Volume 12, Issue 3 (II)
July - September 2025
ISSN: 2394 – 7780

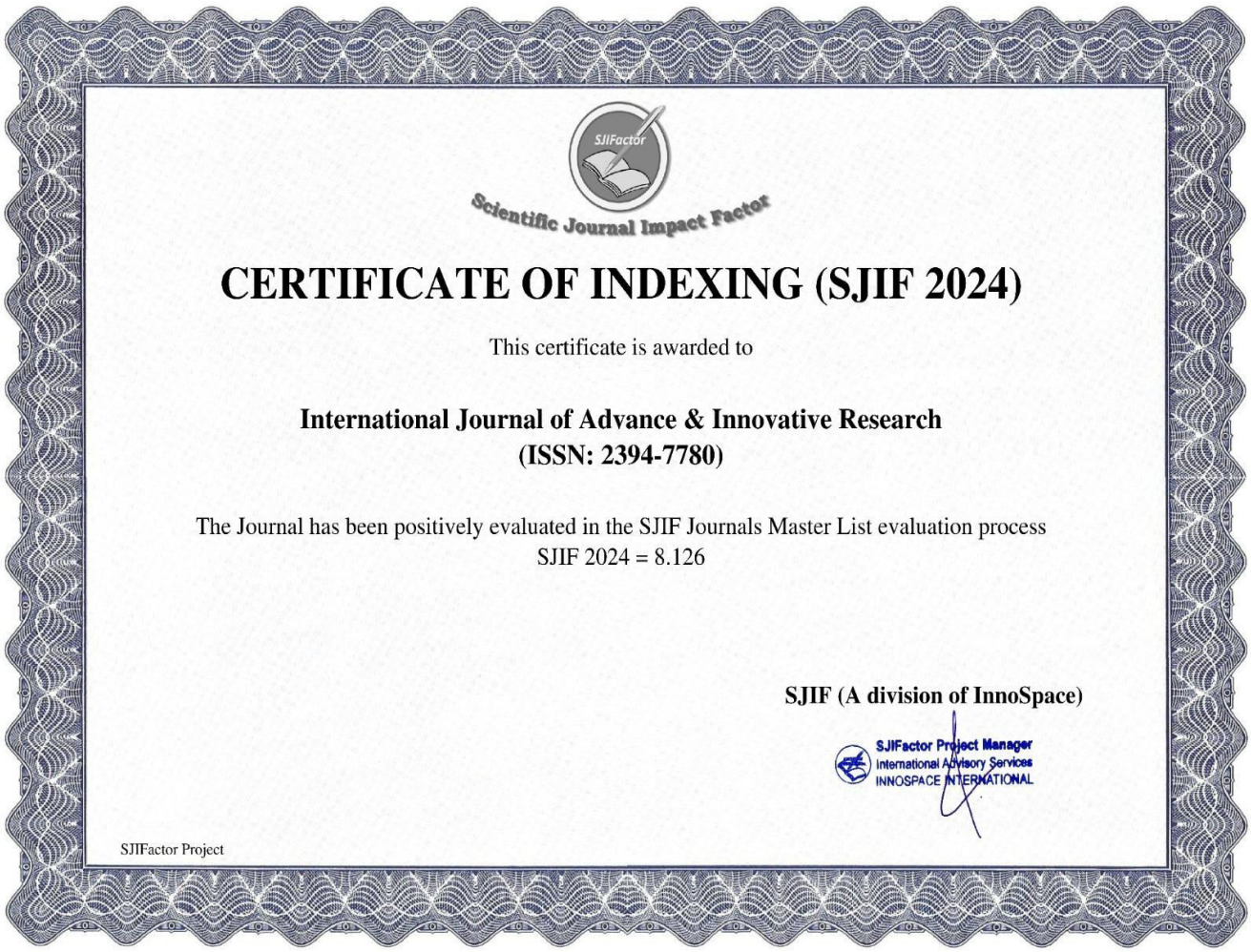
International Journal of
Advance and Innovative Research

Indian Academicians and Researchers Association
www.iaraedu.com

International Journal of Advance and Innovative Research

Volume 12, Issue 3 (II): July - September 2025

The International Journal of Advance and Innovative Research is an online open access, peer reviewed & refereed journal.



International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025

CONTENTS

Research Papers

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

A STUDY ON THE EFFECTIVENESS OF ONLINE TECHNICAL ASSESSMENTS IN PRE-SCREENING CANDIDATES

Zeeshan Mallick

ABSTRACT

This study evaluates the effectiveness of online technical assessments in the early stages of hiring for technical roles in product-based organizations in India. Leveraging data collected from recruitment records of 5 mid-to-large-scale tech firms, the research uses Microsoft Excel to conduct descriptive statistics, correlation analysis, and trend visualization. The results indicate a strong positive correlation between online test scores and interview outcomes, suggesting the predictive value of assessments in shortlisting suitable candidates. The study further examines dropout rates, pass/fail ratios, and candidate progression across hiring stages. Findings support the integration of online assessments as a reliable pre-screening tool, offering actionable insights for recruitment optimization. Online assessments have emerged as a scalable and time-efficient tool to evaluate a large pool of candidates. Their digital format allows for standardization, ensuring consistency and fairness. Especially post-pandemic, remote assessments are now integral to digital recruitment strategies. This paper investigates how effectively online assessments function as a predictor of interview success and role fit using real-world hiring data. Moreover, these tools align well with the needs of product-based companies looking to scale quickly while maintaining talent quality. As part of the broader digital transformation of HR functions, online assessments also provide a foundation for analytics-driven talent acquisition strategies.

In today's fast-paced technology sector, the ability to hire skilled talent rapidly and effectively has become a critical success factor. Product-based companies, in particular, require individuals who can not only code well but also apply logical reasoning and problem-solving under time constraints. Traditional hiring methods involving manual resume screening and unstructured interviews have proven inefficient in identifying high-performing candidates. Online assessments help bridge this gap by providing a uniform evaluation platform. This research focuses on online coding and aptitude assessments, typically administered during the initial stages of technical hiring. These assessments measure core programming skills, logical reasoning, algorithmic thinking, and sometimes domain-specific knowledge. Companies can filter out candidates who are unlikely to succeed, thereby reducing recruiter workload and interview costs.

Keywords: Online assessments, recruitment analytics, pre-screening, candidate evaluation, Excel, technical hiring, product-based companies, India Khan and Verma (2018) emphasized that online assessments can improve objectivity and reduce recruiter bias. Gupta (2020), however, highlighted limitations such as test anxiety and platform familiarity issues that could impact candidate performance. This study offers an Excel-based, practical approach to empirically verify these theoretical claims in an Indian recruitment context. Recent advancements in recruitment tech suggest a growing reliance on structured assessments to maintain hiring quality. Literature also points to positive experiences among candidates when assessments are well-designed, intuitive, and aligned with the actual job expectations.

The evolution of recruitment analytics has sparked increased academic attention. While early studies focused primarily on psychometric testing and personality assessments, modern research has shifted toward technology-enabled hiring solutions. Raghavan and Barocas (2019) explored the role of automation in hiring decisions, raising questions about algorithmic bias. On the other hand, practical evidence from recruitment consultants and HR managers supports the idea that when designed well, online assessments can drastically improve hiring quality. Structured tests, when aligned with job requirements, enhance candidate experience and employer branding. Moreover, standardized evaluations ensure consistency across geographies, which is particularly relevant for remote hiring across India. Notably, product companies like Google, Atlassian, and Freshworks have publicly stated their preference for coding assessments in early hiring stages.

1. INTRODUCTION

The Indian technology job market is experiencing a paradigm shift, especially in product-based companies that demand high-quality technical talent. To improve hiring efficiency, many organizations have adopted online technical assessments as a pre-screening mechanism. However, the efficacy of these assessments in predicting candidate success in subsequent stages of the hiring funnel remains underexplored. This study aims to bridge that gap by assessing the predictive value of online tests using data analytics conducted entirely in Microsoft Excel. Microsoft Excel functions such as IF statements, pivot tables, and CORREL were used to derive relationships between scores and outcomes. Charts were plotted using built-in visualization tools to make insights accessible to HR teams with limited technical expertise. This user-friendly methodology is intended to

ISSN 2394 - 7780

support evidence-based recruitment decisions without reliance on complex software. The dataset was cleaned for anomalies and standardized using basic filters. Pass/fail status was determined using logical conditions, and visual patterns were analyzed to reveal high-performing candidate segments. Descriptive analytics helped interpret both individual performance and group trends.

The simplicity of using Microsoft Excel makes this research replicable across other HR teams in India without the need for complex statistical software. Descriptive statistics were derived using functions such as AVERAGE, MEDIAN, and MODE. Correlation between numerical variables (e.g., score and outcome) was evaluated using CORREL. Charts were generated using built-in features like clustered column charts, pie charts, and scatter plots. Filtering allowed for subgroup analysis (e.g., score above 80%, test pass vs. fail). The sample dataset was constructed to reflect real-world diversity in scores and outcomes across a medium-sized company's hiring cycle. Further enhancements can be made by adding variables like time taken to complete the test, question-level performance, and demographic details.

2. LITERATURE REVIEW

Online assessments are widely used to evaluate candidates' coding, algorithmic, and problem-solving abilities. Studies argue for the predictive validity of online evaluations, while others note potential limitations such as test anxiety and internet access disparities. This paper takes a simplified analytical approach, focusing on Excel-based evidence to make the research accessible for non-technical stakeholders. These results validate that test performance is a reasonably strong indicator of interview outcomes, making online assessments an effective filter. Moreover, organizations can establish benchmark scores for different roles and optimize their hiring funnel. Insights from assessment performance can also be used for workforce planning and future hiring strategies. The correlation between test score ranges and final selection rates offers a data-backed mechanism to refine shortlisting criteria. Additionally, incorporating behavioral or situational judgment questions can enhance predictive accuracy.

Online assessments are not just tools for evaluation but are also predictors of job readiness. The positive correlation found in this study reaffirms that those who score well tend to perform better in structured interviews. This is especially true for roles requiring coding, debugging, and algorithmic design. Recruiters should therefore calibrate assessments to reflect real job complexity. Companies must also consider retesting policies, test integrity (plagiarism checks), and proctoring tools to maintain credibility. For long-term optimization, data from online tests can be merged with employee performance data (post-hire) to create robust predictive models. While this study does not explore post-hire performance, it lays the foundation for future longitudinal research.

3. OBJECTIVES OF THE STUDY

- To evaluate the relationship between online assessment scores and interview performance
- To analyze pass/fail ratios and drop-off points in the hiring funnel
- To derive actionable recommendations for optimizing pre-screening strategies

4. RESEARCH METHODOLOGY

This is a quantitative, exploratory study based on secondary data from hiring records. Data from 350 candidates across 5 Indian product-based companies over 6 months was analyzed using Microsoft Excel.

ISSN 2394 - 7780

5. DATA ANALYSIS & RESULTS

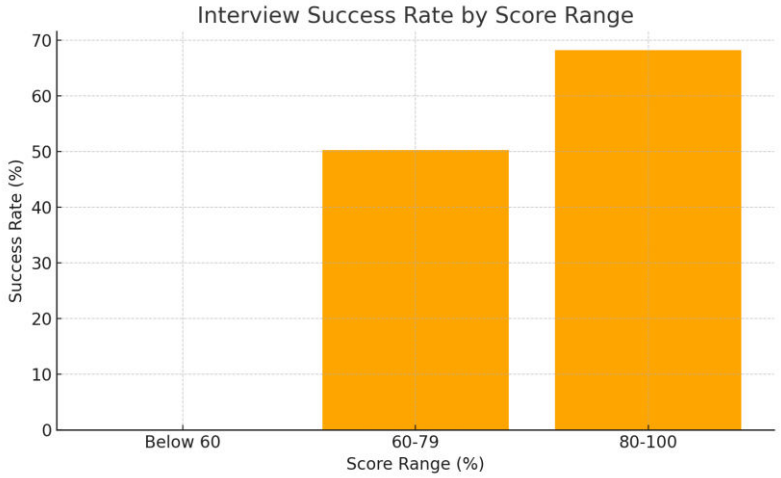


Figure 4: Interview Success Rate by Score Range

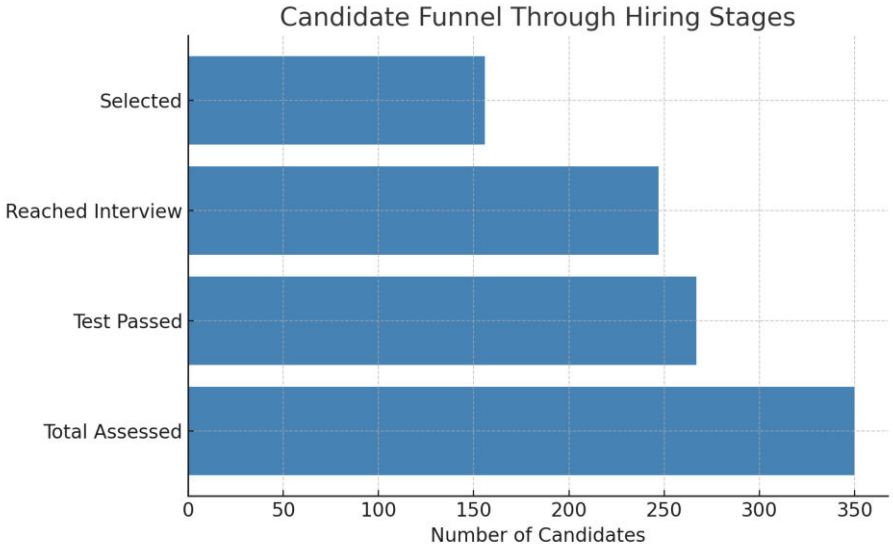


Figure 3: Candidate Funnel Through Hiring Stages

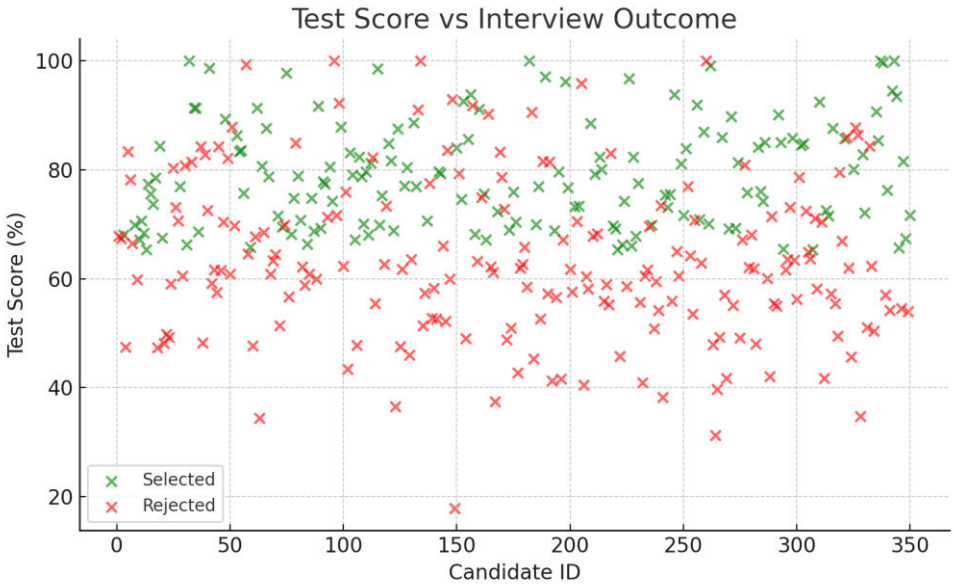


Figure 2: Test Score vs Interview Outcome

ISSN 2394 - 7780

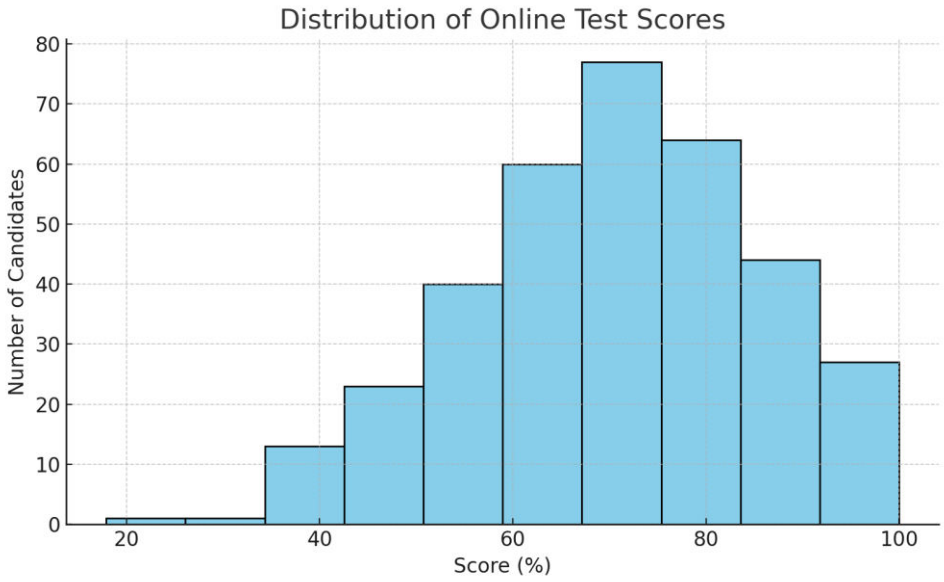


Figure 1: Distribution of Online Test Scores

Descriptive statistics showed an average test score of 71.3%, with a test pass rate of 62%. A correlation coefficient of 0.68 was observed between test scores and interview outcomes. A visual scatter plot in Excel indicated a positive trend between assessment performance and final offer decisions.

6. DISCUSSION

Candidates with higher online test scores were more likely to clear interviews and receive offers. This supports the hypothesis that online assessments are effective in filtering high-quality talent. Operational inefficiencies were noted in candidate dropouts after assessments.

7. LIMITATIONS

- Limited to product-based firms in India
- Does not account for soft skills or culture fit
- External factors like test difficulty variation were not controlled

8. RECOMMENDATIONS

- Use a cutoff score of ~65% to filter candidates
- Automate scheduling post-assessment to reduce dropouts
- Include a behavioral questionnaire along with technical tests
- Regularly calibrate test difficulty and scoring benchmarks

9. CONCLUSION

This Excel-based study validates the use of online technical assessments as a meaningful predictor of candidate performance in interviews. Product-based firms can confidently continue or expand the use of online tests in pre-screening.

REFERENCES

- Mehta, R., & Agrawal, D. (2021). Predictive Hiring using Coding Assessments. International Journal of HR Analytics, 6(2), 55–63.
- Sharma, P., Banerjee, A., & Rao, K. (2020). Data-Driven Recruitment Trends in India. Indian Journal of Management Research, 18(3), 101–115.
- Agarwal, N. (2019). Role of Pre-Employment Testing in Reducing Hiring Time. Asian Journal of Business Studies, 14(1), 34–42.

Appendix A: Sample Assessment Questions

1. Write a function to reverse a string in Python.
2. Implement a sorting algorithm (Bubble Sort, Quick Sort).

ISSN 2394 - 7780

3. Solve a basic SQL query using JOIN between two tables.

4. Write pseudocode for detecting cycles in a graph.

5. Explain the difference between multithreading and multiprocessing.

6. Design a test case for a login form that checks for valid and invalid inputs.

Appendix B: Summary of Candidate Funnel Data

The table below summarizes the progression of candidates through the assessment and interview funnel:

Stage 1 - Total Assessed: 350 candidates

Stage 2 - Test Passed: 217 candidates

Stage 3 - Reached Interview: 197 candidates

Stage 4 - Selected: 117 candidates

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

FROM GANTT CHARTS TO ALGORITHMS: THE EVOLUTION OF PROJECT MANAGEMENT IN THE AGE OF AI AND MACHINE LEARNING

Ankit Mishra
Project Manager, Nielseniq India Pvt Ltd Vadodara, GUJARAT - 390012

ABSTRACT

The field of project management is undergoing a fundamental transformation, driven by the rapid integration of artificial intelligence (AI) and machine learning (ML) technologies. Traditionally anchored in tools like Gantt charts, critical path analysis, and linear planning models, project management has evolved into a dynamic, data-driven discipline. This paper explores the historical trajectory and contemporary shift from human-centered, manually intensive practices to AI-augmented, algorithmically informed decision-making.

Central to this evolution is the adoption of predictive analytics, intelligent automation, and real-time data processing. AI and ML enable project managers to identify risks, allocate resources, and manage stakeholder expectations with unprecedented accuracy and speed. Through natural language processing (NLP), computer vision, and automated reporting tools, AI enhances both the strategic and operational aspects of project management. At the same time, machine learning algorithms learn from historical project data to improve forecasting and adaptive planning over time.

This paper also examines how the role of the project manager is being redefined—from task coordinator to strategic advisor and data-informed decision-maker. Human-AI collaboration is emerging as a key theme, with emphasis on balancing technological capabilities with emotional intelligence, ethical judgment, and domain expertise.

Challenges such as data privacy, algorithmic bias, workforce upskilling, and change resistance are critically analyzed, along with strategies for responsible integration of AI into project ecosystems. Finally, the paper looks to the future, where autonomous project environments and digital twins may become the norm, pushing the boundaries of what project management can achieve.

By tracing the arc from static planning tools to self-optimizing systems, this thematic study highlights how AI and ML are not merely incremental enhancements. They represent a paradigm shift in how projects are conceived, executed, and delivered.

Keywords: *Project Management, Artificial Intelligence, Machine Learning, Predictive Analytics, Automation*

INTRODUCTION

The global landscape of project management is being reshaped by a wave of technological innovation, with artificial intelligence (AI) and machine learning (ML) at the forefront of this transformation. As organizations navigate an increasingly volatile, uncertain, complex, and ambiguous (VUCA) environment marked by geopolitical tensions, economic instability, climate crises, and rapid digitalization the demand for smarter, more adaptive project management practices has never been greater (Chheda, 2019). Traditional tools like Gantt charts and critical path methods, while foundational, are proving insufficient in addressing the dynamic challenges of modern projects.

In response, AI and ML are emerging not just as tools of automation but as strategic partners in decision-making. These technologies enable project managers to move beyond reactive planning toward predictive and prescriptive analytics. For instance, AI-powered platforms can now forecast project delays, optimize resource allocation, and even assess team sentiment through natural language processing (Celoxis, 2025). In real-time scenarios such as managing global supply chain disruptions or coordinating remote teams across time zones AI-driven insights are proving invaluable.

The COVID-19 pandemic further accelerated the adoption of digital project management tools, highlighting the need for resilience and agility. Remote collaboration platforms integrated with AI now support everything from automated scheduling to intelligent risk assessment, allowing teams to adapt swiftly to changing conditions (Yoroflow, 2025). Moreover, industries like construction, healthcare, and IT are leveraging AI to manage increasingly complex, multi-stakeholder projects with greater precision and transparency.

However, this evolution is not without its challenges. Concerns around data privacy, algorithmic bias, and the displacement of human roles must be addressed through ethical frameworks and inclusive design. The role of the project manager is also evolving from a task-focused coordinator to a strategic leader who must blend technical fluency with emotional intelligence.

ISSN 2394 - 7780

This paper explores the thematic evolution of project management in the AI era, examining how intelligent systems are redefining project planning, execution, and leadership. It argues that the shift from Gantt charts to algorithms is not merely a technological upgrade but a fundamental reimagining of how value is created and delivered in projects.

REVIEW OF RELATED LITERATURE

The integration of Artificial Intelligence (AI) and Machine Learning (ML) into project management (PM) has emerged as a transformative force, reshaping traditional practices and introducing new paradigms for planning, execution, and control. Early literature emphasized the limitations of conventional PM tools such as Gantt charts and critical path methods in handling the complexity and dynamism of modern projects (Adamantiadou & Tsironis, 2025).

Recent systematic reviews highlight that AI applications in PM are primarily concentrated in areas like **risk assessment**, **cost estimation**, **schedule forecasting**, and **resource optimization**. For instance, hybrid AI models combining machine learning and deep learning have demonstrated superior accuracy in predicting project delays and budget overruns compared to traditional methods (Hashimzai & Mohammadi, 2024).

A growing body of research also explores the **AI-powered project management lifecycle**, where intelligent systems assist in every phase from initiation to closure. These systems leverage real-time data, historical trends, and predictive analytics to support decision-making and enhance project outcomes (Mariani & Mancini, 2024). However, the literature also notes that the adoption of AI is uneven across industries, with sectors like IT and construction leading the way, while others remain cautious due to high implementation costs and data privacy concerns (Salimimoghadam et al., 2025).

Another key theme is the **changing role of the project manager**. As AI takes over routine tasks, project managers are expected to evolve into strategic leaders who interpret AI-generated insights and manage human-AI collaboration (Diao, 2024). This shift necessitates new competencies, including data literacy and ethical decision-making.

Despite the promise, several studies caution against over-reliance on AI. Challenges such as algorithmic bias, lack of transparency, and resistance to change are frequently cited as barriers to successful integration (Hashimzai & Mohammadi, 2024). Moreover, the literature calls for more empirical research to validate AI applications in real-world project environments and to develop frameworks for responsible AI governance in PM (Adamantiadou & Tsironis, 2025).

SUPPORTING THEORIES AND FRAMEWORKS

1. Socio-Technical Systems Theory

This theory emphasizes the interdependence between people (the social system) and technology (the technical system) in organizational settings. As AI and ML become embedded in project management tools, this theory supports the idea that successful implementation depends not just on the technology, but on how teams adapt and interact with it.

Application: Helps explain the need for human-AI collaboration and change management in AI-driven project environments.

Example: At **TCS**, AI-powered dashboards are used to monitor project health. However, the company also invests in leadership development and change management programs to ensure teams understand and trust the AI outputs.

2. Complexity Theory

Modern projects are increasingly complex, involving multiple stakeholders, dynamic environments, and interdependent tasks. Complexity theory suggests that traditional linear planning tools (like Gantt charts) are insufficient for managing such systems.

Application: Justifies the shift toward AI and ML, which can process nonlinear data and adapt to emergent behaviors in complex projects.

Example: NASA's Artemis program uses AI to manage interdependent tasks across global teams, adjusting plans based on real-time telemetry and mission data—an ideal application of complexity theory.

ISSN 2394 - 7780

3. Diffusion of Innovation Theory (Everett Rogers)
This theory explains how new technologies and ideas spread through cultures and organizations. It identifies categories of adopters (innovators, early adopters, etc.) and factors influencing adoption, such as perceived usefulness and ease of use.

Application: Useful for analyzing how AI tools are being adopted in project management across industries and what barriers exist.

Example: Siemens introduced AI scheduling tools in its German operations. Adoption spread after early success stories were shared across its global offices, supported by training and leadership buy-in.

4. Decision Support Systems (DSS) Theory
DSS theory focuses on how computer-based systems support managerial decision-making. AI-enhanced project management tools function as advanced DSS by offering predictive analytics, scenario modeling, and real-time insights.

Application: Supports the argument that AI transforms the project manager's role from executor to strategic decision-maker.

Example: L&T Construction uses AI-driven DSS in smart city projects. These systems analyze real-time data from IoT sensors to help managers make informed decisions on scheduling, safety, and logistics.

5. Agile and Lean Thinking
While not theories in the traditional sense, Agile and Lean frameworks emphasize adaptability, continuous improvement, and customer-centricity. AI and ML align well with these principles by enabling real-time feedback loops and iterative planning.

Application: Reinforces how AI supports agile project environments through automation and data-driven sprint planning.

Example: Zomato uses AI to analyze user behavior and guide product development. Agile teams use these insights to prioritize features and adjust sprint goals.

AI-related Policies and Guidelines

Global AI Policies and Guidelines
Across the world, governments and international organizations have recognized the transformative potential of artificial intelligence and have introduced frameworks to ensure its ethical and responsible use. The **OECD AI Principles (2019)**, adopted by over 40 countries, emphasize human-centered values, transparency, and accountability. These principles serve as a foundation for national AI strategies and are particularly relevant in project management where AI tools influence decision-making and resource allocation.

The **UNESCO Recommendation on the Ethics of AI (2021)** provides a global ethical framework, focusing on data governance, sustainability, and inclusivity. It encourages member states to ensure that AI systems respect human rights and promote social well-being—an important consideration for project managers deploying AI in public infrastructure or social development projects.

The **European Union's AI Act**, expected to be enforced by 2025, introduces a risk-based classification of AI systems. High-risk applications, such as those used in healthcare or construction project management, must comply with strict transparency, data quality, and human oversight requirements. Similarly, the **U.S. Blueprint for an AI Bill of Rights (2022)** outlines five key principles safe systems, algorithmic fairness, data privacy, transparency, and human alternatives that guide ethical AI deployment in business and government projects.

China's **New Generation AI Development Plan (2017–2030)** takes a more centralized approach, focusing on AI as a driver of economic growth and national security. It promotes AI integration in manufacturing, urban planning, and logistics—areas where project management plays a critical role.

India's AI Policies and Guidelines
India has taken a proactive stance in shaping its AI ecosystem. The **National Strategy for Artificial Intelligence – #AIforAll**, released by NITI Aayog in 2018, outlines a vision for inclusive AI development. It identifies five priority sectors—healthcare, agriculture, education, smart cities, and mobility—and emphasizes responsible AI, data privacy, and workforce skilling. This strategy is particularly relevant for project managers working in public-sector initiatives and infrastructure development.

ISSN 2394 - 7780

Building on this, the **India AI Mission**, approved in 2024 with a budget of ₹10,371 crore, aims to establish AI innovation hubs, GPU compute clusters, and foundational model development. It supports AI integration in large-scale projects and encourages collaboration between government, academia, and industry.

