The creation of decision-making tools for energy management is supported by sophisticated mathematical frameworks. These tools forecast demand, schedule energy use, and save operating costs by using optimization algorithms and predictive models. Consequently, industries might attain improved resource use and increased operational efficiency.

4. Integration of Renewable Energy in Heavy Industries

By partially substituting fossil fuel-based energy sources, hybrid renewable systems can help energy-intensive industries like steel, cement, and chemical processing. In order to make industrial processes more sustainable, mathematical models help with feasibility assessment, energy mix optimization, and environmental effect reduction.

5. Impact on the Economy and Environment

Long-term financial gains from the use of hybrid renewable energy systems include lower maintenance and energy expenses. By reducing greenhouse gas emissions and promoting adherence to legal requirements, it also promotes environmental sustainability.

Conclusion:

A thorough mathematical modeling and optimization framework for hybrid renewable energy systems designed for industrial use is presented in this paper. The suggested model successfully tackles the problems of energy variability and reliability by combining solar photovoltaic systems, wind energy conversion, and energy storage technologies. Efficient energy management is made possible by the use of optimization techniques like differential equation-based modeling and linear programming, which lead to better system performance, lower operating costs, and less reliance on traditional grid power.

In terms of efficiency, stability, and economic viability, the simulation findings show that hybrid systems perform noticeably better than isolated renewable sources. Additionally, the integration of storage systems guarantees a steady power supply, which makes the strategy ideal for crucial industrial processes. In order to create resilient and sustainable energy infrastructure, this study emphasizes the critical role that applied mathematics plays in bridging the gap between theoretical modeling and practical industrial energy solutions.

Future Scope:

Even with the encouraging outcomes, there are still a number of directions for future study and advancement:

1. **Artificial intelligence (AI) integration**: Future models will be able to predict wind patterns and solar irradiance using machine learning and AI-based forecasting approaches, allowing for real-time adaptive optimization.
2. **Advanced Methods of Optimization**: System performance and solution accuracy can be further improved by using metaheuristic algorithms like Genetic Algorithms (GA), Particle Swarm Optimization (PSO), and Ant Colony Optimization (ACO).
3. **IoT-Powered Intelligent Energy Systems**: In industrial settings, integration with Internet of Things (IoT) devices can improve responsiveness and efficiency by enabling real-time monitoring, control, and automation.
4. **Real-time implementation and scalability**: Future studies could concentrate on scaling the model for smart grids and large industrial networks, including real-time deployment and validation with industrial data.

5. **Analysis of Economics and Policy**: The financial viability and adoption potential of hybrid renewable systems in various industrial sectors can be assessed by incorporating economic models and government policy frameworks.

6. **Incorporating Other Energy Sources**: System variety and resilience can be improved by adding biomass, geothermal, or hydrogen energy systems to the model.

References:

1. Alhijazi, M., Al-Saadi, M., Al-Greer, M., & Short, M. (2023). Hybrid renewable energy systems for sustainable energy supply: A review. *Sustainability, 15*(24), 16803.
2. Gómez, T., Sánchez, R., & López, J. (2023). Hybrid renewable energy systems: A comprehensive review of design, optimization, and applications. *Clean Technologies, 4*(2), 84–102.
3. Khalid, F., & Zhang, Y. (2019). Optimization of renewable energy systems using linear programming. *Energy Conversion and Management, 185*, 365–378.
4. Li, H., & Wang, J. (2021). Hybrid solar-wind-storage systems: Modeling and simulation. *Applied Energy, 298*, 117–132.
5. Patel, S., & Mehta, P. (2024). Techno-economic analysis of solar-wind-battery hybrid systems for industrial applications. *Scientific Reports, 14*, 77946.
6. Patil, S., & Deshmukh, M. (2017). Optimization techniques for hybrid renewable energy systems. *Journal of Industrial Energy, 9*(3), 45–58.
7. Pérez, A., Rodríguez, L., & Martinez, D. (2024). Hybrid renewable energy systems in microgrids: Design and performance analysis. *Energies, 17*(11), 2578.
8. Schleifer, A., Müller, F., & Schmidt, T. (2023). Energy storage integration in hybrid renewable systems: Enhancing stability and reliability. *Frontiers in Energy Research, 11*, 1036183.
9. Singh, A., & Kumar, R. (2020). Mathematical modeling of hybrid energy systems for industrial applications. *Renewable Energy Journal, 145*, 123–135.
10. Sopian, K., Othman, M., & Yatim, A. (2018). Modeling of photovoltaic-wind hybrid system for industrial applications. *Energy Procedia, 157*, 1123–1131.

The Illusion of Understanding: Artificial Intelligence Hallucination and Epistemic Risk in Mathematics Education

Qazi Merajuddin Qazi Faheemuddin
Dr. H.N. Sinha Arts & Commerce College, Patur, Dist. Akola

Abstract

Artificial intelligence is increasingly shaping how mathematics is learned by providing quick answers and step-by-step explanations that appear clear and reliable. Systems such as ChatGPT often create a strong impression of understanding. However, these systems can sometimes produce incorrect information while presenting it with confidence. This phenomenon, known as hallucination, raises important concerns for mathematics education. This paper examines how such outputs are generated and why they pose a risk to learners. It argues that while AI tools are useful, they must be used carefully, and their responses should not be accepted without verification.

1. Introduction

Artificial intelligence is being used more frequently in mathematics education. Students rely on AI systems to solve problems, understand concepts, and access step-by-step solutions. These tools make learning faster and more accessible.

At the same time, a serious concern has emerged. AI systems sometimes provide answers that appear correct but are actually wrong. This issue is referred to as hallucination. In mathematics, where accuracy and logical reasoning are essential, even small errors can lead to misunderstanding. Therefore, it is important to examine the reliability of such systems in educational contexts.

2. Understanding Hallucination in Artificial Intelligence

Hallucination occurs when an AI system generates information that is incorrect but appears believable. Unlike human learners, who may express uncertainty, AI systems often present responses with confidence regardless of their accuracy.

This happens because AI models are trained on large amounts of data and generate responses based on patterns rather than verifying truth [1]. As a result, they may produce answers that sound convincing but are logically incorrect. This difference between appearing correct and being correct is central to the problem.

3. Theoretical Foundations of Hallucination

The issue of hallucination can be understood from both computational and philosophical perspectives.

From a computational point of view, AI systems rely on statistical patterns rather than genuine understanding [2]. Their goal is to generate the most probable response, not necessarily the most accurate one.

From a philosophical perspective, John Searle argued that a system can simulate understanding without actually possessing it [3]. In a similar way, AI systems can produce meaningful-looking explanations without truly understanding the underlying concepts.

In addition, Alan Turing showed that computational systems operate within formal limits and do not inherently verify truth beyond predefined rules [4].

4. Hallucination as an Epistemic Problem

Epistemology deals with questions of knowledge—what is true, how we know it, and why we believe it. AI hallucination creates a challenge in this area because it can present false information in a convincing manner.

Since AI-generated responses are based on patterns rather than verified reasoning, they may lack proper justification [5]. This can lead learners to believe they understand something when, in reality, their understanding is incomplete or incorrect.

5. Mathematics and the Requirement of Precision

Mathematics requires precision, logical consistency, and clear reasoning. Even a small mistake can make an entire solution invalid.

AI hallucination can lead to:

- incorrect intermediate steps
- misuse of formulas or theorems
- missing logical reasoning

Because these errors are presented confidently, students may not easily recognize them. This creates an illusion of understanding, where learners feel confident about a concept without fully grasping it.

6. Illusion of Authority and Epistemic Overtrust

AI systems often present answers in a structured and confident way, which creates a sense of authority. This can lead users to trust the output without questioning it.

This tendency is related to epistemic overtrust, where individuals accept information without sufficient verification [6]. In mathematics education, this can reduce critical thinking and encourage passive learning.

7. Balanced Perspective

Despite these concerns, AI systems offer important benefits. They provide:

- quick solutions
- clear explanations
- support for independent learning

However, their usefulness should not be confused with reliability. AI should be treated as a supportive tool, not as a final authority. Students must remain actively engaged in verifying and understanding the material.

8. Educational Implications

The presence of hallucination in AI systems has important implications for education:

1. Students should be encouraged to verify AI-generated answers
2. Teachers should guide students in responsible AI use
3. Learners must understand the limitations of AI systems
4. Greater emphasis should be placed on reasoning rather than answers

9. Conclusion

AI hallucination is an important issue in mathematics education. While AI tools can support learning, they can also produce incorrect information that appears convincing.

For this reason, students must approach AI critically and avoid accepting answers without verification. By combining the strengths of AI with careful human reasoning, it is possible to benefit from these tools without falling into the illusion of understanding.

References

1. E. M. Bender, T. Gebru, A. McMillan-Major, and S. Shmitchell,"On the dangers of stochastic parrots: Can language models be too big?"*Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (FAccT)*, 2021.
2. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 3rd ed. Pearson, 2010.
3. John Searle, "Minds, brains, and programs," *Behavioral and Brain Sciences*, vol. 3, no. 3, pp. 417–457, 1980.
4. Alan Turing, "On computable numbers, with an application to the Entscheidungsproblem," *Proceedings of the London Mathematical Society*, 1936.
5. L. Floridi et al.,"AI4People—An ethical framework for a good AI society," *Minds and Machines*, vol. 28, no. 4, pp. 689–707, 2018.
6. R. S. Nickerson,"Confirmation bias: A ubiquitous phenomenon in many guises," *Review of General Psychology*, vol. 2, no. 2, pp. 175–220, 1998.

"Impact of Digitalization on Everyday Human Existence".

Mr. Krushna S. Dombale
Assistant professor (Adhock)
Department of Computer Science

Abstract

Digitalization stands as a dominant driver reshaping contemporary human existence. It involves weaving digital tools into society's fabric, revolutionizing daily activities, work, interactions, and cognition. This study examines digitalization's broad influence across communication, learning, medical care, finances, and societal norms. Although it boosts efficiency and reach, it sparks issues like data vulnerabilities, tech dependency and interpersonal disconnection. The goal is to offer an even-handed view of how digitalization is remolding human reality.Introduction

In today's era, digitalization is indispensable rather than elective. Breakthroughs in AI, cloud systems, IoT, and vast data sets have deeply reshaped human routines. Smartphones and connected homes now permeate daily life, amplifying ease and output yet prompting debates on reliance, morality and relationships.

Keywords: Digitalization, Education Impact, Communication Shift, Healthcare Evolution, Economic Change, Psychological Effects, Social Dynamics, Privacy Risks, References,

Digital shift, school changes, talk tweaks, health upgrades, money shifts, mind impacts, people dynamics, privacy dangers.This paper breaks down digital tech's hand in main life parts, showing the good, bad, and in-between.

Introduction :

This paper dissects digitalization's role in key life areas, highlighting upsides and downsides.

1. **Effects on Communication Digitalization** has transformed outreach profoundly. Old-school letters and fixed-line phones have given way to instant chats, social networks, and virtual meetings.Global real-time links foster stronger bonds, teamwork, and cultural sharing. Companies gain from swift exchanges, sharpening choices and performance.Yet, this pivot diminishes in-person encounters, fostering emotional distance amid constant connectivity. Text-based exchanges risk misunderstandings without vocal cues. Heavy social media use often yields shallow ties and weaker social abilities.

2. **Effects on Education Digitalization** Has upended learning, promoting flexibility and broad access. Virtual platforms, smart classrooms, and online materials let learners tap global resources anytime.Self-paced study via videos, quizzes, and apps suits diverse needs. Educators leverage tech for dynamic, captivating instruction, extending reach to isolated regions.Still, unequal device and internet access widens gaps. Prolonged screens harm focus and wellness, while virtual setups may stunt social growth.

3. **Effects on Healthcare Digital tools** Have elevated medical services through telehealth, digital files, fitness trackers, and AI diagnostics, enhancing delivery and availability.Remote consultations cut travel and delays; streamlined records speed analysis. Devices enable ongoing health tracking for proactive steps.Drawbacks include data breaches risking private health details. Tech dominance might erode the empathy vital for patient rapport.

4. **Economic Effects Digitalization** has overhauled economies worldwide, spawning sectors, revamping models, and streamlining operations.Online shopping, cashless systems, and virtual services accelerate deals. Analytics decode buyer patterns for smarter strategies; remote setups tap worldwide skills.Conversely, AI-driven automation displaces roles, spurring job loss. Lifelong skill-building and digital proficiency are now vital.

5. **Social and Cultural Effects Digitalization** redefines interactions and traditions. Networks empower self-expression, idea-sharing, and worldwide dialogues.Easier cultural immersion via content boosts understanding; platforms amplify underrepresented voices for equity.Challenges

encompass online abuse, fake news and bullying, swaying views and sparking discord. Overuse fuels inactivity and issues like stress or depression.

6. **Psychological Effects Digitalization's** mental toll is notable. Convenience and fun come with risks of habit and overdependence.Alerts, feeds, and media fragment focus and efficiency, breeding overload anxiety and curated-life pressure.Positively, apps deliver therapy, forums and campaigns, linking users to aid for better emotional health.

7. **Privacy and Security Issues** Digital growth amplifies data risks, with personal details exposed online to theft or abuse.Firms harvest info for optimization, but consent and openness lag. Threats like breaches and hacks proliferate.Robust laws, defenses, and user vigilance are key to protection.Conclusion

Digitalization permeates human spheres, boosting connectivity, learning, health, and prosperity for greater ease. Yet it breeds isolation, layoffs, breaches and psychological strain.Balance demands adoption with mitigation via education, ethics, and rules—ensuring tech uplifts sustainably. As it advances, proactive oversight will safeguard human flourishing.

Materials & Method :

How Digital Tools Are Changing Our Lives

Quick Overview

Digital tech is the big force shaking up modern life. It mixes computers, apps, and the internet into everything we do, flipping how we talk, learn, work, stay healthy, handle money, and connect with people. This piece looks at its wide effects on chatting, school, doctors, cash, and society. Sure, it makes things faster and farther-reaching, but it brings headaches like data leaks, too much screen time and feeling cut off from others. The point? A fair look at how this tech is remaking our world.

Why It Matters Now :

These days, going digital isn't optional—it's a must. Smarts like AI, online storage, smart gadgets everywhere, and huge piles of data have totally changed our daily grind. Phones in our pockets and homes full of connected devices make life easier and more productive, but they kick up big questions about getting hooked, right and wrong, and real friendships.Key Words: Digital shift, school changes, talk tweaks, health upgrades, money shifts, mind impacts, people dynamics, privacy dangers.This paper breaks down digital tech's hand in main life parts, showing the good, bad and in-between.

1. How It Changes Talking

Digital stuff has flipped how we reach out. Forget slow letters or landline calls—now it's quick texts, social apps, and video hangouts. You can link up worldwide in seconds, building ties, teaming up, and sharing cultures. Businesses love the fast info flow for better calls and results.

But here's the catch: it cuts down face-to-face time, leaving us lonely even when "connected." Texts miss tone, so mix-ups happen. Too much scrolling makes friendships shallow and hurts real people skills.

2. How It Changes College

Digital tools shake up learning big time, making it flexible and open to all. Online classes, tech-smart rooms, and web resources let anyone grab world-class lessons anytime. Videos, tests, and apps fit your speed and style. Teachers use gadgets for fun, engaging lessons that reach far-off spots.

On the flip: not everyone has devices or web, so gaps grow. Staring at screens too long hurts eyes, focus, and health. Online-only can skip building friend skills.