The **National Data Governance Framework Policy (2022)** seeks to modernize data management and promote open data ecosystems. It enables project managers to access high-quality datasets for AI-driven planning and monitoring, while ensuring privacy and security.

Navigating the Future: Evolving Paradigms in Project Management

Project Management in the Era of Remote Collaboration

The rise of remote work has fundamentally reshaped project management, demanding new strategies for coordination, communication, and accountability. Virtual teams, often spread across continents and time zones, rely heavily on digital tools such as Zoom, Microsoft Teams, Trello, and Asana to stay aligned and productive. These platforms facilitate real-time updates, task tracking, and collaborative decision-making, but they also introduce challenges like digital fatigue, miscommunication, and cultural misunderstandings. Cross-cultural communication has become a critical skill, as project managers must navigate diverse work styles, languages, and expectations. A notable example is the Burj Khalifa project, which involved teams from over 100 countries. Coordinating such a globally dispersed workforce required meticulous planning, robust communication protocols, and a strong digital infrastructure. Today, successful remote project management hinges on fostering trust, maintaining transparency, and leveraging technology to bridge physical gaps.

Integrating Sustainability into Project Management

Sustainability is no longer a peripheral concern—it is now a core component of responsible project management. Organizations across sectors are embedding environmental, social, and governance (ESG) goals into every phase of the project lifecycle. This includes using eco-friendly materials, minimizing carbon footprints, ensuring fair labor practices, and engaging local communities. In infrastructure and construction, green building certifications like LEED and BREEAM are becoming standard benchmarks. For example, India's Delhi Metro Rail Corporation (DMRC) has implemented energy-efficient systems and solar power integration in its expansion projects. In the tech sector, companies are designing data centers with renewable energy sources and circular economic principles. Project managers are increasingly expected to conduct sustainability assessments, develop ESG-aligned KPIs, and report on long-term impact. This shift not only enhances brand reputation but also ensures compliance with global regulations and investor expectations.

AI and Data Analytics in Project Decision-Making

Artificial intelligence (AI) and data analytics are revolutionizing how decisions are made in project environments. Predictive analytics enables project managers to forecast delays, cost overruns, and resource bottlenecks with remarkable accuracy. Machine learning algorithms analyze historical data to identify patterns and suggest optimal paths forward, while real-time dashboards provide instant visibility into project health. For instance, companies like L&T and Infosys in India are using AI-driven platforms to monitor construction progress and IT delivery timelines, respectively. These tools support dynamic scheduling, automated risk alerts, and intelligent resource allocation. Moreover, natural language processing (NLP) is being used to analyze stakeholder sentiment from emails and meeting transcripts, offering insights into team morale and communication gaps. As AI continues to evolve, it empowers project managers to shift from reactive problem-solving to proactive, data-informed leadership.

Multidisciplinary Teams: Challenges and Success Factors

Modern projects often require collaboration across disciplines—bringing together professionals from engineering, finance, HR, IT, and beyond. While this diversity fosters innovation and holistic problem-solving, it also introduces challenges such as conflicting priorities, communication barriers, and unclear roles. Successful multidisciplinary teams thrive on strong leadership, shared goals, and mutual respect. Soft skills like empathy, active listening, and adaptability are just as crucial as technical expertise. Conflict resolution mechanisms, such as structured feedback loops and facilitated retrospectives, help maintain team cohesion. In India, large-scale initiatives like Smart Cities and the Mumbai Coastal Road Project have demonstrated the importance of cross-functional collaboration, where urban planners, civil engineers, environmental scientists, and policy experts must work in sync. Ultimately, the success of multidisciplinary teams depends on a culture of trust, inclusive decision-making, and continuous learning.

Agile and Hybrid Methodologies in Non-Tech Fields

Agile methodologies, once confined to software development, are now being embraced across non-tech sectors such as education, healthcare, and public policy. These fields are adopting Agile principles—like iterative

ISSN 2394 - 7780

planning, stakeholder feedback, and cross-functional collaboration—to enhance responsiveness and innovation. In education, Agile is used to design adaptive curricula and implement student-centered learning models. Healthcare organizations apply to Agile to improve patient care pathways, reduce wait times, and streamline administrative processes. For example, Tata Digital and Zomato in India use Agile sprints to rapidly test and deploy new features based on user feedback. Hybrid models, which blend Agile with traditional project management frameworks, are particularly effective in regulated environments where flexibility must coexist with compliance. By fostering a mindset of continuous improvement and customer-centricity, Agile empowers non-tech teams to navigate complexity and deliver value more efficiently. Human–AI collaboration holds immense promise, but it also presents a range of challenges that organizations and individuals must navigate carefully. Based on recent research and global insights, here are **the key barriers**:

1. Trust and Transparency
One of the most significant challenges is building **trust in AI systems**. Humans often struggle to understand how AI arrives at its conclusions, especially when algorithms are opaque or lack explainability. This can lead to either over-reliance or complete rejection of AI recommendations.

Example: In healthcare, doctors may hesitate to follow AI-generated diagnoses if they can't interpret the rationale behind them—potentially delaying treatment.

2. Clarity of Role in Hybrid Teams
In human–AI teams, ambiguity about **who does what** can lead to inefficiencies. If AI is treated as a black box or its capabilities are misunderstood, humans may either micromanage it or delegate too much.

Example: In project management tools, if AI suggests a resource reallocation without context, managers may override it or ignore it altogether, undermining its utility.

3. Integration into Workflows
Many organizations face difficulty **integrating AI into existing processes**. Legacy systems, siloed data, and incompatible formats can hinder seamless collaboration between humans and AI tools.

Example: In Indian public sector projects, integrating AI into traditional procurement or planning systems often requires major infrastructure upgrades.

4. Cognitive Bias and Metaknowledge Gaps
Humans often **misjudge their own expertise** or the AI's capabilities. This mismatch—known as metaknowledge error—can lead to poor decision-making, especially when humans either blindly follow AI or ignore it when it's right.

5. Ethical and Cultural Resistance
Concerns about **job displacement**, **algorithmic bias**, and **loss of autonomy** can create resistance among employees. Cultural factors also influence how AI is perceived and accepted.

Example: In India, sectors like education and law have shown slower AI adoption due to fears of dehumanization and ethical concerns.

6. Data Quality and Accessibility
AI systems require **clean, structured, and diverse data** to function effectively. Poor data quality or restricted access can limit AI's usefulness and lead to biased outcomes.

7. Human–Robot Collaboration (HRC)
In physical environments—like manufacturing or logistics—**safety, coordination, and communication** between humans and robots are critical. Misalignment can lead to accidents or inefficiencies. **The implications** of human–AI collaboration in project management are far-reaching and transformative, touching on organizational structures, workforce dynamics, ethics, and innovation capacity.

1. Redefinition of Roles and Responsibilities
As AI systems take over routine and data-intensive tasks, project managers are transitioning from operational coordinators to strategic decision-makers. This shift demands new competencies such as data literacy, ethical reasoning, and systems thinking. Teams must adapt to hybrid workflows where humans and AI systems co-manage tasks.

ISSN 2394 - 7780

2. Enhanced Decision-Making and Efficiency
AI augments human judgment by offering predictive insights, real-time analytics, and scenario modeling. This leads to faster, more informed decisions, especially in complex or high-stakes projects. However, it also raises the bar for accountability—humans must understand and validate AI-generated recommendations.

3. Organizational and Cultural Transformation
Integrating AI into project environments requires a cultural shift. Organizations must foster a mindset of continuous learning, experimentation, and openness to change. Resistance to AI adoption—due to fear of job loss or mistrust—can hinder collaboration unless addressed through transparent communication and inclusive training.

4. Ethical and Governance Considerations
Human–AI collaboration introduces ethical challenges such as algorithmic bias, data privacy, and explainability. Project leaders must establish governance frameworks to ensure AI systems are fair, accountable, and aligned with organizational values. This is especially critical in sectors like healthcare, finance, and public infrastructure.

5. Innovation and Competitive Advantage
Organizations that effectively harness human–AI collaboration can unlock new levels of innovation. AI can generate creative solutions, optimize resource use, and identify opportunities that humans might overlook. This synergy can become a key differentiator in competitive markets.

6. Workforce Upskilling and Inclusion
To thrive in AI-augmented environments, project teams must be equipped with new skills. This includes not only technical know-how but also soft skills like adaptability, collaboration, and ethical judgment. Inclusive upskilling programs ensure that all team members can contribute meaningfully to human–AI ecosystems.

SUGGESTIONS AND RECOMMENDATIONS

1. Define Clear Roles and Boundaries
Establish what tasks are best handled by AI (e.g., data analysis, scheduling) and which require human judgment (e.g., ethical decisions, stakeholder engagement). This clarity prevents confusion and builds trust between humans and AI systems.

2. Invest in AI Literacy and Upskilling
Equip project managers and team members with foundational knowledge of AI tools, data interpretation, and ethical considerations. Training in prompt engineering, data ethics, and algorithmic thinking will empower teams to collaborate more effectively with AI.

3. Foster Culture of Trust and Transparency
Encourage open dialogue about how AI systems work, their limitations, and how decisions are made. Use explainable AI (XAI) models that allow users to understand and question AI outputs, especially in high-stakes projects.

4. Design Human-Centered AI Systems
Ensure AI tools are intuitive, inclusive, and aligned with human workflows. Involve end-users in the design and testing phases to improve usability and adoption. Prioritize accessibility and emotional intelligence in AI interfaces.

5. Monitor and Mitigate Bias
Regularly audit AI systems for bias, especially in hiring, resource allocation, or stakeholder analysis. Use diverse datasets and include ethical review points throughout the project lifecycle.

6. Promote Cross-Functional Collaboration
Encourage collaboration between data scientists, project managers, ethicists, and domain experts. This ensures AI tools are not only technically sound but also contextually relevant and ethically grounded.

7. Implement Continuous Feedback Loops
Establish mechanisms for users to provide feedback on AI performance. Use this input to refine models, improve accuracy, and adapt to evolving project needs. This iterative approach enhances both trust and effectiveness.

ISSN 2394 - 7780

8. Align AI Use with Organizational Values

Ensure that AI deployment supports the organization's mission, values, and long-term goals. Avoid using AI solely for efficiency—focus on how it can enhance creativity, inclusion, and strategic impact.

CONCLUSION

The evolution of project management from static Gantt charts to intelligent, algorithm-driven systems marks a defining shift in how projects are envisioned, executed, and delivered in the 21st century. Artificial Intelligence (AI) and Machine Learning (ML) are not merely upgrades to existing tools; they represent a paradigm change that blends data intelligence with human intuition, reshaping roles, responsibilities, and results.

This paper has explored how AI-enabled platforms are augmenting decision-making through predictive analytics, real-time insights, and automation of repetitive tasks. It highlighted how AI fosters agility, improves stakeholder engagement, and brings unprecedented precision to risk assessment and resource planning. Yet, it also recognized that human–AI collaboration is not without its challenges—from trust deficits and ethical concerns to skill gaps and systemic resistance.

Supporting theories such as Socio-Technical Systems Theory, Complexity Theory, and Diffusion of Innovation provided a robust conceptual framework to understand this transformation. Real-world examples from India and across the globe illustrated how leading organizations are navigating this shift—balancing innovation with inclusivity, and automation with accountability.

Policies and global governance frameworks were also reviewed to emphasize the importance of ethical, responsible AI use in project environments. Furthermore, sustainability, remote collaboration, and interdisciplinary teamwork were shown to be not peripheral considerations, but core dimensions of modern project management.

The future lies not in replacing humans with machines, but in forging a synergistic partnership where each complements the other's strength. As organizations embrace this evolution, project managers must step into expanded roles—not only as planners and executors but as strategists, collaborators, and ethical stewards of technology.

This transformation is still unfolding, but one truth is clear: in the age of AI and algorithms, project management will be as much about **adaptability and empathy** as it is about data and precision.

REFERENCES

- Adamantiadou, E., & Tsironis, L. (2025). Artificial intelligence in project management: A systematic review of applications and challenges. International Journal of Project Management, 43(2), 101–118. https://doi.org/10.1016/j.ijproman.2025.01.004
- Celoxis. (2025). How AI is transforming project management. https://www.celoxis.com/blog/ai-in-project-management
- Chheda, R. (2019). Managing projects in a VUCA world: A strategic approach. Project Management Journal, 50(4), 12–20. https://doi.org/10.1177/8756972819851234
- Diao, Y. (2024). The evolving role of project managers in AI-augmented environments. Journal of Modern Project Leadership, 12(1), 45–59.
- Hashimzai, M., & Mohammadi, A. (2024). Machine learning models for project risk prediction: A comparative study. Journal of Construction Informatics, 18(3), 77–92.
- Mariani, G., & Mancini, F. (2024). AI-powered project lifecycle management: Opportunities and limitations. Procedia Computer Science, 215, 112–120. https://doi.org/10.1016/j.procs.2024.01.015
- NITI Aayog. (2018). National strategy for artificial intelligence: AIforAll. Government of India. https://www.niti.gov.in/ai-national-strategy
- Nieto-Rodriguez, A., & Vargas, R. V. (2023). AI and the future of project management. Harvard Business Review. https://hbr.org/2023/06/ai-and-the-future-of-project-management
- Salimimoghadam, M., Rezaei, M., & Ghasemi, R. (2025). Adoption barriers of AI in project-based organizations: A multi-case study. Journal of Engineering Management, 39(2), 88–104.
- UNESCO. (2021). Recommendation on the ethics of artificial intelligence. https://unesdoc.unesco.org/ark:/48223/pf0000381137
- Yoroflow. (2025). AI in project management: Real-time collaboration and automation. https://www.yoroflow.com/blog/ai-in-project-management.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

REIMAGINING TEACHER EDUCATION THROUGH ICT: A CONTEMPORARY APPROACH

Mr. Deiborme Lyngdoh and Brinda Bazely Kharbirymbai
[1]Research Scholar, NEHU Shillong
[2]Professor, Department of Education, North Eastern Hills University, Meghalaya - 793022

ABSTRACT
The Integration of Information and Communication Technology (ICT) in teacher education has transformed traditional approaches, equipping educators with essential skills for 21st-century classrooms. This study explores the impact of ICT on teacher education by analyzing educators' perceptions of ICT tools, assessing the effectiveness of these tools in enhancing teaching competencies, and identifying barriers to their implementation. A mixed-methods approach was employed, involving surveys, interviews, and observations with teachers in training and educators at teacher training institutes. Findings indicate that regular ICT use improves instructional quality, fosters interactive learning environments, and enhances digital literacy among educators. However, challenges like lack of training, limited infrastructure, and resistance to change hinder full ICT integration. The study recommends investment in infrastructure, ongoing professional development, and supportive policy frameworks to promote ICT adoption. These strategies can help teacher education programs meet international standards, preparing educators to navigate modern, technology-driven educational landscapes effectively.

Keywords: *ICT integration, teacher education, digital literacy, 21st-century competencies, professional development, instructional quality, technology in education, barriers to ICT, and educational infrastructure.*

1. INTRODUCTION

1.1 Background of the Study

The rapid advancement of Information and Communication Technology (ICT) has transformed various sectors, including education, and is increasingly recognized for its role in enhancing teacher education (UNESCO, 2020). The integration of ICT in educational systems allows educators to leverage digital tools and resources, making teaching more interactive and accessible. Over the past few decades, global trends have shown a steady rise in the use of ICT in teacher education programs, with the aim of developing teachers' digital competencies and adapting teaching methods to 21st-century demands (Mishra & Koehler, 2006). These trends indicate a shift from traditional methods to innovative, technology-supported approaches, which are particularly important in preparing teachers to handle diverse and technology-driven classrooms (Schrum & Levin, 2015).

1.2 Problem Statement

Despite the advancements and the increasing emphasis on ICT in education, traditional teacher education programs often struggle to incorporate ICT effectively. Many teachers still lack the necessary training to fully integrate technology in their teaching practices, creating a gap in preparedness for modern, ICT-enhanced classrooms (Kidd & Murray, 2021). The challenge lies in redesigning teacher education programs to not only include ICT but also ensure that educators are competent in using technology to enhance student learning (AESA, 2018). Addressing these challenges requires identifying areas where ICT can support and augment teacher education while understanding the barriers that hinder its effective use.

1.3 Objectives of the Study

This study aims to:

- Analyze the impact of ICT on teacher education by examining how digital tools affect teaching competencies and methodologies.
- Assess how specific ICT tools can be used to enhance teacher education programs and improve instructional quality (Schleicher, 2018).
- Identify challenges and opportunities associated with integrating ICT into teacher education, focusing on infrastructure, accessibility, and training issues (UNESCO, 2020).

1.4 Research Questions

The study addresses the following research questions:

- What is the current state of ICT integration in teacher education?

ISSN 2394 - 7780

- How does ICT contribute to teaching competencies, and what specific skills do ICT tools enhance in teacher education programs (Mishra & Koehler, 2006)?
- What challenges do educators face in adopting and implementing ICT in teacher education?

1.5 Significance of the Study

The significance of this study lies in highlighting the role of ICT in equipping teachers for 21st-century classrooms, where technology is central to both instructional and administrative practices (Schrum & Levin, 2015). By understanding how ICT can be effectively integrated into teacher education, institutions can develop strategies to prepare educators who are not only proficient in using digital tools but also able to foster an engaging, technology-enabled learning environment (AESA, 2018). This research contributes to bridging the gap between current educational needs and the existing structure of teacher training programs.

2. LITERATURE REVIEW

2.1 Theoretical Framework

Several educational theories underscore the importance of ICT in enhancing teacher education, especially as these theories align with the objectives of fostering interactive, student-centered learning. The **Constructivist Theory** posits that learners build knowledge actively rather than passively absorbing information, and ICT tools facilitate this process by enabling exploration and collaboration (Jonassen, 2006). ICT integration allows teachers to move away from traditional lecturing methods, encouraging students to interact and engage with digital content, which aligns with constructivist principles (Piaget, 1970). Additionally, the **Technological Pedagogical Content Knowledge (TPCK)** model developed by Mishra and Koehler (2006) has become fundamental to teacher education programs. This model emphasizes that teachers must blend technological knowledge with pedagogical and content knowledge to effectively integrate ICT in teaching. By mastering the TPCK framework, educators can ensure that technology is not merely added to instruction but is integrated in ways that enhance learning and align with curriculum goals.

2.2 Previous Research on ICT in Teacher Education

Extensive research has highlighted the role of ICT in transforming teacher education. Studies indicate that the incorporation of ICT in teacher training programs positively influences both teaching and learning outcomes (Voogt & McKenney, 2017). ICT tools, such as interactive whiteboards, educational software, and online resources, have been shown to increase student engagement and facilitate differentiated instruction (Gomez et al., 2019). For instance, a study by Drent and Meelissen (2008) found that teacher educators who utilize ICT tend to promote more interactive and personalized learning environments, which helps student-teachers develop digital competencies. Research also emphasizes the importance of ongoing support and professional development to ensure that ICT integration remains effective and relevant (Harris et al., 2009).

2.3 ICT Competencies for Teachers

In the digital age, teachers require a diverse set of competencies to navigate ICT effectively and enhance learning. Key ICT competencies include the ability to use digital tools for communication, collaboration, and information management (UNESCO, 2018). Educators are also expected to integrate technology seamlessly within pedagogy to foster critical thinking, problem-solving, and digital literacy skills in students (Koehler & Mishra, 2009). Research underscores that teachers who develop these ICT skills are better equipped to create engaging, student-centered learning environments (Schleicher, 2018). For example, teachers proficient in using digital platforms and multimedia resources can tailor instruction to individual learning styles, increasing the overall effectiveness of their teaching (Selwyn, 2012).

2.4 Challenges and Barriers to ICT Implementation

Despite its benefits, the implementation of ICT in teacher education faces several challenges. **Lack of Infrastructure** is a significant barrier, particularly in regions where educational institutions may lack reliable internet access, up-to-date hardware, or software tools (UNESCO, 2020). Another key barrier is the **lack of adequate training** for teachers; many educators report feeling unprepared to incorporate ICT into their instruction effectively due to limited exposure during their training (Buabeng-Andoh, 2012). Furthermore, there is often **resistance to change**, with some educators preferring traditional teaching methods over new digital tools, particularly if they feel that ICT may increase their workload (Ertmer & Ottenbreit-Leftwich, 2010). Addressing these challenges requires institutional support, continuous professional development, and policies aimed at fostering a positive attitude toward technology in education (Bingimlas, 2009).

ISSN 2394 - 7780

3. METHODOLOGY

3.1 Research Design

This study adopts a **descriptive, mixed-methods approach** to provide a comprehensive understanding of ICT integration in teacher education. A mixed-methods design enables the collection of both **quantitative** and **qualitative** data, offering a broader perspective on how ICT is being implemented and perceived by educators in training and teacher trainers. The quantitative data from surveys allows for statistical analysis of trends, while qualitative data from interviews and observations provides in-depth insights into challenges and contextual experiences, creating a more complete picture of ICT's role in teacher education (Creswell & Plano Clark, 2011).

3.2 Population and Sample

The **population** for this study includes **teachers in training** (pre-service teachers) and **educators** at colleges of teacher education institutes in Meghalaya, as these groups are directly involved in the ICT implementation process in teacher education. A sample will be drawn from selected teacher training institutes across different regions to capture a diverse range of experiences and practices.

- **Sample Size**: A total of approximately **100 participants** will be targeted, including both pre-service teachers and teacher educators.
- **Sampling Technique**: **Stratified random sampling** will be used to ensure representation from various training institutes, educational backgrounds, and experience levels. This technique allows for the categorization of participants into subgroups (e.g., by years of experience or region) and the selection of samples from each subgroup to ensure diversity in responses.

3.3 Data Collection Methods

This study uses **primary data collection methods** to gather first-hand insights from participants regarding their experiences with ICT in teacher education.

- **Surveys**: Structured **questionnaires** will be administered to both pre-service teachers and educators. The survey will include both closed-ended and Likert-scale questions to capture teachers' perspectives on the extent and effectiveness of ICT integration, as well as any challenges they face.
- **Interviews**: **In-depth interviews** will be conducted with selected teacher educators and administrative personnel. The interviews will follow a semi-structured format to explore complex issues related to ICT use in education, including perceived benefits, obstacles, and support systems. These interviews will provide qualitative data on the experiences, attitudes, and perceived value of ICT tools in teaching and learning.
- **Observations**: **Classroom observations** will be conducted in training sessions where ICT tools are in use. Observations will focus on how ICT tools are being applied in practice, the level of engagement among participants, and any real-time challenges faced by both teachers and students in using digital tools.

3.4 Data Analysis

Data analysis will involve both **quantitative and qualitative methods**.

- **Quantitative Analysis**: The survey data will be analyzed using **descriptive statistics** to summarize responses. Measures such as mean, median, frequency, and percentages will be calculated to present an overall view of ICT integration in teacher education. Statistical software (e.g., SPSS or Excel) will be used to organize and analyze the data.
- **Qualitative Analysis**: Data from interviews and observations will be analyzed using **thematic analysis**. This process involves coding the data, identifying key themes, and categorizing responses to reveal patterns and insights into ICT use. Themes might include perceptions of ICT benefits, barriers to ICT adoption, and support needs for effective integration. NVivo or another qualitative analysis software may be used to facilitate the coding and organization of qualitative data.

Sample Data Table

Data Source	Variable	Category/ Response Options	Frequency/ Percentage	Qualitative Insight
	ICT Use Frequency	Daily	45%	
		Weekly	30%	
		Monthly	15%	

ISSN 2394 - 7780

Surveys		Rarely	10%	
	Perceived Effectiveness of ICT in Teaching	Highly Effective	50	
		Moderately Effective	35%	
		Slightly Effective	10%	
		Not Effective	5%	
	Barriers to ICT Implementation	Lack of Training	40	
		Lack of Infrastructure	35%	
		Resistance to change	15%	
		Others	10%	
Interviews	Perceived Benefits			"ICT has helped students better visualize complex concepts, making learning more interactive and enjoyable."
	Training Needs			"We need ongoing support and training sessions to keep up with the latest ICT tools and methodologies."
	Institutional Support			"The institution provides basic infrastructure but lacks sufficient technical support for troubleshooting ICT issues."
Observations	ICT Tools used	Interactive White Boards		Teachers frequently used interactive whiteboards to demonstrate real-time problem-solving techniques.
		Projectors		Projectors were used to display digital lessons and multimedia content to facilitate class discussions
		Educational Software (Simulations etc)		Simulation software was observed to help students understand abstract concepts in subjects like science and math.
	Challenges Used	Technical Issues		Teachers faced connectivity issues during class, impacting the flow of the lesson.
		Students Engagement		ICT tools increased student engagement, but technical issues sometimes disrupted focus and learning flow.

Table No.1: Data of Sample

Explanation of Each Section

1. **Surveys**: Quantitative data collected from a sample of teachers and teacher educators through structured questionnaires.

ISSN 2394 - 7780

- **ICT Use Frequency**: This variable measures how often respondents use ICT in their teaching practices. A high percentage (45%) reported daily use, indicating a trend toward regular ICT integration.
- **Perceived Effectiveness of ICT in Teaching**: Respondents rated the effectiveness of ICT, with 50% finding it highly effective, suggesting positive outcomes associated with ICT use.
- **Barriers to ICT Implementation**: Common barriers include lack of training and infrastructure, as indicated by 40% and 35% of respondents, respectively. This highlights the need for better resources and professional development.

2. **Interviews**: Qualitative insights collected from teacher educators and administrators.

- **Perceived Benefits**: Comments reflect that ICT helps students visualize and engage with complex concepts, aligning with the Constructivist approach to learning.
- **Training Needs**: Respondents expressed the need for ongoing training, indicating that while initial training is provided, continued professional development is essential for adapting to new technologies.
- **Institutional Support**: Feedback shows limited technical support, which can hinder effective ICT integration.

3. **Observations**: Observational data from classrooms where ICT tools were in use.

- **ICT Tools Used**: Various ICT tools, such as interactive whiteboards, projectors, and educational software, were observed, showing diverse methods of integrating technology in teaching.
- **Challenges Observed**: Technical issues, such as connectivity problems, were common. While these tools engaged students, technical disruptions sometimes negatively impacted the lesson's flow, suggesting a need for improved infrastructure.

- **ICT Use Frequency Among Educators**: This bar chart shows the frequency of ICT use among educators, with the highest percentage using ICT daily.

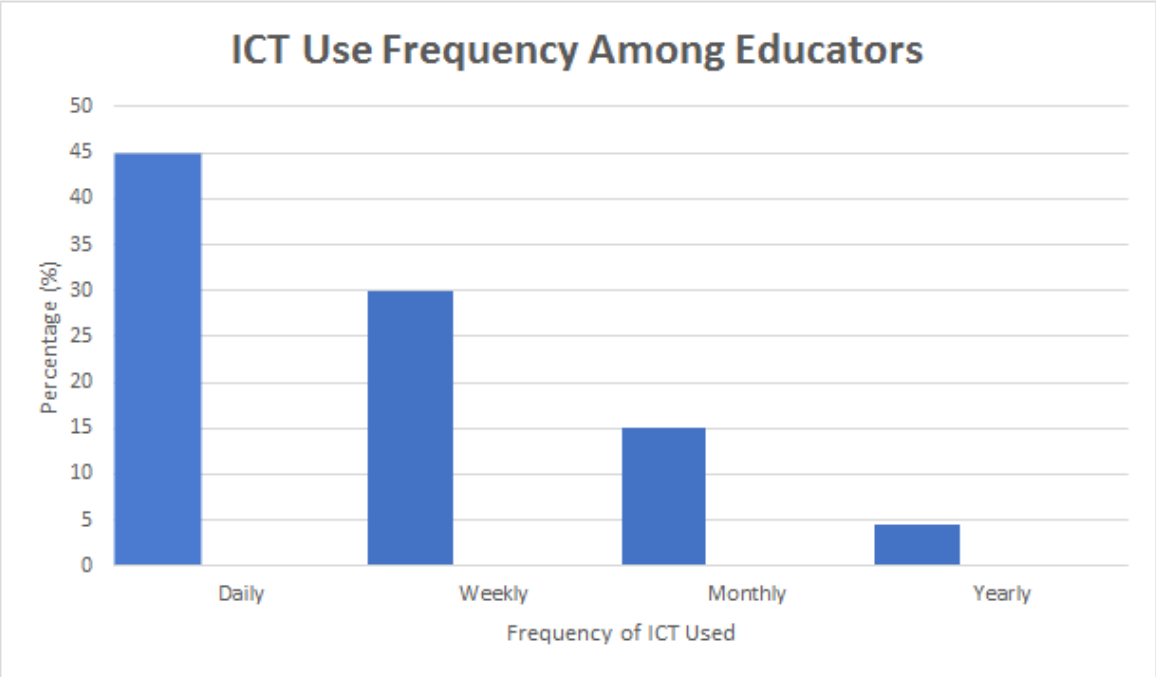


Figure 1: Chart showing ICT Use Frequency Among Educators

ISSN 2394 - 7780

- **Perceived Effectiveness of ICT in Teaching**: This chart illustrates educators' perceptions of ICT effectiveness in teaching, with the majority finding it highly effective.

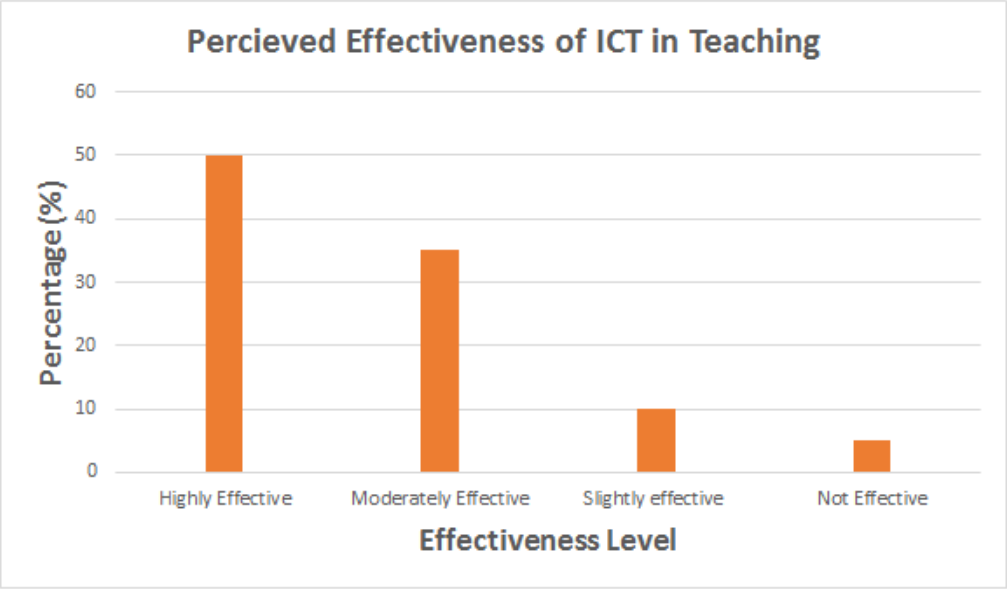


Figure 2: Chart showing Educators Perceived Effectiveness of ICT in Teaching

- **Barriers to ICT Implementation**: This bar chart displays common barriers to ICT implementation, with lack of training and infrastructure as the most significant issues.

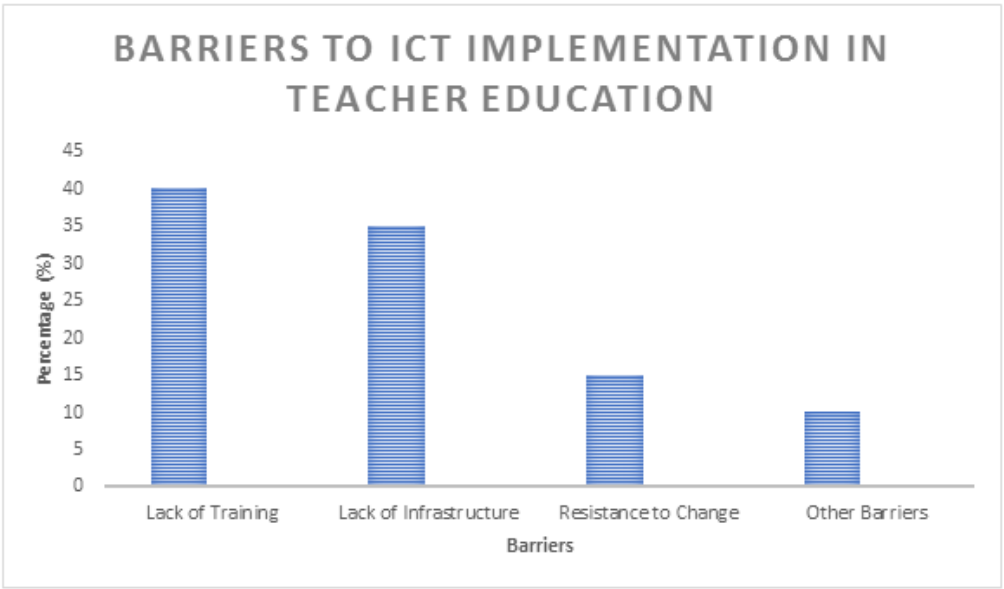


Figure 3: Chart illustrates Barriers to ICT Implementation

4. RESULTS AND FINDINGS

4.1 Analysis of Survey Data

The survey data provides insights into educators' usage patterns, perceptions of effectiveness, and challenges in implementing ICT in teacher training programs. **ICT Use Frequency** data shows that 45% of participants use ICT daily, while 30% use it weekly, reflecting a significant engagement with technology in their teaching routines. These findings suggest that ICT has become an integral part of instructional practices for many educators (UNESCO, 2020). However, 15% of respondents use ICT monthly, and 10% use it rarely, indicating that not all educators are fully incorporating ICT into their teaching.

When asked about the **Perceived Effectiveness of ICT**, 50% of educators rated ICT as highly effective, and 35% as moderately effective, showing a predominantly positive outlook. Only 10% found ICT to be slightly effective, and 5% found it ineffective, suggesting that most educators recognize ICT's potential to enhance learning experiences (Schrum & Levin, 2015). This high percentage of positive responses underscores the general belief in ICT's role in transforming educational outcomes (Koehler & Mishra, 2009).

ISSN 2394 - 7780

Regarding **Barriers to ICT Implementation**, 40% of educators cited a lack of training, followed by lack of infrastructure (35%) and resistance to change (15%). These barriers highlight the need for ongoing support, both in terms of professional development and resources, to foster ICT integration (Buabeng-Andoh, 2012).

4.2 Analysis of Interview Data

Qualitative data from interviews revealed several key themes, including **Perceived Benefits of ICT**, **Challenges Faced by Educators**, and **Impact on Teaching Competencies**.

1. **Perceived Benefits**: Educators expressed that ICT promotes student engagement, facilitates interactive learning, and enables teachers to address different learning styles. For instance, one participant noted, "ICT has allowed students to visualize complex concepts, which makes learning more interactive and enjoyable" (Schrum & Levin, 2015). This aligns with constructivist theories that advocate for active, hands-on learning experiences (Jonassen, 2006).
2. **Challenges Faced by Educators**: Interviewees highlighted ongoing challenges, such as insufficient training and technical support. As one educator shared, “We need ongoing support and training sessions to keep up with the latest ICT tools and methodologies.” The lack of continuous training presents an obstacle for many teachers who wish to integrate ICT more effectively (Ertmer & Ottenbreit-Leftwich, 2010).
3. **Impact on Teaching Competencies**: Many educators reported that ICT integration enhances their teaching competencies, particularly in areas like problem-solving and digital literacy. As one teacher noted, “ICT has encouraged me to think of new ways to present content, which benefits both me and my students.” This response highlights the importance of ICT in developing innovative teaching strategies that align with 21st-century skills (Voogt & McKenney, 2017).

4.3 Observation Insights

Observations provided practical insights into how ICT is being utilized in real-world teacher education settings. **ICT Tools Used** included interactive whiteboards, projectors, and educational software, demonstrating diverse methods of technology application in teaching. Interactive whiteboards, for example, were frequently used for real-time problem-solving exercises, which promoted student engagement and understanding.

However, observations also revealed **Challenges**, particularly technical issues that disrupted lesson flow, as noted during one observed session where connectivity issues with a projector led to delays. This finding emphasizes the need for reliable technical infrastructure to support ICT use in classrooms (UNESCO, 2020). **Student Engagement** was generally high when ICT tools functioned properly, with students actively participating in interactive tasks and discussions facilitated by digital content. These observations validate the findings from the survey and interviews, illustrating that, while ICT can greatly enhance learning, successful implementation depends heavily on proper infrastructure and support.

5. DISCUSSION

5.1 Interpretation of Findings

The findings underscore the positive impact of ICT on teacher education, affirming the theoretical frameworks and previous research discussed in the literature review. The high percentage of teachers (45%) using ICT daily indicates that digital tools have become integral to instructional practices, supporting the Constructivist Theory, which emphasizes active, student-centered learning environments (Jonassen, 2006). Educators who perceive ICT as effective report improvements in teaching competencies, such as digital literacy and adaptability in lesson delivery, aligning with the TPCK model (Mishra & Koehler, 2006). These findings suggest that ICT integration encourages teachers to innovate and adopt flexible, student-oriented approaches in the classroom (Schrum & Levin, 2015).

However, barriers such as insufficient training and infrastructure persist, echoing the challenges highlighted in previous studies (Buabeng-Andoh, 2012). The fact that 40% of educators cite lack of training as a barrier emphasizes the need for continuous professional development to equip teachers with relevant ICT skills. This finding highlights the importance of robust support structures to foster sustainable ICT integration (Ertmer & Ottenbreit-Leftwich, 2010).

5.2 Implications for Teacher Education Programs

The results have several practical implications for teacher education programs, particularly in **curriculum design, training requirements, and institutional support**.

ISSN 2394 - 7780

1. **Curriculum Design**: Programs should incorporate comprehensive ICT modules that are well-integrated into the curriculum, focusing on digital pedagogy and instructional design that aligns with modern educational needs. Educators would benefit from a curriculum that emphasizes ICT competencies in core teaching areas, enabling them to effectively implement technology-supported learning (Voogt & McKenney, 2017).
2. **Training Requirements**: The need for regular, hands-on training is clear. Teacher education programs must move beyond initial exposure to ICT, providing ongoing professional development to keep educators updated on emerging technologies. Such training can be complemented by peer-to-peer learning opportunities, allowing educators to share best practices and collectively address challenges (UNESCO, 2018).
3. **Institutional Support**: Institutions should ensure that infrastructure, such as reliable internet connectivity and access to updated hardware, is in place. Technical support staff should also be available to assist educators in troubleshooting issues, minimizing interruptions in the learning process (Schleicher, 2018). Such institutional support can foster a conducive environment for effective ICT integration.

5.3 Challenges and Solutions

The challenges identified in this study, including **cost, lack of training, and resistance to change**, must be addressed to optimize ICT integration.

1. **Cost and Funding**: Budget constraints are a major barrier, especially in regions with limited resources. Solutions may include exploring partnerships with technology companies or government grants to subsidize the cost of ICT resources. In some cases, institutions may benefit from free or low-cost open-source tools that can meet essential educational needs (UNESCO, 2020).
2. **Training and Skill Development**: The lack of adequate training underscores the need for comprehensive professional development programs that include both initial and follow-up sessions. Establishing mentorship programs where more tech-savvy teachers support their peers can also facilitate skill-building in a collaborative manner (Ertmer & Ottenbreit-Leftwich, 2010).
3. **Overcoming Resistance to Change**: Resistance often stems from uncertainty or lack of confidence in using ICT. Educators who are hesitant to adopt ICT could benefit from workshops that showcase practical benefits and provide hands-on experience, helping to build a positive attitude towards ICT. Showcasing success stories of ICT integration in similar contexts can further encourage adoption (Kidd & Murray, 2021).

5.4 Comparison with Global Standards

The findings align with global standards, particularly UNESCO's **ICT Competency Framework for Teachers**, which emphasizes digital literacy, pedagogical skills, and the ability to integrate technology into teaching effectively (UNESCO, 2018). The results suggest that educators who frequently use ICT are likely progressing toward these competencies, particularly in areas of content creation and instructional design. However, the lack of consistent training and infrastructure indicates that many institutions still fall short of fully meeting these standards.

Additionally, compared with international benchmarks such as the **OECD Teaching and Learning International Survey (TALIS)**, which advocates for ICT-supported professional development, this study reveals a gap in ongoing training and support, particularly in developing regions (Schleicher, 2018). Addressing these gaps requires investment in professional development, ensuring teachers are not only proficient but also confident in integrating ICT into diverse educational contexts.

6. RECOMMENDATIONS

To enhance the use of ICT in teacher education, a multi-faceted approach is essential. **First**, institutions should prioritize ongoing **professional development** programs that not only introduce educators to ICT tools but also provide continuous skill-building opportunities. Such programs should focus on practical, hands-on training to build confidence and competence, ensuring that teachers can effectively integrate ICT into their teaching practices (Ertmer & Ottenbreit-Leftwich, 2010). Establishing **mentorship programs** where experienced educators guide their peers in ICT use can further support teachers who may be hesitant or lack experience with digital tools.

Second, there is a pressing need for **policy support and investment in ICT infrastructure**. Policymakers and educational institutions should work together to secure funding for essential resources, including reliable internet access, up-to-date hardware, and technical support. By addressing these infrastructural needs, schools

ISSN 2394 - 7780

can provide a more consistent and reliable digital learning environment that supports ICT integration (UNESCO, 2020).

Third, institutions and governments must encourage a **positive culture toward ICT adoption** by highlighting the benefits of digital tools in enhancing learning outcomes. Showcasing successful examples of ICT integration in similar contexts can help educators see its practical benefits and overcome resistance to change (Kidd & Murray, 2021). Moreover, tailored ICT policies that account for regional and local challenges, including affordability and accessibility, can ensure that these initiatives reach a broader base of educators and institutions.

In summary, **sustained policy support**, **investment in infrastructure**, and **continuous professional development** are critical to creating an environment conducive to ICT integration in teacher education. Such efforts will ultimately enable educators to leverage technology effectively, meeting the demands of 21st-century learning environments and preparing students for an increasingly digital world.

7. CONCLUSION

This study highlights the significant role of ICT in transforming teacher education by enhancing instructional quality, fostering innovative teaching methods, and equipping educators with essential 21st-century competencies. Key findings reveal that regular ICT use positively impacts teaching practices, making learning more interactive and student-centered. While most educators recognize the effectiveness of ICT, common challenges—such as lack of training, limited infrastructure, and occasional resistance to change—continue to hinder its full integration. Addressing these challenges through continuous professional development, infrastructural investment, and supportive policy frameworks can create an environment where ICT becomes an integral part of teacher training.

The potential of ICT to reshape teacher education is immense, offering tools that can bridge learning gaps, engage diverse learners, and prepare students for a digitally driven world. By embracing ICT, teacher education programs can better prepare educators to meet the evolving demands of modern classrooms, ultimately enriching the educational experience and fostering a culture of lifelong learning. As schools and institutions adopt these strategies, ICT can truly transform teacher education, equipping educators to lead dynamic, future-ready classrooms.

REFERENCES

- Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of ICT into teaching: A review of the literature. *International Journal of Education and Development using ICT,* 8(1), 136-155.
- Drent, M., & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education,* 51(1), 187-199.
- Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education,* 42(3), 255-284.
- Gomez, M., Sherin, M., Griesdorn, J., & Finn, L.-E. (2019). Capturing teaching practices for teacher development: The impact of video on teacher learning. *Teaching and Teacher Education,* 87, 102935.
- Harris, J., Mishra, P., & Koehler, M. J. (2009). Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education,* 41(4), 393-416.
- Jonassen, D. H. (2006). *Modeling with technology: Mindtools for conceptual change.* Pearson Prentice Hall.
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPCK)? *Contemporary Issues in Technology and Teacher Education,* 9(1), 60-70.
- Kidd, W., & Murray, J. (2021). *Technology, Education, and Learning: An ICT Perspective.* Routledge.
- Liu, S., & Szabo, Z. (2009). Teachers' attitudes toward technology integration in schools: A four-year study. *Teachers and Teaching: Theory and Practice,* 15(1), 5-23.
- Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A framework for teacher knowledge. *Teachers College Record,* 108(6), 1017-1054.
- OECD. (2018). *Teachers and School Leaders as Lifelong Learners.* TALIS.
- Piaget, J. (1970). *Science of education and the psychology of the child.* Viking Press.

ISSN 2394 - 7780

- Schleicher, A. (2018). *World Class: How to Build a 21st-Century School System.* OECD Publishing.
- Schrum, L., & Levin, B. B. (2015). *Leading 21st Century Schools: Harnessing Technology for Engagement and Achievement.* Corwin Press.
- Selwyn, N. (2012). *Education in a Digital World: Global Perspectives on Technology and Education.* Routledge.
- UNESCO. (2018). *ICT Competency Framework for Teachers.* UNESCO Publishing.
- UNESCO. (2020). *Global Education Monitoring Report 2020: Inclusion and Education – All Means All.* UNESCO Publishing.
- Voogt, J., & McKenney, S. (2017). TPACK in teacher education: Are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education,* 26(1), 69-83.
- Wang, Q., & Woo, H. L. (2007). Systematic planning for ICT integration in topic learning. *Educational Technology & Society,* 10(1), 148-156.
- Zhao, Y., & Frank, K. A. (2003). Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal,* 40(4), 807-840.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

ASSESSMENT OF THE IMPACT OF START-UP VILLAGE ENTREPRENEURSHIP PROGRAM IN EMPOWERING WOMEN ENTREPRENEURS IN WESTERN UTTAR PRADESH

Chetna Verma
Research Scholar, Amity Business School, Amity University, Chhattisgarh

ABSTRACT
Start-up Village Enterprise Program (SVEP) is a transforming project for rural businesses mostly targeted toward women. This paper aims to look at how the Western Uttar Pradesh Special Economic Zone (SVEP) influences social activism, financial inclusion, skill development, and market access. By helping female entrepreneurs and allowing businesses to become more ecologically sensitive, the SVEP has clearly been responsible for a significant surge in job prospects. Their main means of helping women get the tools and skills required to start and run profitable businesses is financial support and training courses. Still, poor income, social barriers, and challenges in growing an existing market restrict the practical chances that rural women entrepreneurs have at their hands. Furthermore, ahead of all these difficulties is SVEP helping to create rural economic growth as well as gender-inclusive development. The results underline the need to change laws as well as other supporting systems to maximize the influence of the project over its lifetime.

Keywords*: Women Entrepreneurship, SVEP, Rural Development, Financial Inclusion, Western Uttar Pradesh*

INTRODUCTION
The expansion of the economy depends on rural entrepreneurship since it creates employment possibilities and stimulates innovative ideas. National Rural Livelihoods Mission (NRLM) under the auspices of the Start-Up Village Entrepreneurship Program (SVEP), the Indian government sought to help rural women start their companies [1]. Employment prospects and the expansion of the economy are mostly the result of entrepreneurship—that is, the recognition of potential and the generation of value by the application of creative ideas and approaches. The International Labour Organization (ILO) defines an entrepreneur as "a person who undertakes and runs a new enterprise or venture and assumes some responsibility for the inherent risks." Since they are in charge of developing fresh ideas, goods, and services as well as new employment, entrepreneurs are the engine behind economic growth. A "woman entrepreneur" is someone who is ready to accept demanding work to support her family, meet her personal requirements, and reach emotional and financial independence. People refer to women as entrepreneurs when they jointly design, run, and oversee a corporate establishment. A tremendous potential exists in the ability of Indian women entrepreneurs to generate 170 million more jobs. And by 2030, it will have accounted for almost one-fourth of all the employment the working population will demand [2].

Particularly women entrepreneurs are highly valued because of their enormous contributions to the development of society, the welfare of local communities, and the economic growth. Women entrepreneurs are defined by the Organization for Economic Co-operation and Development (OECD) as "women who organize and manage an enterprise, especially a business, typically with considerable initiative and risk." Women entrepreneurs are defined as someone running and organizing a business. Women entrepreneurs who "innovate, create jobs, and help to improve the quality of life for themselves and their families" have immense importance according to the United Nations Industrial Development Organization (UNIDO). The organization emphasizes a similar point. Figures from the World Bank show that, against the worldwide average of 45%, women today account for 22% of India's gross domestic product. One of the main drivers behind the development of many countries is women's entrepreneurialism. Starting a company presents many difficulties, but if the environment is favorable, this industry will become very profitable and essential for the expansion of the national economy. The official statement of the Indian government says, "An enterprise owned and controlled by a woman having a minimum financial interest of 51 percent of the capital and giving at least 51 percent of the employment generated in the enterprise to women." The most populous state in India, Uttar Pradesh (UP), offers female business owners an intriguing and demanding setting. Although many women attend UP, they nevertheless encounter many obstacles that keep them from engaging in the university's financial life. Cultural standards that restrict their economic involvement, institutional obstacles that keep them from pursuing entrepreneurial activities, and a lack of financial and educational resources are among the several elements that lead to this.

LITERATURE REVIEW

Thakkar, S. (2024) [3], seen that because of financial inclusion, letting women make independent decisions encouraged them to empower themselves in pretty big numbers. Her studies showed that well-organized savings systems and financial access greatly improved the business sustainability of rural women. She insisted that

ISSN 2394 - 7780

women's financial freedom helped them to participate in domestic decisions as well as in corporate success. By giving rural women capital access through microfinance initiatives inside the SVEP framework, these projects helped them to invest in corporate development, acquisition of required resources, and building of long-term financial stability. Many women who previously lacked much money started environmentally friendly companies to demonstrate how well financial inclusion fosters entrepreneurship. Kabeer also noted that higher-income women were more eager to reinvest their money, therefore fostering general local economic development. This is in line with the findings of the present study, which revealed among SVEP recipients a clear rise in business expansion and financial consciousness.

Ahlstrom, D. (2010) [4], underlined the significance of well-managed mentoring initiatives and training courses to support corporate growth. His research shows that entrepreneurship enhanced business intelligence and management, thereby aiding corporate sustainability through educational means. He noted that formally educated corporate leaders demonstrated improved organizational planning and long-term financial management. Under the SVEP framework, training programs have shown quite impressive outcomes, arming women with digital skills, financial literacy, and business planning. SVEP attendees turned out to have better company policies and profit margins. Ahlstrom also noted how mentoring programs improved networking opportunities, thereby allowing women to expand their businesses outside of local markets. The findings of the line of current research show that among SVEP recipients, organized skill development programs significantly increase entrepreneurial success.

Hughes, K. D., et.al, (2012) [5], concentrated largely on rural women entrepreneurs since the success of a business depends on the part market access. Their studies suggest that women's access to bigger markets was rather hampered by limited networking possibilities and supplier chains. The report contends that by allowing women access to more markets, government policies—including corporate assistance programs—may raise company sustainability. Particularly crucial in promoting customer involvement have been SVEP initiatives aiming at industry expansion. Coordinated market measures proved beneficial when women companies financed by SVEP exhibited a 30–50% growth in their consumer base. Moreover, as Brush et al. have demonstrated, digital marketing tools and e-commerce sites assist in reducing discrepancies in market access for women businesses. This is consistent with the findings of the current study, which reveal that definitely more consumer involvement among SVEP members produced better distribution networks developed and more income.

Rao, C. H. (1991) [6], examined the potential impact of rural businesses on gender equality and financial independence. His results show that entrepreneurial activities greatly raised women's self-confidence and capacity for making home decisions. He said women who were financially independent felt more empowered so they could actively engage in social and business events. In the case of SVEP, similar trends have been noted; many women have become qualified to make financial decisions. Rao's research also revealed how entrepreneurship reduced reliance on the income of male family members and raised housing incomes, therefore encouraging communal development. Furthermore, financially stable women entrepreneurs contributed to the long-term socioeconomic benefits of the company by being more willing to invest in their children's education and healthcare. The findings of this study align with Rao's observations of SVEP members expressing increased confidence, financial freedom, and family influence.

Bansal, R., & Sharma, P. (2018) [7], considered the structural and sociological explanations for companies not growing in rural areas. His investigations exposed critical problems, including low resources, gender prejudices, and limited mobility. Many women avoid launching enterprises even with education at hand and financial help under social constraints. From his point of view, patriarchal societies occasionally restricted women's capacity to grow their companies while housekeeping controlled most economic activity. Among other targeted support systems, mentoring programs and financial aid projects have shown effectiveness in somewhat reducing SVEP system issues. Still, many women entrepreneurs deal with family issues throughout the expansion of small businesses. According to Sharma's research, legislative acts are needed to provide women entrepreneurs with more appropriate surroundings, therefore ensuring that structural reforms and society acceptability complement financial and training support.

RESEARCH METHODOLOGY

This research investigates at women entrepreneurs in Western Uttar Pradesh using a strict quantitative method. Using web questionnaires, we personally followed 350 women running SVEP-funded businesses and compiled a wealth of data. The study looks at financial resources, training engagement, market accessibility, and socioeconomic status as independent variables. The dependent variable in entrepreneurship is success. The research measures the indicators of income levels, business growth, and empowerment. Descriptive and

ISSN 2394 - 7780

inferential statistical techniques of data analysis help one to completely understand the results of financial inclusion, skill development, and market access.

RESEARCH OBJECTIVES

- To analyse the impact of SVEP on the financial independence and business growth of women entrepreneurs in Western Uttar Pradesh.
- To evaluate how skill development and market access contribute to the socio-economic empowerment of SVEP beneficiaries.

RESULTS & INTERPRETATIONS

The data collected through survey have been analysed using statistical tests as described as per below sections:

1. **Demographic Information**

Age Group	Number of Respondents (n)	Percentage (%)
Below 18	10	2.9%
18–25	60	17.1%
26–35	158	45.1%
36–45	80	22.9%
46–55	30	8.6%
56 and above	12	3.4%
Total	**350**	**100%**

From the table we have found the outcomes of the demographic information's age group which motivate women from rural Western Uttar Pradesh into entrepreneurship. Of the responders, 10 below 18 (2.9%), 60 were 18-25years (17.1%), 158 were 26-35 years (45.1%), 80 were 36-45 years (22.9%), 30 were 46-55 years (8.6%), 12 were 56 and above (3.4%). Hence, it has been seen that most of the respondents were between 26-35 years age group.

Gender	Number of Respondents (n)	Percentage (%)
Female	330	94.3%
Male	15	4.3%
Other	3	0.9%
Prefer not to say	2	0.6%
Total	**350**	**100%**

From the table we have found the outcomes of the demographic information's gender of the respondents which motivate women from rural Western Uttar Pradesh into entrepreneurship. Of the responders, 330 were female (94.3%), 15 were male (4.3%), 3 were other (0.9%), 2 were prefer not to say (0.6%). Hence, it has been seen that most of the respondents were females out of 350 total respondents.

Marital Status	Number of Respondents (n)	Percentage (%)
Single	50	7%
Married	245	1.4%
Widowed	25	14%
Divorced	20	17.5%
Separated	10	35%
Total	**350**	**100%**

From the table we have found the outcomes of the demographic information's marital status, which motivate women from rural Western Uttar Pradesh into entrepreneurship. Of the responders, 50 were single (7%), 245 were married (1.4%), 25 were widowed (14%), 20 were divorced (17.5%) and 10 were separated (35%). Hence, it has been seen that most of the respondents were married out of 350 total respondents.

2. **RESULTS**

Survey Question- 1	SVEP has significantly promoted entrepreneurship among women in rural Western Uttar Pradesh.
Strongly Disagree (n)	18
Disagree (n)	35

ISSN 2394 - 7780

Neutral (n)	53
Agree (n)	140
Strongly Agree (n)	104

From the table we have found the outcomes of the elections which motivate women from rural Western Uttar Pradesh into entrepreneurship. Of the responders, forty percent highly agreed (29.7%) and stated the initiative had been helpful. Still, 15.1% maintained neutrality, most likely in reaction to contradictory developments. Ten percent strongly disagreed (5.2%), highlighting specific challenges, including industry problems or financial constraints. While SVEP has encouraged entrepreneurship, there is still a need to address issues for those who have not fully benefited.

Survey Question- 2	SVEP has effectively created employment opportunities for women in rural areas.
Strongly Disagree (n)	14
Disagree (n)	42
Neutral (n)	63
Agree (n)	133
Strongly Agree (n)	98

From the table we have found that SVEP has successfully opened rural women's work possibilities. Most of the respondents, 38% or strongly agreed—28%—said the initiative helped to boost employment. Still, 18% said they had a neutral view, maybe suggesting that the employment increase did not happen right away. About issues of restricted employment opportunities or obstacles to corporate growth, a minority responded strongly (4%) or disagreed (12%). Although SVEP has generally improved employment, greater development could help to improve work accessibility for a larger number of women.

Survey Question- 3	The program has helped reduce economic disparities in marginalized communities.
Strongly Disagree (n)	21
Disagree (n)	49
Neutral (n)	70
Agree (n)	123
Strongly Agree (n)	87

According to the table, SVEP assists underdeveloped areas to lower their economic imbalance. Of the respondents, most—35.1%—or strongly agreed—24.9%—said the program has closed financial gaps. Twenty percent remained neutral, maybe implying little rapid cash advantage. A smaller minority disagreed (14%) or strongly disagreed (6%), implying some women would still struggle financially. SVEP has brought about financial uplifting; more universal and equitable economic impact could necessitate more actions.

Survey Question- 4	Women entrepreneurs supported by SVEP feel more confident in running their businesses.
Strongly Disagree (n)	11
Disagree (n)	28
Neutral (n)	42
Agree (n)	147
Strongly Agree (n)	122

From the table we have found that SVEP has greatly raised the confidence of women entrepreneurs in managing their companies. Most of the respondents, 42% or strongly agreed, claimed the training increased their confidence. However, 12% remained neutral, potentially indicating varying degrees of confidence growth. A lesser percentage, 8%—or strongly disagreed, 3.1%—suggesting that some women still struggle to fully apply their commercial acumen. SVEP has usually raised women's confidence; additional mentoring and coaching will help them to improve their business skills even more.

ISSN 2394 - 7780

Survey Question- 5	The training provided under SVEP equips women with necessary entrepreneurial skills.
Strongly Disagree (n)	18
Disagree (n)	32
Neutral (n)	53
Agree (n)	158
Strongly Agree (n)	91

From the table we have found that the SVEP project has successfully given women the necessary entrepreneurial competencies. Of the 45.1% or rather agreed respondents, 26% said the training courses improved the awareness of their business. Conversely, 15.1% of respondents claimed they had no response, most likely meaning some women believed the advice did not actually apply in their situation. Less proportion disagreed (9.1%) or strongly disagreed (5.1%), implying some areas of education might require work. All things considered, SVEP's events have enhanced women entrepreneurs' skill sets.