3. How It Changes Health

Tech boosts doctor care with video visits, online records, fitness watches, and AI checkups—making it quicker and closer. No-travel chats save time; easy files speed up decisions. Gadgets track your health daily for heads-up fixes.

Downsides: hacks steal your private health info. Leaning too hard on tech might kill the warm doctor-patient chat.

4. How It Changes Money and Jobs

Digital revamps the whole economy, creating new fields, flipping business styles, and speeding things up. Web shopping, card payments, and online services make buys zippy. Data spots what customers want for sharp plans; work-from-home grabs talent worldwide.

But AI robots take jobs, causing layoffs. Now you need constant learning and tech know-how.

5. How It Changes People and Culture

Digital rewires how we hang out and keep traditions. Apps let you speak out, share thoughts, and chat globally. Easy access to other cultures builds understanding; sites lift quiet voices for fairness. **Troubles**: online hate, lies, and bullies twist opinions and stir fights. Too much use leads to couch-potato life, stress, or down moods.

6. Mind and Mood Effects

Digital's brain hit is real. Easy fun comes with addiction risks and leaning too much on it. Pings, endless scrolls, and perfect feeds wreck focus, ramp up stress, and pressure fake lives.

Good side: apps offer counseling, support groups, and awareness drives to boost mental health.

7. Privacy and Safety Worries

More digital means more personal info out there, ripe for stealing or misuse. Companies scoop data to tweak things, but they skimp on asking permission or being clear. Hacks and breaks skyrocket. Fixes need strong rules, protections, and smart user habits.Wrapping Up

Digital weaves into all we do, linking us, teaching us, healing us, and growing wealth with huge convenience. But it sparks alone time, job cuts, info thefts, and mind strain.

Smart balance means embracing it while fixing harms through learning, morals, and laws—so tech helps long-term. As it grows, staying ahead keeps us thriving.Sources (For school use): Studies from trusted journals on tech shifts, society-tech reports, mags on school/health/money, digital libraries.

Conclusion :

Digital tech is everywhere now, boosting how we connect, learn, heal, earn, and live—with tons of convenience. Apps link us globally, online classes open doors for all, video docs save trips, web shops speed buys, and shares spark ideas across cultures.But it hits hard too: less face-time leaves us lonely, screen gaps widen divides, hacks steal health secrets, robots kill jobs, bullies and fakes stir fights, addictions wreck focus and moods, and data grabs invade privacy without asking.The fix? Jump in smart—pair tech with real-life balance, teach ethics and skills, make tough rules for safety. That way, as gadgets evolve, they lift us up without dragging us down. Stay watchful to keep human joys thriving.

References :

(Optional for academic use)Peer-reviewed studies on digital shiftsTech-society reportsJournals in education, health, and financeDigital archives and publications

1. Turkle, S. (2011). Alone Together: Why We Expect More from Technology and Less from Each Other. Basic Books.Covers communication shifts, social isolation, and shallow ties from digital overuse.
2. Carr, N. (2010). The Shallows: What the Internet Is Doing to Our Brains. W.W. Norton & Company.Explains psychological effects like fragmented focus and tech dependency on cognition.
3. World Economic Forum. (2023). The Future of Jobs Report 2023. Geneva: WEF.Details economic changes, AI job displacement, and need for lifelong digital skills. Link
4. UNESCO. (2020). COVID-19 Education Response: How EdTech Can Help Close the Gap. Paris: UNESCO.Discusses education impacts—flexibility vs. digital divides and screen harms.
5. Mehta, V., & Mann, S. (2022). Telemedicine: Gains and Challenges During and Beyond COVID-19. Journal of Medical Internet Research, 24(5), e28132.Healthcare evolution: telehealth benefits, access, and data breach risks.
6. Peer Research Center. (2021). The State of Online Harassment. Washington, DC: Pew.Social/cultural effects: online abuse, fake news, bullying, and cultural dialogues.
7. Zuboff, S. (2019). The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power. PublicAffairs.Privacy/security issues: data harvesting, consent gaps, and corporate exploitation.
8. Twenge, J. M. (2017). iGen: Why Today's Super-Connected Kids Are Growing Up Less Rebellious, More Tolerant, Less Happy—and Completely Unprepared for Adulthood. Atria Books.Psychological and social effects of social media on youth—addiction, anxiety, depression.

9. Brynjolfsson, E., & McAfee, A. (2014). The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies. W.W. Norton & Company.Economic overhaul: automation, new sectors, remote work, and global talent shifts.
10. Selwyn, N. (2016). Digital Downsides: Exploring University Students' Negative Engagements with Digital Technology. Higher Education, 72(5), 639-652.Education downsides: screen time harms focus/wellness and social stunting.
11. Orben, A., & Przybylski, A. K. (2019). The Association Between Adolescent Well-Being and Digital Technology Use. Nature Human Behaviour, 3(2), 173-182.Balanced psych effects: tech fun/therapy vs. overload, anxiety from notifications.
12. Acemoglu, D., & Restrepo, P. (2020). The Wrong Kind of AI? Artificial Intelligence and the Future of Labor Demand. NBER Working Paper No. 27636.Economic focus: AI automation's job losses and reskilling needs.

Reflection of Cross Cultural Elements as A Social Milieu in the Novels of Arvind Adiga

Rameshwar Samadhan Saykhede
Research Scholar
Dr. Rahul S. Sudke
Head, Department of English**,** Dr. Gopalrao Khedkar College Gadegaon (Telhara). Dist- Akola. Maharashtra.

Abstract:-

As a shining star of the galaxy of world literature, novels of Arvind Adiga provide a critical examination of India's shifting social fabric under the influence of globalization. His works including The White Tiger, Between the Assassinations, Selection Day and Last Man in Tower highlights cultural hybridity and cross cultural encounters, which define contemporary Indian identity.

The present research paper is an attempt to analyse the reflection of cross cultural elements as a social milieu in novels of Arvind Adiga. His novels serves as a critical lens that highlights the friction between traditional Indian Heritage and modern western values. Cross cultural analysis in the works of Arvind Adiga reveal a profound conflict between conventional Indian values rooted in caste, servitude and communal loyalty and imported capitalist, individualistic values of the west.

Keywords: - cross cultural, globalization, multicultural, imperialism, subaltern.

Objectives.

- To explore cross cultural elements in the novels of Arvind Adiga.
- To Analyse cross cultural elements in the novels of Arvind Adiga.
- To examine the clash of Tradition and Modernity and cultural imperialism.

Introduction: -

In Arvind Adiga's literary works, cross cultural refers to the dynamic and violent collision between traditional Indian social structures as well as the globalised Western- influenced modern world. The term cross cultural first emerged in the social sciences during the 1930s. It is an English compound adjective, which formed by the 'cross' and 'cultural'. Cross means 'across' or 'intersecting' and cultural means anything relating to the shared ideas, customs, arts and social behaviours of a specific group of people or society.

Arvind Adiga is a pioneering figure in modern Indian English Literature. Born in Madras (currently known as Chennai) India on October 23, 1974, as son of Dr. K. Madhav Adiga and Usha Adiga. He spent part of his youth in Australia. He is an alumnus of both Columbia and Oxford universities. Before turning to fiction, he began a career in journalism, his articles have appeared in 'The Financial Time', 'The Sunday Time', and 'The Independent'. Adiga is the author of five critically acclaimed works of fiction The Man Booker prize winning novel 'The White Tiger'(2008), 'Between the Assassinations'(2008), 'The Last Man in Tower'(2011), 'Selection Day'(2016), and 'Amnesty'(2020) in addition to several short stories.

Arvind Adiga highlights the tension between traditional Indian values and westernization, globalization and class disparities through a multicultural lens within itself pitting rural, traditional India against urban, modern, westernized and capitalist India. Depicting Two India's "India of Darkness and India of Light" (The White Tiger 14) Adiga creates a stark contrast between Rural India like Laxmangarh, Dhanbad and modern urban India such as Delhi, Bangalore. It presents rural vs. urban westernized cross culture. Traditional, rural (Darkness) represented by poverty, caste rigidity, servitude and traditional family structure. Globalized, urban (Light) represented by high-tech, Americanized lifestyles, call centres and westernized food and night life. He projects the clash between the cultures through the protagonist Balram Halwai of The White Tiger, who moves rural to urban, experiencing a traumatic cultural encounters, where Balram must abandon his traditional loyalty to adopt a ruthless, capitalistic mind-set to get success.

Arvind Adiga reflects cultural imperialism and globalization. How Western culture reshapes and penetrates human psyche and Indian society, often prioritizing wealth over tradition. Depiction of

Americanization through the characters of Mr. Ashok and Pinky Madam in The White Tiger reflects cultural imperialism. Mr. Ashok try to recreate American Life in Delhi for his foreigner wife Pinky, which show the influence of foreign culture on the Indian Rich elites.

The consumerism through the rise of shopping malls, skyscrapers, modern banking and the consumption of western goods signifies a shift from traditional Indian values of simplicity to a westernised consumerist foreign culture.

Arvind Adiga also highlights the impact of foreign language such as English. How the ability to speak English language is linked to power and sophistication, while those of, who lack behind n it relegates one to a subaltern status.

Adiga presents Class and Caste as cultural barriers. He portraits class and caste discrimination as a rigid system. Class discrimination often more intense than caste in urban, globalised settings through servant- master relationship. The relationship between Balram and Mr. Ashok is a direct confrontation between the poor, middleclass, marginalised rural class and the rich, elites, urbanized, western educated class.

The novel Selection Day reflects cultural hybridity. It highlights intersections of cricket, sexuality and parental ambition. Adiga presents sport as a cultural vehicle. Here cricket is portrayed as a billion Dollar business that blends traditional athletic passion with intense corporate, westernized investment. The novel touches the hidden taboo and homosexuality within a traditional patriarchal sporting community.

Adiga frequently focuses on degradation of customary values. How the modern India has led to the loss of traditional, moral, ethical and familial values, replacing them with a desire for wealth, selfishness, greed and upward social mobility. The pursuits of money, selfishness and greed fuelled by globalization make changes in psyche. Character like Balram abandon ethics and lead to criminal acts.

Adiga also touches upon the rise of religious extremism and communal tension in the novel Between the Assassinations. The narrative deals with the coexistence and conflicts between different religious communities such as Hindu, Muslims and Christians.

Arvind Adiga as a crucial 21st century voice navigating the conflict between tradition and modernity. His work is a critique of neo-colonialism and globalization. As western education and journalistic background Adiga acts as a mediator and interprets cultural struggle. He reflects a cynical generation in India that is losing faith in traditional societal and turn towards Materialism.

Conclusion:-

Arvind Adiga's literary work serves as a mirror to contemporary society. He depicted the real picture and condition of socio-cultural elements. Cross cultural aspects are effectively reflects in his work. He handles cross cultural themes such as local vs. global, neo-colonialism, impact of globalization.

References:-

1. Adiga, Arvind. *The White Tiger*. HarperCollins Pub. India, 2009. ISBN:978-81-7223-847-6
2. Adiga, Arvind. *Between the Assassinations*. Picador India, 2009. ISBN:978-93-82616-75-7
3. Adiga, Arvind. *Last Man in Tower*. HarperCollins Pub. India, 2011. ISBN:978-93-5029-519-9
4. Adiga, Arvind. *Selection Day*. Fourth Estate. New Delhi, 2019. ISBN:978-93-5302-622-6
5. Nimsarkar, P. *Arvind Adiga: An Anthology of Critical Essays.* Creative book, 2011. ISBN-8180430804, ISBN-978-8180430800.
6. Kaur, Harleen R. and Vineeta, S. Kaur. *"Indian Social Milieu in the novels of Arvind Adiga".* International Journal of English and Literature. ISSN-(P):2249-6912, ISSN (E):2249-8028, vol.7, issue- I, Feb. 2017. pp. 21-26.
7. Gawai, Sachin R. "*Arvind Adiga: A Representation of Indian Reality*." IJCESR, ISSN-(P):2393-8794. vol.5, issue-5, 2018. pp.132-134.
8. Saquib, Mohd, and Faiyazurrehman. *"A Study of Socio-Cultural Aspects in the Selected Fiction of Arvind Adiga".* Journal of Emerging Technologies and Innovative Research, 2020. Joell.in/wp-content/uploads/2020/08/70-74-ULTURAl-ASPECTS-IN-THE-SELECTED-FICTION-OF-ARVIND-ADIGA.pdf.

Web sources:-

1. http://en.m.wikipedia:org>wiki.
2. www.researchgate.com

Insights into Flowering Phenology and Floral Dynamics of *Ruellia ciliatiflora* and *Thunbergia erecta*

Ashwini Bhalchandra Phokmare
Department of Botany
Shri Shivaji Arts, Commerce and Science College, Akot

Abstract-

Flowering phenology and floral dynamics play a crucial role in understanding plant reproductive biology and their interaction with environmental factors. The present study investigates the flowering phenology and floral dynamics of two members of Acanthaceae, *Ruellia ciliatiflora* Hook. and *Thunbergia erecta* (Benth.) T. Anderson. Detailed field observations were conducted to record the timing, duration and pattern of flowering, along with floral opening, longevity and associated dynamic events. Both species exhibited distinct phenological patterns influenced by seasonal variations. *Ruellia ciliatiflora* showed a relatively shorter flowering span with synchronized blooming, whereas *Thunbergia erecta* demonstrated an extended flowering period with intermittent flowering peaks. Floral anthesis in both species occurred during early morning hours, facilitating effective pollinator interactions. Differences were observed in flower longevity and timing of reproductive events, indicating species-specific adaptations. The study highlights that flowering behavior in these species is closely linked with environmental conditions such as temperature and light. The observed variations in phenology and floral dynamics may contribute to reproductive success and pollination efficiency. These findings provide valuable insights into the ecological significance and adaptive strategies of Acanthaceae members, which can be useful for further studies on plant–pollinator interactions and conservation biology.

Key Words- Phenology, dynamics, anthesis, anther dehiscence etc

1.Introduction-

One of the most detrimental effects of global warming on ecosystems with distinct seasonality, such alpine ecosystems at mid-to high latitudes, is phenological change. Plant-pollinator interactions are expected to be impacted by variations in flowering timing and length in plant groups. However, very little research has been done on how global warming affects community-scale phenology in alpine ecosystems (Kudo, Gaku.,2019). To comprehend the dynamics of plant reproduction and the availability of resources for pollinators, flowering patterns are essential. Flower and leaf phenology is limited by seasonal environment, and the hues of flowers and leaves probably change with the seasons. The primary floral characteristic that draws pollinators is color; however, pollinators' perception of flower color contrasts is influenced by seasonal variations in the leaf-background colors (Martins AE et al., 2021). Flowering patterns, which define temporal changes in plant reproduction, resource availability for flower visitors, maintenance of plant–pollinator variety, and plant reproductive success, are shaped by seasonality and are closely linked to the dynamics of plant communities. (Gentry, 1974; Lieth, 1974; Ramírez, 2006; Morellato et al., 2016). Temporal variation in morphological and life-history traits is directly linked to phenotypic plasticity in perennial plants. Phenotypic plasticity in reproductive phenology determines colonisation ability and population persistence in invasive weeds (Munguia-Rosas, 2013). A number of ecological factors frequently influence blooming phenology at the community level, and depending on resource availability, the time of year when flowering yields the highest seed setting rate may change from year to year (Mahoro, 2002; Rathcke & Lacey, 1985).