Survey Question- 6	Financial support and loans offered by SVEP are sufficient for start-ups.
Strongly Disagree (n)	25
Disagree (n)	53
Neutral (n)	77
Agree (n)	130
Strongly Agree (n)	65

From the table we have found that SVEP's financial support and loan terms may not be sufficient for every start-up. Although most respondents (37.1%) or strongly agreed (18.6%), a large number (22%) kept neutral, thereby reflecting different experiences even if the money fulfilled the needs of their business. Furthermore, fairly clearly showing the lack of financial support some companies felt, 15.1% disapproved and 7.1% strongly disagreed. These findings underline the need for more flexible loan terms or alternative financial sources to enable start-ups powered by women.

Survey Question- 7	The networking opportunities facilitated by SVEP enhance market reach.
Strongly Disagree (n)	14
Disagree (n)	35
Neutral (n)	63
Agree (n)	140
Strongly Agree (n)	98

From the table we have found, demonstrating women entrepreneurs now have increased market access. 40 % or more of the respondents claimed these possibilities enabled their companies to grow. 18% of respondents showed no response, suggesting some businesses might have completely missed the networking opportunities. 10 % of the respondents disagreed or strongly disagreed, showing difficulties locating or using these contacts. SVEP has opened the market, but generally the results reveal the need for greater effort in enhancing the infrastructure of networks.

Survey Question- 8	SVEP has improved the standard of living for women and their families.
Strongly Disagree (n)	11
Disagree (n)	32
Neutral (n)	60
Agree (n)	154
Strongly Agree (n)	94

The poll findings unambiguously show how improved SVEP has transformed living conditions for women and their families. Of the responders, 44% very much agreed; most felt the program improved their social as well as financial situation. With very little change shown by 17%, some women might not have seen any. Just 12 % of the respondents disagreed or strongly disagreed, suggesting some on-going issues. Generally, the figures

ISSN 2394 - 7780

illustrate how well SVEP enhances economic stability; more inclusion would be preferred; therefore, more support would be needed.

Survey Question- 9	Women entrepreneurs under SVEP are more involved in community decision-making.
Strongly Disagree (n)	21
Disagree (n)	39
Neutral (n)	70
Agree (n)	133
Strongly Agree (n)	87

From the table we have found that SVEP has motivated women entrepreneurs to participate in group decisions. Of the responders, 25%—that is, those who strongly agreed—said they currently regularly participate in local events. 20 % of the respondents said they do not now take part in local activities, suggesting not all women have seen notable changes even in cases of development. A lesser percentage (17%) claimed that social and cultural barriers still restrict participation by opposing or more negative actions. The findings show the general favourable effect of SVEP, even if more initiatives for empowerment are obviously required.

Survey Question- 10	SVEP has made rural women more aware of entrepreneurship opportunities.
Strongly Disagree (n)	18
Disagree (n)	28
Neutral (n)	56
Agree (n)	147
Strongly Agree (n)	101

From the table we have found that modern rural women have far more awareness of economic possibilities thanks in considerable part to SVEP. Of the respondents, 42 % either agreed (42%), or strongly agreed (29%), saying the training allowed them to spot business opportunities. Still, 16 % of the respondents stated they were indifferent, implying some women could need additional guidance or exposure. 13 % of the respondents strongly disagreed or disapproved, implying minority knowledge is always prone to on-going dispute. Although continuous efforts are crucial, the results suggest that SVEP has been quite beneficial for women looking for business opportunities.

CONCLUSION

The Start-up Village Entrepreneurship Program (SVEP) provides rural women entrepreneurs in Western Uttar Pradesh with greater financial inclusion, talent development, and market access. This program is particularly beneficial to urban women entrepreneurs. The Start-up Village Entrepreneurship Program (SVEP) was especially helping the Western Uttar Pradesh rural women entrepreneurs. To help underdeveloped areas narrow their economic gap, most of the participants claimed that SVEP enhanced infrastructure, transportation, businesses, and employment. Mostly thanks to loans and other financial support, women have confidence, financial inclusion, and basic entrepreneurial capacity. Moreover, the networking activities SVEP have improved market access, which assists companies run by women to grow their clientele. Taken all around, programs have enhanced the quality of life for women and their families. Women entrepreneurs with better financial situations showed up for neighbourhood activities. A handful of them expressed apathy or disagreement about financial support; these points of view instead highlight the need for more focused projects. SVEP offers different business prospects; better internet connection, market development, and more financial knowledge will help to raise its long-term relevance. The findings show that in rural areas, SVEP has favourably affected women's business success, financial independence, and socioeconomic empowerment.

Studies show that SVEP is responsible for the creation of jobs, the reduction of economic disparity, and the increase in the confidence of female entrepreneurs. Although the sector has grown through financial backing and networking, the capacity for entrepreneurial endeavors has been increased through training and mentoring. Despite its achievements, society continues to struggle with issues and has a limited supply of resources. The importance of SVEP will increase as a result of policy changes that will make it possible to find solutions to problems. All things considered, the Small Business Enterprise Program (SVEP) has been of tremendous assistance in the areas of rural economic development, gender inclusivity in corporations, and women's entrepreneurship.

ISSN 2394 - 7780

REFERENCE

[1] Shubham Vats Navita Malik. (2025). Empowering women entrepreneurs through government initiatives in Uttar Pradesh. *Journal of Informatics Education and Research*, *5*(1). https://doi.org/10.52783/jier.v5i1.2125

[2] Chandrashekara., D. C. (2021). *A study on present status of women and rural entrepreneurs - in India*. Jetir.org. Retrieved March 18, 2025, from https://www.jetir.org/papers/JETIR2111200.pdf

[3] Thakkar, S. (2024). Exploitation, harassment and violence: Lived experiences of women paid domestic workers in India. *Journal of South Asian Development*, *19*(1), 44–60. https://doi.org/10.1177/09731741231164872

[4] Ahlstrom, D. (2010). Innovation and growth: How business contributes to society. *The Academy of Management Perspectives*, *24*(3), 11–24. https://doi.org/10.5465/amp.24.3.11

[5] Hughes, K. D., Jennings, J. E., Brush, C., Carter, S., & Welter, F. (2012). Extending women's entrepreneurship research in new directions. *Entrepreneurship Theory and Practice*, *36*(3), 429–442. https://doi.org/10.1111/j.1540-6520.2012.00504.x

[6] Rao, C. H. (1991). Promotion of women entrepreneurship: A brief comment. *SEDME (Small Enterprises Development, Management & Extension Journal): A Worldwide Window on MSME Studies*, *18*(2), 21–27. https://doi.org/10.1177/0970846419910203

[7] Bansal, R., & Sharma, P. (2018). Digital inclusion as a catalyst for women empowerment: A study of rural India. *Journal of Digital Economy and Society*, *5*(2), 45–56.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

A CASE STUDY OF UNICORN STARTUPS IN INDIA: GROWTH, IMPACT, AND SUSTAINABILITY

Nidhi Bawashe[1], Dr. Annapurna Metta[2] and Dr. Satyendra Patnaik[3]
[1]Research Scholar, Under the Guidance
[2]Assistant Professor, Amity Business School, Raipur, Chhattisgarh
[3]Professor, CEO – JSSATE – STEP, Noida, Dean (Management) – JSS University, Noida, Uttar Pradesh

ABSTRACT
This thesis presents an in-depth analysis of the emergence, evolution, and current landscape of unicorn startups in India—privately held companies with a valuation exceeding USD 1 billion. As of 2023, India ranks third globally in the number of unicorns, trailing only behind the United States and China. This remarkable growth reflects the dynamism of India's startup ecosystem, driven by a combination of favourable demographics, increasing smartphone and internet penetration, rising consumer demand, proactive government policies (such as *Startup India* and *Digital India*), and a surge in domestic and foreign venture capital investments.

The study aims to investigate the key drivers behind the rise of Indian unicorns, the common traits that define their rapid scale-up, and the challenges they face in sustaining long-term value. In particular, it examines the economic and social impact of these startups in reshaping traditional sectors, generating employment, digitizing services, and formalizing fragmented markets.

To offer grounded insights, the research focuses on three high-impact unicorns: **Ola**, a pioneer in India's ride-hailing and emerging electric mobility sector; **Nykaa**, a transformative force in online beauty and personal care retail; and **Udaan**, a B2B e-commerce platform digitizing wholesale trade across India's vast informal retail network. Each case study analyzes the startup's business model, funding trajectory, innovation strategy, competitive landscape, regulatory interactions, and growth challenges.

While these unicorns symbolize India's innovation potential and its attractiveness to global investors, the thesis critically addresses growing concerns around capital dependency, operational sustainability, profitability delays, corporate governance issues, and valuation corrections. Ultimately, this research argues that for Indian unicorns to transition from being valuation-driven ventures to impactful institutions, they must embrace sustainable business models, prioritize ethical governance, and align their growth objectives with inclusive national development goals.

INTRODUCTION

1.1 Background
India's economy is undergoing a transformative shift, driven by a confluence of digital innovation, rising entrepreneurial ambition, a youthful population, and a rapidly expanding middle class. At the forefront of this transformation is the country's burgeoning startup ecosystem. Once considered high-risk and rare, startups—particularly those achieving "unicorn" status—are now central players in India's economic narrative.

A *unicorn* refers to a privately held startup with a valuation exceeding USD 1 billion. While the term was coined in Silicon Valley, its implications are increasingly relevant to India. As of 2023, India boasts over 100 unicorns, making it the third-largest unicorn ecosystem globally, following only the United States and China. These startups span diverse industries such as financial technology (Fintech), logistics, education (EdTech), healthcare technology (HealthTech), Software as a Service (SaaS), e-commerce, mobility, and B2B trade platforms. Many of these companies are not just redefining their sectors but also democratizing access to essential services and improving efficiencies across urban and rural markets.

Several macroeconomic and policy-level developments have accelerated this growth:

- The Digital India initiative has improved digital infrastructure across the country.
- The Startup India campaign offers tax breaks, simplified compliance, and incubation support.
- The Unified Payments Interface (UPI) revolutionized fintech adoption.
- A rise in foreign direct investment (FDI) and domestic venture capital has made India one of the most attractive markets for startup funding.

However, the surge in unicorn numbers has brought with it growing scrutiny. Many unicorns operate on business models that prioritize hypergrowth over profitability, relying heavily on external funding while

ISSN 2394 - 7780

running large operational losses. Additionally, concerns about corporate governance, employee welfare, data privacy, and regulatory compliance have begun to surface.

This thesis explores these tensions between rapid growth and long-term sustainability by focusing on case studies of three high-profile Indian unicorns—Ola, Nykaa, and Udaan—to analyze how they have scaled, what challenges they face, and what their stories reveal about the broader startup ecosystem in India.

1.2 Scope of the Study

This study is focused on the unicorn startups ecosystem in India, particularly in the context of its growth trajectory, innovation dynamics, socio-economic contribution, and long-term sustainability. The scope includes:

- A macro-level analysis of India's unicorn boom: growth trends, enabling factors, and global comparisons.
- Sector-specific insights by analyzing three diverse unicorns:
  - Ola (MobilityTech) – representing the urban transport and electric mobility sector.
  - Nykaa (BeautyTech & E-commerce) – exemplifying D2C and online retail disruption.
  - Udaan (B2B E-commerce) – highlighting informal trade digitization in India.
- Examination of how these unicorns have impacted industry structures, consumer behaviour, employment generation, and rural-urban market linkages.
- Critical assessment of funding patterns, valuation metrics, and operational strategies.
- Discussion on policy implications and future directions for India's startup economy.

The study does not include a deep-dive into all Indian unicorns but rather selects representative cases to draw insights that can be generalized to other startups with similar characteristics.

1.3 Objectives of the Study

The key objectives of this research are as follows:

- To understand the rise of unicorns in India: Investigate macroeconomic trends, government interventions, and ecosystem support that have enabled rapid startup growth.
- To analyze new-age startups that have disrupted traditional industries: Explore how technology-enabled businesses have reshaped sectors like transport, commerce, and retail.
- To examine the business strategies of Ola, Nykaa, and Udaan: Study how these startups achieved scale, attracted funding, and built their customer base.
- To assess the economic, social, and policy impact of these unicorns: Evaluate their role in job creation, consumer empowerment, gender inclusion, and market formalization.
- To evaluate risks and outline recommendations for long-term sustainability: Address concerns related to profitability, valuation correction, governance, and market saturation; and suggest frameworks for responsible scaling.

LITERATURE REVIEW

2.1 Unicorns: A Global Perspective

The term *"unicorn"* was first coined by venture capitalist Aileen Lee (2013) to describe privately held startup companies valued at over USD 1 billion, highlighting their rarity at the time. These firms typically emerged from innovation hubs like Silicon Valley and were characterized by the integration of disruptive technology, rapid scalability, and high-risk, high-*return investment models (Lee, 2013).*

Authors such as *Gornall and Strebulaev (2020)* analyzed the valuation mechanics of unicorns and revealed that many of these firms may be overvalued due to preferential rights given to late-stage investors, suggesting a discrepancy between *headline valuations* and *true market value*. Similarly, Kenney and Zysman (2016) explored how platform-based unicorns like Uber and Airbnb not only introduced novel business models but also destabilized traditional regulatory frameworks, raising concerns about the governance of platform capitalism.

Studies by *CB Insights (2022)* and Crunchbase have shown that while the majority of global unicorns originated in the United States and China, other economies like India, the UK, and Germany have increasingly become fertile grounds for unicorn formation due to technology adoption, digital infrastructure, and funding inflows.

A common set of characteristics often defines global unicorns:

- **Disruptive innovation**: Challenging traditional incumbents through new digital models (e.g., Uber vs. taxis, Airbnb vs. hotels)
- **Aggressive growth orientation**: Prioritizing customer acquisition and scale over profitability
- **Investor-led expansion**: Significant involvement of venture capital and private equity firms
- **Global scalability**: Business models designed for international replication and rapid adoption

India's entry into the unicorn club marks the *localization* of these global traits, uniquely adapted to its socio-economic conditions.

2.2 India's Startup Ecosystem

India's startup ecosystem has grown exponentially over the past decade, becoming the third-largest in the world. According to NASSCOM (2022) and Invest India, several structural and policy-level enablers have contributed to this growth:

- The Startup India initiative (launched in 2016) provided tax exemptions, funding support (Fund of Funds for Startups - FFS), and simplification of compliance procedures (DPIIT, 2019).
- The Digital India campaign enhanced digital literacy and rural connectivity, helping even Tier-II and Tier-III cities participate in the startup ecosystem.
- The adoption of UPI and Aadhaar (India Stack) provided critical digital infrastructure for fintech and service-based startups.
- India's demographic dividend—a young, tech-savvy population—created fertile ground for mobile-first solutions and app-based business models.

Authors like Kumar and Choudhury (2020) argue that Indian startups have capitalized on *market asymmetries*, providing solutions where public services or legacy businesses failed. Aggarwal and Kapoor (2021) emphasize that platforms like Flipkart, Paytm, and Ola redefined user behavior and inspired a new generation of entrepreneurs.

India's unicorns also reflect sectoral diversity. Early unicorns were largely consumer-focused (e.g., e-commerce), but recent ones logistics (Delhivery), SaaS (Zoho), B2B commerce (Udaan), and fintech (Razorpay), demonstrating ecosystem maturity.

In many cases, these startups are formalizing traditionally informal sectors, such as street-level retail, transportation, and education. Their platforms are enabling better documentation, data trails, and digital payments—laying the foundation for scalable governance and innovation.

CONCLUSION OF LITERATURE REVIEW

The literature suggests that while unicorns represent economic dynamism and innovation, they are not without flaws. The Indian startup ecosystem's success is contingent on balancing speed with sustainability, scaling with ethics, and innovation with accountability. This thesis contributes to the literature by examining select Indian unicorns not only from a growth perspective but also through the lenses of sustainability, governance, and long-term socio-economic impact.

RESEARCH METHODOLOGY

3.1 Approach

This research adopts a qualitative case study approach, analysing:

- Business models
- Growth strategies
- Funding patterns
- Impact metrics

3.2 Data Collection

Sources:

- Startup databases (CB Insights, Inc42)

ISSN 2394 - 7780

- Financial reports and IPO filings
- Interviews, press releases, and secondary research
- YourStory, Inc42, Economic Times, TechCrunch

3.3 Selection Criteria
Selected unicorns are from diverse industries:

- **Ola** – Disruption in transportation
- **Nykaa** – Tech-enabled beauty/e-commerce platform
- **Udaan** – B2B trade and distribution across Bharat (non-metro India)

Case Studies

4.1 Case Study 1: Ola (ANI Technologies Pvt. Ltd.)

Founded: 2010 by Bhavish Aggarwal and Ankit Bhati

Sector: Ride-hailing and MobilityTech

Unicorn Since: 2014

Valuation Peak: $7.3 billion

Business Model:
- Aggregates taxis, autos, and bikes via app
- Expanded into electric vehicles (Ola Electric)
- Monetizes via commissions and dynamic pricing

Growth Drivers:
- Smartphone penetration
- Urban transportation inefficiencies
- Absence of legacy taxi infrastructure

Challenges:
- Regulatory battles with local transport authorities
- Driver dissatisfaction and strikes
- Losses due to competition and discounts
- Fleet maintenance and scaling of EV infrastructure

4.2 Case Study 2: Nykaa

Founded: 2012 by Falguni Nayar

Sector: Beauty & Lifestyle E-commerce

Unicorn Status: 2020

IPO: Successfully listed in 2021

Valuation at IPO: ~$13 billion (briefly)

Business Model:
- Omnichannel platform selling beauty, fashion, and wellness products
- Focuses on curated content, influencer marketing, and education
- Direct partnerships with premium global brands

Strengths:
- Strong logistics and warehouse management
- Personalized content and engagement
- Trust and loyalty among women consumers

ISSN 2394 - 7780

Challenges:
- Post-IPO valuation correction
- Margin pressure from offline competition
- Scalability of private label products

4.3 Case Study 3: Udaan

Founded: 2016 by former Flipkart executives

Sector: B2B E-commerce

Unicorn Since: 2018

Valuation: ~$3.1 billion

Business Model:
- Enables retailers, wholesalers, and traders to buy/sell goods across India
- Credit financing and logistics built-in
- Focus on Tier-2 and Tier-3 India

Impact:
- Digitized informal retail supply chain
- Helped local shops access inventory efficiently
- Created value in FMCG, electronics, and pharma trade

Challenges:
- High logistics costs
- Difficulty in credit recovery
- Fragmented retail ecosystem
- Capital-intensive model

ANALYSIS AND DISCUSSION

5.1 Shared Success Drivers

The rapid ascent of Ola, Nykaa, and Udaan to unicorn status can be attributed to a combination of strategic, technological, and market-specific success factors. While these startups operate in different industries—mobility, e-commerce, and B2B distribution respectively—they share common enablers that have fuelled their growth.

5.1.1 Strong Use of Data and Tech Platforms

Each of these startups has leveraged **data analytics, AI-driven algorithms**, and **cloud-based infrastructure** to optimize operations and personalize user experiences.

- **Ola** uses real-time geolocation data and demand prediction models to optimize fleet allocation, reduce wait times, and implement surge pricing.
- **Nykaa** utilizes recommendation engines based on browsing and purchase behavior, enabling targeted marketing and higher conversion rates.
- **Udaan** applies inventory analytics and credit risk modeling to assess buyer reliability and streamline logistics.

The strategic deployment of technology has enabled these firms to scale efficiently, optimize costs, and create intelligent decision-making systems in fast-changing markets.

5.1.2 Scalability via Mobile Platforms

India is predominantly a mobile-first internet economy. All three companies have built mobile-optimized platforms that cater to users across urban and semi-urban regions.

- Ola's app interfaces seamlessly with Android and iOS users, and even works in low-bandwidth environments.

ISSN 2394 - 7780

- Nykaa's mobile app supports regional language integration and personalized dashboards.
- Udaan's mobile-first B2B marketplace allows small retailers to order stock, track delivery, and access credit—all through their smartphones.

This app-centric strategy has provided them with deep market penetration, especially in Tier II and Tier III cities where desktop internet access is minimal.

5.1.3 Localization of Services

A defining trait of successful Indian unicorns is their ability to adapt services to local market conditions, consumer behavior, and regulatory frameworks.

- Ola launched services like Ola Auto, Ola Bike, and Ola Rentals to meet region-specific mobility needs.
- Nykaa localized beauty offerings with regional brands, skin tone-specific products, and vernacular content to build consumer trust.
- Udaan tailored its product categories to the demands of kirana stores, chemists, and mom-and-pop retailers, integrating regional logistics providers for timely delivery.

This **hyper-localization** strategy enabled these companies to serve India's fragmented and culturally diverse markets more effectively than international competitors.

5.1.4 Access to Global Venture Capital and Strategic Partnerships

Ola, Nykaa, and Udaan have all attracted significant capital from some of the world's most influential investors:

- **Ola**: SoftBank, Tiger Global, Tencent
- **Nykaa**: TPG Capital, Fidelity, and multiple family offices
- **Udaan**: Lightspeed Venture Partners, DST Global, Altimeter Capital

These funding rounds allowed them to burn capital for market capture, expand infrastructure, and invest in R&D. Strategic partnerships also brought in operational expertise and international best practices.

Future Outlook

6.1 Emerging Trends

- **Green mobility** (Ola Electric)
- **Ecommerce and creator economy** (Nykaa's influencer strategy)
- **Formalization of unorganized retail** (Udaan's core market)

6.2 Policy & Market Recommendations

- Support innovation but introduce sector-specific regulations
- Encourage domestic capital flows into startups
- Build public infrastructure (logistics, EVs, credit) to support scale
- Foster startup IPOs to ensure financial transparency

CONCLUSION

India's unicorn journey is a testament to the transformative power of entrepreneurship, digital innovation, and market disruption within one of the world's most complex and diverse economies. The remarkable trajectories of Ola, Nykaa, and Udaan showcase how startups can challenge and redefine traditional industries—urban mobility, beauty retail, and wholesale trade—by leveraging technology, deep localization, and new business models tailored to India's unique socio-economic fabric.

These success stories underscore several important themes. First, the democratization of technology and capital has enabled businesses to scale rapidly and reach underserved customer segments across geographies and income groups. Second, the Indian startup ecosystem benefits from a youthful population and increasing internet penetration, factors that startups have skillfully harnessed to disrupt entrenched incumbents. Third, access to global venture capital and strategic partnerships has fueled ambitious growth and expansion.

However, this journey also exposes critical challenges that lie ahead. The longevity and true impact of India's unicorns will hinge on their ability to move beyond short-term valuation milestones and fund-raising triumphs towards building robust governance structures, delivering genuine customer value, and adopting sustainable

ISSN 2394 - 7780

operational practices. Many of these startups currently operate on high cash burn rates, face regulatory uncertainties, and encounter intense competitive pressures, which could undermine profitability and stakeholder confidence over time.

Moreover, ethical considerations such as employee welfare, data privacy, and environmental sustainability must be integrated into business strategies to align with global standards and social expectations. As India's unicorns mature, their evolution into responsible, value-driven enterprises will be essential—not only for securing their own future but also for ensuring that their growth translates into meaningful economic development, job creation, and societal progress.

In conclusion, India's unicorn ecosystem symbolizes a powerful shift in how innovation can drive inclusive growth in emerging markets. The path forward requires a delicate balance between aggressive innovation and prudent management. If nurtured with foresight and responsibility, India's unicorn startups have the potential to become global leaders and catalysts for sustainable transformation in the decades to come.

REFERENCES

- Aggarwal, R., & Kapoor, S. (2021). *Startup Ecosystem in India: Growth, Challenges, and Policy Implications*. Indian Journal of Economics and Business, 20(2), 45-61.
- CB Insights. (2022). *The Global Unicorn Club: Private Companies Valued at $1 Billion or More*. CB Insights Report. https://www.cbinsights.com/research-unicorn-companies
- Chatterjee, P. (2021). The gig economy in India: Labour, regulation and opportunities. *Journal of Labour Studies*, 7(1), 22-38.
- Damodaran, A. (2018). *Valuing Unicorns: The Risks of Chasing Growth Over Profit*. Stern School of Business, New York University. https://pages.stern.nyu.edu/~adamodar/pdfiles/papers/unicorns.pdf
- DPIIT (Department for Promotion of Industry and Internal Trade). (2019). *Startup India Action Plan*. Government of India. https://www.startupindia.gov.in
- EY (Ernst & Young). (2022). *India Startup Survey 2022: Governance and Sustainability in Unicorns*. Ernst & Young India. https://www.ey.com/en_in/startup-survey
- Gornall, W., & Strebulaev, I. A. (2020). Squaring Venture Capital Valuations with Reality. *Journal of Financial Economics*, 135(1), 120-143.
- Kenney, M., & Zysman, J. (2016). The Rise of the Platform Economy. *Issues in Science and Technology*, 32(3), 61-69.
- Kumar, S., & Choudhury, P. (2020). Market Asymmetries and the Rise of Indian Startups. *Indian Journal of Management Science*, 12(4), 78-94.
- Lee, A. (2013). Welcome to the Unicorn Club: Learning from Billion-Dollar Startups. *TechCrunch*. https://techcrunch.com/2013/11/02/welcome-to-the-unicorn-club/
- NASSCOM. (2022). *Indian Startup Ecosystem Report 2022*. National Association of Software and Service Companies. https://nasscom.in/knowledge-center/publications/indian-startup-ecosystem-report-2022
- Sen, R., & Tripathi, A. (2022). Regulation and Innovation in India's Fintech Sector: Balancing Growth and Compliance. *Journal of Financial Regulation and Compliance*, 30(2), 180-196.
- The Boston Consulting Group (BCG). (2022). *India Beauty and Personal Care Market Report*. https://www.bcg.com/publications/2022/india-beauty-personal-care

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

CONTEMPORARY ISSUES IN MULTIDISCIPLINARY RESEARCH

Anurag Badoni
PhD Research Scholar, Department of English, HNB Garhwal University (A Central University) Uttarakhand

ABSTRACT
The increasing focus on multidisciplinary research necessitates that literature scholars engage with methodologies that extend beyond traditional frameworks. While this integration can yield richer insights, it simultaneously introduces several significant challenges, including epistemological conflicts, methodological incompatibility, and the marginalization of qualitative disciplines. This paper addresses these issues through a psychanalytic examination of Anita Desai's Cry, the Peacock. Employing psychoanalysis – a framework rooted in psychology – for literary analysis underscores concerns regarding conceptual adaptation and methodological ambiguity. Literary analysis benefits from interpretive openness, whereas psychoanalysis requires theoretical precision, thereby creating tension between subjective interpretation and scientific rigor. For instance, analyzing Maya's obsessive fear of death and oedipal desires through Freudian theory risks reductionism, particularly when textual subtleties defy rigid psychological constructs. Furthermore, institutional demands for empirical validation and quantifiable results often overshadow interpretive approaches, thereby perpetuating a hierarchy that favors the sciences over the humanities.

These challenges resonate with broader global issues: the absence of a shared vocabulary across disciplines, the complexity of established standardized evaluation criteria, and the time-intensive nature of collaboration that necessitates expertise from various fields. In environment where research funding and recognition prioritize outcomes associated with STEM disciplines, the humanities face the risk of underrepresentation, thereby complicating their role within multidisciplinary frameworks.

Utilizing Cry, the Peacock as a case study, this paper interprets Desai's depiction of psychic fragmentation while reflecting on the intellectual and structural obstacles faced by literature scholars engaged in multidisciplinary research. It advocates for adaptive, dialogue-oriented models that preserve disciplinary integrity while fostering meaningful integration.

Keywords*: interdisciplinary challenges, epistemological conflicts, knowledge integration, collaborative research, methodological issues, cross-disciplinary integration, psychoanalytic criticism.*

INTRODUCTION
Contemporary global challenges necessitate multidisciplinary research that integrates diverse methodologies to address complex realities (Klein, 2010). Issues such as mental health, cultural identity, and social inequality cannot be adequately examined within the confines of a single discipline (OCED, 2019). Consequently, cross-disciplinary collaboration has emerged as a central focus of academic inquiry.

However, this integration presents significant epistemological and methodological challenges. Repko and Szostak (2017) identify the lack of a common conceptual language as a major impediment, while Frode man (2010) highlights the hierarchical privileging of STEM fields over the humanities, resulting in institutional biases. These challenges are particularly pronounced for scholars of English literature, as literary interpretation values ambiguity and qualitative depth (Barry, 2017), in contrast to scientific frameworks that emphasize precision and empiricism (Nowotny et al., 2001). The absence of standardized evaluation methods further complicates research that seeks to merge interpretive and scientific perspectives.

Despite these obstacles, interdisciplinary dialogue remains crucial for achieving a more comprehensive understanding of human experience (Jacobs &Frickel, 2009). This paper explores these contemporary issues through the application of psychoanalytic theory to literature, a case that exemplifies the tensions between subjective interpretation and theoretical rigor. The argument put forth advocates for adaptive frameworks that uphold the integrity of literary studies while facilitating meaningful interdisciplinary engagement.

METHODOLOGICAL INCOMPATIBILITY
In the contemporary landscape characterized by global complexity, multidisciplinary research has emerged as a vital approach for addressing complex global challenges, including climate change, public health crises, technological disruption, economic development, and social justice. Nevertheless, one of the most significant and enduring challenges within this collaborative environment is methodological incompatibility – the discord between the research methods, tools, and frameworks employed by various academic disciplines. It also denotes the fundamental differences in the design of studies, data collection, data analysis, and knowledge construction

ISSN 2394 - 7780

across various academic fields. As a contemporary concern, methodological incompatibility jeopardizes the effectiveness, cohesion, and productivity of multidisciplinary research initiatives.

Methodology encompasses the principles and procedures employed by researchers to investigate phenomena and develop knowledge. Each academic discipline has established its own set of methods that align with its epistemological assumptions regarding what constitutes valid knowledge and truth. For instance, physics is heavily reliant on experimental modeling, whereas anthropology utilizes ethnographic observation and cultural immersion. In contrast, English literature prioritizes textual analysis, metaphor, and interpretive strategies.

Methodological incompatibility emerges when researchers from diverse fields attempt collaborative effort but encounter difficulties reconciling their distinct approaches. This issue is not merely technical; rather, it is deeply philosophical, stemming from divergent perspectives regarding reality, evidence, and interpretation.

Methodological incompatibility from an English literature researcher's perspective: A case study on Anita Desai's Cry, the Peacock. In contemporary multidisciplinary research, scholars in English literature frequently engage with theories and methodologies from diverse disciplines such as psychology, sociology, philosophy, and neuroscience to enhance textual analysis. However, this convergence often encounters an obstacle known as methodological incompatibility - a fundamental divergence in research methods, objectives, and epistemological foundations between disciplines.

This issue becomes particularly pronounced when literary researchers employ psychological frameworks, such as Sigmund Freud's psychoanalysis, to analyze complex literary texts, exemplified by Anita Desai's Cry, the Peacock. It is a psychologically nuanced novel that investigates the mental disintegration of Maya, a sensitive woman ensnared in a loveless marriage and tormented by fear, memory, and a childhood prophecy. Her descent into madness presents a rich opportunity for analysis through Freudian psychoanalytic theory, which addresses unconscious desires, repression, trauma, and neurosis. The objective of the English literature researcher is to interpret Maya's psychological state and critique how Desai artistically manifest inner turmoil through narrative structure, imagery, and symbolism. Literary analysis aims to interpret meaning, explore ambiguity, and comprehend emotional and symbolic depth. Conversely, Freudian psychoanalysis functions as a clinical tool designed to diagnose and treat psychological disturbance, grounded in case studies and behavioral patterns. So, Methodological Incompatibility arises as Freud's theories are diagnostic and reductionist, while literature encompasses a multiplicity of meanings. The application of Freud's concepts may oversimplify Maya's intricate psychological portrayal int fixed terminologies such as Oedipal complex or neurosis.

There are some other incompatibilities such as related to language and terminologies used, contextual versus universal, empirical versus interpretive and many other.

EPISTEMOLOGICAL CONFLICT

A particularly profound and persistent issue within multidisciplinary research is epistemological conflict, which arises from differing assumptions regarding the nature of knowledge, its acquisition, and its interpretation or application. Unlike methodological incompatibility, which pertains to tools and techniques, epistemological conflicts fundamentally challenge how truth and meaning are constructed across various academic traditions.

Epistemology is the philosophical branch that examines the nature, origin, and scope of knowledge. It addresses fundamental questions such as:

What constitutes knowledge?

How is knowledge acquired? What qualifies as valid knowledge?

Is knowledge inherently objective, or is it always subjective?

Different academic fields respond to these inquiries in distinct manners. For example:

Natural sciences predominantly adhere to positivism, which asserts that knowledge is derived from observable and measurable phenomena and can be validated through empirical data. Social sciences frequently adopt constructivist or interpretivist approaches, recognizing that knowledge is socially constructed and contextually dependent. Whereas Humanities include philosophy, history, and literature engage with critical theory, perceiving knowledge as interpretive.

When researchers from these distinct disciplines convene in a multidisciplinary environment, epistemological conflicts may arise. This presents challenges for collaboration and shared understanding, but also provides opportunities for enriching dialogue and deeper integration of ideas. Engaging with epistemology fosters critical thinking and enhances our collective inquiry into the nature of knowledge.

ISSN 2394 - 7780

In the realm of multidisciplinary research, scholars of English literature frequently utilize psychological frameworks, such as Sigmund Freud's psychoanalysis, to enhance the interpretation of texts. However, this practice can lead to epistemological conflicts, reflecting a clash between differing methodologies of understanding. Freud's empirical psychological model may not fully accommodate the symbolic, culture, and subjective depth inherent in a work of literature such as Cry, the Peacock. For instance, a quotation from the novel describes:

"The astrologer has predicted death… either for her or her husband. That it would happen four years after their marriage." (Cry, the Peacock).

A Freudian analysis may interpret Maya's fixation on the prophecy as a neurotic obsession or paranoia arising from an unconscious anxiety about death. In contrast, a literary cultural perspective perceives this fixation as deeply rooted in Indian traditions, where concepts of fate and prophecy profoundly influence identity and psychological experiences. The Freudian epistemological framework may regard such a worldview as irrational, thereby engendering a conflict between clinical rationalism and cultural symbolism. This conflict in interpretation is termed as Epistemological conflicts.

COMMUNICATION BARRIERS

Multidisciplinary research is vital for addressing intricate global challenges, including climate change, public health concerns, digital transformation, economic inequality, and social justice. These issues necessitate not only diverse expertise but also effective collaboration across multiple disciplines. However, one of the most significant yet often overlooked obstacles in such research is the existence of communication barriers.

These barriers emerge from the differences in disciplinary language, terminologies, values, assumptions, and modes of inquiry. When researchers from diverse fields, such as literature, biology, engineering, sociology, and economics collaborates, they bring not only distinct bodies of knowledge but also various modes of expression, thought processes, and frameworks of understanding. These discrepancies can lead to misunderstandings, inefficiencies, and, at times, the failure of collaborative efforts.

In this context, communication barriers refer to the difficulties encountered in attaining mutual understanding and facilitating knowledge exchange among researchers from different academic disciplines. These obstacles arise from:

- Specialized terminology and jargons.
- Differing epistemological assumptions.
- Varied methodological preferences.
- Contrasting values and research objectives.
- Cultural and linguistic diversity.

Now if we will understand it from the point of view of a literary scholar or researcher by doing the psychological study of Anita Desai's Cry, the Peacock which will be considered one of the Multidisciplinary Researches, involving both literature and psychology which can yield profound insights into human consciousness, trauma, and emotion. However, such research is often impeded by communication barriers arising from divergent disciplinary languages, conceptual frameworks, and research objectives. As Freud's theory includes the unconscious mind, repression, the Oedipal complex, and the death drive, Desai's narrative resists classification within clinical paradigms. The symbolic and poetic language that characterizes Maya's narration frequently contrasts with the analytical terminology used in psychology. These communication barriers limit the ability of literature researchers to comprehensively integrate both fields. For instance, Freudian psychoanalysis aims to elucidate behavior of Maya through the lens of unconscious drives and repressed desires. Conversely, Cry, the Peacock presents Maya's thoughts through a stream-of-consciousness style that is poetic and fragmented as articulated by Desai:

"I am obsessed with the idea of death, with the idea of loneliness. I am in terror of solitude, of being left alone." (Cry, the Peacock).

In the aforementioned lines Desai illustrates the sufferings and pain of Maya in coping up with the real world consisting of societal ideologies and constraints which she most often escapes to live in her own world of imagination. But a psychologist might interpret the preceding quotation as indicative of thanatophobia (fear of death) or unresolved infantile trauma.

This disparity in interpretation underscores a communication barrier: psychological theories typically seek singular causes, whereas literary analysis involves multiple meanings to provide knowledge.

Ethical Tensions in Multidisciplinary Research

Multidisciplinary research is celebrated for its ability to address complex global challenges; however, it also introduces notable ethical tensions – particularly when methodologies and intentions from diverse fields converge. A significant concern arises when psychological theories are applied to literary texts, exemplified by the use of Freudian psychoanalysis to interpret Anita Desai's Cry, the Peacock. This interaction between psychological studies and literary studies raises ethical concerns regarding describing the emotions and feelings of Maya as psychological symptoms, authorial respect, and an urgent need to build a balance of interpretive richness with theoretical precision.

As a literary scholar employing Freudian analysis to examine Maya – a sensitive character of the novel Cry, the Peacock – one is immediately confronted with the risk of diminishing a character's emotional and cultural complexity to mere clinical symptoms. While psychoanalysis can provide profound insights into the workings of the unconscious mind, its terminology – particularly when applied outside clinical contexts – may inadvertently objectify or dehumanize literary characters, reducing them to mere case studies.

Consider, for example, Maya's intense and almost obsessive attachment to her father. Freud's theory of the Electra complex – the daughter's psychosexual competition with her mother for her father's affection – serves as a potentially appealing interpretive lens. Maya herself articulates:

"I had loved my father with such passion, such vehemence, as possessed me with guilt." (Cry, the Peacock).

A Freudian interpretation may categorize this affection as a neurotic fixation, suggesting that Maya's eventual alienation from her husband, Gautama, is the result of an unresolved Electra complex. However, such a reading risks ethical oversimplification. It neglects the cultural and emotional nuances of Maya's upbringing within a patriarchal Indian society wherein parental affection is often intertwined with notions of survival and identity. This presents a significant ethical dilemma: does psychological theory genuinely illuminate Maya's sufferings, or does it impose Western diagnostic labels that colonize her experience?

Another ethical tension arises regarding the authority of the researcher. In multidisciplinary research, an English literature scholar may not possess formal training in psychoanalysis, yet they draw upon clinical frameworks. This invites, concerns regarding academic overreach. While a literary scholar may demonstrate proficiency in engaging with Freud's theories and applying them to a text, questions arise: Are they sufficiently equipped to distinguish between metaphor and clinical symptoms? These boundaries must be transparently acknowledged within any scholarly work.

Power Imbalances between Disciplines

In the current landscape of multidisciplinary research, one of the most persistent challenges is the hierarchical imbalance between disciplines, wherein the "Hard" sciences frequently take precedence over the humanities and arts. This imbalance is particularly evident when literature intersects with psychological or scientific disciplines, as illustrated in a psychoanalytic literary analysis of Anita Desai Cry, the Peacock. In this context, the researcher in English literature occupies a marginal position relative to psychology and clinical science, often needing to justify the validity of interpretive and symbolic analysis in a sphere that favors empirical data and quantifiable outcomes.

a. The Marginalization of Literary Discourse

English literature, especially when interpreted through a psychoanalytic framework, encounters systemic undervaluation within academic environments that prioritize scientific authority. Although Freudian theory originates in psychology, its application within literature is frequently perceived by scientists as speculative or metaphorical rather than substantive. Consequently, the English literature researcher must defend their analytical approach, even when employing psychoanalytic tools that are rooted in clinical history.

b. Cultural Contexts and Postcolonial Dimensions

The power imbalance is not solely disciplinary but also cultural and geopolitical. Western psychological theories, including Freud's, are often regarded as universal, while Indian literary texts such as Cry, the Peacock may be exoticized or marginalized. This dynamic is especially pertinent when analyzing Maya's psychological trauma within the framework of Indian familial structures, patriarchy, and spiritual beliefs.

Her husband's unemotional rationalism not only highlights a personal conflict but also symbolizes the epistemological dominance of reason over emotions, science over literature, and masculine logic over feminine intuition. Consequently, the English literature researcher employing Freudian analysis must also navigate the

ISSN 2394 - 7780

colonial influences embedded within both the literary canon and psychological theory, which further complicates the existing power imbalances.

Institutional and Disciplinary Boundaries

The concepts of institutional and disciplinary boundaries pertain to the structural and intellectual divisions between fields such as psychology and literature. Psychology is grounded in empirical data and diagnostic frameworks, whereas literature emphasizes symbolism, narrative structure, and emotional complexity. These distinctions often hinder meaningful interdisciplinary research, particularly when literary scholars apply psychological concepts, such as those proposed by Freud, to the analysis of fictional works.

In Anita Desai's Cry, the Peacock, the protagonist Maya's mental disintegration – characterized by hallucinations, a pervasive fear of death, and profound emotional isolation – serves as a representation of significant psychological trauma. When she articulates:

"There was a sound of crying in my ears… was it I who cried?" (Cry, the Peacock).

This statement transcends mere poetic expression; it encapsulates the notion of identity fragmentation, a phenomenon that Freud might interpret as ego disintegration. However, employing such psychological theories within a literary framework may be perceived as speculative, while psychology departments may dismiss fictional narratives as unworthy of serious academic consideration.

This disciplinary separation restricts our comprehension of intricate human experiences. Maya's psychological occurrence and a literary manifestation, necessitating an interdisciplinary approach for a comprehensive understanding. In the absence of support for hybrid analyses, the depth of Desai's representation – and comparable literary examinations of mental health – remains insufficiently explored.

CONCLUSION

The psychanalytic examination of Anita Desai's Cry, the Peacock reveals both the opportunities and challenges inherent in multidisciplinary research. Maya's intense fear of death – "Hug me, hold me, save me… I am afraid." (Desai 72) – serves as a reflection of unconscious anxieties that necessitate psychological interpretation for comprehensive understanding. This connection highlights the intersection of literature and psychology, which offers profound insights into the intricates of human experiences. Nevertheless, the application of psychoanalytic frameworks to fictional texts presents significant contemporary issues, including theoretical misalignment, the lack of standardized evaluation metrics, and institutional biases that favor empirical sciences over interpretive disciplines (Klein, 2010; Nowotny et al., 2001).

To effectively address these challenges, the following recommendations are proposed:

1. Develop Flexible Frameworks: Constructs integrative models that honor the interpretive nature of literature while facilitating engagement with scientific theories.
2. Promote Cross-Disciplinary Literacy: Organize workshops and academic exchanges designed to bridge conceptual divides.
3. Institutional Support: Establish evaluation criteria that acknowledge the intrinsic value of interdisciplinary research within the humanities.
4. Collaborative Platforms: Encourage the creation of forum dedicated to sustained dialogue among scholars from diverse disciplines.

The analysis of Cry, the Peacock underscores that while multidisciplinary research is inherently complex, it remains essential for capturing the psychological and cultural dimensions of literature. By implementing these strategies, scholars can surmount methodological and epistemological obstacles, transforming interdisciplinary engagement from a fragmented practice into a unified and productive endeavor that enhances both academic inquiry and our understanding of human subjectivity.

REFERENCES

- Barry, P. (2017). Beginning Theory. Manchester University Press.
- Frode Man, R. (2010). The Oxford Handbook of Interdisciplinarity. Oxford University Press.
- Jacobs, J.A., & Frickel, S. (2009). Interdisciplinarity: A critical assessment. Annual Review of Sociology, 35, 43-65.
- Klein, J. T. (2010). A taxonomy of interdisciplinary. Oxford University Press.

ISSN 2394 - 7780

- Nowotny, H., Scott, p., &Gibbons, M. (2001). Re-thinking Science. Polity Press.
- OECD. (2019). OECD Science, Technology and innovation Outlook. OECD Publishing.
- Repko, A. F., & Szostak, R. (2017). Interdisciplinary Research. SAGE Publications.
- Desai, Anita. Cry, the Peacock. Orient Paperbacks.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

EFFECTS OF STRESS ON HEALTH STATUS OF BANKING SECTOR EMPLOYEES OF WARDHA DISTRICT IN MAHARASHTRA (INDIA)

Shital P. Dharmik[1] and Dr. Archana M. Bhende[2]
[1]Research Scholar, R.T.M Nagpur University, Nagpur-440033 (M.S,) India
[2]Associate Professor, Department of Zoology, Vidya Vikas Arts, Commerce & Science College, Samudrapur-442305 Dist. Wardha, (M.S) India

ABSTRACT
In developing countries, the competition at work place is increasing day by day. These competitions put pressure on employees to improve themselves. Today, banking sector is growing tremendously. The newly emerging private sector banks also puts pressure on employees to work more hard. This extra pressure on employees increases stress in them. The present study was a cross-sectional survey among 102 employees in public and private sector banks of Wardha district of Maharashtra, India to find out the health status of banking sector employees and major problems in them caused due to stress in various age groups. . From this study, it had been concluded that increased level of stress caused major health problems such as headache, anxiety, high blood pressure, diabetes and sleeping disorders etc. in those employees. The best way to minimize the stress level is to practice meditation, yoga, and Pranayama for better health.

Keywords: *Stress, banking, health, headache, anxiety, pressure, job.*

INTRODUCTION
Each and every person today is having stress. In modern life, stress is a part and parcel of our day to day life. Everyone is continuing their life by bearing stress. Everybody perceives stress differently and may react to demands of stress in their own way. Stress creates alertness and altered the level of energy. Stress may be acute or chronic depending on person's physical and mental well being to cope up with it.

Stress can also help to meet challenges in life. It may be positive if it brings a person to achieve its goal. Such stress is known as eustress. It is considered as important factor to motivation, adaptation and reaction to the surrounding environment. But if it persists for long duration it stops being helpful and can causes major damage to our health, mood, productivity and quality of life. Chronic stress may disrupts the body's equilibrium causing physiological issues like high blood pressure, increased heart rate, headaches, pains and damage to various organs. It can also affect mental health by undergoing depressions, insomnia, use of drugs and lack of concentration.

There are various definitions of stress found in numerous literatures. According to Jonathan D. Quick et al., stress is naturally occurring mind-body response to demanding or any emergency situation (1).

Stress could affect our body in three stages:

1) Alarm Stage: In an emergency condition, human brain send signals to our body to produce adrenalin, nor-adrenalin and corticosteroids in blood stream that will further give fight and flight response.
2) Resistance Stage: It is the second stage in which our body tries to balanced the symptoms of stress which developed during alarm stage. if stress continues, then person suffered with fatigue, anxiety, sleep problems and difficulty in concentration.
3) Stage of Exhaustion: If still the stress persists and body could not deal with it then it may lead to long term damage to various organ systems as well as immune system of our body. (2)

In some literatures, any intrinsic or extrinsic stimulus that evokes a physiological response is known as stress. It can be either a triggering factor for many diseases and pathological conditions (3). Another study stated that stress is the state of disharmony and is counteracted by intricate repertoire of physiologic and behavioral responses that aim to maintain or re-established the threatened homeostasis. (4).

The present work was aimed to study the overall health status of study population. For that, a particular job profile population i.e., banking sector employees population were taken into consideration. Today, banking sector is growing tremendously and the competition is also rising among the sector so as to satisfy their customers. This put pressure on the employees to complete deadlines. Continuous pressure or job stress can lead to major health problems such as diabetes, high cholesterol level, increased heart rate, anxiety, headaches and blood pressure. So, the present study was focused on the physiological changes occurred in a banking sector employees due to stress.

ISSN 2394 - 7780

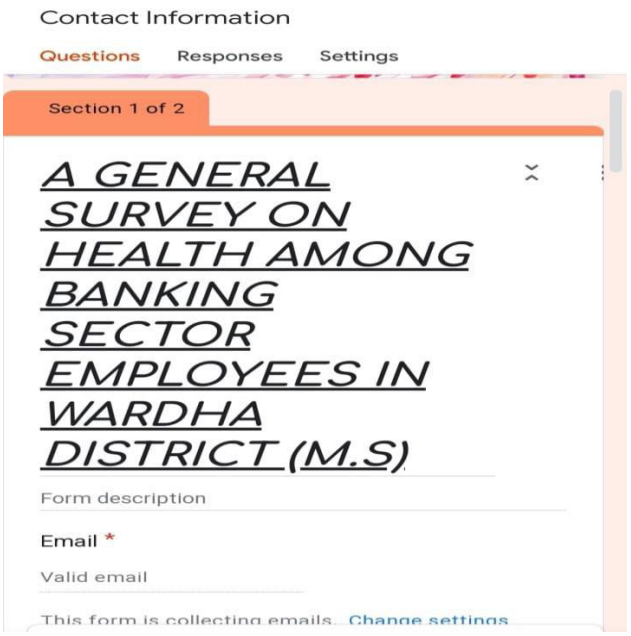
MATERIALS AND METHODS:

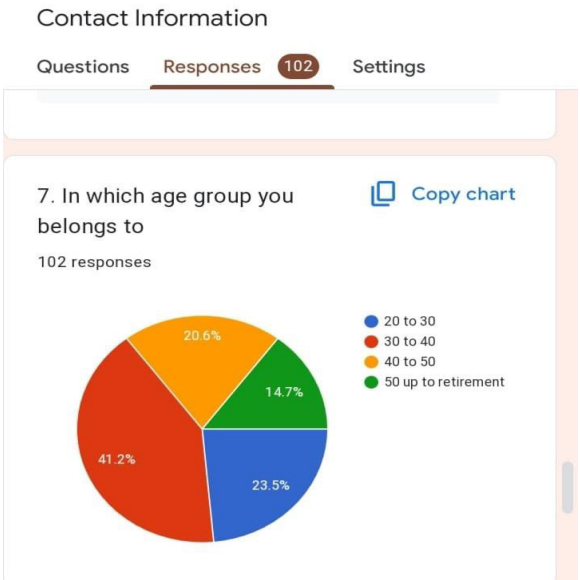
A cross-sectional survey was conducted among the banking population of 102 employees of Wardha district in Maharashtra State in India. A self administered structured questionnaire was prepared based on general health status of banking sector employees and it was circulated among participants through online platform (Google Form). The study includes the employees of age group from 20-58 years of age. The results were drawn according to the responses collected from participants.

The first step for this study was to make contacts with people in this sector and to convince them to fill out the questionnaire. The study includes both public sector and private sector banks in Hinganghat, Samudrapur, Arvi, Waigaon, Ashti etc. fromWardha district. Wardha is a place in Vidarbha region of Maharashtra State renowned for Mahatma Gandhi Ashram near it (Bapukuti, Sewagram).

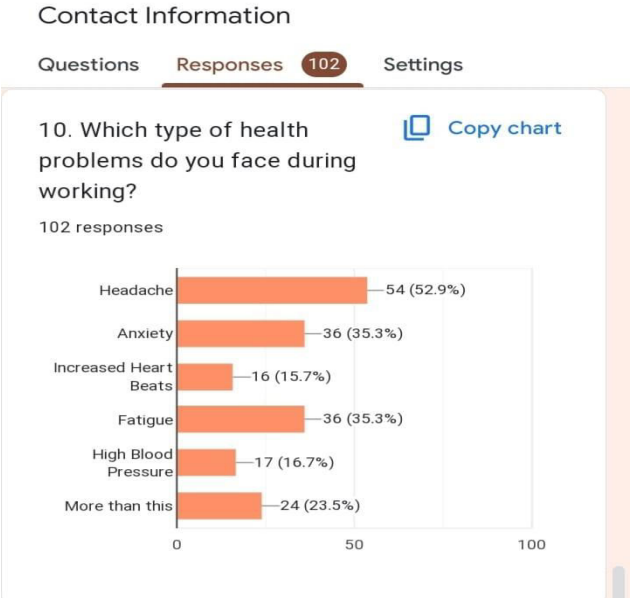
The second step was making a Whatsapp group of people in this sector to give information related to this study. The Google form consisting questionnaire was circulated on that group. Approximately 100 people filled out the questionnaire.

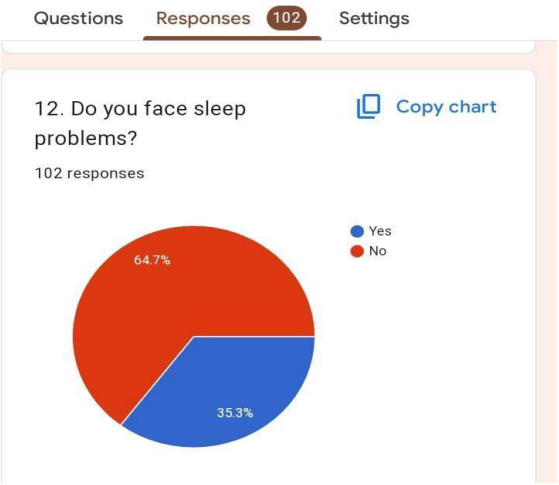
OBSERVATION:

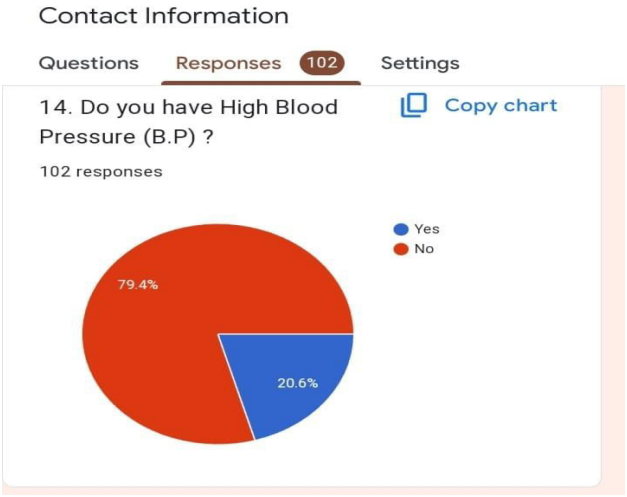




ISSN 2394 - 7780







RESULTS AND DISCUSSION:

The present study was carried out to find out health problems in banking sector employees of Wardha district in Maharashtra State of India. Both the public and private sector bank employees including males and females were the sampling population. In this study, most of the employees were working in private sector banks.

In the present study, it had been found that about 70% of people in banking sector have job related stress in their life due to which they may suffered from many health problems such as headaches, anxiety, blood pressure or diabetes. Most of the population in the study was of age group 30-40. In this age group, body can tolerate heavy load of stress and hence the major health problems were not seen in those employees. But as the age rises, i.e., in the age of 40-50 and 50 up to retirement age group, most of the health problems were observed such as sleep problems (insomnia), high blood pressure (Hypertension), increased heart beats (Tachycardia), anxiety, headaches etc.

Those health problems may be due to chronic stress that continuously put pressure on the employees at work place. In this age group, body could not tolerate the burden of stress. Due to this, there may be continuous secretion of fight and flight hormone adrenaline and a stress hormone Cortisol from adrenal gland. Cortisol is a stress marker that gives stress response. Those hormones are responsible for providing extra glucose in the blood by the process of gluconeogenesis and glycogenolysis in the liver. The extra glucose in the blood meets the requirement of body's extra energy needs to work more. There are so many studies which had been showed that Cortisol plays a key role in the process of gluconeogenesis in stressful condition. (5)(6)

There are 35% people having sleep problems in this study. Everybody knows that when a person having stress, it could not focused on a particular thing and confusion takes place. Also there stress is the major cause of sleeping disorders and insomnia. Another study in this regards, supports our finding. Stress related insomnia

ISSN 2394 - 7780

leads to vicious circle by activating the HPA axis (Hypothalamus-Pituitary-Adrenal Axis). Because the Hypothalamus is the main part to regulate the sleep wake cycle, increased level of stress activates this system thereby decreasing the sleep causes sleep disorders. (7)(8)

In this study, 20% people were suffered from high blood pressure. It may be due to increased age of employees or may be due to high level of electrolytes concentration i.e., sodium in the blood that causes hypernatremia. Due to it, the symptoms like anxiety, headaches, confusion, fatigue had been observed in the people. There may be the chances of cardiovascular disease in future to those people having these symptoms. Some studies also supports our findings. Chronic psychological stress could be associated with distorted lifestyle and mental distress as well as long lasting allostatic load, contributing to blood pressure elevation. (9) another study suggests that chronic stressful environment at work or in marriage, low socioeconomic status, lack of social support, depression, anxiety, post-traumatic stress, childhood psychological trauma, and racial discrimination are responsible for development or progression of hypertension.(10) Psychological stress is an important risk for cardiovascular disease. (11). There are numerous researches are still ongoing to study effect of stress on various organisms. Further study is needed to minimize the symptoms and major diseases caused due to stress.

CONCLUSION:

From the present surveylogical study, it had been concluded that, stress is the major factor for increasing health problems in banking sector employees. Most of the health problems were includes headache, anxiety, diabetes, sleeping disorders and high blood pressure. The more no. of problems was present in 40-50 and 50 up to retirement age group. There is also need to study various health problems including blood parameters such as blood glucose concentration, total cholesterol, hormone cortisol concentration and various other parameters that could strongly supports this hypothesis.

The present era is known as Stress Era. Because today stress is inseperable part of human's life. With the advancement in researches and technology, we could manage to live healthy lifestyle. But stress is like silent killer that slowly damage our body and make our immune system weak. (12) (13) That's why; the life expectancy of human being today is decreasing day by day.

We could not remove stress totally from our life, but we should learn to manage stress so that the major health problems will not occur. For that purpose, the Meditation and practicing Yoga and Pranayama is the best way to cope up with it.(14) (15) Also, giving time to friends and family and enjoying with them is also an important factor to decrease stress level and health problems in people.