2.Material and Method-

The flowering phenology of the ornamental plant species under study was examined throughout the course of five days at various sites. Dates for the beginning, middle, and finish of flowering were recorded. The interval between the blossoming of the first and last flowers is known as the flowering phase. A 10x hand lens, which recorded the anther dehiscence time in the field both before and after

the flower opened, was used to measure the time of anthesis, or flower opening, and anther dehiscence, or mature anther splitting to release pollen grain. Additionally, recorded were the duration and duration of nectar secretion.

3. Observation and Result

Ruellia ciliatiflora

Thunbergia erecta

3.1 Flowering phenology of studied plant species *Ruellia ciliatiflora and Thunbergia erecta*

Ruellia ciliatiflora flowers on March 30th when the temperature rises and the amount of sunlight increases. The plant produces the most flowers during the peak flowering period, which runs from June 16 to August 28. November 17th marks the end of the blossoming phase. It might bloom all year long under the right circumstances. On November 28, when there is less daylight, *Thunbergia* flowers first appear. The plant produces the most flowers during the peak flowering period, which runs from December 5 to February 25. March 5th marks the end of the flowering phase. It may continue to bloom all year long under favourable circumstances.

3.2 Floral Dynamics of studied plant species *Ruellia ciliatiflora and Thunbergia erecta*

Anthesis of *Ruellia ciliatiflora* began between 06.30 and 07.00 am. The dehiscence of anther was observed after 07.30 am after the opening of flower. Between 8:00 and 9:00, nectar was secreted following anther dehiscence. The nectar remained available from 08.00 am to 16.00 pm. Anthesis in *Thunbergia erecta* began between 06.00 and 07.00 in the morning. After the bloom opened at 07.030 am, the anther began to dehiscence. Nectar was secreted between 07.30 and 08.30 following anther dehiscence. The nectar was accessible from 8:00 am till 17:00 pm.

4. Discussion

The study shows clear differences in flowering phenology between *Ruellia ciliatiflora* and *Thunbergia erecta*, reflecting their adaptation to seasonal environmental conditions. *Ruellia ciliatiflora* flowers from late March with a peak during the monsoon (June–August), while *Thunbergia erecta* flowers from late November with a peak in winter (December–February). This seasonal variation reduces competition for pollinators and supports reproductive success.

Both species exhibit similar floral dynamics with early morning anthesis, followed by anther dehiscence and nectar secretion. Such synchronization favors pollination by diurnal pollinators. Nectar availability from morning to late afternoon further enhances pollinator visitation and pollination efficiency. Overall, the differences in phenology and timing of floral events indicate ecological adaptations that optimize reproductive success in both species.

5. Conclusion

The study concludes that *Ruellia ciliatiflora* and *Thunbergia erecta* exhibit distinct yet well-coordinated flowering phenology and floral dynamics. *Ruellia ciliatiflora* is primarily a monsoon-flowering species, while *Thunbergia erecta* shows a winter flowering pattern, indicating adaptation to different seasonal niches. Both species display early morning anthesis followed by timely anther dehiscence and nectar secretion, ensuring efficient pollinator attraction. The duration of nectar availability further supports effective pollination by extending the period of floral rewards. These synchronized floral events enhance reproductive success and demonstrate the ecological significance

of phenological and dynamic traits. The findings contribute to a better understanding of reproductive biology in Acanthaceae and provide a basis for future studies on pollination ecology and conservation strategies.

6. References

1. GentryA. H. (1974). Flowering phenology and diversity in tropical Bignoniaceae.Biotropica664–68. 10.2307/2989698
2. Kudo, Gaku. (2019). Dynamics of flowering phenology of alpine plant communities in response to temperature and snowmelt time: Analysis of a nine-year phenological record collected by citizen volunteers. Environmental and Experimental Botany. 170. 103843. 10.1016/j.envexpbot.2019.103843.
3. Lieth H. (1974). "Introduction to phenology and modeling of seasonality," in Phenology and Seasonality Modeling, ed.LiethH. (Springer Verlag: Berlin), 3–19.
4. Mahoro, S. (2002). Individual flowering schedule, fruit set, and flower and seed predation in Vaccinium hirtum Thunb. (Ericaceae). Canadian Journal of Botany, 80(1), 82–92
5. Martins AE, Camargo MGG and Morellato LPC (2021) Flowering Phenology and the Influence of Seasonality in Flower Conspicuousness for Bees. Front. Plant Sci. 11:594538. doi: 10.3389/fpls.2020.594538
6. Morellato L. P. C. AlbertonB.Alvarado S. T. Borges B. Buisson E. Camargo M. G. G.et al (2016). Linking plant phenology to conservation biology.Biol. Conserv.19560–72. 10.1016/j.biocon.2015.12.033
7. Munguia-Rosas, Miguel & Parra-Tabla, Víctor & Montiel, S. (2013). Extreme variation in the reproductive phenology of Ruellia nudiflora. Weed Research. 53. 10.1111/wre.12028.
8. RamírezN. (2006). Temporal variation of pollination classes in a tropical Venezuelan plain: the importance of habitats and life forms.Can. J. Bot.84443–452. 10.1139/b06-015
9. Rathcke, B. , & Lacey, E. P. (1985). Phenological patterns of terrestrial plants. Annual Review of Ecology and Systematics, 16, 179–214.

Teaching English Language and Literature in the Era of Artificial Intelligence

Dinesh Kumar
Associate Professor of English, Dyal Singh College, Karnal (India)

Abstract

There is no doubt in denying the fact that English literature is a complex mosaic that traces the development of human ideas, culture, and emotions. It is more than just words on a page. It encompasses a variety of genres, styles, and voices that tell stories of love, sorrow, ambition, and societal challenges throughout a period of centuries. A reader can experience the lives and viewpoints of people who have long since gone into history thanks to the rich fabric of English literature, which cuts over geographical and temporal barriers. It sheds light on the past by providing a window into the hopes, phobias, and beliefs of earlier generations.

Keywords: Artificial Intelligence, literature, effect, mirror, timeless.

Without any shadow of doubts, the field of literature, especially English literature, is a timeless fabric made of the imagination, feelings, and experiences of people. English literature encapsulates the crux of human existence and civilization throughout time. It can be perceived from the majesty of Shakespeare's masterpieces to Jane Austen's moving prose. It serves as a mirror reflecting the changing nature of human nature, frequently inspiring readers to consider existential, moral, and social issues.

The introduction of Artificial Intelligence (AI) into the field of English literature starts a new era of investigation, discovery, and transformation as technology advances. The present paper explores the enormous effects of AI on English literary study methodology, the discovery of untapped knowledge, and its role in igniting societal change.

A minute analysis and incisive study and reading, literary analysis, and interpretation have always been the mainstays of English literature scholarship. In-depth analysis of themes, characters, and narrative structures would be done by academics, who frequently delved into the biographical background of authors. Although useful, this method requires a lot of time and has cognitive limitations. With the development of digital technology, research procedures became more streamlined. Access to a sizable textual library and more effective data analysis were made possible.

By removing the constraints of physical distance and limited resources, the development of online databases and digital libraries democratized access to literary works. This represented a significant turning point since it allowed researchers to interact with a wider range of works, from canonical classics to undiscovered treasures. However, the sheer amount of information accessible presented its own difficulties, necessitating creative approaches to identify themes, relationships and patterns.

Enter Artificial Intelligence, a ground-breaking development that is revolutionizing the field of English literature study. AI puts computational power in the spotlight, strengthening established research techniques and improving the quality and scope of analysis. The immense breadth of literary works may now be combed through using machine learning algorithms, natural language processing, and text mining approaches, revealing hidden insights and patterns that could evade human scholars.

AI programmes can quickly scan through huge amounts of text to find recurrent themes, grammatical quirks, and cross-textual allusions that present novel viewpoints. Sentiment analysis makes it possible to comprehend the emotional undercurrents in texts, illuminating the intentions of authors and the social conditions that shaped their works. Additionally, AI-driven recommendation systems broaden readers' scopes of exploration by introducing them to works that are relevant to their interests

Besides, the fusion of artificial intelligence and English literature research goes beyond quantitative analysis. AI systems that are creative can create poetry, dialogue written in the manner of

a certain author, and even suggest alternative story pathways. The lines between authors are blurred by the interaction of human creativity and AI innovation, adding new perspectives to the study of literary production and progress.

It is a worldwide fact that AI has also make it easier for a wider range of readers to engage with literary works. AI-powered language translation eliminates language boundaries and opens up works to audiences worldwide. Readers can converse with characters on interactive platforms that use AI-driven conversation agents, promoting immersive literature experiences. A more literate society could be fostered by this democratization of literary engagement, which has the power to rekindle a love of reading and learning across demographic lines.

To improve research, analysis, and creative processes in several areas of English literature, artificial intelligence (AI) can be used. Large volumes of literary texts can be scanned and analyzed by AI algorithms to find themes, trends, and patterns that might be hard for humans to see. This has made it easier for researchers to quickly extract relevant information from lengthy publications and give them the research they actually need.

AI can speed up and increase the accuracy of text mining and information retrieval procedures. 5 Based on the precise objectives of your text mining and information retrieval jobs, it's critical to select the best AI technique and tool combination. Artificial intelligence (AI)-powered text mining and analysis has fundamentally changed literature in many ways. We now have more knowledge about literary works and the processes by which they are produced, shared, and consumed thanks to the new opportunities these technologies have given for scholars, writers, publishers, and readers.

The process of applying artificial intelligence (AI) and natural language processing tools to identify the sentiment or emotional tone expressed in a piece of text is known as sentiment analysis, also referred to as opinion mining. The procedure for comprehending sentiment in literature is comparable to sentiment analysis for other forms of text data, however due to the intricacy and nuance frequently present in literary works, various changes and considerations may be necessary. Here is how sentiment analysis for literature is carried out:

A dataset of literary texts is first required. This dataset is open to all kinds of literary works, including novels, poems, reviews, and more. The texts may be available digitally as text files or eBooks.

Figurative language, metaphors, and intricate phrase constructions are common in literary works. Additional context analysis may be required because AI models may find it difficult to understand these subtleties. (By contrasting the AI's predictions with human-annotated sentiment labels, you can evaluate the sentiment analysis's accuracy.)

To help readers comprehend the emotional tone of the literature, visualize the sentiment analysis results using sentiment heat maps or charts. A sentiment analysis model for literature may need to be fine-tuned to perform better depending on the domain and particular requirements. We should keep in mind that sentiment analysis for literature is fundamentally subjective because various readers may have different interpretations of the same text. Furthermore, a literary work's cultural and historical background can affect sentiment, making it a difficult but exciting field for AI research and application.

Artificial intelligence (AI)-powered recommendation systems can greatly help with literature studies and analysis in a variety of ways, improving the procedure's effectiveness and depth of knowledge.

Books, articles, and research papers can be suggested to users based on their own interests and requirements using AI-based recommendation systems. These systems can compile a customized list of pertinent literature by looking at a user's reading preferences, past reading choices, and academic or research objectives.

These tools can guide readers to fresh, pertinent literature they might not have otherwise encountered. These systems can make literary recommendations based on how closely a piece of

literature resembles something the user has already read or enjoyed by utilizing collaborative filtering, content-based filtering, or hybrid methods.

Topic Exploration: Recommendation systems can provide a starting point for academics or students wanting to investigate a certain topic by recommending seminal books or key literature on the subject. By doing so, users can save time and lay a solid groundwork for their research. Managing citations and references for academic papers and research projects can be facilitated by AI-powered recommendation systems. Based on the information in your work, they might advise you on relevant sources to list in your bibliography.

Ancient or fragile manuscripts and texts can benefit from AI's assistance in being digitized and preserved, ensuring that scholars and fans will have access to them indefinitely. Artificial intelligence (AI) and digital preservation have a substantial impact on the advancement and preservation of literature in a number of ways.

Artificial intelligence (AI) can be used to improve or restore damaged or outdated literary writings. AI algorithms, for example, can restore missing or faded text, eliminate noise, and enhance overall legibility of scanned or digitized manuscripts, making them easier to access and understand.

Automated transcription and translation: Tools with artificial intelligence (AI) can turn typed or handwritten manuscripts into digital text. Additionally, by translating writings into different languages while maintaining the core of the original work, AI-driven translation services can assist in making literature accessible to a global audience.

By recommending books to users based on their tastes, AI-powered recommendation systems can help promote and preserve lesser-known literary masterpieces. Readers may be exposed to a wider variety of literary genres and voices as a result.

Language Processing for Analysis: Techniques for natural language processing can help with large-scale literary analysis. In order to further literary studies, researchers can employ AI technologies to find stylistic trends, authorship attribution, and theme components in vast corpora of texts. AI can be used to conserve and promote languages that are in danger of extinction. This includes indigenous languages and languages that are endangered. AI can assist in recording and preserving these priceless cultural resources by digitizing and transcribing oral traditions and literature.

The detection of plagiarism is one area where artificial intelligence (AI) has significantly changed many facets of our life. The use of AI in the detection of plagiarism has produced a number of advantages for the advancement of academics, literature, and the protection of intellectual integrity.

Here is a look at how AI benefits this significant project:

Tools that use AI to identify plagiarism can swiftly scan large amounts of text and compare it to databases of academic papers, books, articles, and other sources. This effectiveness identifies suspected plagiarism cases considerably more quickly than manual methods, saving both instructors and researchers considerable time. Accuracy and Precision: Since AI algorithms are made to evaluate text at a detailed level, they can identify similarities and possible plagiarism with high accuracy. For the sake of upholding academic integrity, these algorithms can detect both verbatim matches and paraphrased information.

AI can help prevent plagiarism in addition to plagiarism detection. Publishers and educational institutions can use AI-based solutions to give writers immediate feedback, assisting them in understanding and avoiding accidental plagiarism. This instructional component encourages ethical research and better writing techniques.

AI-powered plagiarism detection tools can be adapted to the unique requirements of certain organizations, publications, or sectors. Additionally, they may be readily incorporated into existing content management systems, which makes it simpler for enterprises to include plagiarism detection into their workflow

In the end, AI in plagiarism detection improves literature by encouraging ethical research and writing techniques. It promotes a culture of knowledge creation and creativity by upholding the standards of academic integrity and encouraging writers to create unique, high-quality content.

Character analysis in literary works can benefit greatly from the use of artificial intelligence (AI). It can aid writers, scholars, and readers in gaining a greater understanding of the motivations, personalities, and character development of the characters. The following are a few ways AI can help in character analysis.

In this way, after making an indepth and incisive study of different applications of Artificial Intelligence in English literature, we can safely and rightly aver the fact that the introduction of AI into the field of English literature has ushered in a revolutionary period that holds enormous promise for academics, authors, teachers, and fans alike. AI has demonstrated to be a potent instrument capable of altering research methodology, revealing profound literary insights, and sparking significant social revolutions, as this study paper explores.

Automated literature analysis helps scholars find complex themes and patterns in texts that could have escaped them otherwise. In order to foster a greater understanding of literary works and the creative process itself, it gives helpful aid in authorship attribution, sentiment analysis, and content development. The accessibility of literary gems to a global audience has also increased thanks to AI's applications in translation, language learning, and accessibility, which have helped to dissolve language boundaries and promote cross-cultural interaction.

By personalizing recommendations to each reader's preferences, AI-driven recommendation systems have completely changed how readers find new literary jewels. The collaborative writing potential of AI and its contribution to the preservation of literary legacy, meantime, serve as reminders of its transformative powers.