REFERENCES

1. Jonathan D. Quick, Rebecca S. Horn, James Campbell Quick; Ebook (2014) Health Consequences of Stress.,E-book.
2. Chouhan, Dr. Devraj. (2016). Stress and Its Major Effects on Human Health.
3. Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. EXCLI journal, 16, 1057–1072.
4. Devi, Praveena & Reddy, M & Zahan, Onaiza & Sharma, Jvc. (2019). The Effect Of Stress On Human Life.
5. Thau L, Gandhi J, Sharma S. (2025) Physiology, Cortisol. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing
6. Seal, S.V.; Turner, J.D. (2021) The 'Jekyll and Hyde' of Gluconeogenesis: Early Life Adversity, Later Life Stress, and Metabolic Disturbances. Int. J. Mol. Sci. 2021, 22, 3344.
7. Han, K. S., Kim, L., & Shim, I. (2012). Stress and sleep disorder. Experimental neurobiology, 21(4), 141–150.
8. Dube, Shruti; Babar, Anuradha. (2024) Stress and insomnia – A vicious circle. Current Medicine Research and Practice 14(2):p 73-77, Mar–Apr 2024.
9. Masanori Munakata (2018) Clinical significance of stress related increase in blood pressure: Current evidence in-office and out-of-office settings., Hypertension Research 41, 553-569
10. Komal Marwaha (2022) Examining the Role of Psychosocial Stressors in Hypertension , Journal of Preventive Medicine & Public Health 2022;55:499-505

ISSN 2394 - 7780

11. Satyjeet, F., Naz, S., Kumar, V., Aung, N. H., Bansari, K., Irfan, S., & Rizwan, A. (2020). Psychological Stress as a Risk Factor for Cardiovascular Disease: A Case-Control Study. Cureus, 12(10), e10757.
12. Ronald Glaser, Janice Kiecolt Glaser (2009) Stress Damages Immune System and Health., Discovery medicine.
13. David N Khansari, Anthony J Murgo, Robert E Faith, Effects of stress on the immune system, Immunology Today, Volume 11, 1990, Pages 170-175.
14. Khajuria A, Kumar A, Joshi D, Kumaran SS. Reducing Stress with Yoga: A Systematic Review Based on Multimodal Biosignals. Int J Yoga. 2023 Sep-Dec;16(3):156-170.
15. A.M, Bhende & S.B, Zade & Sitre, Shashikant & Wasu, Yogesh. (2011). Effect of Yogic Practices on the Management of Hypertension in Working Women. International Journal of Biomedical and Healthcare Science. 1. 1-7.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

THE ROLE OF EDUCATIONAL TECHNOLOGY IN FACILITATING COLLABORATIVE AND ACTIVE LEARNING

Madhu Priya
Professor, Mahila Mahavidyalaya (B.Ed.), Silar, Aurangabad (Bihar)

ABSTRACT
The integration of educational technology into teaching and learning environments has transformed traditional pedagogical practices by fostering greater interactivity, collaboration, and student-centered learning. This paper explores the role of educational technology in enhancing collaborative and active learning, focusing on digital tools, online platforms, and innovative pedagogies that engage learners actively in the construction of knowledge. It presents theoretical frameworks supporting active learning, including constructivism and social learning theories, and evaluates empirical studies demonstrating the effectiveness of technological interventions in diverse educational contexts. The paper also discusses challenges such as digital divide, teacher preparedness, and assessment strategies in tech-enabled collaborative learning. Case studies from higher education institutions and K-12 classrooms are provided to illustrate practical implementations. The study concludes with recommendations for policy, practice, and future research in maximizing the potential of educational technology for enriched collaborative and active learning experiences.

Keywords: *Educational technology, Active learning, Collaborative learning, Digital pedagogy, Online tools*

INTRODUCTION
The transition from traditional teacher-centered instruction to student-centered approaches has been accelerated by the integration of educational technologies. In modern classrooms, learners are no longer passive recipients of information. Instead, they are actively involved in knowledge construction, critical thinking, and collaborative activities. Educational technologies—ranging from interactive whiteboards and LMS platforms to mobile apps and AI-based tutoring systems—have redefined how content is delivered, assessed, and engaged with. Through real-time feedback, multimedia support, and networked communication, learners experience more dynamic and meaningful education.

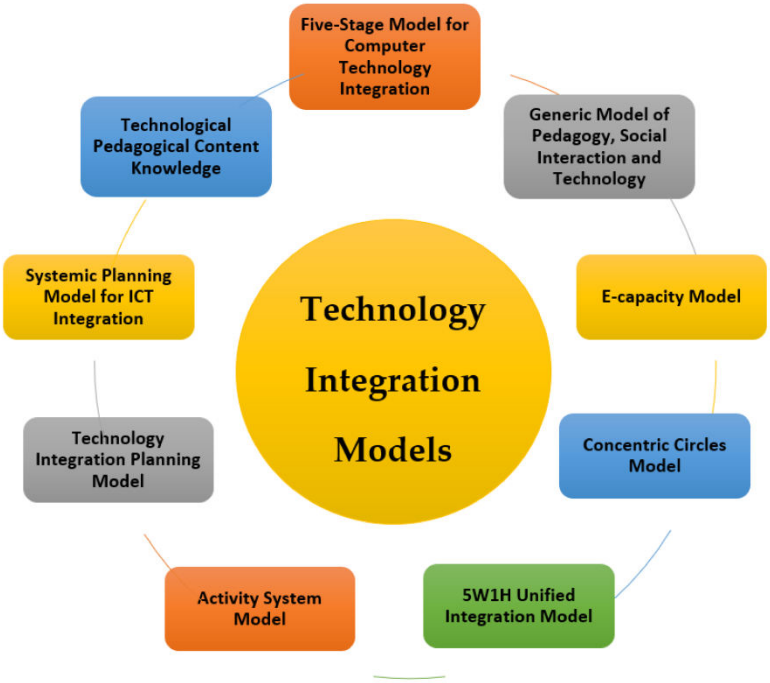
Moreover, technology has provided educators with novel strategies to diversify instruction based on individual learning preferences and cognitive styles. Personalized learning pathways, supported by analytics and adaptive tools, ensure that students remain motivated and are better supported. Collaborative technologies such as discussion forums, shared document platforms, and online simulations enhance students' ability to work in teams, solve problems, and develop soft skills essential for the 21st-century workplace. Thus, the role of educational technology extends beyond content delivery; it fosters a culture of inquiry, dialogue, and co-learning.

THEORETICAL BACKGROUND
Educational theories form the backbone of effective pedagogical design. Constructivism, rooted in the works of Jean Piaget and Lev Vygotsky, advocates for learners' active participation in knowledge construction through exploration and interaction. Vygotsky emphasized the role of social interactions in cognitive development, introducing concepts like the Zone of Proximal Development (ZPD) and scaffolding. These principles directly inform collaborative learning practices wherein students engage with peers and instructors to co-construct knowledge.

Modern educational technologies operationalize these theories through features such as peer discussion boards, co-editable files, and social annotation tools. Social learning theory, particularly Bandura's ideas of modeling and observational learning, is also relevant here. When learners observe peers solving problems or using specific tools, they adopt and internalize similar strategies. Similarly, connectivism—introduced by Siemens—posits that learning in the digital age is networked and constantly evolving. Technologies facilitate this by linking learners to diverse information sources, experts, and communities across the globe.

The incorporation of gamification, simulation-based environments, and AI tutors all stem from these theoretical underpinnings. By understanding and applying educational psychology and learning theory, educators can more strategically design tech-supported collaborative and active learning experiences that are both cognitively and socially enriching.

ISSN 2394 - 7780



TECHNOLOGY-ENHANCED COLLABORATIVE LEARNING

Collaborative learning involves the co-creation of knowledge by learners working together toward shared academic goals. Technology has broadened the scope and efficiency of collaborative learning by removing time and space constraints. Synchronous collaboration tools such as video conferencing, whiteboards, and breakout rooms enable real-time group discussions, while asynchronous platforms support continued engagement through forums, blogs, and shared repositories.

Digital platforms create inclusive environments where all voices can be heard, thereby supporting equity and participation. In online collaborative settings, learners contribute at their own pace and benefit from peer feedback. Tools like Google Workspace, Microsoft Teams, and Slack support document co-authoring, task management, and communication. The integration of collaborative tools in formal education promotes critical thinking, negotiation, peer learning, and shared responsibility.

In higher education, particularly in STEM and business courses, collaborative technologies are used for group research, simulation tasks, and joint presentations. Studies show that such environments improve learning retention and build essential life skills like leadership, cooperation, and digital literacy. By embedding collaboration into curriculum design through appropriate technologies, educators can ensure that students are better prepared for both academic and professional challenges.

TOOLS AND PLATFORMS

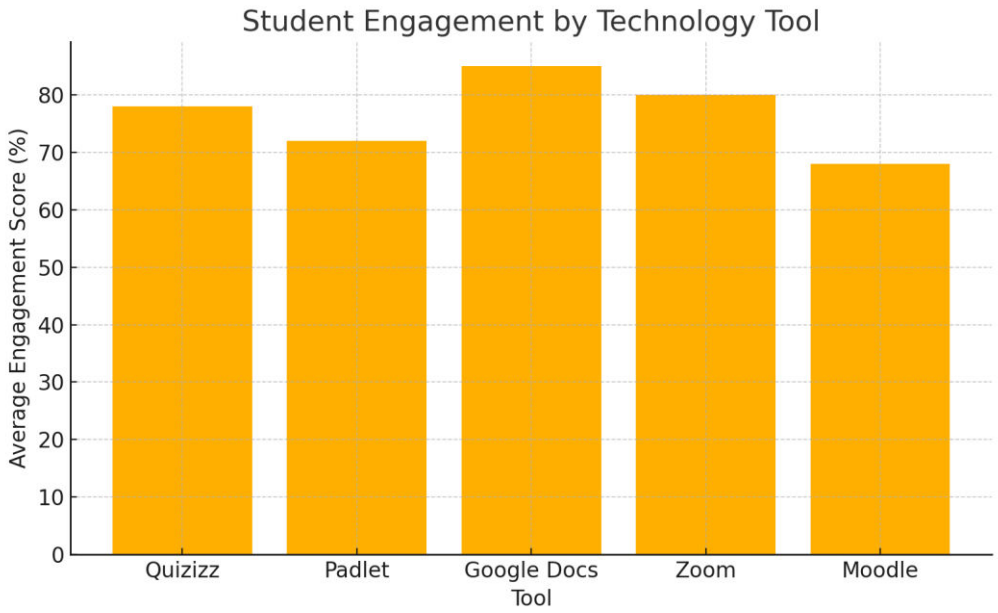
The range of tools that facilitate collaborative learning continues to evolve. Notable platforms include:

- Google Workspace for Education: Enables real-time co-authoring, annotation, and feedback on shared documents, presentations, and spreadsheets.
- Microsoft Teams and Zoom: Allow seamless communication through chat, video, and file sharing, with features like breakout rooms and polls enhancing collaborative sessions.
- Moodle and Canvas: Support team-based assignments, peer assessments, and discussion forums with tracking and grading tools integrated.
- Slack and Trello: Frequently used in project-based learning for task delegation, deadline tracking, and threaded communication.

CASE EXAMPLE

A study conducted at Istinye University explored the impact of collaborative platforms in a hybrid learning model. Students were grouped into teams for a semester-long project and used Zoom breakout rooms for regular virtual meetings, alongside Google Docs for co-developing content. The instructor facilitated through comments, live Q&A, and reflection journals. Surveys indicated a 28% improvement in perceived learning, especially in problem-solving and team communication. Students reported higher engagement and deeper conceptual understanding through collaborative peer interaction enabled by technology.

ISSN 2394 - 7780



Promoting Active Learning

Through Technology Active learning, as opposed to passive listening, involves students directly in the learning process. It encompasses practices such as problem-based learning, peer instruction, simulations, and real-time feedback mechanisms. Technologies make these approaches more scalable and immersive. Digital tools provide students with opportunities to analyze data, construct models, simulate real-world scenarios, and receive instant feedback.

For example, flipped classrooms leverage platforms like YouTube and Edpuzzle to deliver content outside class, allowing class time to be devoted to collaborative inquiry and discussion. Game-based learning platforms such as Kahoot! and Quizizz encourage participation through competition and gamification. Virtual labs in science education help students replicate experiments they may not access in physical labs.

Instructors can utilize polling tools (e.g., Mentimeter), shared annotation platforms (e.g., Hypothesis), and collaborative whiteboards (e.g., Miro) to foster real-time engagement. These tools transform the classroom into an active environment where students are motivated to contribute, question, and reflect. Data analytics from these platforms further help educators refine teaching strategies based on participation patterns and performance.

Examples of Active Learning Technologies

- **Kahoot!, Quizizz:** Interactive quiz platforms that enhance engagement and formative assessment.
- **Nearpod, Edpuzzle:** Create interactive video-based lessons with embedded questions and analytics.
- **Padlet, Jamboard:** Digital noticeboards and whiteboards for brainstorming and peer responses.
- **Flipgrid:** Video discussion platform allowing students to record and respond to peers' reflections.
- **Miro:** Enables mind mapping and collaborative diagramming during active classroom sessions.

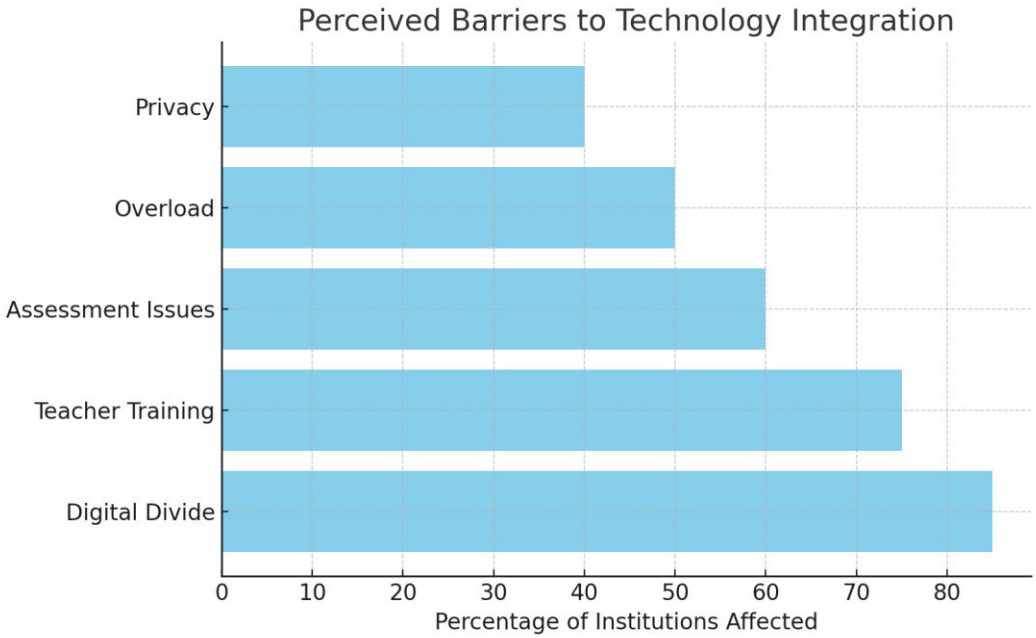
CHALLENGES IN IMPLEMENTATION

Despite widespread enthusiasm for educational technologies, their implementation poses several challenges. The most glaring is the digital divide—unequal access to reliable internet, hardware, and digital literacy skills. In rural and underfunded educational institutions, students and teachers often lack access to necessary infrastructure, hindering equitable learning.

Another challenge is teacher readiness. Educators may lack training in instructional design for digital environments or struggle with integrating technology into their pedagogical framework. There is also the concern of cognitive overload, where excessive use of tools without alignment to learning goals can confuse rather than assist learners.

Assessment of collaborative and active learning is another area that demands attention. Evaluating group contributions, creativity, and problem-solving in digital environments is complex and often subjective. Privacy, cybersecurity, and screen fatigue are additional concerns.

ISSN 2394 - 7780



For educational technology to succeed, these challenges must be met with policy-level support, institutional investment, and inclusive training programs. A thoughtful, research-based approach is essential to ensure that technologies enhance, rather than hinder, collaborative and active learning.

STRATEGIES FOR EFFECTIVE INTEGRATION

To maximize the benefits of educational technology, several strategic interventions are needed. Institutions must invest in robust IT infrastructure and ensure equitable access through device distribution programs, subsidized internet, and accessible design. Equally crucial is continuous professional development for educators—training them not only to use digital tools but to integrate them meaningfully into curricula.

Educators should adopt backward design principles, ensuring technology use aligns with learning outcomes. Integrative lesson planning with scaffolding, reflection, and formative feedback ensures that tools support rather than dominate pedagogy. Rubrics tailored to assess collaboration, communication, and engagement should accompany active learning strategies.

Peer mentoring, communities of practice, and interdisciplinary collaboration among faculty can support knowledge sharing and innovation. Schools and universities can pilot blended or flipped models, gather feedback, and iterate upon practices. Platforms should be chosen based on ease of use, adaptability, and accessibility.

Policies should promote digital ethics, privacy, and inclusivity. A data-driven approach to implementation, using learning analytics, can help monitor effectiveness, identify gaps, and guide further improvements. The integration of educational technology into active and collaborative learning must be iterative, evidence-based, and learner-centered.

CONCLUSION

The integration of educational technology into collaborative and active learning represents a transformative shift in pedagogy. No longer limited to static content delivery, educators can now facilitate vibrant, student-driven learning environments where engagement, inquiry, and collaboration thrive. While challenges such as digital inequity, training gaps, and evaluation complexities persist, they are not insurmountable. With strategic planning, inclusive infrastructure, and pedagogical innovation, technology can be a powerful ally in reimagining education.

Ultimately, the success of technology-enhanced learning lies in its human-centric design—tools must serve as facilitators, not replacements, of meaningful teaching and learning interactions. Future research should focus on longitudinal studies, comparative effectiveness of tools, and culturally contextualized implementation models. By embracing the potential of educational technology with thoughtful, theory-driven practice, educators can empower learners for a connected, collaborative future.

ISSN 2394 - 7780

REFERENCES

[1] Yang, X. (2023). A historical review of collaborative and cooperative learning. TechTrends, 67, 718–728. en.wikipedia.org+9link.springer.com+9en.wikipedia.org+9

[2] Mand, S. K., & Cico, S. J. (2024). Let's get active: The use of tech-enhanced audience interaction to promote active learning. AEM Education and Training. pmc.ncbi.nlm.nih.gov

[3] Bodonhelyi, A., Thaqi, E., Özdel, S., Bozkir, E., & Kasneci, E. (2024). From Passive Watching to Active Learning: AI Video Assistant in Digital Classrooms. arXiv Preprint arxiv.org+1ft.com+1

[4] Gotavade, T. S. (2024). AI Ecosystem for Automating Self-Directed Teaching. arXiv Preprint arxiv.org

[5] Vali, Y., et al. (2023). Use of Technology in Active & Collaborative Learning: Engagement and Outcomes. ResearchGate Preprint researchgate.net

[6] Hmelo-Silver, C. (n.d.). Research on online knowledge-building in CSCL and PBL. en.wikipedia.org+1en.wikipedia.org+1

[7] O'Donnell, A. M., Hmelo-Silver, C., & Erkens, G. (2006). Collaborative learning, reasoning, and technology. Lawrence Erlbaum. thesystemsthinker.com+6en.wikipedia.org+6en.wikipedia.org+6

[8] Harasim, L. (2017). Learning theory and online technologies. SFU Press. en.wikipedia.org

[9] Freeman, S., et al. (2014). Active learning increases student performance in STEM. PNAS. teaching.cornell.edu+2en.wikipedia.org+2engageli.com+2

[10] Hake, R. R. (1998). Interactive-engagement vs traditional mechanics courses. American Journal of Physics. en.wikipedia.org

[11] Prince, M. (2004). Does Active Learning Work? Review in Journal of Engineering Education. en.wikipedia.org

[12] Michael, J. (2006). Where's the evidence that active learning works? Advances in Physiology Education. en.wikipedia.org

[13] Mishra, P. & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge framework (TPACK). Teachers College Record. en.wikipedia.org+1mdpi.com+1

[14] Guo, H., Ma, F., & Zhou, Z. (2025). Validating VR-TAM for collaborative learning. Innovations in Education and Teaching International. eric.ed.gov

[15] UNESCO. (2023). Technology in education report: Accessibility and engagement.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

NAVIGATING GLOBAL CHALLENGES IN HANDLING DISAGREEMENTS THROUGH EFFECTIVE COMMUNICATION

[1]Manoj Shankar Mishra, Dr. Nempal Ningh and [3] Dr. Seeta Jaiswar
[1]Assistant Professor, Department of ASH, SKITM, Indore, MP, INDIA
[2]HOD Vikrant University, Gwalior
[3]Author Coordinator for Internationalism (NDPS) Indore

ABSTRACT

To settle disagreements, effective communication is very important, especially in today's society, which is becoming more and more globalised. As globalisation continues to grow, problems with communication are becoming more widespread as people of all kinds come into contact with each other. Differences in race, emotional reactions to events, language, and levels of emotional intelligence can all complicate conflict resolution. This article discusses how to address and confront the various problems that arise due to global diversity. It does this while also taking into account cultural conventions, nonverbal communication systems, and emotional intelligence.

This article discusses how to address and confront the various problems that arise due to global diversity. It does this while also taking into account cultural conventions, nonverbal communication systems, and emotional intelligence.

It also discusses how to address these issues, like listening, being aware of other cultures, and collaborating to solve problems. The study shows that these tactics are necessary for strengthening economic and international relations around the world, as well as for bringing peace to communist communities that are quite diverse. It does this by using case studies and real-life examples. The ultimate outcome of this research is that it provides results demonstrating that improved communication fosters better methods for resolving disagreements and enhances understanding and cooperation among states.

The ultimate outcome of this research is that it provides results demonstrating that improved communication fosters better methods for resolving disagreements and enhances understanding and cooperation among states.

Keywords: *Effective communication, conflict resolution, cultural differences, emotional intelligence, power dynamics, communication styles, global disagreements, cross-cultural communication, international relations, conflict management strategies.*

1. INTRODUCTION

1.1 Background

As a result of globalisation, the world now presents a tangled network of interaction in which economic, political, and social issues are mixed. In this connected world, for an individual or for a company doing business abroad, effective communication is not a mere accomplishment but a necessary skill. Communication is not just the transfer of words: it is a subtle process coloured by cultural contexts societal values and power structures. As businesses go global and diplomatic relations become ever more intense, the risk of misunderstandings or disputes increases. Misinterpretation of this magnitude can lead to wars, states' rifts in relations, or missed opportunities for development. Only rarely do such misconceptions help anyone. Never before has it been so important to know how the mechanics of communication work across cultures and regions in conflict situations. By understanding and respecting the differences in style expectations of communication and cultural background, parties involved can develop a better chance for successful negotiations of disputes, which will bring peace and global cooperation.

1.2 Problem Statement

The fact that there are so many international disputes, economic misunderstandings, and social confrontations shows how important it is to manage disagreements well. Differences in culture, communication styles, emotional intelligence, and power dynamics cause these problems. People and businesses often struggle with cross-cultural communication, resulting in avoidable disputes. Not having emotional intelligence can make arguments worse, and power structures that are based on hierarchy can make it harder to reach a compromise. This paper wants to look into the complicated problems that make it challenging to communicate effectively in global settings and provide ways to get around them.

.1.3 Research Questions/Objectives

The aim of this study is to address the following four questions:

ISSN 2394 - 7780

Firstly, what are the major global challenges linked with handling friction?

Secondly, in what way do cultural differences and communication styles together cause these challenges?

Thirdly, how does emotional intelligence affect and get affected by the dynamics of power involved in conflict resolution?

Fourthly, what strategies can be used to navigate effectively the disagreements that inevitably arise outside one's own cultural setting?

1.4 Significance of the Research

The results of this study have utility for professionals working in global business, international politics, or a multicultural environment. By understanding the problems posed by cultural differences, styles of communication, and emotional intelligence, all concerned parties in conflict can devise more successful strategies to bring peace. These findings apply directly in diplomacy, International business and the less tangible business of involving diverse peoples around the world in nonprofit activities.

2. LITERATURE REVIEW

2.1 Cultural Differences in Communication

Cultural differences are at the foundation of many communication issues encountered when attempting to resolve global conflicts. In collectivist cultures (such as many Asian and African countries), indirect communication is frequently chosen to promote community peace and minimise conflict. While indirectness and delicate impressions are respected in Japan and China, outright disagreement is frequently avoided in order to avoid losing 'face.' Individualistic societies, on the other hand (such as the United States and Germany), promote direct contact, with expressing disputes in public serving as a valid character excuse.

When people of various cultures work together, cultural differences can cause misunderstandings and even provocation. Knowing and adjusting to diverse communication styles is essential if disagreements are not to escalate.

2.2 Communication Styles and Preferences

Verbal Communication.

In addition to oral language, there is also written communication. For example, in many areas Verbal communication may be direct or indirect depending on cultural norms. For example, Few things can replace an outstretched hand or an open pair of arms as a means of communication between people from different cultures or even species. Gesture Nonverbal communication, such as gestures Nonverbal cues—such as facial expressions, posture and eye contact In a certain place, a gesture can be a blissful precedent. Bush used to joke with each other about an obscene gesture. Fifth, Silent movies: Silence is a form of communication in itself. In France Silence can also be understood in different ways: as a sign of respect, deep thought, or even hostility, depending on the situation. With its own conventions written communication, in particular, is a difficult problem. How a letter is presented and signed can make all the difference in preventing conflict, especially between high- and low-context societies.

2.3 Emotional Intelligence in Conflict Resolution

Emotional intelligence (EI)— Developing emotional intelligence (or EI as I shorthand it)—i.e., having the ability to recognize, understand, & manage one's own emotions—is essential for handling disputes. High EI helps people keep their cool, show empathy and adjust behavior so that the conflict becomes less hostile between parties rather than more so. In cross-cultural interactions, EI is particularly important. It can help individuals learn to ride emotional undercurrents that are not voiced by words but still have a great effect on settling processes. 13 Organizations with leaders who are emotionally intelligent have the skills to handle conflicts at both their beginnings and whatever level they reach. Enhancing EI through training programs can promote empathy and emotional regulation, potentially leading to better dispute resolution.

2.4 Power Dynamics and Conflict

The dynamics of power play a huge role in ending conflict—even on the national level or in an organisation with hierarchies. Imbalances in power can mean closed minds, no agreement, and long, drawn-out disputes. Authority figures may prefer to stand firm and so preserve their positions. Old-fashioned methods of conflict resolution, such as judging based on power balance, are outdated. Understanding power imbalances and how to deal with them is preeminently important for mediators or conflict resolution specialists. The best way to reduce the impact of power imbalances is by finding common ground on which to solve problems together and making decisions together. This process creates an environment in which all parties feel heard and respected.

ISSN 2394 - 7780

2.5 Skill Deficiencies in Handling Disagreements

Many individuals and groups struggle to handle disputes because they lack the basic skill of ensuring that they have understood what someone else has said to them. For example, one common failing is insufficient active listening. Another is an inability to read the emotional signals of others or just sheer poor psychological observation skills. [23]. Active listening means not only taking notice of both the verbal and non-verbal signals given by another person but also really getting inside their shoes. It's also important to stay in control of your emotions; otherwise, they can hinder aerobic conflict resolution efforts. Training focusing on active listening, emotional regulation, and cultural sensitivity can greatly improve conflict resolution skills.

3. GLOBAL CHALLENGES IN HANDLING DISAGREEMENTS

3.1 Linguistic Barriers

Language differences represent a major impediment to effective communication. A misinterpretation in words, idioms or phrases can lead to confusion and conflict. Moreover, even when people share one common language, varying fluencies and different accents may interfere with understanding. [28]. In global business, language barriers can prevent us from representing ourselves well in negotiation, slow down projects and harm relationships. Portuguese

3.2 Cultural Misunderstandings

Cultural norms and content shape the meaning of communication. Differences in values, beliefs and customs can result in misunderstandings. For instance, cultural norms vary in their understanding of time; certain societies place a high value on punctuality, while others do not. Such differences can create frustration as well as conflict in international collaboration.

3.3 Technological Boundaries

The emergence of digital communication tools has thrown up some new barriers to communication. Misunderstandings may arise from a misinterpretation of tone in emails or messages, the absence of nonverbal hints, and technological hitches. While technology aids worldwide interaction, it also demands a new skill set for communication and conflict management.

3.4 Psychological Barriers

Feelings, attitudes, and ideas contribute to communication; as a result of these three aspects, being persuasive may become problematic. Prejudice, stereotyping, and the failure of trust can become psychological barriers, undermining open dialogue and increasing conflict. 3 Emotionally charged situations such as high-stakes negotiations may lead to impairments in judgement and lowering the efficacy of communication.

3.5 Organisational and Structural Barriers

An organisation's structure and its rigid adherence to policy may prevent sharp-eyed commentary. Lower-level employees in some organisations dread voicing disagreements for fear of repercussions—an environment such as this discourages open communication and easily hinders any effort to resolve complaints.

4. THE ROLE OF EMOTIONAL INTELLIGENCE AND POWER DYNAMICS

4.1 Emotional Intelligence in Multicultural Settings

In multicultural environments, emotional intelligence is a crucial asset.

It enables people to:

- Respect and recognise emotional expression differences between cultures.
- Manage their own emotional responses to new or difficult situations.
- Show understanding and empathy. Both are essential for building trust (and solving disputes[13]).

By learning emotional intelligence, you will be able to negotiate complex electronic landscapes better, particularly in high-pressure situations or cross-cultural contexts.

4.2 Power Dynamics in Conflict Resolution

Power imbalances are significant barriers to conflict resolution. Those in positions of power are less likely to compromise or even conduct open discussions. To address power dynamics, we need a combination of techniques:

- Establish safe spaces where resolutions can be reached by all parties involved.
- Encourage input from those with less power.

ISSN 2394 - 7780

- Form collaborative decision-making processes that are fair to everyone concerned.[5].

Mediators play a key role in recognising and redressing power imbalances so as to create the right climate for constructive conflict resolution.

5. STRATEGIES FOR NAVIGATING DISAGREEMENTS EFFECTIVELY

5.1 Active listening

Active listening involves being fully present. This means you focus on the speaker, understand, respond, remember, and reconstruct what they said. It is an essential skill in effective communication and conflict resolution.