Technology and literature are increasingly combining, thanks to the development of interactive storytelling, literary chatbots, and adaptable curriculum design. With AI's ability to assess character development, linguistic growth, and even plagiarism, literary academics now have more tools at their disposal to explore the subtleties of literary works.

The impact of AI on English literature extends to how cultures interact with and consider their cultural narratives in the larger context of societal transformation. It has the potential to democratize literature by opening it up to a wider range of audiences, promoting literary debates around the world, and furthering literary studies. As this investigation comes to a close, it is clear that artificial intelligence is a catalyst for change in the field of English literature rather than just a tool. Its continual incorporation into research approaches and creative processes has the potential to open up new vistas of comprehension and awe.

While the impact of AI on English literature is still developing, one thing is certain: it will have a lasting impact on how we read, write, teach, and ultimately appreciate literature's eternal beauty. It is a revolution with the potential to improve our literary heritage and motivate future 16 generations when wisely tapped into

Works cited:

1. Bainbridge, William Sims. *The Spaceflight Revolution: A Sociological Study.* New York: John Wiley, 1976.
2. Ahern, Laura M. *Invitations to Love: Literacy, Love Letters, and Social Change in Nepal*. Ann Arbor: University of Michigan Press, 2001.
3. Bassett, Caroline. *Better Made Up: The Mutual Influence of Science Fiction and Innovation*. London: Nesta, 2013.
4. Broussard, Meredith. *Artificial Unintelligence: How Computers Misunderstand the World*. Cambridge: The MIT Press, 2018.
5. Buckland, Adelene. *Novel Science: Fiction and the Invention of Nineteenth-Century,* 2013.

Improvement of Teaching Methods with AI Knowledge and Pedagogical Expertise

Researcher
Vedant P. Ghotkar
(M.C.A, NET, B.Ed)

Abstract :

Artificial Intelligence (AI) in education (AIEd) has become an indispensable tool for both educators and learners in India as it has begun to change the whole educational system. Almost 70% of teachers use AI for teaching purposes and 85% students use AI for their study purposes. To provide effective, learner-centred and self paced learning and to keep up with the current fast changing vast knowledge base, AI integration is becoming a necessity.

In the very centre of this evolution is knowledge integration, where this research paper examines how pedagogical expertise with technical AI knowledge and ethics create a robust learning environment in classrooms.

Various teaching methods in combination with AI tools are examined and the effectiveness of these strategies are reviewed.

Keywords : AIEd, learner-centred, pedagogical expertise, knowledge integration, ethics

Improvement Of Teaching Methods With AI Knowledge And Pedagogical Expertise :

This paper addresses two main topics, 1) how the artificial intelligence in combination with proper pedagogical methods lead to an effective learning environment, and 2) what measures should be taken to ensure the successful implementation. This paper will begin by defining what is AIEd, what are teaching methods and pedagogical strategies in concerned research topics. Next, the paper examines the need to use AI with pedagogy and its effectiveness. The paper will then look at what sort of measures should a teacher or educator take in order to ensure successful implementation of the process. This paper plays an important role in creating a robust learning environment with integration of AI and right pedagogical strategies to make learning most effective as well as efficient.

Definitions :

1) **Artificial Intelligence (AI) :** It is a branch of computer science that develops such systems which mimic some of the capabilities of the human brain to perform tasks without or with minimal human intervention.
2) **AIEd (Artificial Intelligence In Education) :** It involves using various machine learning based analysis tools and generative AI to provide personalized, automated and adaptive learning experiences.
3) **Teaching Methods :** They are the systematic and structured techniques and strategies used by teachers to ensure achievement of specific educational goals.
4) **Pedagogical Strategies :** It refers to study of teaching approaches and how they affect learners. Pedagogy directs the teacher regarding the teaching strategies employed by the teacher to deliver the content in class to enhance the expected learning outcomes.

Need Of Artificial Intelligence in educational institution :

In modern educational scenarios the integration of AI has become a fundamental necessity for improving learning outcomes and institutional efficiency. Here are some of the core needs of AI in education include :

1) It offers personalised, adaptive and self paced learning with targeted support to improve overall performance of learners.
2) It helps teachers cut their workload by 40-50% as it can help with lesson planning, academic and non-instructional administrative tasks.
3) It can help in identifying students who may be likely to fail or drop out, allowing teachers to intervene early thus by increasing student retention.

4) It helps in optimising curriculum by analysing it to find the most easy and difficult parts for students.

Why pedagogical expertise is necessary even when using AI :

Artificial Intelligence is a tool for instruction and not a replacement for teaching. While AI can generate content, grade papers it lacks the professional judgement to know how or why a specific student learns. Reasons for pedagogical expertise is a necessity are as follows :

1) AI more so than often produces "hallucinations" - information that sounds confident but is factually wrong. A teacher with proper knowledge of subject matter and pedagogical expertise can act as a filter.
2) AI can overwhelm students with too much information. Here a teacher with pedagogical understanding can break down the huge information into small easy digestible topics.
3) AI cannot understand the emotional condition of students as they come from various cultural backgrounds, have different interests and struggles. A pedagogy expert can use his own insight to provide AI data in a way that is relevant to the classroom.
4) Learning is a social process. We can't expect AI to understand, empathise, or encourage us. Pedagogical expertise ensures that technology doesn't isolate students, but instead is used to facilitate human-to-human collaboration.

Implementation of AI Integration And Pedagogical Approach In Teaching Methods :

To improve the teaching a teacher should use AI as an efficient engine and pedagogy as the steering wheel. Pedagogy ensures the technology serves a learning goal rather than just being an information gathering tool.

Here are two practical examples to showcase the how the synergy between AI and Pedagogy evolves the teaching methods to create an efficient learning environment :

1) In Science class a teacher can use AI to apply ZPD (Zone of Proximal Development) to teach photosynthesis.
   a) AI Tool : Generative AI like claude or ChatGPT
   b) Pedagogy : Teacher ensures the complexity of explanation is challenging enough to learn something new but not so hard that student cannot understand.
   c) Procedure : Teacher asks AI to explain photosynthesis in three different levels: easy, moderate and tough for students below, at and above grade level.
   d) Benefit : All heavy task of rewriting the content is done by AI
   e) Measure for Successful Implementation : Verify the authenticity, clarity of content presented by AI
2) In Math class a teacher uses AI tools to create quizzes that summarize results in heat map representation to perform the Real Time Formative Assessment.
   a) **AI Tool** : Google Gemini, ChatGPT or Olama
   b) **Pedagogy** : Teacher plans today's lesson based on data driven instruction on what students did not understand yesterday
   c) **Procedure** : After a math lesson on trigonometry, students take a 5 question quiz and after reviewing the result heatmap teacher understands what parts and formulas students have not understood thus changing teaching strategies to improve learning outcomes.
   d) **Benefit** : Improves the learning outcomes thereby improves overall students performance in subject
   e) **Measure for Successful Implementation** : Observe how student attempts question rather than just focusing on result

Ethical Practices To Follow In Implementation Of Above :

Teachers are responsible for protecting student digital data and thus should follow proper ethical guidelines while using AI services and tools. Here are some of key considerations :

1) They should always read 'terms of service' of any AI tools before uploading student data.

2) Teachers should teach students not to insert or upload PII(Personally Identifiable Information) like their full names, address in public AI models.
3) Always examine information generated by AI with references to verify and validate the facts.
4) Use AI platforms as a helping tool rather than a substitute for preparing lesson plans, making visual presentations and automated grading.
5) Teachers should value students' efforts and creative thinking rather than just blindly follow AI graded results.

Conclusion :

In modern educational scenarios just using AI is not enough as it is just a cool gadget for information gathering and visual representation. Expertise of teachers in subject matter and understanding of pedagogical approaches is crucial to successfully integrate AI in teaching-learning environments. Without proper understanding of pedagogy principles students may feel isolated, overwhelmed or lag behind which negatively affect their academic performances. It is a teacher's responsibility to validate content, provide ethical mentorship, and foster all round development of students. This research paper concludes that a synergy between AI technology and pedagogy is the necessity to evolve the long standing teaching practices.

References :

1) Indian Teacher using AI Tools Survey https://www.indiatoday.in/education-today/latest-studies/story/70-indian-teachers-using-ai-tools-but-many-misunderstand-it-survey-2763565-2025-07-30
2) Artificial intelligence in education: A systematic literature review https://www.sciencedirect.com/science/article/pii/S0957417424010339
3) Mishra, P., & Koehler, M. J. (2006). *Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge.*
4) *Vygotsky, L. S. (1978). Mind in Society.*
5) AI in Education Statistics for 2026 https://codegnan.com/ai-in-education-statistics/
6) Case Studies on Reduction Of Teacher Workload Using AI https://www.unowa.eu/blog/ai-for-teacher-workload-reduction-case-studies#:~:text=Frequently%20Asked%20Questions%20(FAQ),adequate%20teacher%20training%20and%20support
7) International Journal of Artificial Intelligence in Education Research and Development (IJAIERD) Volume 3, Issue 1, January-June 2025, pp. 1-18, Article ID: IJAIERD_03_01_001 Available online at https://iaeme.com/Home/issue/IJAIERD?Volume=3&Issue=1 Journal ID: 1706-7659; DOI: https://doi.org/10.34218/IJAIERD_03_01_001
8) Artificial intelligence in education: Addressing ethical challenges in K-12 settings https://pmc.ncbi.nlm.nih.gov/articles/PMC8455229/

Universal Humanism and Harmony in Togore's Art

Dr. Maruti B. Gouda
Associate Professor,
Govt. First Grade College, Varthur, Bangalore East-87, Karnataka State.

Abstract:

The focal point of the paper is on the well-rounded expression of Tagore's philosophy of harmony. The infinite and finite point is the metaphysical aspects of harmony, freedom and Bondage having ethical suggestion. Feeling and form evokes the aesthetic side of universal harmony. This paper focuses on universalism over narrow nationalism and patriotism. He believed in oneness of humankind and a borderless world. This paper highlights the concepts of harmony and integration, aiming to bridge the gap between the individual and the universe, nature and man, and the East and the West.

Keywords: Universal, humanism, philosophical, harmony, integration, man and nature

Introduction:

Tagore was not just a poet and writer; he was also a song composer, playwright, essayist and painter. Tagore revolutionised the dimensions of Bengali art and literature. Tagore's ideas of harmony has two implications: first, there is an assumption that the intellectual, practical and others aspects of human nature must confirm to the aesthetics; and second, that within the aesthetic side of life itself there should be a harmonious coexistence of the rational and the intuitive, the sensuous and spiritual, the individual and universal aspects of the creation and appreciation of beauty. As for the first, Tagore shows a decided preference for the ancient attitude, in which art and literature are regarded as indivisible elements of the total process of living and experiencing, in distinction from the modern tendency towards overspecialisation.

The main feature of Tagore's philosophy, which has direct bearing upon his aesthetics, is the positive and integrative spirit in which he views all aspects of life, reality, thought and knowledge. This philosophy of reconciliation and Harmony, of balance and proportion, is of special significance in the field of aesthetics. Yet the discussion is on Tagore's views on harmony in his comments on art. Tagore powerfully invented in unity in diversity, believer for communal harmony as the establishment of India's integration.

Tagore applies his philosophical world-view on a strong emphasis on harmony and integration, to his aesthetics. Tagore does not give us any definition of Beauty but he tries to bring out the concept of the beautiful from various angles. While recognising that sensitivity to beauty is part of man's universal endowment, he also looks at the gradual refinement of this feeling in the course of man's cultural development. Thus far, we have been looking at Tagore's views on the harmony which flows through nature in human life; in other words the harmony which pervades the manifested world, *prakrit* or *jagat* or whatever name we may choose to give it. However, there is a deeper implication of this universal rhythm or harmony which points Reality in its essential nature; apart form its specific manifestation.

The paper emphasises on harmony is a persistent feature of Tagore's writings spread over a long period of more than fifty years. It is seen that in his emphasis on harmony and proportion feels more comfortable with the aesthetics ideals of the ancient world than with the modern preoccupation with the strange and the unusual. However, Tagore has nothing but admiration for one important feature of modern thought: its recognition of the value of individual personality. To sum up the matter brilliantly in these words 'personality is the harmony of the unique, while the peculiar is the discords of the unique'.

Tagore said that art is the response of man of love throughout the entire world. To achieve the union the divine reality is the chief aim of art and poetry. The realisation of harmony, of the feeling of oneness with the Eternal is accomplished through personality. Togore thinks that man feels his

personality more than other creatures and this efflux of the consciousness of personality requires an outlet of expression in the form of art. Tagore writes: "In Art the person in us is ending its answers to the supreme Person, who reveals Himself to us in a world of endless beauty across the lightless world of facts".(Satish Kumar, 76).

Man's personality finds powerful expression in art and poetry. It enables him to fight against the insane and the invert and to transform everything which he has any true concern into the human .And art is like the spread of vegetation, to show far man has reclaimed the desert for his own. Tagore envisioned a freedom where children could learn in harmony with nature, promoting creativeness and holistic progress. Sine art originates from personality, the content it expresses is emotionally tinged and it enriches human life by sublimating or illuminating feeling. Poetry leads us in higher and healthier ways than those of the world, and interprets to us lesson of Nature and the Mystery of God. Tagore rejects the "art for art's sake" theory and again asserts that the aim of the artist is to bring to light the ultimate reality. Poetry reveals truth poetic truth is not the mass of materials, but their universal relatedness. The real significance of art consists in "the joy of attaining the infinite within the finite. So, poetry, like all other arts is an expression of man's emotional energy: "Man has a find of emotional energy which is not all occupied with his self-preservation. This surplus seeks its outlet in creation of Art for man's civilisation is built upon his surplus"(Satish Kumar, 77).

In Tagore's conception of harmony, the ideas of unity and proportion are supplemented by that of rhythm. It is through rhythm that harmony acquires a fluid and dynamic character. Unity and proportion in themselves may represent the aspect of stillness or "sheer harmonious existence" without any hint of flux or transformation. It is man's prerogative to express rhythmically the unity at the centre of creation. In Tagore's words: " Even birds can repeat a single note, or a very simple combination of notes. But man builds his world of music and establishes ever-new rhythmic relationships of notes, which reveal to him the universal mystery of creation"(S Ramswamy and V.S Sethuraman, 341)

Tagore's conviction that art can be instrumental in bringing man closer to the highest reality presents an interesting contrast to the Platonic view that the artist takes us away from reality. Accepting the traditional Greek assumption that all art is essentially imitative or representational, Plato passed strong strictures on the function of the artist in society. He felt that by making "copies of copies" the artist is "twice removed from reality"; that he leads us from Reality to Appearance, unlike the philosopher who rises from Appearance to Reality. Tagore did not face the difficulties regarding art which Plato felt: firstly because for Tagore art is not imitative, and secondly because he does not see a dichotomy between Reality and Appearance. If the artist leads us to the world of appearance, Tagore would say, what of it? "In the appearance is the Reality" . He explains this through a suggestive metaphor. When we look at a painting, we know that the canvas is tangible- and in that sense 'real'- While the picture is mere 'appearance'. Yet it is the picture, not the canvas that evokes in us an intense feeling of Reality. The principle of harmony in Tagore's aesthetics is expressed through the ideas of unity, proportion, rhythm and the sense of oneness with Reality. Art is neither an imitation of Reality nor an escape from Reality. Art is essentially evocative and suggestive. "Art evokes in our mind the deep, rich awareness of Reality." Tagore sees in aesthetic experience the "magic wand". Which unites us with Reality? His views on this question are similar to those of Bergson. "The Object of art", says Bergson, is "is to reveal to us, within us and outside of us, in nature and in the soul, things which we cannot reach through the consciousness."(S Ramswamy and V.S Sethuraman, 344) And Tagore says that where the mind fails to unite us with Reality, art succeeds.

What is true of Form is also true of feeling. In both, unity and differentiation are equally necessary. If *Bhava* reflects only difference, it becomes aggressive. This may resulting in making the art work grotesque. Aesthetic emotion must' accept the universe' it must obey the truth of its surroundings, and this demands a sense of oneness. When inner harmony is reflected in outer form, which is itself clothed in proportion, we get the satisfaction that true communication has indeed taken place. Without such a communication, aesthetic experience would remain incomplete. in art , what is

not given away is wasted . A great work of art is like a bank in which emotion is deposited, not to be locked up for ever but to be taken, lent out again. Rasa, like wealth demand circulation.

In poetry, too, the law of harmony operate by accepting both unity and difference. If the main ingredient of painting is the line, that of poetry is the word. Like lines, words must also have their balance and proportion. To this balance we give the name *chhanda* (metre). But metre represents only the exterior. Poetry demands inner harmony as well, the harmony of feeling. This inner harmony is conveyed through *vyanjana* (suggestion or suggestiveness). This element in poetry corresponds to the element of Varna (colour) in painting. Though colour, the line transcends its own limit and reaches out into the world of freedom. Similarly, though suggestion words transcends the limits impose upon them by meaning and urge into the Unknown. To see the outer in and through the inner, and to express the inner through the medium of the outer: such is the twofold aim of painting, poetry, and of all art.

It emphasises on harmony and proportion Tagore more comfortable with the aesthetic ideals of the ancient world than with the modern preoccupation with the strange and the unusual. However, Tagore has nothing but admiration for one important feature of modern thought: its recognition of the value of the individual personality. In Modern western civilisation, this feature has been carried to extreme lengths and the ideas of personality have been expressed through rank subjectivism. An artist is laughed if he does something unusual, even bizarre, and just to show that he is different from others. Tagore condemns these excesses of modern individualism. Nevertheless, he feels that in the Indian aesthetic tradition there has been too much concern with the notion that an artist should regards himself merely as an instrument for the expression of eternal truths, too much expectation of anonymity, too little stress on the artist's own unique personality. In Tagore's aesthetic we find a happy blend of the ancient adherence to the principle of harmony and the modern recognition of the individual's role.

Tagore's view has metaphysical implications. He regards Ultimate Reality as Supreme Personality. Because of the immense authority and influence of absolute monism represented most powerfully by Shankaracharya's *advaita Vedanta*, the impersonal aspect of the Infinite has been emphasised in the Indian Philosophical tradition. Nevertheless, even in the Upanishads, though the dominant trend is towards the impersonal Absolute, the idea of personality has not been excluded. Tagore has quoted in his discourse many passages from like Upanishad in support of a personality interpretation of the infinite. This philosophical conviction that reality can only have any meaning for us if it is interpretation in term of the category of personality is reinforced, Tagore maintains, by all the three major aspects of man's inward life: the ethical , the religious and above all the aesthetic.

In the fact the very concept of unity, proportion and harmony can be intelligible only in relation to the leaving, growing personality. The ancient ideal of harmony conflicts only with the egocentric individualism that is fashionable in some modern art-circle – a kind of individualism which tends to glorify the bizarre, the strange and the unusual. The ideal harmony of harmony is fully consistent with recognition of the value of personality in aesthetic creativity and enjoyment. Tagore sum up the matter brilliantly in these worlds: "Personality is the harmony of the unique, while the peculiar is the discord of the unique" (Rabindranath Tagore 21) True religion is love, harmony, simplicity.

Conclusion:

Rabindranath Tagore was a poet and composer among many things who shaped Bengali literature, music as well as Indian arts. He was not just a poet or an artist but a visionary who wanted to redefine humanity's relationship with itself and the world. He highlights the spiritual unity of humankind, the significance of creativeness and self-determination, and the moral responsibility. He was thus a symbol of harmony, love, and synthesis. This paper promotes learning in harmony with nature, ensuring that education incorporated rational growth with artistic self-expression.

Works Cited:

1. Devy, G. N (2010) *Indian Literary Criticism: Theory and Interpretation* , Orient BlackSwan, Bangalore,
2. S Ramswamy and V.S Sethuraman, (1986) *English Critical Tradition, An Anthology of English Criticism,* Macmillan Madras
3. Satish Kumar,(2001) A Survey of Indian English Poetry, Prakash Book depot Bareilly
4. Rabindranath Tagore in Perspective, A Bunch Of Essays, Viswabharati Culcutta, 1989

Green Chemistry for Sustainable Industrial Development: Recent Advances and Future Perspectives

Prof. Trupti Chaware (Ingle)
Shri Shivaji Arts, Commerce & Science College, Akot, Dist. Akola (M.S.)
Dr. Gajanan Ingle
Dr. Gopalrao Khedkar Mahavidyalaya, Gadegaon (Telhara), Dist. Akola (M.S.)
Dr. Sanjay Kolhe
(Affiliated to Sant Gadge Baba Amravati University, Amravati)

Abstract:

The recent developments in green chemistry and its implications for advancing sustainability in a variety of industries are thoroughly reviewed in this study. In response to the pressing demand for ecologically acceptable solutions in chemical synthesis and industrial applications, green chemistry also referred to as sustainable chemistry has become a crucial field of study. The design and execution of chemical processes that reduce environmental effect while optimizing efficiency and resource use are highlighted by the concepts of green chemistry. The use of renewable feedstocks, catalysis, solvent selection, energy efficiency, waste reduction, recycling, and life cycle assessment (LCA) are important areas of advancement. More effective and selective chemical transformations are made possible by catalysis, which lowers energy consumption and waste production. The dangers to the environment and human health associated with conventional solvent-based operations are reduced by the use of cleaner, more sustainable solvents as well as solvent-free and solid-state reactions. Reducing carbon emissions and improving resource efficiency are two benefits of energy efficiency advancements, such as process intensification methods and renewable energy technology. The circular economy is supported by waste reduction and recycling techniques like atom economy and cradle-to-cradle design, which also lessen the environmental impact of chemical products. Additionally, a variety of industries, such as materials science, pharmaceuticals, agrochemicals, and renewable energy, use green chemistry. Businesses can improve their competitiveness and market acceptability by implementing green chemistry concepts to create safer, more sustainable goods and processes.

Keywords: *Advancements, Green Chemistry, Sustainable Synthesis and Applications.*

Introduction:

Green chemistry, sometimes referred to as sustainable chemistry, has become a game-changing strategy for resolving the social and environmental issues brought on by conventional chemical processes. Green chemistry, which is based on the ideas of resource conservation and environmental stewardship, aims to create chemical processes and products that reduce or completely do away with the usage and production of dangerous compounds.

Chemists Paul Anastas and John Warner initially introduced the idea of "green chemistry" in the 1990s. They offered a framework for creating chemical systems that are intrinsically safer, more effective, and less detrimental to the environment and human health. Fundamentally, green chemistry is a collection of guidelines designed to support sustainability at every stage of a chemical product's life cycle, from the extraction of raw materials to disposal. The use of renewable feedstocks, catalysis, solvent selection, energy efficiency, waste reduction, recycling, and life cycle assessment (LCA) are some of these guidelines. Green chemistry provides a route to a more sustainable and circular economy by incorporating these ideas into chemical design and manufacturing procedures.

Growing awareness of resource scarcity, climate change, and environmental degradation has accelerated the implementation of green chemistry ideas in academia, business, and government. Green chemistry has the potential to completely transform the production, consumption, and management of chemicals through interdisciplinary cooperation and innovation, with real advantages for the economy, ecosystems, and human health. Green chemistry offers a framework for promoting

innovation, resilience, and sustainability in the global chemical sector as we face the intricate issues of the twenty-first century.

Objective:

The recent developments in green chemistry and its implications for advancing sustainability in a variety of industries are thoroughly reviewed in this study.

Methodology:

The secondary sources of information used in this study include books, journals, articles, research papers, websites, and other sources. Green chemistry advances: sustainable synthesis and use. The goal of green chemistry is to reduce the negative effects that chemical processes and products have on the environment. In order to promote environmental stewardship and human health, it aims to provide sustainable solutions that minimize or completely eradicate the usage and production of dangerous substances. Paul Anastas and John Warner first proposed the idea of "green chemistry" in the 1990s, and it quickly gained traction as a revolutionary strategy for chemical discovery.

Essential Green Chemistry Principles:

Sustainable Feedstocks: Due to its heavy reliance on non-renewable resources like fossil fuels, traditional chemical synthesis contributes to resource depletion and environmental damage. The use of renewable feedstocks, such as biomass, agricultural waste, and carbon dioxide (CO2), has been the focus of developments in green chemistry. Researchers have created sustainable substitutes for chemicals obtained from fossil fuels by utilizing renewable resources like lignocellulosic biomass and sugars derived from plants. Furthermore, the transformation of CO2 into Value-added products, like chemicals and fuels, present a viable way to combat climate change and reduce greenhouse gas emissions.

Catalysis: The process of catalysis allows reactions to continue at milder conditions and lowers energy consumption and waste generation; catalysis is essential to green chemistry. To enable effective and selective transformations, a variety of catalysts, including as enzymes, metal complexes, and organocatalysts, have been produced.

In particular, enzymatic catalysis is a desirable choice for green synthesis due to its benefits, which include high specificity, gentle reaction conditions, and biodegradability. Additionally, the design of heterogeneous catalysts makes recycling and separation simple, which improves sustainability even more.

Selection of Solvents: Chemical processes require solvents, but because of their toxicity and volatility, many traditional solvents are hazardous to the environment and human health. The use of safer, more environmentally friendly solvents, like water, ionic liquids, and supercritical fluids, is emphasized in green chemistry.

Efficiency of Energy Use: Since energy-intensive processes contribute to resource depletion and greenhouse gas emissions, increasing energy efficiency is a major goal of green chemistry. Shorter reaction durations and more effective energy use are made possible by process intensification techniques like flow chemistry, photochemistry, and microwave and ultrasound irradiation. These methods are economically feasible for industrial applications since they not only save energy consumption but also increase yield and productivity.

Recycling and Waste Reduction: A key tenet of green chemistry is minimizing waste formation, with an emphasis on creating procedures that use recyclable materials and generate fewer byproducts. Techniques like biodegradable polymers, catalytic recycling, and atom economy enhance resource efficiency and reduce environmental effect.

Life Cycle Evaluation (LCA): A methodical approach of assessing a product or process's environmental effects over the course of its whole life cycle is called life cycle assessment, or LCA. LCA concepts are used in green chemistry to evaluate the sustainability of chemical processes and inform choices. LCA helps find areas for optimization and development by taking into account variables including resource depletion, energy use, and greenhouse gas emissions. Additionally, LCA

helps make well-informed decisions about the use of materials, procedures, and technologies that reduce environmental impacts.

Green Chemistry Applications in the Pharmacy:

To create safer and more environmentally friendly medicinal compounds and production methods, the pharmaceutical industry has embraced the concepts of green chemistry.

Pharmaceuticals can be synthesized more effectively and with less of an impact on the environment thanks to green chemistry techniques like solvent substitution, catalytic processes, and biocatalysis. Additionally, the use of green metrics like process mass intensity (PMI) and E factor makes it possible to measure sustainability performance at every stage of the drug development process.

Crop Protection and Agrochemicals: Green chemistry in the agrochemical industry provides chances to create fertilizers and insecticides that are less harmful to human health and ecosystems. When compared to traditional synthetic chemicals, bio-based insecticides made from natural sources—such as plant extracts and microbial metabolites—show less toxicity and environmental persistence. Furthermore, crop protection agents are more sustainable and effective because to precision agricultural technology including controlled release formulations and nanoencapsulation.

Nanotechnology and Materials Science: In materials science and nanotechnology, green chemistry concepts are being used more and more to create environmentally benign materials with improved functionality and performance. Sustainable polymers, like bioplastics and biodegradable materials, provide non-toxic, biocompatible substitutes for petroleum-based plastics. Additionally, green synthesis techniques like sol-gel and bioinspired assembly make it possible to create nanomaterials with specific characteristics for a range of uses, such as drug delivery, sensors, and catalysis.

Technologies for Renewable Energy: The development of renewable energy technology, including solar cells, batteries, and fuel cells, depends heavily on green chemistry. Next-generation photovoltaic devices use sustainable ingredients like organic dyes and perovskite compounds to increase stability and efficiency. Furthermore, green High-performance energy storage systems with less of an impact on the environment can be produced thanks to synthetic pathways for battery electrodes and electrolytes. Additionally, biofuels made from renewable feedstocks provide a sustainable substitute for fossil fuels, promoting energy security and decarbonization.

Industry Views and Difficulties: Although green chemistry has the potential to improve sustainability in a number of industries, a number of obstacles must be overcome before it can reach its full potential. These include cultural opposition to change, economic limitations, regulatory obstacles, and technological restrictions. Furthermore, making the switch to greener options would necessitate large infrastructural, research, and development expenditures. However, industry stakeholders are under increasing pressure to adopt green chemistry principles and spur innovation in the direction of a more sustainable future due to growing environmental awareness and demand to cut carbon emissions.

Regulations and Policies of the Government: In order to encourage green chemistry activities and provide a favorable regulatory environment, government policies and regulations are essential. Businesses are encouraged to invest in green technologies and implement sustainable practices through incentives like tax credits, grants, and subsidies. Furthermore, laws like the Toxic Substances Control Act (TSCA) and REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) require the assessment and management of chemical risks, which encourages the use of safer substitutes and pollution control strategies. Additionally, multilateral accords like the Paris Agreement and the Sustainable Development Goals (SDGs) offer a framework for international collaboration on climate action and environmental sustainability.

Prospects & Future Paths: With prospects for interdisciplinary cooperation and technology transfer, the subject of green chemistry is well-positioned for future expansion and innovation. New tools for expediting the discovery and development of sustainable materials and processes are provided by emerging trends including artificial intelligence (AI), machine learning, and materials informatics.

Additionally, incorporating circular economy concepts like extended producer responsibility and product stewardship would improve waste management and resource efficiency even more. Furthermore, multi-stakeholder projects and public-private partnerships can promote knowledge exchange and capacity building to handle challenging sustainability issues globally.

Conclusion:

The development of green chemistry is an important step in tackling the urgent environmental and social issues of the twenty-first century. Green chemistry provides a route to sustainable synthesis and applications in a variety of industries by embracing concepts including renewable feedstocks, catalysis, solvent selection, energy efficiency, waste reduction, recycling, and life cycle evaluation. Adopting green chemistry principles has the potential to improve human health and well-being, reduce pollution, mitigate climate change, and conserve resources. Green chemistry has the potential to completely transform how chemicals are created, manufactured, and used through interdisciplinary cooperation and innovation, promoting a more sustainable and circular economy.

Green chemistry provides a ray of hope for building a more resilient and prosperous future as we tackle the intricate problems of sustainability. We can create a society where prosperity and environmental stewardship coexist and leave a lasting legacy for future generations by using chemistry for good.