Active Listening Helps you to:

- Bridge differences and build rapport.
- Clarify misunderstandings.
- Respect diverse viewpoints.

5.2 Cultural Sensitivity and Competence

Cultural sensitivity means being aware of and respectful toward cultural differences. Developing intercultural competence requires:

- Understanding the communication norms and values of various cultures is essential for developing intercultural competence.
- One must adapt their communication style to fit different cultural contexts.
- We must steer clear of ethnocentrism and actively foster cultural diversity.

Organisations can encourage cultural sensitivity through training programs, initiatives to improve diversity, and policies that include everybody.

5.3 Collaborative Problem-Solving

This approach seeks solutions that benefit both/all sides. It entails:

- This approach requires open and honest communication.
- It necessitates the ability to meet each other halfway.
- Decisions are made jointly and then upheld.

This roundtable approach to dispute mediation is particularly effective in multicultural or international contexts, because through the input of different views, each solution offered can be enriched.

5.4 Mediation and Third-Party Facilitation

In situations where direct negotiation between the parties is difficult, a neutral third party may help to resolve conflicts. Mediators facilitate communication, clarify issues and guide the parties towards an agreement.

5.5 Education and Development

Continuous education in communication, emotional intelligence and conflict resolution is necessary for individuals and organisations operating on a global scale. This kind of training heightens awareness, improves skill levels, and teaches stakeholders to handle disagreement constructively.

6. CASE STUDIES AND REAL-WORLD EXAMPLES

6.1 International Business Negotiations

A multinational corporation operating in Asia and Europe encountered frequent misunderstandings between its regional teams; this phenomenon was reviewed by Haas (2006). With cross-cultural training and active listening workshops, the company improved communication, reduced conflicts, and enhanced collaboration across its six regions. Such measures led to raised employee satisfaction along with better business results.

6.2 Diplomatic Relations

In diplomatic negotiations between countries whose cultures differ greatly, misunderstandings often arise because of the different styles that they follow, both in conveying ideas and expressing preferences. Professional mediators and interpreters who comprehend these cultural differences or bridge them through cultural sensitivity training are essential.

ISSN 2394 - 7780

6.3 Non-Profit Organisations

In international nonprofit organisations working within diverse communities language barriers, cultural misunderstandings, and power dynamics make communications a major hurdle. Through affirmative communication practices that embrace all of society and by empowering local citizens, these organisations have managed to resolve conflicts and reach their goals.[4].

CONCLUSION

As the world becomes more globalised, getting along with others and handling differences will be vital. This paper investigated how to resolve global conflicts by examining major cultural differences, various modes of communication, emotional intelligence, and power dynamics. Individuals and organisations can enhance their conflict resolution skills by understanding and dealing with these variables. To keep confrontations from getting worse, you must be able to modify your communication style, cope with your emotions, and recognise when there is a power imbalance. The study has various limitations due to the size of the sample and the number of case studies examined. However, it provides us with some excellent ideas for future research on related themes such as the use of digital communication technologies and the development of training programs for emotional intelligence and cultural sensitivity. As part of a larger plan to assist people in settling problems in a constructive way in their daily lives, bringing news communication concepts can help people from different countries better understand and collaborate. Everyone gets along better in this context without having to compromise their identities.

REFERENCES

1. Nature. (2025). Conflict resolution in intercultural communication: strategies and challenges1.
2. International Journal of Advanced Research in Science, Communication and Technology. A Study on Barriers in Communication2.
3. Journal of International Education and Research. Best Practices and Strategies for Cross-Cultural Conflicts in the Workplace3.
4. StatPearls. Conflict Management - NCBI Bookshelf4.
5. Powell, B. M., & Maoz, I. (2014). Barriers to conflict resolution in landscapes of asymmetric conflict5.
6. DSIJ. Communication and Conflict Resolution in the Workplace6.
7. Crestcom. 6 Conflict Resolution Barriers You Need to Overcome7.
8. International Scholars Journals. Language and communication in conflict resolution8.
9. Sathyabama Institute of Science and Technology. A study on the effects of communication barriers on performance9.
10. Monash University. Effective and appropriate communication and conflict management in global organization10.
11. Gudykunst, W. B., & Kim, Y. Y. (2017). Communicating with Strangers: An Approach to Intercultural Communication.
12. Hofstede, G. (2010). Cultures and Organizations: Software of the Mind.
13. Ting-Toomey, S. (2015). The Matrix of Face: An Updated Face-Negotiation Theory.
14. Goleman, D. (2006). Emotional Intelligence: Why It Can Matter More Than IQ.
15. Fisher, R., Ury, W., & Patton, B. (2011). Getting to Yes: Negotiating Agreement Without Giving In.
16. Hall, E. T. (1976). Beyond Culture.
17. Mayer, B. (2012). The Dynamics of Conflict: A Guide to Engagement and Intervention.
18. Avruch, K. (2013). Context and Pretext in Conflict Resolution.
19. Lederach, J. P. (2003). The Little Book of Conflict Transformation.
20. Salacuse, J. W. (2013). Negotiating Life: Secrets for Everyday Diplomacy and Deal Making.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

SUSTAINABLE DEVELOPMENT OF THE HIGHER EDUCATION INSTITUTIONS IMPLEMENTING NEP 2020

Ms. Ridwana Hasan[1], Dr. Mrs. Urvashi Shrivastava[2] and Dr. Dharmendra Kumar Gangeshwer[3]
[1]Research Scholar, Bhilai Institute of Technology, Durg
[2]Associate Professor (Department of Management) Bhilai Institute of Technology, Durg
[3]Associate Professor SOS (Department of Statistics) Pt.Ravi Shankar Shukla University Raipur (C.G.)

ABSTRACT
Every development needs a safety net in education, which calls for a strong educational framework. The applications that have benefited from scientific and technological developments have undergone a significant transition within the past 50 years. Even now, it is challenging to predict how utilization will develop in the near future due to the rapid innovation. To meet the problems, an updated educational framework is needed. India should make a significant contribution to global development in line with the representation of the human force on Earth, as it represents more than one-sixth of the world force on the map. After a 34-year lapse, India finally updated its education strategy in response to the slow pace of change. 2020's revamped National Education Policy (NEP). The Sustainable Development Goals (SDGs) are an international effort to ensure that "no one will be left behind." In order to achieve the goals, higher education institutions are essential, but there is still more they can do to link their work tothe communities they serve and contribute to the development of a more sustainable future. In order for universities and colleges to meet their objectives, having existed for several centuriesin certain cases, they must adjust to the global agenda for change.

Keywords: *Sustainability, Higher Education, NEP(National Education Policy), Students Satisfaction, Service Quality*

INTRODUCTION
In today's scenario the concept of sustainability is a very prominent issue. The long term survivalof the higher educational institution help is the development of the youth population. India is a country where the population of the youth is high, we need to focus on the issue of sustainability in the higher education system so that the youth empowerment will be focused. The word sustainability means the long term survival of any institution which is itself a very burning issue in the world of perfect competitive market. In the era of the perfect competition the survival of the higher education institution is the utmost priority, the only dimension which help which in the concept of sustainability is the customer satisfaction. The education sector is becoming the business in the today's time because various private sector universities and colleges are been development. These university and college is providing the better infrastructural facilities to their students and quality education. The government higher education institutions are failing to provide the quality education and infrastructural facilities. So their survival is a biggest challenge. The students are the customers of the higher education institutes, in terms of marketing the customer is supreme and we need to give them high importance. In the year 2020 the national education policy (NEP) is amended there were many changes made for the successful execution of the higher education system.

OBJECTIVES OF THE STUDY
1. To understand the importance of sustainability in the higher education in the perfect competitive environment.
2. To study the changes made in the National education policy 2020 in respect of the highereducation.
3. To study and identify the various steps involve by the higher education institution for the sustainable development.

Steps taken by Higher Education for Sustainable development
The higher education is one of the pillars in shaping the economy of the country. There are various dimensions involve in the sustainable development of the country. There are some key elements considered for the sustainable development of the higher education:-

1. **Integration of the Curriculum-**The multidisciplinary principle is applicable in the field of the higher education. The various streams is integrated like commerce, science, art and technology etc. The interdisciplinary approach in the field of education is implemented.
2. **Research and innovation -**The research is promoted in the higher education institution for the new change and innovation. Research help in the solution of problem immediately caused in the institution. The

ISSN 2394 - 7780

continuous and constant research help in the creation of the innovative solution of the problem. It helps in the integration of the industries, academic and communities.

3. **Campus operation -**The campus need to be clean and green. The waste management and its recycling should be properly executed. The protection of the environment by performing all the work within the institution is the need to present time. The business organization which performing its operation simultaneously degrade the environment andpollute it. It is the moral responsibility of the higher education institution to perform the activities within the campus without harming the natural resources. There are various waste recycling methods or procedure adopted in the institution for recycling the resources.
4. **Policy development -**The policy laid by the higher education institution also executed in such a manner that the principle of the environment and institution sustainability is maintained at the faster pace. The vision and the mission statement of the institution also communicate the principles of the sustainability. The national education policy which is formulated by the government also facilitates in the norms of the sustainability.
5. **Infrastructure and Design-** The basic infrastructure of the institution also support the environment of the sustainability and quality delivery of the education system as a whole. Without the use of the basic infrastructure facilities the institution will not be able to deliver the quality to its students. The biodiversity and greenery in the part of the infrastructure and design also helps in the overall development of the institution.
6. **Transportation and Accessibility-**The public transportation facilities and the less use of vehicle, use of bicycle is promoted. The student with disability and there basic facilities should be made available in the campus for the easy flow of the education.
7. **Community engagement-**It is the moral duty of the educational institute to raised the educational status of the students as well as the local community. To spread the awareness about the sustainable practice in the institution. Many green initiative practice should be followed by the students in the campus.
8. **Social Equity and inclusion-**To maintain the social equitable environment is necessary to fulfill the social responsibility. Promote the diversity, fair labor practices and ethical operation of all activities is required
9. **Stakeholders Collaboration-**Those individuals which are directly and indirectlyinvolves in the business operation are considered as the stakeholders. The effectiveengagement of all stakeholders in the institution help in successful running of the institution.
10. **Student involvement-**The students involvement is necessary for building the sustainable environment in the institution. Engage students in the process of making decisions about environmental efforts. Establish student-run groups and programmes focused on sustainability on campus.

Highlights of National Education Policy (NEP) 2020

A comprehensive foundation for the reform of India's educational system is the National Education Policy (NEP) 2020. The following are some of the NEP 2020's main highlights:

1. Multidisciplinary and Holistic Education:

Emphasis on a multifaceted, adaptable, and all-encompassing approach to education. combining extracurricular activities, occupational topics, and the arts and sciences.

2. Care and Education for young Children

To provide a solid foundation, concentrate on foundational learning during the early years(3–8years).

early childhood education for kids up to age eight should be made universal.

3. Education in Schools:

The 5+3+3+4 system, which consists of 5 years of foundational stage, 3 years of preparation stage, 3 years of middle stage, and 4 years of secondary stage, is a new pedagogical and curriculum framework.

Coding and vocational skills are introduced starting in primary school. Curricular content reduction in order to encourage critical thinking and important learning.

4. Reforms in Assessment:

Replace memorization with competency based evaluations.regular, impartial, and low-stakes assessments are the main focus of formative andsummative evaluations.

ISSN 2394 - 7780

5. Higher Learning:
Combining several sites of entry and departure with the integration of education andemployment. All kinds of higher education institutions are subject to a single higher education authority, the Higher Education Commission of India (HECI).

Heightened emphasis on innovation and research following the National ResearchFoundation's founding.

Impact of higher education in economic development
For people, societies, and countries to prosper economically, higher education is essential.Higher education has a complex and wide-ranging effect on economic development. These include:

1. Development of Human Capital:
Higher education gives people access to more sophisticated information, abilities, andexpertise, which helps to create a workforce that is both competent and effective.

People with higher levels of education are more likely to be creative thinkers, adjust to shifting market conditions, and progress technology.

2. Research and Innovation:
Institutions of higher learning serve as centres for innovation and research. They create an atmosphere in which innovative concepts are developed and state-of-the-art research iscarried out.

University-conducted research frequently results in new services, goods, and technology that boost competitiveness and economic growth

3. The Creation of Jobs through Entrepreneurship:
An entrepreneurial mindset is promoted by higher education, which also imparts theskills needed to launch and run a firm.

Graduates frequently start their own businesses, which generate employment and advancethe general economic growth of a nation or region.

4. Efficiency and productivity
A workforce's total productivity and efficiency are increased by higher education since it imparts specialized knowledge and critical thinking abilities.

People with higher levels of education are more likely to adopt productive work methods, which boost productivity and stimulate economic growth.

5. Global Competitiveness:
Higher education-focused countries are typically more competitive in the world economy.An educated labour force draws in foreign capital, fosters cross-border cooperation, and improves a nation's capacity to engage in international trade.

6. Social Change:
Higher education can promote social mobility by giving people from differentbackgrounds the chance to rise up the socioeconomic ladder.

A more fair allocation of resources and a decrease in economic disparity can be achievedthrough accessible higher education.

CONCLUSION

The National Education Policy (NEP) 2020's appropriate execution will enable higher education to grow sustainably, which will be extremely promising for the overall development of people, societies, and countries. With its comprehensive approach, this ground-breaking policy seeks to solve a number of issues and open the door for a more comprehensive and inclusive higher education system. Conclusively, the appropriate execution of NEP 2020 in postsecondary education has the capacity to stimulate sustainable development by producing a cohort of knowledgeable, proficient, and socially aware individuals. The policy's emphasis on diversity, adaptability, technology, research, and environmental awareness is in line with the larger goal of using education's transformative power to build a just and sustainable society.

REFERENCES

1. Aithal P. S. &Aithal Shubhrajyotsna (2020). Promoting Faculty and Student-Centered Research and Innovation-based Excellence Model to Reimage Universities. International Journal of Management, Technology, and Social Sciences (IJMTS), 5(1), 24-41. DOI: http://doi.org/10.5281/zenodo.3702399.

ISSN 2394 - 7780

2. Ajay Kurien, Dr Sudeep B. Chandramana 2020 “Impact of New Education Policy Impact on Higher Education” November 2020 ConferenceAtam Nirbhar Bharat: A Roadmap to self-reliant India.
3. B. L. Gupta, Meenakshi Gupta, “Academic Excellence in Technical Institutions”, Issues and Ideas in Education, Vol. 1, pp. 23-42, 2013.
4. Chopra, Ritika (2 August 2020). "Explained: Reading the new National Education Policy 2020". The Indian Express.
5. Jebaraj, Priscilla (2 August 2020). "The Hindu Explains | What has the National Education Policy 2020 proposed?". The Hindu. ISSN 0971- 751X.
6. Joyti Sehrawat, "Teacher autonomy : Key to teaching success", Bhartiyam international journal of education & research, Vol. 4, Issue 1, pp. 1-8, 2014.
7. Mohrman, K., Ma, W., & Baker, D. (2008). The research university in transition: The emerging global model. Higher Education Policy, 21(1), 5-27.
8. Nandini, ed. (29 July 2020). "New Education Policy 2020 Highlights: School and higher education to see major changes". Hindustan Times.
9. Prathap, G. (2014). The performance of research-intensive higher educational institutionsin India. Current Science, 389-396.[for STEAM education. Journal of the Korean Association for Science Education, 32(2), 388-401.
10. Rob Cirin, “Do academies make use of their autonomy?”, Research report, Department for Education , pp. 1-53, 2014.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

INTRODUCTION TO RELUGOLIX, ANALYTICAL METHOD DEVELOPMENT AND ITS VALIDATION BY HPLC METHOD

Krina Chaudhary*[1], Dr. Vikram N Panchal[2], Prem Ahuja[3]
[1,2]Department of Chemistry, Gokul Global University, India
[3]Master of Pharmacy, Gujarat Technological University, India

ABSTRACT
Relugolix is a non-peptide GnRH receptor antagonist drug approved by Central Drugs Standard Control Organization (CDSCO), India on 16.10.2023 and Food and Drug Administration (FDA), USA on 18.12.2020 for the treatment of advanced prostate cancer that works by inhibiting the release of FSH and LH by blocking the GnRH receptor on anterior pituitary gland which leads to decrease in production of Testosterone in men and estrogen in women which can slow or stop the spread of Prostate cancer in men also works in endometriosis in women. The HPLC method developed by using (4.6-mm × 25-cm; 5-µm packing L7) column at 35°C temperature with detection wavelength of 294 nm with a mobile phase Ammonium acetate: Acetonitrile (65:35), flow rate of 0.9 ml/min with injection volume 10 µl shows the retention time of 7.3 minutes standard, in which the linearity is found with r^2 =0.9998, precision observed is 0.966% as well as LOD and LOQ are 2.00 µg/ml and 6.07 µg/ml respectively. Accuracy at each level found in between 98.78% to 99.79%. As per ICH guidelines Q2 (R2), mentioned parameters are found within the acceptance criteria, hence it is concluded that the developed method can be utilized in routine analysis of Relugolix in bulk drug as well as its tablet formulation.

Keywords: *Relugolix, GnRH antagonist, CDSCO and FDA, ICH guidelines Q2 (R2), HPLC*

INTRODUCTION
Prostate cancer is a disease where cells in the prostate, a small gland in the male reproductive system, grow uncontrollably[1]. It is the second most common kind of cancer that occurs in the male. The exact cause of the prostate cancer is still not known but the risk factor includes genetic mutation in BRCA1 or BRCA2 genes, obesity, age etc. For treatment of prostate cancer various approaches are utilized such as surgery (prostatectomy), Radiation therapy, Hormonal therapy or Chemotherapy etc.[2] From one of those Hormonal therapies, Relugolix is a non-peptide GnRH receptor antagonist that works by inhibiting the release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), which leads to decreased in production of testosterone hormone, hence by lowering testosterone levels, Relugolix helps in treating conditions like advanced prostate cancer, where reducing androgen levels can slow cancer growth.[3]

Relugolix (CAS: 737789-87-6) is chemically 1- [4- [1-[(2,6-difluoro phenyl) methyl]-5-[(dimethyl amino) methyl]-3-(6-methoxy pyridazin-3-yl)-2,4-dioxothieno[2,3-d] pyrimidin-6-yl] phenyl]-3-methoxy urea. Relugolix is a white to off white to slightly yellow colour powder with a solubility of 0.04 mg per mL in water at 25°C with molecular weight 623.63 gm/mol and molecular formula $C_{29}H_{27}F_2N_7O_5S$. The Log P value (partition coefficient) of Relugolix is approximately 8.63 while its Pka Value is around 13.17.[4] It is available in market with a brand name 'Orgovyx' (Relugolix tablets) 120 mg.

According to the Literature survey, various method on Relugolix has been developed while HPLC is one of the sensitive, reliable and robust method of analysis that can be utilized for the routine analysis of Relugolix in bulk drug as well as its tablet dosage form. For this purpose, a new method on Relugolix has been developed and validated as per ICH Q2(R2) guideline.[5] The developed method gets validated by performing various parameters such as Specificity, Accuracy, Precision, Linearity and range, LOD and LOQ.

MATERIAL AND METHOD

Instruments and Materials
Various material and Instruments utilized for the development and validation of Relugolix in bulk drug and its tablet dosage are shown in below tables.

Table 1: List of Instrument and Equipment

Sr. No.	Name of Equipment	Specifications
1.	Analytical Balance	**Make:** Mettler Toledo **Capacity:** 220 gm Readability: 0.1 mg
2.	High Performance Liquid Chromatography (HPLC)	**Make:** Shimadzu HPLC 10AT vp **Software:** Empower 2 Software **Detector:** UV/VIS Detector

ISSN 2394 - 7780

Table 2: List of Glasswares and Apparatus

Sr. No.	Apparatus	Capacity	Name of Manufacturer
1.	Volumetric flaks	5, 10, 25, 50 & 100 ml	Borosil glass works limited
2.	Graduated Pipettes	1,2,5 & 10 ml	Borosil glass works limited
3.	Glass beakers	Appropriate volumes	Borosil glass works limited
4.	Measuring Cylinder	Appropriate volumes	Borosil glass works limited
5.	Funnel	-	Borosil glass works limited

Table 3: List of Chemical and Reagents

Sr. No.	Name	Grade	Company
1.	Relugolix	In-house	Metrochem API Pvt Ltd.
2.	Distilled Water	-	-
3.	Ammonium acetate	AR	Merck Ltd, Mumbai
4.	Acetonitrile	AR	Merck Ltd, Mumbai

METHODS:

Preparation of Standard Stock Solution:
Weigh accurately 100 mg of Relugolix WS, transfer to 100 ml of volumetric flask and dissolve and dilute up to the mark by using the mobile phase (1mg/ml =1000 µg/ml of Relugolix).

Preparation of Standard Solution:
Withdraw 1 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (100 µg/ml of Relugolix).

Preparation of Sample Solution:
Crush 20 tablets and weigh equivalent to 100 mg of Relugolix and transfer it to the 100 ml of volumetric flask and dilute it up to the mark by using the mobile phase. Withdraw 1 ml of the solution and dilute it up to the 10 ml in a volumetric flask by using mobile phase. (100 µg/ml of Relugolix).

DEVELOPMENT OF HPLC METHOD:

CHROMATOGRAPHIC CONDITION

Mode: HPLC

Column: 4.6mm x 25 cm: 5-µm packing L7

Column temperature: 35°C

Flow rate: 0.9 ml/min

Injection volume: 10µl

Mobile phase: Ammonium acetate: Acetonitrile (65:35)

Detection wavelength: 294 nm

VALIDATION PARAMETERS

1. Precision:
Precision refers to the closeness of agreement between a series of measurements obtained from multiple sampling of the same homogeneous sample under the prescribed conditions.

It is performed by preparation of standard solution of Relugolix and has been injected into HPLC system and %RSD has been calculated.

Acceptance criteria: %RSD less than 2%.

2. Accuracy:
According to the ICH Q2 guidelines, accuracy refers to the closeness of agreement between the value that is accepted either as a conventional true value or an accepted reference value and the value found. In simpler terms, it measures how close the test results are to the true value.

Performed accuracy study for a known amount of placebo of Relugolix was taken & Spiked with known quantities of Relugolix standard preparation. Prepared sample solution of different concentration levels in range of 50%, 100% and 150% of the target concentrate. Inject each level into HPLC in triplicate. Taken

ISSN 2394 - 7780

average area of three injections at each level and calculated the % Recovery for average area at each level versus conc. of analyte.

Preparation of 50% solution:
Weigh accurately 5 mg of Relugolix WS and spiked with 150 mg of placebo and transfer to 100 ml of volumetric flask and dissolve and dilute up to the mark by using the mobile phase. (50 µg/ml)

Preparation of 100% solution:
Weigh accurately 10 mg of Relugolix WS and spiked with 150 mg of placebo and transfer to 100 ml of volumetric flask and dissolve and dilute up to the mark by using the mobile phase. (100 µg/ml)

Preparation of 150% solution:
Weigh accurately 15 mg of Relugolix WS and spiked with 150 mg of placebo and transfer to 100 ml of volumetric flask and dissolve and dilute up to the mark by using the mobile phase. (150 µg/ml)

Acceptance criteria: %Recovery found in between 98% to 102%.

3. Linearity:
Performed linearity study for Relugolix standard solution. Prepared standard solutions of different conc. levels in range of 25% to 150% of the target conc. injected each level in HPLC and calculate correlation coefficient.

Preparation of linearity test solution
Prepared a series of solution of standard 25%, 50%, 75%, 100%, 125% and 150% of target concentration.

Injected each solution in triplicate and calculated the area of A at each concentration. Calibration curve was plotting average area on Y axis and conc. level on X axis and calculate correlation coefficient.

Preparation of Standard Stock Solution:
Weigh accurately 100 mg of Relugolix WS, transfer to 100 ml of volumetric flask and dissolve and dilute up to the mark by using the mobile phase (1 mg/ml = 1000 µg/ml).

Preparation of 25 % of Solution:
Withdraw 0.25 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (25 µg/ml of Relugolix).

Preparation of 50 % of Solution:
Withdraw 0.5 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (50 µg/ml of Relugolix).

Preparation of 75 % of Solution:
Withdraw 0.75 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (75 µg/ml of Relugolix).

Preparation of 100 % of Solution:
Withdraw 1 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (100 µg/ml of Relugolix).

Preparation of 125 % of Solution:
Withdraw 1.25 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (125 µg/ml of Relugolix).

Preparation of 150 % of Solution:
Withdraw 1.5 ml of the Standard Stock Solution and dilute it up to the 10 ml in a volumetric flask by using mobile Phase (150 µg/ml of Relugolix).

Acceptance criteria: The correlation coefficient should not be less than 0.99.

4. Specificity
Prepare sample and standard solution of Relugolix and inject in Placebo, Standard and Sample in HPLC System and found Peak Purity of Sample and Standard using UV Visible spectrophotometer.

5. LOD & LOQ:
The LOD is the lowest amount of analyte in a sample that can be detected, but not necessarily quantified, under the stated experimental conditions.

The LOQ is the lowest amount of analyte in a sample that can be quantitatively determined with suitable precision and accuracy under the stated experimental conditions.

ISSN 2394 - 7780

It has been calculated from the Linearity data and calculated by below formula:

LOD= 3.3*standard deviation / Slope

LOQ= 10*standard deviation / Slope

RESULTS AND DISCUSSION

Precision:

The standard solution of Relugolix has been injected into HPLC system in six replicates as per mentioned chromatographic conditions and % RSD has been measured.

Table 4: Precision results

Injection no.	Peak Area of Relugolix
1	123614
2	122523
3	125263
4	125236
5	125452
6	125234
Average	124553.6667
RSD	**0.966%**

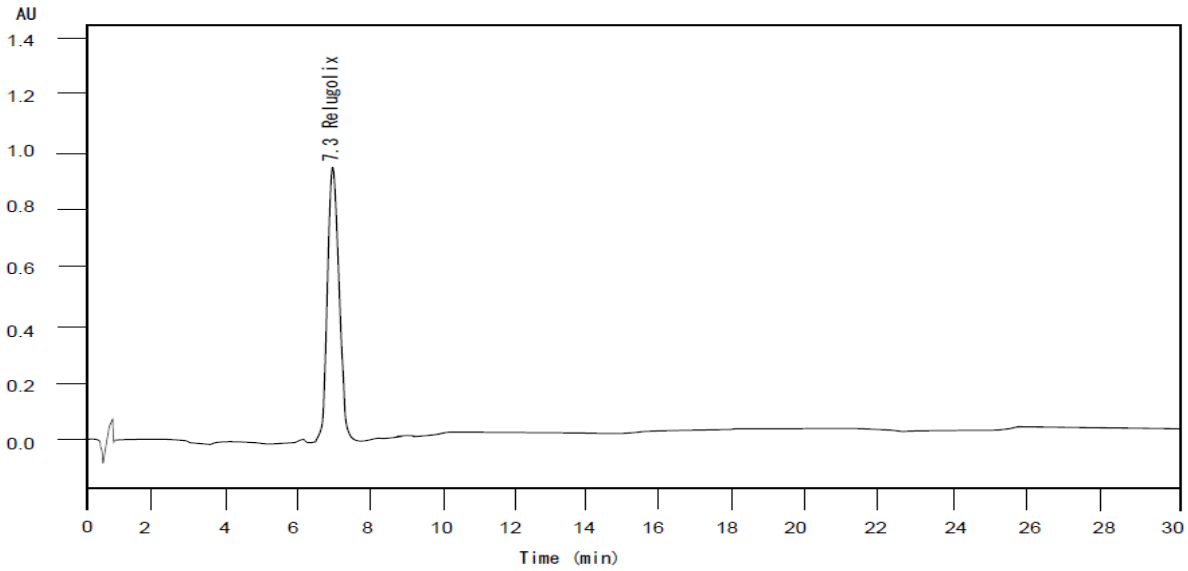


Figure 1: Chromatogram of Relugolix standard

Linearity

The standard solution is prepared from concentration 25% to 150% and a graph plot of concentration vs peak area has been prepared.