References:

1. Anastas, P. T., & Warner, J. C. (1998). Green Chemistry: Theory and Practice. Oxford University Press.
2. Sheldon, R. A. (2015). Green chemistry and resource efficiency: towards a green economy. Green Chemistry, 19(1), 18-43.
3. Clark, J. H., & Farmer, T. J. (2015). Green chemistry, biofuels, and biorefinery. Annual Review of Chemical and Biomolecular Engineering, 10, 1-29.
4. Constable, D. J. et al. (2002). Metrics to 'green' chemistry—which are the best? Green Chemistry, 4(5), 521-527.
5. Hartung, J. (2015). Green chemistry in the pharmaceutical industry. Green Chemistry Letters and Reviews, 13(3), 184-198.

Reimagining English Language Teaching in the Age of Artificial Intelligence: Emerging Perspectives for Undergraduate Education

Gajanan Dayaramji Tayade
Associate Professor of English
Shri Shivaji Arts, Commerce & Science College, Akot, Dist. Akola

Abstract:

The rapid advancement of artificial intelligence (AI) has significantly transformed the landscape of higher education, particularly in English Language Teaching (ELT). Traditional pedagogical approaches, often characterized by one-size-fits-all instruction, limited feedback, and resource constraints, are being redefined through the integration of intelligent technologies. These tools enhance learning outcomes, personalize instruction, expand access to resources, and create more dynamic, learner-centred environments. This paper explores emerging perspectives in ELT for undergraduate students in the age of AI. It examines pedagogical shifts, benefits, challenges, and future implications of AI-driven instruction. Drawing upon recent empirical studies and theoretical frameworks, the paper argues that while AI offers transformative opportunities—such as adaptive learning pathways and immediate feedback—its effective implementation requires critical awareness, ethical considerations, teacher adaptation, and a balanced hybrid approach that preserves human elements of education.

The expansion of AI in ELT is not merely technological but represents a paradigm shift. Tools powered by natural language processing (NLP), machine learning, and generative models (e.g., large language models like those underlying ChatGPT) now handle tasks ranging from automated writing evaluation to conversational practice and pronunciation feedback. In undergraduate contexts, where students transition from general English proficiency to academic and professional communication skills, AI addresses longstanding issues like heterogeneous proficiency levels in large classes, insufficient individualized attention, and limited opportunities for authentic practice outside the classroom.

This reimagining aligns with broader trends in higher education toward digital transformation, where AI augments rather than replaces human instruction. However, realizing its potential demands moving beyond hype to evidence-based integration that considers contextual factors, including varying institutional resources, cultural nuances in language learning, and the diverse needs of undergraduate learners in regions like South Asia or other EFL-dominant contexts.

Keywords: Artificial Intelligence (AI), English Language Teaching (ELT), Higher Education, Adaptive Learning, Natural Language Processing (NLP), Machine Learning, Generative AI, Undergraduate Education, Language Pedagogy,

1. Introduction

English Language Teaching (ELT) has historically evolved in response to social, cultural, and technological changes. From the grammar-translation method to communicative language teaching (CLT) and task-based learning, pedagogies have continuously adapted to shifting priorities, emphasizing accuracy, fluency, or real-world application. The emergence of Artificial Intelligence (AI) marks a new phase in this evolution, characterized by computational systems capable of performing tasks that typically require human intelligence, such as language processing, pattern recognition, decision-making, and even creative content generation.

In higher education, these technologies are increasingly integrated into language classrooms through adaptive platforms, chatbots, automated assessment tools, speech recognition systems, and generative AI applications. Undergraduate education represents a crucial stage where students develop academic communication skills, critical thinking, intercultural competence, and linguistic proficiency

essential for global mobility and employability. However, many undergraduates, particularly in non-English dominant contexts such as India, China, and other EFL settings, enter university with varying proficiency levels shaped by prior schooling, regional dialects, and exposure to English-medium instruction. Traditional classrooms often struggle with large enrolments, time constraints, and the inability to provide timely and personalized feedback on writing, speaking, or listening skills.

Artificial Intelligence offers significant opportunities to address these challenges. Adaptive learning systems can analyse student performance data in real time to adjust difficulty levels, recommend appropriate resources, and scaffold learning tasks. Conversational agents simulate authentic dialogues, thereby reducing speaking anxiety and enabling unlimited practice opportunities. Automated writing tools provide immediate feedback on grammar, coherence, and style, allowing instructors to focus on higher-order cognitive and communicative aspects of learning. Recent research suggests that AI reshapes language learning environments by enhancing engagement, motivation, and overall skill development.

This paper seeks to reimagine ELT within this evolving technological landscape by exploring emerging perspectives aligned with contemporary undergraduate education. It draws on empirical evidence from studies published between 2024 and 2025, highlighting both quantitative gains—such as improvements in writing accuracy and speaking fluency—and qualitative insights into learner experiences. The discussion emphasizes that AI is not a panacea; its effectiveness depends on thoughtful pedagogical design, ethical oversight, and active teacher agency. Without these considerations, challenges such as over-reliance on technology, bias amplification, and widening educational inequities may arise. Ultimately, the paper advocates for a human-AI collaborative model in which technology enhances, rather than replaces, the relational, creative, and critical dimensions of language education.

2. Literature Review

The integration of Artificial Intelligence (AI) into language education has been widely examined in recent scholarship, particularly following the mainstream adoption of generative AI tools during 2022–2023. Systematic reviews and meta-analyses indicate that AI enhances language learning through personalized instruction, real-time feedback, and adaptive content delivery. These technologies enable learners to progress at their own pace while addressing individual weaknesses in vocabulary, grammar, pronunciation, and discourse organization more efficiently than traditional pedagogical approaches.

Studies focusing on undergraduate learners demonstrate that AI tools, such as automated writing evaluation (AWE) systems, significantly improve writing skills. Meta-analytic evidence from experimental and quasi-experimental studies conducted between 2019 and 2025 reports a large overall effect (Hedges' $g \approx 1.10$) on English as a Foreign Language (EFL) outcome. Notably, substantial gains are observed in writing accuracy, speaking fluency, and learner motivation. In addition to cognitive improvements, affective benefits have also been documented, including reduced anxiety and increased enjoyment, particularly when AI provides non-judgmental and supportive learning environments.

Conversational agents powered by natural language processing (NLP) further expand opportunities for authentic communication practice, which is often limited in traditional classrooms due to large class sizes or learner inhibitions. Empirical studies on AI-driven speaking applications among university students reveal improvements in oral proficiency, as these tools simulate real-life communicative scenarios and provide immediate pronunciation feedback. For example, a case study involving Chinese university students using AI-based speaking applications reported enhanced fluency and confidence through repeated, low-stakes interactions.

Another important dimension highlighted in the literature is the psychological impact of AI-supported learning environments. AI-driven tools have been shown to influence learner creativity, reduce foreign language anxiety, and promote self-reflection. Features such as gamification and scaffolded feedback align with self-determination theory by fulfilling learners' needs for autonomy, competence, and relatedness. Consequently, learners exhibit higher levels of engagement when AI

systems tailor content to their proficiency levels and personal interests, thereby fostering self-regulated learning.

Despite these advantages, the literature also identifies several challenges associated with AI integration in language education. Issues such as the digital divide, limited infrastructure, and inadequate teacher training hinder effective implementation, particularly in resource-constrained institutions. Additionally, concerns about over-dependence on technology may lead to reduced critical thinking and superficial learning processes. Algorithmic biases—such as privileging standardized forms of English over diverse accents and World Englishes—also raise questions about inclusivity and linguistic diversity.

Recent scoping reviews further indicate that much of the existing research is concentrated in higher education contexts, particularly in regions such as China and other parts of Asia, with a predominant focus on writing skills and English language learning. There is a growing call for more diverse and longitudinal studies that examine different educational levels, multilingual settings, and the long-term effects of AI on learner autonomy. Ethical considerations, including data privacy, academic integrity, and equitable access, are gaining prominence but require more comprehensive and context-sensitive frameworks.

Overall, the reviewed literature supports the positive role of AI in enhancing language skills and learner motivation. However, its effectiveness remains highly context-dependent and is influenced by factors such as pedagogical integration, teacher preparedness, and institutional support. The findings collectively underscore the importance of adopting hybrid instructional models that combine the efficiency of AI technologies with the critical guidance and facilitation provided by human educators.

3. Theoretical Framework

The reimagining of ELT in the age of AI draws on several complementary theoretical perspectives that provide a robust lens for understanding technology integration.

Constructivist learning theory posits that learners actively construct knowledge through interaction and experience rather than passively receiving information. AI-based tools align well with this by enabling interactive, learner-centred environments. Adaptive systems respond dynamically to student input—analysing errors, providing scaffolds, and adjusting pathways—supporting individualized knowledge construction. Generative AI can act as a "more knowledgeable other," offering models, explanations, or prompts that help learners build linguistic competence within their zone of proximal development.

The Technology Acceptance Model (TAM) offers insight into adoption by students and teachers. Perceived usefulness (e.g., how AI improves learning efficiency or outcomes) and perceived ease of use (e.g., intuitive interfaces) predict behavioural intention to integrate tools. Studies on undergraduates show that positive attitudes toward AI—shaped by prior experience and demonstrated benefits—significantly influence its uptake. Extended TAM frameworks incorporate trust, institutional support, and sociocultural factors for richer predictions in educational settings.

Sociocultural theory (Vygotsky) emphasizes the role of interaction, collaboration, and cultural tools in learning. Language develops through social mediation. AI-mediated platforms facilitate interaction not only between learners and machines but also among peers via collaborative tools or shared virtual spaces. AI can serve as a cultural artifact or scaffold, expanding the learning community beyond the physical classroom to include global interlocutors or simulated authentic contexts. This supports communicative competence while addressing power dynamics in multilingual or EFL settings.

Additional frameworks like Communicative Language Teaching (CLT), Cognitive Load Theory, and TPACK (Technological Pedagogical Content Knowledge) complement these. CLT prioritizes meaningful interaction, which AI chatbots and immersive environments can enhance without overwhelming cognitive resources. TPACK underscores that effective AI integration requires teachers to blend technological, pedagogical and content expertise. Together, these theories advocate for AI as

an enhancer of human-centred learning rather than a replacement, guiding the design of tasks that promote deep processing, critical evaluation of AI outputs, and ethical use.

4. Emerging Perspectives in English Language Teaching

4.1 Personalized Learning and Adaptive Instruction

One of AI's most significant contributions is **personalized learning**. Adaptive systems collect and analyze learner data (performance, preferences, pace) to deliver customized content, exercises, and pathways. In undergraduate classrooms characterized by diverse proficiency levels—ranging from basic interpersonal skills to advanced academic literacy—this addresses heterogeneity effectively. For example, a student struggling with academic vocabulary might receive targeted modules, while an advanced learner tackles complex discourse analysis or genre-specific writing.

Personalized approaches enhance engagement and motivation by respecting individual differences and allowing self-paced progress. They also support differentiated instruction at scale, which is challenging in large classes. Empirical evidence shows gains in proficiency and self-efficacy when learners feel ownership over their trajectory. However, effective personalization requires high-quality data and algorithms sensitive to cultural and linguistic diversity, avoiding one-size-fits-all biases toward Inner Circle Englishes.

4.2 Automated Feedback and Assessment

AI-powered tools provide immediate, detailed feedback on writing, grammar, pronunciation, and even discourse features. Automated writing evaluation systems analyze essays for coherence, vocabulary range, and mechanics, offering revision suggestions. Speech recognition and pronunciation apps give real-time corrections on intonation or segmental accuracy.

This reduces teacher workload on routine corrections, allowing focus on higher-order skills like critical analysis, argumentation, creativity, and cultural nuance. Assessment shifts toward formative, continuous models rather than high-stakes summative exams. Meta-analyses confirm positive effects on skill improvement, particularly when feedback is actionable and combined with teacher oversight. Challenges include ensuring feedback quality (AI may miss pragmatic or rhetorical subtleties) and training students to critically engage with it rather than accept outputs uncritically.

4.3 Interactive and Immersive Learning Environments

AI facilitates interactive environments via chatbots, virtual assistants, intelligent tutoring systems, and speech technologies. These simulate real-life scenarios—job interviews, academic discussions, or travel situations—enabling safe, repeated practice of speaking and listening, skills often sidelined in traditional settings due to time or anxiety.

Immersive tools (e.g., VR/AR combined with AI) create contextualized experiences that boost retention and transfer. Benefits are pronounced for oral skills, with studies showing improved fluency and reduced anxiety. For undergraduates preparing for global careers, this builds pragmatic competence and confidence in using English across varieties.

4.4 Data-Driven Pedagogy

AI enables collection and analysis of vast learner data to identify patterns, track progress, predict difficulties, and inform decisions. Teachers gain dashboards showing class-wide trends or individual needs, supporting evidence-based adjustments. Early identification of struggles (e.g., persistent grammar errors or low engagement) allows timely interventions.

This promotes reflective teaching and resource allocation. However, it requires data literacy among educators and ethical handling to avoid surveillance perceptions or misuse.

4.5 Redefining the Role of Teachers

AI shifts teachers from primary knowledge transmitters to facilitators, mentors, curators, and ethical guides. Instructors design tasks that leverage AI (e.g., prompt engineering for generative tools), evaluate AI outputs critically, and foster human elements like empathy, motivation, and community-building. This necessitates professional development in AI literacy, prompt design, bias detection, and hybrid pedagogy.

Teacher identity evolves toward "AI-augmented educators" who orchestrate human-AI collaboration. Successful implementation depends on training programs that build confidence and address fears of obsolescence.

5. Challenges and Ethical Considerations (as it is, properly formatted)

5.1 Digital Divide

Access to devices, high-speed internet, and AI tools remains uneven across regions, institutions, and socioeconomic groups. Students from disadvantaged backgrounds or rural areas may lack resources, exacerbating educational inequalities. In contexts like undergraduate programs in developing regions, infrastructure gaps limit AI's benefits to privileged learners.

5.2 Academic Integrity

AI raises concerns about plagiarism, authorship, and dishonesty. Generative tools can produce essays or responses that mimic student work, blurring lines between assistance and substitution. Over-reliance may undermine original thinking and skill development. Institutions need clear policies on disclosure, process-oriented assessment (e.g., drafts, reflections), and detection balanced with trust.

5.3 Over-Dependence on Technology

Excessive reliance risks reduced cognitive engagement, shallower processing, and diminished autonomy. Students may bypass deep learning by accepting AI suggestions without reflection, potentially eroding critical thinking or creative expression. Long-term effects on learner agency require monitoring.

5.4 Ethical Use of Data and Algorithmic Bias

AI systems collect sensitive data, raising privacy and security issues. Institutions must implement robust protections and transparent consent practices. Additionally, biases in training data can perpetuate standard language ideologies, disadvantaging non-native accents, dialects, or World Englishes users. Ethical frameworks should prioritize fairness, transparency, and inclusivity.

Addressing these demands multi-stakeholder approaches: policy development, teacher training, student education on responsible use, and ongoing research into equitable design.

6. Implications for Undergraduate Education

AI integration has profound implications for undergraduate ELT.

Curriculum design must embed digital literacy, AI literacy, critical evaluation of technology outputs, and ethical reasoning alongside traditional language skills. Students should learn to use AI as a cognitive co-pilot while developing independent competencies. Curricula could include modules on prompt engineering, bias detection, and hybrid task design.

Teacher education programs need to incorporate AI-based pedagogy, covering tool selection, integration strategies (guided by frameworks like TPACK or ATS), and management of challenges. Professional development should be ongoing, practical, and context-sensitive.

Assessment practices require re-examination. Shift toward authentic, process-focused methods—portfolios, reflective journals, oral defences, or AI-human collaborative projects—that value creativity, collaboration, and critical thinking over easily automated outputs. Rubrics should explicitly address AI use and originality.

Broader institutional implications include investing in infrastructure, fostering cross-disciplinary collaboration (e.g., between language departments and computer science), and developing guidelines for responsible AI use. In diverse undergraduate contexts, policies must account for equity to ensure AI narrows rather than widens gaps.

7. Future Directions

The future of ELT in the AI age lies in hybrid learning models that intelligently combine human interaction with technological support. AI excels at efficiency, personalization, and scale, but cannot replicate empathy, cultural sensitivity, moral reasoning, or spontaneous creativity central to language as a social practice. Optimal models position AI as a scaffold or co-pilot within teacher-orchestrated environments.

Future research should prioritize:

- Longitudinal studies on long-term impacts on language proficiency, learner autonomy, critical thinking, and affective outcomes.
- Diverse contexts beyond dominant research settings (e.g., more work in South Asia, Africa, or multilingual classrooms).
- Ethical and equity dimensions, including bias mitigation, data governance, and inclusive design for World Englishes.
- Teacher-AI collaboration mechanisms, professional development efficacy, and student training in responsible use.
- Multimodal and immersive AI applications, alongside evaluations of hybrid intelligence in real classrooms.
- Development of guidelines, frameworks, and open tools that promote transparency and pedagogical alignment.

Innovation should focus on human-centred AI that augments strengths—e.g., AI handling routine practice while teachers facilitate deep discussion and cultural exchange. International collaboration among educators, developers, and policymakers will be key to responsible advancement.

8. Conclusion

Artificial intelligence is reshaping English Language Teaching by introducing innovative pedagogical approaches, enabling personalization at scale, and transforming traditional practices. For undergraduate students, it offers unprecedented opportunities for tailored learning experiences, interactive engagement, immediate feedback, and skill development in authentic contexts. Meta-analytic and empirical evidence supports gains in linguistic competence, motivation, and self-regulation when integrated thoughtfully.

However, integration also presents challenges related to equity, ethics, academic integrity, over-dependence, and the preservation of human dimensions in education. Reimagining ELT requires a balanced, critical approach: leveraging AI's strengths while safeguarding against risks through robust policies, teacher empowerment, student literacy, and evidence-based design. By adopting reflective, hybrid perspectives grounded in constructivist, sociocultural, and technology acceptance theories, educators can harness AI to create more inclusive, effective, and meaningful learning experiences. The goal is not technology-driven education but technology-enhanced human flourishing in language learning—preparing undergraduates not only to use English proficiently but to navigate an AI-augmented world with agency, ethics, and creativity. This balanced vision ensures AI serves as a powerful ally in undergraduate ELT, expanding access and potential while honouring the fundamentally social and humanistic nature of language education.

References

1. Dogar, M. F., & Khan, S. (2025). AI-enhanced English language learning at the undergraduate level: A mixed-methods analysis of effectiveness and challenges. ASSA Journal.
2. Peña-Acuña, B. P., & Fernandes Durão, R. C. (2024). Learning English as a second language with artificial intelligence for prospective teachers: A systematic review. *Frontiers in Education*.
3. Shah, I., & Fatima, A. (2024). Exploring artificial intelligence and English language learning practices of undergraduate students. *Social Sciences Spectrum*.
4. He, M., Abbasi, B. N., & He, J. (2025). AI-driven language learning in higher education. *Humanities and Social Sciences Communications*.
5. Dai, L., & Wu, F. (2025). An AI-powered conversational system for college students learning English. *Education and Information Technologies*.
6. Feng, H. (2025). Artificial intelligence in the English language education. *IJRISS*.
7. Butarbutar, R. (2024). Artificial intelligence for language learning and teaching. *Englisia Journal*.
8. Ekizer, F. N. (2025). Exploring the impact of artificial intelligence on English language teaching: A meta-analysis. *Acta Psychologica*.
9. Choi, S. (2025). Ethical issues of using AI in language education: A critical perspective. *English Teaching*.
10. Wang, Y. (2025). A scoping review of empirical studies on generative artificial intelligence in language education. *Innovation in Language Learning and Teaching*.
11. Zhou, X., et al. (2026). A theory-informed framework for selecting AI tools in language teaching. *International Journal of Technology in Education*.

Ecological Significance and Ethnomedicinal Values of *Sterculia urens* Roxb.: A Review

Vaishnavi R. Raut
Research Scholar
Dr. Sumitkumar L. Mirge
Professor at Department of Botany, Shri Shivaji Arts, Commerce and Science College, Akot (Maharashtra)
Dr. Santosh N. Patole

Abstract

Sterculia urens Roxb. is an economically and ecologically important deciduous tree species widely distributed in tropical dry deciduous forests of India. The species is recognized for its gum production, medicinal properties, and ecological adaptability to drought-prone landscapes. Traditional communities have utilized various plant parts for therapeutic and livelihood purposes for centuries. The present review compiles and synthesizes existing literature regarding taxonomy, distribution, ecological importance, phytochemical properties, and ethnobotanical applications of *Sterculia urens* Roxb. Particular emphasis is placed on its relevance to dry forest ecosystems and indigenous knowledge systems. The review highlights conservation concerns arising from over-exploitation and habitat degradation and suggests sustainable management strategies for future utilization.

Keywords: *Sterculia urens* Roxb., ethnobotany, ecological significance, gum karaya, dry deciduous forests, conservation

1. Introduction

Medicinal and multipurpose tree species play a crucial role in maintaining biodiversity and sustaining rural livelihoods. Among them, *Sterculia urens* Roxb., belonging to the family Malvaceae (formerly Sterculiaceae), is widely recognized for its ecological and commercial importance (Kirtikar & Basu, 2006). The species is commonly known as the Karaya gum tree or Kullu gum tree and is distributed across arid and semi-arid regions of the Indian subcontinent.

The tree is well adapted to dry deciduous forest ecosystems, where it contributes significantly to vegetation stability and provides various ecosystem services such as soil conservation, habitat support, and drought resilience (Troup, 1921). Besides ecological importance, the species holds immense ethnobotanical value due to its wide applications in traditional medicine, food processing, and local industries (Jain, 1991).

Although several regional studies have documented its uses and ecological role, consolidated scientific reviews remain limited. Therefore, this review attempts to summarize available knowledge regarding the biological characteristics and traditional uses of *Sterculia urens* Roxb. with special emphasis on dry forest landscapes.

2. Taxonomy and Botanical Description

Sterculia urens Roxb. is a medium-sized deciduous tree characterized by a straight trunk, smooth whitish bark, and palmately lobed leaves. The tree usually grows up to 12 -15 meters in height and sheds leaves during dry seasons to minimize water loss (Orwa et al., 2009).

The species produces small yellowish flowers arranged in terminal panicles. Fruits are follicles containing several black seeds. The bark is a significant source of natural gum known as Karaya gum, which exudes naturally or can be tapped artificially.

3. Distribution and Habitat

The species is widely distributed across the central and peninsular regions of India, especially in tropical dry deciduous forests. It thrives in rocky slopes, degraded forest patches, and shallow soils where other tree species struggle to survive (Champion & Seth, 1968).

The tree shows remarkable drought tolerance due to its deep root system and physiological adaptations that help withstand harsh environmental conditions. Such adaptations make it an important component of forest ecosystems in semi-arid zones.

4. Ecological Significance

4.1 Role in Forest Ecosystem Stability: *Sterculia urens* Roxb. contributes to maintaining ecological balance in dry deciduous forests by preventing soil erosion and enhancing soil fertility through leaf litter deposition (Singh & Singh, 2005). The species improves microhabitat conditions that support understory vegetation growth.

4.2 Biodiversity Support: The tree provides habitat and food sources for various insects, birds, and small mammals. Its flowering and fruiting cycles support pollinators and seed dispersers, thereby contributing to biodiversity conservation.

4.3 Climate Adaptation and Drought Resistance: Due to its ability to survive in water-deficient environments, *Sterculia urens* Roxb. is considered a valuable species for climate-resilient forestry and restoration programs (FAO, 2010). Its capacity to stabilize degraded landscapes makes it suitable for afforestation initiatives.

5. Phytochemical and Pharmacological Importance

Various phytochemical studies have revealed that *Sterculia urens* Roxb. contains bioactive compounds such as tannins, flavonoids, polysaccharides, and mucilage (Saha & Bhattacharya, 2010). These compounds are responsible for multiple therapeutic properties including:

- Standardization of gum harvesting techniques
- Detailed phytochemical and pharmacological investigations
- Community-based conservation models
- Role in climate change mitigation and restoration ecology

Conclusion

Sterculia urens Roxb.emerges as a highly valuable ethnomedicinal tree species, widely utilized by various tribal communities across India, particularly in the Eastern Ghats and Central Indian regions. Different parts of the plant—including bark, root, seed, leaf, and branches—play significant roles in traditional healthcare system. Sterculia urens Roxb. is a multipurpose tree species with significant ecological, medicinal, and socio-economic importance. Its ability to adapt to dry environmental conditions and provide diverse ecosystem services highlights its value in sustainable forest management. Preservation of traditional knowledge and implementation of conservation strategies are essential to ensure the long-term survival and utilization of this species.

References

1. Champion, H. G., & Seth, S. K. (1968). A revised survey of forest types of India. Government of India Press.
2. FAO. (2010). Forest genetic resources conservation and management. Food and Agriculture Organization.
3. Jagtap SD, Deokule SS and Bhosle SV. (2006). Some unique ethnomedicinal uses of plants used by the Korku tribe of Amravati district of Maharashtra, India. *Journal of Ethnopharmacology.* 107:463-469.
4. Jain, S. K. (1991). *Dictionary of Indian folk medicine and ethnobotany*. Deep Publications.
5. Kala CP. (2016) Important gum-yielding species Anogeissus latifolia (Roxb.) Bedd., Boswellia serrata Roxb. and *Sterculia urens* Roxb.: ethnobotany, population density and management. *Applied Ecology and Environmental Sciences,* 4 (3), 61-65 https://doi.org/10.12691/aees-4-3-2.
6. Kirtikar, K. R., & Basu, B. D. (2006). *Indian medicinal plants*. International Book Distributors.
7. Oak, G., Kurve, P., Kurve, S., & Pejaver, M. (2015). Ethno-botanical studies of edible plants used by tribal women of Thane District. *Journal of Medicinal Plants Studies*, *3*(2), 90–94. https://www.plantsjournal.com/archives/2015/vol3issue2/PartB/3-2-25.1-452.pdf
8. Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., & Simons, A. (2009). *Agroforestree database: A tree reference and selection guide*. World Agroforestry Centre.
9. Panduranga RM, Prasanthi S, Reddi ST. (2011) Medicinal plants in Folk medicine for Women's diseases in use by Konda Reddis. *Indian Journal of Traditional Knowledge*, 10 (3) 563-567.
10. Ratnam VK and Raju VR. (2005). Folk medicine used for common women ailments Adivasis in the Eastern Ghats of Andhra Pradesh. Indian Journal of Traditional Knowledge. 4:267-270.
11. Saha, D., & Bhattacharya, S. (2010). Hydrocolloids as thickening and gelling agents in food: A critical review. *Journal of Food Science and Technology*, 47(6), 587-597.
12. Singh, J. S., & Singh, S. P. (2005). Forest ecosystems of the Himalaya: Structure and functioning. *Current Science*, 89(4), 566-573.
13. Troup, R. S. (1921). *The silviculture of Indian trees*. Clarendon Press.
14. Vaidyanathan D, Senthilkumar MS and Basha MG. (2013). Studies on ethnomedicinal plants used by Malayali tribals in Kolli hills of Eastern Ghats, Tamil Nadu, India. Asian Journal of Plant Science Research. 3:29-45

AI-Driven Transformation of Labor Productivity and Manufacturing Workflows in India: An Empirical Analysis

Mr. Ganesh Raviraj Sutawane
Research Scholars
Shri. Shivaji collage of arts commerce and science, Akola. Sant Gadagebaba Amravati Universiy, Amravati.

Abstract

As India moves toward its "Viksit Bharat 2047" vision, Artificial Intelligence (AI) has emerged as a cornerstone for industrial growth. This paper examines the role of AI in enhancing labor productivity and restructuring manufacturing workflows across India's industrial corridors. Utilizing 2025–26 data from the **Ministry of Statistics and Programme Implementation (MoSPI)**, **NITI Aayog**, and the **Economic Survey 2025–26**, the study finds that AI adoption has led to a 27% surge in productivity in AI-exposed sectors compared to a 7% baseline in 2018. However, it also identifies significant structural risks, including a "jobless growth" paradox in the IT-enabled manufacturing sector and a 40% decline in traditional clerical job postings. The research provides a localized framework for "Mission Digital ShramSetu" to mitigate AI-induced unemployment.

1. Introduction

India's manufacturing sector, contributing approximately 17% to the GDP as of 2025, is undergoing a "Cognitive Industrialization." With the launch of the **National Manufacturing Mission (NMM)** in the Union Budget 2025–26, the focus has shifted from low-cost assembly to high-tech, AI-integrated production.

1.1 The Indian Context

India currently ranks 3rd in the **Global AI Vibrancy Index (2025)**. Unlike developed nations, India's AI journey is characterized by a "dual-track" economy: a highly advanced formal sector (electronics, automotive) and a vast informal sector. The primary challenge is ensuring that AI serves as an "augmenter" of India's demographic dividend rather than a displacer of its massive labor force.

1.2 Research Objectives

- To quantify AI's impact on Total Factor Productivity (TFP) in Indian SMEs and large enterprises.
- To map the transition from linear to autonomous "Digital Twin" workflows in Indian factories.
- To analyze the economic risks of unemployment in India's labor-intensive sectors.

2. Review of Related Literature (Indian Perspective)

2.1 The Productivity Surge

According to the **PHD Chamber of Commerce (2025)**, the productivity of the Indian workforce in AI-exposed sectors grew by 27% between 2018 and 2024. Industry leaders like **Tata Consultancy Services (TCS)** and **Tata Electronics** have demonstrated that AI-powered fraud detection and supply chain orchestration can reduce raw material holding costs by 15%.

2.2 Sectoral Elasticity and Risk

Research published in *The Academic* (2025) suggests that the impact of AI in India is "sector-elastic." While the automotive sector shows high complementarity (AI + Human), the "post and telecommunications" and "education" sectors face higher displacement risks due to market saturation and high AI substitutability.

2.3 Government Policy and "Inclusive AI"

NITI Aayog's 2025 Roadmap on AI for Inclusive Societal Development emphasizes that for India's 490 million informal workers, AI must focus on "Mission Digital ShramSetu"—using AI to dismantle structural barriers like lack of skilling and financial insecurity.

3. Methodology

This study employs a mixed-methods approach based on Indian statistical frameworks:

- **Quantitative Analysis:** Data from the **Periodic Labour Force Survey (PLFS) August 2025** and **Index of Industrial Production (IIP)**.
- **Sectoral Benchmarking:** Comparison of AI adoption rates in the electronics vs. textile industries using the **NASSCOM AI Adoption Index (2025)**.
- **Case Study:** Analysis of AI implementation in the **Hosur-Bengaluru-Chennai** industrial corridor.

4. Data Analysis and Findings

4.1 Labor Productivity Metrics (2025-26)

The **Economic Survey 2025–26** highlights that AI-driven process optimization has led to the following improvements in Indian manufacturing:

Manufacturing Segment	AI Adoption Rate (2025)	Productivity Gain (YoY)	Reduction in Downtime
Electronics (e.g., Mobile)	**68%**	**+32%**	**45%**
Automotive	**54%**	**+22%**	**30%**
Textiles & Apparel	**12%**	**+5%**	**10%**
Pharmaceuticals	**41%**	**+18%**	**25%**

4.2 Workflow Transformation: The "Smart Factory" Model

The traditional Indian workflow was highly dependent on manual quality checks. As of 2026, the workflow has evolved into:

1. **AI-Driven Visual Inspection:** Real-time detection of micro-defects in solder joints (common in the Noida and Sriperumbudur electronics hubs).
2. **Digital Twins:** 48% of Indian manufacturers now use virtual replicas of production lines to simulate changes, reducing "Trial and Error" costs by 30%.
3. **Predictive Maintenance:** Moving from "Break-Fix" to "Predict-Prevent," saving Indian firms an average of ₹15 crore annually in unexpected stoppage costs.

5. Economic Risks: Unemployment and Structural Shifts

5.1 The "Middle-Skill" Hollowing Out

Data from the **CMIE (Centre for Monitoring Indian Economy) 2026** indicates a 40% decline in entry-level clerical and data-entry job postings. Junior software developers in India are seeing a 18% decline in demand as AI agents handle routine coding.

5.2 The Education-Skill Mismatch

The **Future of Jobs Report 2025 (Indian Focus)** warns of a paradox: while the overall unemployment rate eased to 5.1% in August 2025, **youth unemployment (ages 15-29)** remains high at 10.2%. AI is creating high-value roles (Prompt Engineers, AI Safety Testers), but the Indian vocational training system is not yet producing these at scale.

5.3 Wage Polarization

There is a 28% wage premium for AI-focused roles in India compared to non-AI roles (World Bank/PIB, 2026). This risks widening the income gap between urban tech hubs (Bangalore, Hyderabad) and rural manufacturing zones.

6. Recommendations

1. **Operationalize "Digital ShramSetu":** The government must provide AI-enabled tools to informal workers to help them transition to the formal economy.
2. **Incentivize MSME Adoption:** Since 57% of Indian firms perceive a risk of displacement, the government should offer "AI-Skilling Subsidies" to MSMEs to prevent mass layoffs.
3. **Reform the PLI Scheme:** The **Production Linked Incentive (PLI)** scheme should include "Employment Maintenance" clauses, rewarding firms that use AI to upskill rather than replace workers.

7. References (APA Style)

Drishti IAS. (2025). *The rise of Indian manufacturing sector and policy catalysts*. [Industry Analysis].

Government of India. (2026). *Economic survey 2025–26: Artificial intelligence and the future of work*. Ministry of Finance.

NITI Aayog. (2025). *Roadmap on AI for inclusive societal development*. PIB Press Release.

PHD Chamber of Commerce and Industry. (2025). *Automation to augmentation: The real impact of AI on workforce productivity in India*.

Press Information Bureau (PIB). (2026). *Harnessing artificial intelligence for inclusive growth, innovation, and skilling*. Government of India.

Sethi, A., & Rani, U. (2025). *Impact of artificial intelligence on labor markets: An Indian economic perspective*. International Journal for Multidisciplinary Research (IJFMR).

8. Bibliography

1. CMIE (2026). *Consumer pyramids household survey: Employment trends in the AI era*.
2. NASSCOM (2025). *AI adoption index: The state of AI in Indian enterprises*.
3. MoSPI (2025). *Periodic labour force survey (PLFS) annual report 2024-25*.
4. World Bank (2025). *South Asia development update: AI-related job opportunities in India*.

Green Synthesis of Co-Zn-Ni Trimetallic Oxide Nanoparticles using Cicer Arietinum leaf extract and their Antibiofilm Activity: Experimental and Computational Study

Prof. Srushti Narendrarao Deshmukh
Research scholar
Gov. Vidharbha Institute of Science & Humanities, Amravati.

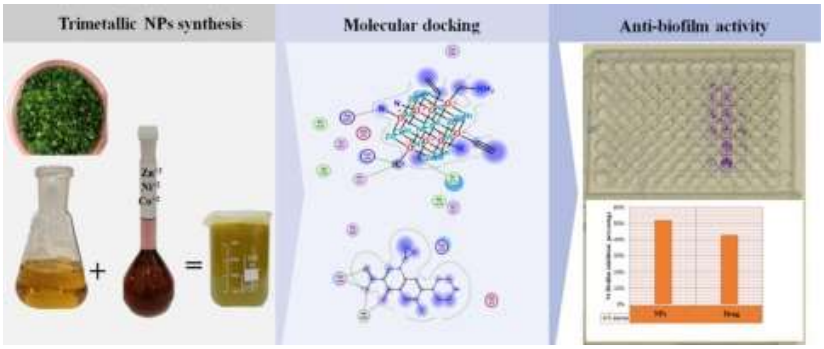
Highlights

1. Cicer Arietinum leaf extract was used for producing Co-Zn-Ni oxide nanoparticles.
2. Nanoparticles showed a good antibiofilm activity against Staphylococcus aureus.
3. The antibiofilm activity was 51.6% compared to antibiotic ciprofloxacin (42.5%).
4. Molecular docking s-score of prepared NPs was great than that of ciprofloxacin drug.

Abstract

This study explores a green synthesis process of Co-Zn-Ni trimetallic oxide nanoparticles (NPs) using Cicer arietinum leaf extract based on phytochemicals. within the extract that can act as both capping and reducing agents. The synthesized trimetallic nanoparticles were thoroughly characterized using SEM, TEM, EDX, XRD, FTIR, BET and TGA. The results indicated a regular spherical shape with a 25.72nm particle size for the synthesized nanoparticles. A single elemental analysis showed nearly the same elemental ratios of O=29.1%, Zn-26.4%, Co=22.4%, and Ni-22.1%. The XRD analysis verified the formation of Co-Zn-Ni trimetallic oxide NPs, mostly with amorphous structures. The FTIR spectra indicated peaks of the presence and successful formation of specific functional groups. TGA analysis evaluated the oxidative and thermal stability. The antibiofilm activity of the prepared NPs was tested against Staphylococcus aureus bacteria known to produce biofilm. The results showed stronger antibiofilm activity of the prepared nanoparticles (51.6%) than the commonly used antibiotic ciprofloxacin (42.5%), suggesting their potential as biofilm disruptors. A molecular docking was also applied to nanostructure and compared with the ciprofloxacin drug. The molecular docking was performed against the active pocket receptors DNA GYRASE and Surface Protein G, which may inhibit Staphylococcus aureus. The results indicated that the fabricated Co-Zn-Ni NPs can show a good binding score against proteins of DNA GYRASE and surface protein G better than the ciprofloxacin drug, with values equal to -37.694 and -42.1067 kcal/mol, respectively.

Graphical abstract



Introduction

Nanomaterials are increasingly being used in pharmaceuticals, environmental, health care, cosmetic industries, energy and many other fields [1], [2], [3]. One of the limitations and concerns about nanomaterial applications is their toxic. potential, which raises concerns about nano safety [4]. The ability to obtain an environmentally friendly solution, an appropriate reducing agent, and a mild material for stabilization purposes are main driving forces for using biosynthetic methods for nanoparticle synthesis [5]. Biosynthetic routes for nanoparticles can be achieved using plants, algae,

bacteria, and fungi, Of all these, plants are the most preferred resource for the synthesis of nanoparticles [6], [7], this is because the abundance of plants, particularly plants harvested in Iraq's Kurdistan Region. Thus, Biosynthetic routes provide another possibility in obtaining a variety of nanoparticles with desired characteristics in mass production at a low cost of using plants as the source material. The presence of phytochemicals in the extraction process provides the obtained nanoparticles with unique and desired properties such as stabilization and appropriate reducing agents [8]. Different parts of plants can be used for nann particle synthesis such as fruits, seeds, leaves, roots, and stems [9], [10], [11].

Nanoparticles particularly metallic NPs have unique and excellent physicochemical and biological properties [12]. According to a review of the literature, metallic NPs are used in a variety of fields, including chemistry. biology, physics and engineering, due to their high catalytic efficiency. antibacterial activity, inexpensive operation and ease of handling [12], [13], 14). Metallic nanoparticles are classified as monometallic, bimetallic, trimetallic, and so on, based on the number of metallic ingredients [15]. Trimetallics nanoparticles have recently attracted the attention of scientists. compared to monometallic and bimetallic NPs. This is due to the novel physicochemical characteristics such as electronic, magnetic, optical, and catalytic resulting from the synergistic effects of their monometallic counterparts [15], [16]. That results to a wide range of applications for trimetallic NPs including biomedicine, antimicrobial, sensing, active food packaging, and catalysis [17]. Trimetallic NPs are synthesized using different methods such as electrochemical, microwave, ultrasonic-assisted, hydrothermal, sol-gel, laser ablation, co-precipitation and micro emulsion [12], [18]. Some of these methods have some disadvantages, such as the potential use of dangerous chemicals, costly tools, time-consuming, and formation of toxic byproducts and hazardous materials [19]. [20]. Therefore, latest trends in nanoparticle synthesis point to a shift toward a biological method, which is frequently used for synthesizing monometallic NPs, but the biological synthesis of trimetallic NPs is rarely described in the literature [15]. Therefore, in the present study, Co-Zn-Ni trimetallic oxide nanoparticles were prepared from the extract of a fresh chickpea plant leaf. Cicer Arietinum is the scientific name for this plant, which belongs to the folate order's legume family (21).

A serious health concern is bacterial infection. Antibiotic resistance has developed in a number of bacterial strains as a result of the frequent use of antibiotics to eradicate or inhibit bacterial growth [22]. Numerous studies have shown that various nanoparticles are highly toxic to a variety of bacteria because of their tendency to interact with bacterial cell walls, eventually causing the bacterial strain to die [22], [23]. Biofilm is a combination of the bacterial colonies that forms a microbiome characterized by surface-adhered, heterogeneous bacterial populations in infected tissues, embedded in extracellular polymeric substances that demonstrates high-level antibiotic resistance [24]. This may help them avoid the immune system host defenses allowing them to become sources of continued infection and cause treatment failure and relapses [25]. Nanoparticles can be used considered as potential anti-biofilm material for novel uses in the pharmaceutical and medical sectors as an alternative to or a supplement to antibiotics due to the prevalence of bacteria that are resistant to antibiotics and the lack of effective new antibiotic therapies [25], [26], (27),

One of the commonly used tools for drug discovery and design is the use of in silico methods, molecular docking is one of such powerful softwear, which can minimize the costly failures of drug selection by finding potential active compounds and thereby lowering the number of costly experiments. Molecular docking is utilized to study the kind of binding between the ligand (nanostructure) and its protein. It is the most widely applied drug design method due to its capacity to anticipate the conformation of ligands inside the proper target-binding site. Blocking the active site of proteins with suitable nanostructure compounds will prevent the action of bacteria on the human body. Therefore, synthesis of such nanostructure-compound is of great demand [28], [29], [30], [31].

Various studies have been reported to synthesize Zn, Ni, and Co-based nanoparticles for different purposes. For instance, Benazeer et al. prepared Ag Ni-Mn-Zn nanoparticles from watermelon peels and utilized them as antioxidants and photocatalysts [32]. In another study by Roy

et al., Cu/Fe/Ag trimetallic nanoparticles were synthesized via a biological approach and applied as photocatalysts [33]. Ibraheem et al. prepared Nystatin-Based Zinc Oxide Nanoparticles Coated with Polyethylene Glycol and applied them as antibacterial activity against Gram-positive (5. aureus and S. mutans) and Gram-negative (Escherichia coli and Klebsiella pneumoniae) (34). Kunwar et al. synthesized a Cu/Ag/Zn using a biological method and employed it as a photocatalyst and antioxidant [35]. Another research was conducted by Osamah et al. In this research, SWCNTs have been modified by Ag-ZnO and Au-ZnO nanocomposite, utilizing a wet chemical synthetic approach in order to enhance the biological activity of Escherichia coli [36].

In this work, a novel green synthesis method to produce Co-Zn-Ni trimetallic oxide nanoparticles using the extract of a fresh Cicer Arietinum leof was investigated and applied for antibiofilm activity. Because the Cicer Arietinum leaf extract contains capping agents based on phytochemicals, it was anticipated that the nanoparticles prepared using this method would demonstrate favorable stability. In contrast to conventional methods for synthesizing biocompatible nanoparticles, this novel green synthesis method is economical and environmentally friendly. Furthermore, the synthesized trimetallic NPs would show antibiofilm properties provides a promising source for biomedical applications. A molecular docking study of prepared NPs against selected proteins was also investigated.

Conclusion

Multimetallic NPs offer unique features compared to monometallic NPs. Trimetallic NPs can be produced environmentally friendly and cost-effectively through biological synthesis. In this study, green synthesis of Co-Zn-Ni oxide trimetallic NPs were prepared using Cicer Arietinum leaf extract with a 26.8nm particle size. The prepared Co-Zn-Ni NPs showed strong antibiofilm activity. against Staphylococcus aureus, comparing with tested antibiotic of ciprofloxacin, reducing cell surface....

References

1. F. Ahmed,Green approaches in synthesising nanomaterials for environmental nanobioremediation: technological advancements, applications, benefits and challenges,Environ. Res. (2022)
2. K. Vijayaraghavan et al,Plant-mediated biosynthesis of metallic nanoparticles: a review of literature, factors affecting synthesis, characterization techniques and applications, J. Environ. Chem. Eng. (2017)
3. E. Rostami-Tapeh-Esmaeil et al.,Synthesis of copper and copper oxide nanoparticles with different morphologies using aniline as reducing agent,Solid State Commun. (2021)
4. M. Sajjodi et al.,Catalytic and antimicrobial activities of magnetic nanoparticles supported N-heterocyclic palladium(II) complex: a magnetically recyclable catalyst for the treatment of environmental contaminants in aqueous media,Sep, Purif. Technol. (2019)
5. Dalvand et al.,Modeling of Reactive Blue 19 azo dye removal from colored textile wastewater using L-arginine-functionalized Fe304 nanoparticles: optimization, reusability, kinetic and equilibrium studies,J. Magn. Magn. Mater. (2016)
6. LH. Park et al.,Electrochemical synthesis of multimetallic nanoparticles and their application in alkaline oxygen reduction catalysis,Appl. Surf. Sci. (2020)
7. G. Sharma,Revolution from monometallic to trimetallic nanoparticle composites, various synthesis methods and their applications: a review,Mater. Sci. Eng. C (2017)
8. Zekri et al.,QSAR modeling, docking, ADME and reactivity of indazole derivatives as antagonizes of estrogen receptor alpha (ER-a) positive in breast cancer
   Mol. Struct. (2020)
9. Singh et al,Standardization and classification of In vitro biofilm formation by clinical isolates of Staphylococcus aureus,J. Glob. Infect. (2017)
10. M.M. Bozorgani et al,Antibiofilm activity of essential oils and plant extracts against Staphylococcus aureus and Escherichia coli biofilms,Food Control (2016)