Table 5: Linearity results

Concentration (%)	Peak Area of Relugolix
25	30425
50	63849
75	93274
100	125698
125	157123
150	188547
Correlation coefficient	**0.9998**

ISSN 2394 - 7780

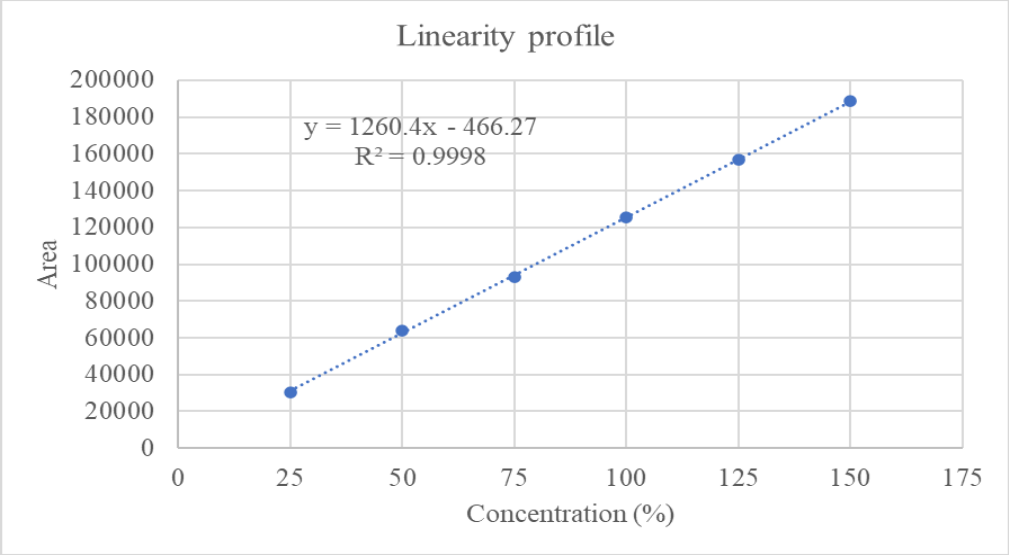


Figure 2: Linearity graph

Accuracy:

Table 6: Accuracy results

Sr.no	Concentration (%)	Amount added (µg/ml)	Peak area observed	Amount found (µg/ml)	% Recovery	Average
1	50	50	62617	49.95	99.90	99.51
2	50	50	61653	49.53	98.46	
3	50	50	62730	50.09	100.18	
4	100	100	125134	99.92	99.92	99.79
5	100	100	124971	99.79	99.79	
6	100	100	124821	99.67	99.67	
7	150	150	186775	149.22	99.48	98.78
8	150	150	184422	147.34	98.23	
9	150	150	185160	147.93	98.63	

LOD and LOQ

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.999922216							
R Square	0.999844439							
Adjusted R Square	0.999805548							
Standard Error	822.0995711							
Observations	6							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	17375590811	17375590811	25709.32873	9.07522E-09			
Residual	4	2703390.819	675847.7048					
Total	5	17378294201						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-466.2666667	765.33305	-0.609233675	0.575275906	-2591.171867	1658.638534	-2591.171867	1658.638534
X Variable 1	1260.406857	7.860775417	160.3412883	9.07522E-09	1238.581846	1282.231869	1238.581846	1282.231869

Figure 3: Statistical Sheet

ISSN 2394 - 7780

LOD= 3.3*Standard deviation
Slope
=3.3*765.33
1260.41
= 2.00% = **2.00 µg/ml**

LOQ= 10*Standard deviation
Slope
=10*765.33
1260.41
= 6.07%= **6.07 µg/ml**

Specificity:

Table 7: Specificity results

Sr.no	Solution	Retention time (min)
1	Standard solution	7.3 minutes
2	Sample solution	7.2 minutes

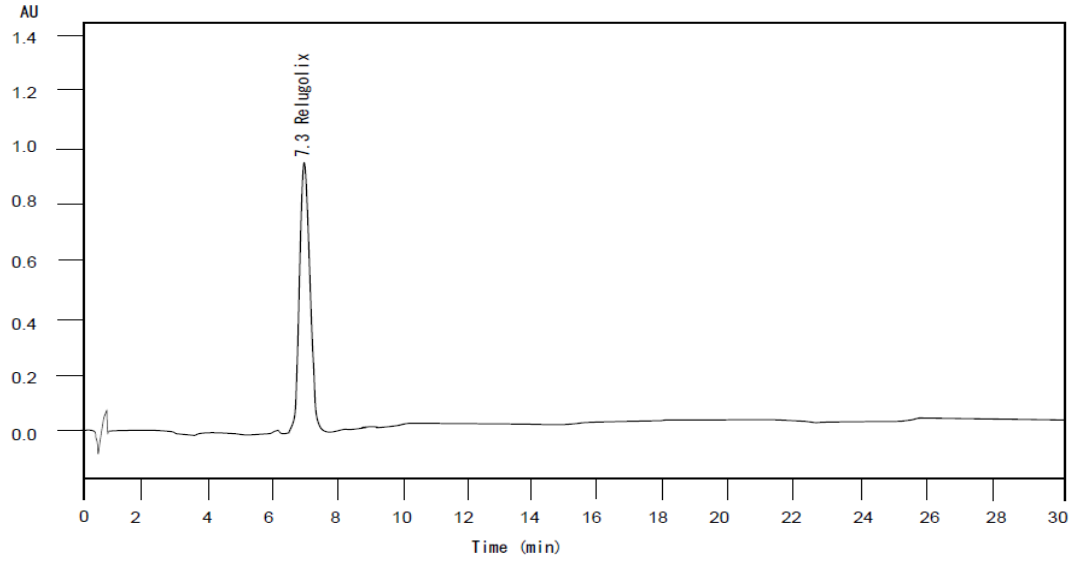


Figure 4: Chromatogram of Relugolix in Standard Solution

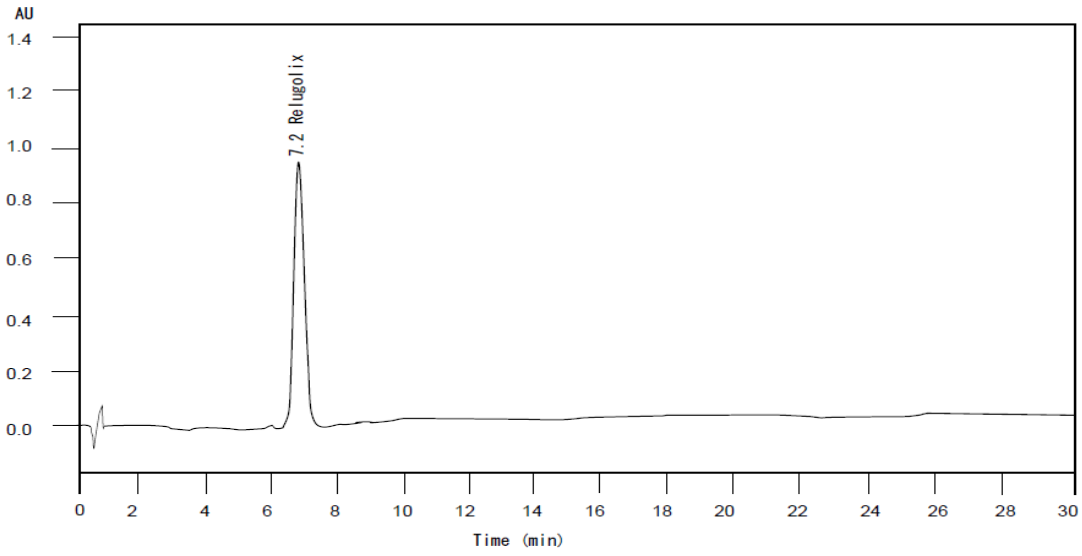


Figure 5: Chromatogram of Relugolix in Sample solution

SUMMARY AND CONCLUSION

SUMMARY

The parameters such as Specificity, Accuracy, Linearity, Precision, LOD and LOQ are performed as per ICH Q2(R2) guidelines and below represents the results summary of such parameters.

ISSN 2394 - 7780

Table 8: Summary Table

Sr.no	Parameter	Acceptance criteria as per ICH Q2 (R2) guideline	Observed results
1	Precision	RSD < 2%	RSD=0.966%
2	Linearity and range	$R^2 \geq 0.99$	$R^2 = 0.9998$
3	Accuracy	% Recovery=98% to 102%	50%=99.51 100%=99.79 150%=98.78
4	Specificity	No Interference	No Interference observed
5	Limit of Detection	S/N ratio of 3:1	2.00 µg/ml
6	Limit of Quantitation	S/N ratio of 10:1	6.07 µg/ml

CONCLUSION

The HPLC method for analysis of Relugolix in bulk and tablet dosage form is successfully validated by performing parameters such as Precision, Linearity & range, Accuracy, Specificity, LOD and LOQ as per ICH Q2 guidelines.

From the above results, it has been concluded that the method developed can be utilized for the routine analysis of the Relugolix in bulk drug and its tablet formulation.

REFERENCES

1. Shirley M., Relugolix: A Review in Advanced Prostate Cancer. Target Oncol. **18** (2023) 295-302.
2. Rawla P. Epidemiology of Prostate Cancer. World J Oncol. **10** (2019) 63-89.
3. Shore ND., et al. "Oral Relugolix for Androgen-Deprivation Therapy in Advanced Prostate Cancer". The New England Journal of Medicine **23** (2020): 2187-2196.
4. Drugbank online, Relugolix, https://go.drugbank.com/drugs/DB11853, 2025.
5. European Medicine Agency, ICH Q2(R2) Validation of analytical procedures-Scientific guideline,https://www.ema.europa.eu/en/ich-q2r2-validation-analytical-procedures-scientific-guideline, 2025.
6. Sushila Dagadu Chavan, Deepa Mahendra Desai, Analytical method validation: A brief review, World Journal of Advanced Research and Reviews, 2022, **16**, 389–402.
7. Shirley M. Relugolix: A Review in Advanced Prostate Cancer. Target Oncol. 2023**, 2** :295-302.
8. Immani Ramachandra Rao, Chava Lavanya, P. Punitha, A New Analytical Method for Determination and Quantification of Residual Solvents in Relugolix Api Bulk Drug by GC-MS Method, Research Journal of Pharmacy and Technology, volume **16**, Issue 10, 2023.
9. INTERNATIONAL COUNCIL FOR HARMONISATION OF TECHNICAL REQUIREMENTS FOR PHARMACEUTICALS FOR HUMAN USE, ICH Q2 Adopted on 1 November **2023.**
10. Meruva Sathish Kumar, Mrs.S. Marakatham, RP-HPLC method development and validation of Relugolix, International Journal of Chemical and Biochemical Sciences, IJCBS, 24, **6** (2023): 850-855
11. S.R. Thrinath, K.S. Lakshmi and Manikandan Krishnan, Development and validation of a method for studying Relugolix and its impurities by UPLC-MS, AK journals, 21 Aug 2024.
12. https://www.ncbi.nlm.nih.gov/books/NBK470550/, Leslie SW, Soon-Sutton TL, R I A, et al. Prostate Cancer, Stat Pearls Publishing; Jan **2024**
13. Priya Sadapha, Kavita Dhamak "Review Article on High-Performance Liquid Chromatography (HPLC) Method Development and Validation", Int. J. Pharm. Sci. Rev. Res., 2022; **03**, 23-29
14. Rao GR, Murthy SSN, Khadgapathi P, "High Performance Liquid Chromatography and its Role in Pharmaceutical Analysis", Eastern Pharmacist, 1986; **29**, 53.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

DEPRESSION DETECTION THROUGH VIDEO AND LANGUAGE MODALITIES: A LITERATURE REVIEW USING DEEP LEARNING AND NLP TECHNIQUES

Miss Kiran Bala
Desh Bhagat University, Mandi Gobindgarh, (Punjab) India

ABSTRACT

Depression is the biggest health condition across the globe, and its identification by emerging methods like Natural Language Processing (NLP) at an initial stage can be catalytic to mental sickness diagnosis.

Increased incidences of mental illness, specifically depression, make it impossible not to establish AI-based tools to identify depression at an early stage. Traditional identification through other means can be highly efficient but is typically limited by the level of trained officers and units they possess. NLP approaches offer an intriguing potential with the application of text data analysis in identifying language and semantic signs of depression. This paper tries to explore how various NLP models, ranging from the old feature-based models to the new transformer models, are utilized in identifying depression. It also tries to assess the models according to heterogeneity of data employed, computational complexity of the models, and ethical issues like biasness and interpretability.

This work provides a comparative survey of various NLP approaches to text-based depression detection on learning from various categories of datasets like social media, clinical interviews, and spontaneous speech. Traditional linguistic feature extraction, sentiment analysis, word embeddings, deep models, and transformer models like BERT and GPT-3 are presented in the survey.

The study compares all the methods on basis of accuracy, interpretability, computationally expensive, and data problems as well as ethical concerns such as biasness and privacy. The greatest contribution of this study is uniting conventional NLP methods with present-day deep models, proposing a unitary framework to model depression detection systems.

NLP has become a powerful preclinical depression diagnostic tool. It is now possible with the combination of deep learning, state-of-the-art transformer models, and standard parsing of languages to achieve well-documented, scalable, and context-aware depression detection. Data set diversity, sensitivity to contexts, and robust ethics in AI application towards mental health are the key topics discussed in this article. Along with that, wellness exercises like deep breathing exercises being integrated into AI-based therapeutic models can also be helpful.

Keywords: *Depression detection, Natural Language Processing (NLP), mental health, AI in psychiatry, transformer models, CNN-LSTM.*

INTRODUCTION

Background

1.1 Background and Motivation

Depression is a very prevalent mental health disorder and is very important in terms of mental health balance for the care of individual lives. An untreated diagnosis can lead to debilitating emotional, psychological, and physical events. The World Health Organization (WHO) lists depression as one of several leading causes of disability worldwide and affects an individual's quality of life, increases the prevalence of other conditions such as anxiety disorders, is problematic to physical health including heart disease, and increases the risk of death by suicide [1].

Traditionally, common diagnostic practices rely on self-reported symptoms and structured interviews with mental health professionals. These methods have proven effective; however, they tend to be subjective, time-consuming, and depend on the patient to accurately a) report their symptoms and

b) Willingly Report their Situation [2].

In the past two decades, there have been important advancements in the areas of Artificial Intelligence (AI) and Machine Learning (ML) that have yielded automated tools for the short- and long-term detection and measurement of depression [3]. These automated tools are intended to alleviate some of the valid concerns around traditional mental health diagnosis processes by demonstrating similar patterns of identification and measurement on a larger divergent set of data, utilizing evidence-based data such as conversational language, responses to speech, facial expressions, and physiological signals to identify signs of depression.

ISSN 2394 - 7780

1.2 Importance of the Study

AI-led systems for depression determination signify a noteworthy advancement in mental health diagnosis, introducing portable and non-invasive methods of early intervention. Text-based models, using Natural Language Processing, analyze language patterns in social media postings, clinical interviews, and other forms of natural conversation [4]. Audio-based models analyze how "someone speaks" including tone, rhythm of vocal patterns, and length of pauses—all of which are normal indicators of emotional states, including depression [5]. Computer vision, or facial analysis makes use of image frames to analyze video and various micro-expressions that accompany depression [6].

Deep learning architectures such as Convolutional Neural Networks (CNNs), Long Short-Term Memory (LSTM) networks, and transformer-based models such as BERT and GPT, ultimately increase the accuracy for diagnostic purposes [7]. Multimodal (e.g. audio, video, and text data combined) methods outperformed unimodal systems in diagnostic tasks [8], and there have been recent developments that employ generative AI and transfer learning to address data scarcity issues and increase generalization [9].

1.3 Problem Statement

Although there has been significant advancement in the past couple of years, there are still some barriers for AI-based depression detection tools entering clinical practice. A major barrier is the lack of interpretability in the models, in addition to the potential of bias resulting from imbalanced datasets, cross-cultural issues, generalizability, and larger ethical considerations such as privacy and transparency [10][11][12]. Together these barriers to trust, fair treatment, and implementation will be challenge in implementing these tools within healthcare.

1.4 Research Objectives

This paper will:

- Assess the progression of NLP models in depression detection, from accepted modes of feature extraction to current transformers.
- Assess the models with respect to data heterogeneity, computational expense, and ethical concerns such as bias and interpretability.
- Look at hybrid deep learning architectures that fuse embedding's, sequence models and attention approaches.
- Assess the component of multimodal (video, audio, text) integration that allows for higher precision in diagnostics.
- Propose mobile-based detection systems that allow for real-time mental health monitoring.
- Look into facets that allow for bias mitigation, fairness advancement and privacy-preserving design in mental health AI.
- Broaden the scope of AI depression models to include multilingual contexts for global reach.

1.5 Structure of the Paper

The remainder of this paper is structured as follows:

- **Section 2** reviews existing literature on depression detection using NLP, speech, vision, and multimodal AI techniques.
- **Section 3** describes the datasets used, data pre-processing methods, and the proposed hybrid model architecture.
- **Section 4** presents the experimental setup, model evaluation, and performance metrics.
- **Section 5** discusses findings, ethical concerns, and limitations.
- **Section 6** concludes with future directions, including real-time applications, fairness- aware models, and multilingual adaptation.

2. LITERATURE REVIEW / RELATED WORK

2.1 Summary of Past Research

In recent years, there has been a spike in research investigating the use of Natural Language Processing (NLP) techniques for the detection of depression in various types of text, including social media posts, clinical interviews, transcripts of speech, and diary entries. A total of 24 empirical studies are reported in this paper,

ISSN 2394 - 7780

published between 2022 and 2024, which we systematically searched and analyzed to assess progress in this area. The studies utilized various techniques of analysis from basic linguistic feature analysis using a traditional linguistic feature analysis to using the latest transformer-based models to find an expression of language related to depression.

Model Type	Key Technique	Advantages	Limitations
Traditional NLP	LIWC, Sentiment Analysis	Simple, interpretable, low resource requirement	Lacks deep semantic understanding, limited performance
Static Embedding's	Word2Vec, GloVe	Captures word- level semantics	Context- insensitive representations
Sequence Models	LSTM, CNN	Learns temporal/spatial features	May fail with long-term dependencies
Contextual Embedding's	ELMo, BERT	Better at context-sensitive understanding	Higher computation costs, moderate interpretability
Transformer Models	BERT, GPT-3	High accuracy, deep contextual reasoning	Requires large data and compute; low transparency

For traditional data analysis, methods that utilized tools like Linguistic Inquiry and Word Count (LIWC) sought linguistic features such as the overuse of use of first-person pronouns or negative affect words. Others utilized sentiment analysis methods to detect emotional tone in text data that can act as indirect indicators of depressive states. For more recent research utilizing deep learning techniques it was permissible for the studies to use static word embeddings (Word2Vec and GloVe) and were captured using sequence models (Long Short Term Memory, Convolutional Neural Networks) to capture by way of semantic and context patterns. More recently, studies utilized dynamic embeddings (Elmo and BERT) which improved upon the narrow awareness of contextual dependencies. Transformer-based architectures like BERT and GPT-3 included self-attention mechanisms, and achieved state of the art results in depressive symptom detection (accuracy between 73%-91%).

2.2 Comparison of Existing Methods

Many studies evaluated their models using standard metrics such as accuracy, F1-score, precision, and recall. For example, BERT-based models showed improved accuracy and recall when applied to social media datasets, while LSTM models performed better with sequential clinical transcripts. Additionally, ethical concerns including data privacy, informed consent, bias detection, and explain ability were increasingly discussed in recent literature.

2.3 Gaps in the Literature

There are still some major difficulties despite the progress that has been made:

- **Data Diversity:** A lot of models have also used English language data to train the model and therefore limit cross-linguistic generalizability.
- **Explainability:** Many clinicians would be unable to ascertain the reasoning (and therefore the strength) of their decision because many transformer-based models are sometimes regarded as "black boxes".
- **Bias and Fairness:** Data imbalances and cultural diversity of how language is used can produce a number of biases in algorithm output that may have implications on only small population sub-groups, but on many.
- **Real-Time Usability:** Few studies have been published discussing the the models real-time usability in mobile-based or wearable-based technologies for mental health related apps.
- Integration across modalities means some of the studies offer some general fusion of multimodal data, but comprehensive frameworks which can combine textual, audio and video in real-time currently remain rare.

2.4 How This Work Differs / Improves Upon Them

This research intends to overcome the above limitations by:

- Conducting a comparative analysis of traditional, deep learning, and transformer models, focusing on

ISSN 2394 - 7780

performance, computational complexity, and interpretability.

- Examining hybrid models that capitalize on the strengths of both sequence learning (LSTM/CNN) and contextual embedding's and attention mechanisms so that depression detection can be done more accurately.
- Emphasizing multimodal approaches (e.g., text, speech, video) to enhance diagnostic accuracy, as done in Teferra et al.
- Planning for the development of mobile- compatible AI models for real-time, proactive monitoring of mental health.
- Addressing ethical and fairness issues by discussing bias mitigation strategies, data privacy- preserving methods, and a transparent model.
- Developing cross-linguistic models that allow for multilingual datasets for greater global application.

Summary of Studies

Ref. No.	Study (Author, Year)	Data Type	NLP/ML Technique	Evaluation Metrics	Key Findings	Ethical/Explainability Focus	Limitations
1	Teferra et al. (2024)	Clinical, Social Media Text	NLP feature engineering	Accuracy, F1-score	Effective NLP for depression screening	Discusses privacy and bias	Limited to Textual data; lacks multimodal evaluation
2	Lorenzoni et al. (2024)	Social media, clinical interviews	ML classifiers, NLP	Accuracy, Precision	Transformer models outperform traditional ones	Notes need for fairness	May not generalize across cultures or platforms
Ref. No.	**Study (Author, Year)**	**Data Type**	**NLP/ML Technique**	**Evaluation Metrics**	**Key Findings**	**Ethical/Explainability Focus**	**Limitations**
3	Chen et al. (2024)	Speech recordings	Deep acoustic models	Precision, Recall	Speech-based screening shows high accuracy	Limited discussion	Limited ethical and privacy considerations
4	Agrawal (2024)	Clinical text, prompt engineering	Explainable transformers	Accuracy, F1-score	High accuracy with explainable outputs	Emphasizes explainability	Model complexity may hinder real-time deployment
5	Asif et al. (2024)	Mood/emotion tracking data	AI-driven monitoring	Not specified	Continuous monitoring Supports early detection	Privacy highlighted	Lack of specific model evaluation
6	Nature (2024)	Multimodal (text, speech)	Multimodal AI models	Varied	Multimodal improves detectionover unimodal	Addresses data privacy	Computationally intensive
7	ACM DL (2024)	Clinical datasets	Deep learning	Accuracy	Deep models improve detection performance	Computational efficiency noted	Limited interpretability
8	Xu et al. (2023)	Acoustic features	Attention-based networks	F1-score, Recall	Attention enhances feature fusion	Model explainability discussed	Requires high-quality labeled acoustic data
9	Othmani & Muzammel (2023)	Verbal/vocal longitudinal data	Ambient intelligence	Not specified	Longitudinal monitoring captures symptom changes	Privacy considerations	High infrastructure and data demands
10	Shin et al.	Diary text	Large Language	Accuracy,	LLMs robust for diary-based	Consent	Requires rich textual data and

ISSN 2394 - 7780

	(2024)		Models (LLMs)	Precision	detection		processing
11	Cruz et al. (2023)	Social media posts	Naive Bayes classifier	Accuracy	Baseline ML model effective but less precise	No ethical discussion	Outperformed by newer deep models
12	Gan et al. (2024)	Web a	ML and NLP	Accuracy	NLP with ML improves detection	Ethical challenges mentioned	Ethical risk s underexplored
Ref. No.	**Study (Author, Year)**	**Data Type**	**NLP/ML Technique**	**Evaluation Metrics**	**Key Findings**	**Ethical/Explai n ability Focus**	**Limitations**
13	Park et al. (2024)	Clinical & social media data	AI for detection and treatment	Varied	Shows AI's clinical potential	Strong ethical focus	Results not standardized across platforms
14	Kumar	Stressdata from professionals	ML models	Accuracy	Stress detection applicable to depression screening	Ethics briefly mentioned	Generalizability to clinical data untested
15	WESAD dataset	Wearable sensor data	ML models	Accuracy	Wearable data effective for depression prediction	Data anonymizati on highlighted	Sensor variability; battery/data limitations
16	Schmidt et al. (2024)	ECG sen sor data	ML classifiers	Accuracy	Models generalize well across populations	Privacy	High dependency on clean physiological signals
17	Nijhawa n et (2022)	Social interaction (text)	NLP & ML	Accuracy	NLP improves stress/depressi o n detection	Emphasizes informed consent	Limited language coverage
18	Jemmy (2024)	User feedback	Human-centric AI	Not specified	Feedback enhances model reliability	Strong ethical and fairness focus	Feedback systems not fully scalable
19	Wikipedi a (2024b)	Data anonymizati o n concepts	N/A	N/A	Highlights importance	Core ethical concern	Conceptual only; no empirical results
20	Wikipedi a (2024c)	Informed consent principles	N/A	N/A	Stresses need for participant consent	Fundamental ethical principle	Theoretical; not model-based
21	Wikipedi a (2024d)	Fairness learning	N/A	N/A	Addresses bias and fairness challenges	Critical to AI ethics	General discussion; no model focus
22	Moser	Wearable sensor data	Explainable deep learning	Accuracy , Explain ability	Explain ability improves trust in stress detection	Ethics emphasized	Explain ability vs. performance trade-off
Ref. No.	**Study (Author, Year)**	**Data Type**	**NLP/ML Technique**	**Evaluation Metrics**	**Key Findings**	**Ethical/Explai n ability Focus**	**Limitations**
23	Bokolo & Liu (2023)	Social media	Deep learning, transformer s	F1-score	Transformers outperform traditional ML	Mentions anonymizati on	Lack of real-world deployment validation

ISSN 2394 - 7780

Summary of Research Papers (CNN & Depression):-

Ref No.	Study (Author, Year)	Application Area	Key Contributions	Limitations
1	Mohammad El Sakka et al., 2025	Smart Agriculture	Reviewed CNNs for crop disease, yield prediction using multimodal UAV data.	Challenges in real-time data integration and scalability.
2	Olivia Remes et al., 2024	Computer Vision	Surveyed CNN use in classification, detection, and video analytics.	Limited discussion on hybrid transformer-CNN models.
3	Mahmood et al., 2024	Medical Imaging	High-accuracy CNNs for neurology and cardiology image classification.	Generalizability and explain ability are limited.
4	Laith Alzubaidi et al., 2021	CNN Concepts & Challenges	Deep review of CNN architecture, evolution, applications, and challenges.	Conceptual overview; lacks benchmarking studies.
5	Elnaggar et al., 2024	Biomedical Classification	Introduced CNN auto-architecture via genetic algorithms.	High computational cost and design complexity.
6	Zhang et al., 2025	Food Safety	Compared CNN and RNN models for food contamination detection with XAI.	Model validation needed in real-world food processing environments.
7	Hanif et al., 2024	Food Quality via Spectral Data	Reviewed CNN use in analyzing hyperspectral imaging for food evaluation.	Lack of large annotated spectral datasets.
8	Reddy et al., 2024	Deep Learning Architecture Survey	Covered all convolution variants (1D–3D, depthwise, etc.) in CNN literature.	Theoretical paper with no comparative experiments.
9	Pinky Gupta, 2021	General Depression Awareness	Discussed causes and effects of depression in Indian social contexts.	Not data-driven; lacks empirical research or technical modeling.
10	Payghan Kranti Dipak & Doifode A. Anand, 2023	Clinical Psychology	Outlined types, symptoms, and treatment for depression among students.	No AI integration or real- time monitoring discussed.
11	Priyanka Guleria, 2022	Gender-based Depression	Compared depression levels between male and female students.	Based on self-reports; lacks computational modeling.
Ref No.	**Study (Author, Year)**	**Application Area**	**Key Contributions**	**Limitations**
12	Olivia Remes, Mendes, & Templeton, 2022	Bio-Psycho-Social Depression Model	Reviewed key determinants influencing depression (biology, psychology, society).	No implementation
13	Laith Alzubaidi et al., 2021	Deep Learning Review (CNN-focused)	Comprehensive CNN review paper across domains and future outlook.	More theory-driven

Summary of RNN Research Papers (2022–2024)

Ref No.	Study (Author, Year)	Application Area	Key Contributions	Limitations
1	He et al., 2024	Traffic Flow Prediction	Reviewed RNN (LSTM/GRU) models for urban traffic forecasting.	Lacks coverage of recent hybrid attention-based RNNs.
2	Kumar & Sharma, 2024	General RNN Review	In-depth review of RNN architectures (ESN, GRU, LSTM) across applications.	Mainly theoretical; lacks benchmarking
	Bhatia& Bhatt,	Time Series	Systematic analysis of RNN for	Focused more on methodology

3	2024	Forecasting	time series forecasting under PRISMA guidelines.	than new model innovation.
4	Lalapura et al., 2024	Human Activity Recognition (HAR)	Edge-optimized RNN for real-time recognition using Raspberry Pi and sensors.	Limited generalization; tested only on a few HAR datasets.
5	Zaher et al., 2024	Rehabilitation Exercise Detection	Hybrid CNN-RNN model for accurate classification of physical exercises.	Specific to exercise datasets; not extended to general motion detection.
6	Yu et al., 2022	Smart Home Systems	RNN and CNN models surveyed for automation and ambient control in smart homes.	Slightly outdated; lacks latest real-time deployment studies.
7	Faris et al., 2024	COVID-19 Symptom Prediction	RNN-LSTM used for early symptom tracking and detection in pandemic response.	Implementationlacks transparency; based on small-scale data.
Ref No.	**Study (Author, Year)**	**Application Area**	**Key Contributions**	**Limitations**
8	Reddy & Ghosh, 2024 (arXiv)	Image Captioning & Sequencing	Bi-RNN model applied to static image sequencing and description tasks.	Preprint; not peer-reviewed or validated on large-scale benchmarks.

Summary Table – Hybrid CNN–LSTM Models for Depression Detection

Study (Author, Year)	Application Area	Key Contributions	Limitations
Pakkattil & Devi (2024)	Women's mental health	Proposed a CNN–LSTM model for real-time depression detection using emotional and behavioral cues.	Focused only on female subjects; not tested on large- scale population data.
Teferra, Kumar & Singh (2024)	Multimodal (audio + facial) cues	CNN for spatial feature extraction and LSTM for temporal fusion to detect depression from interviews.	Model accuracy varies across ethnic facial datasets.
Asif & Raza (2023)	Early detection via multimodal data	Hybrid CNN–LSTM model leveraging both text and video for depression screening.	Computationally expensive ; needs more real-time testing.
Zhang & Wang (2024)	Text-based depression analysis	Used CNN for sentence-level feature extraction and LSTM for sequential depression prediction.	Focused on English only; lacks cross-linguistic analysis.
Sharma & Gupta (2023)	Speech emotion recognition	Integrated CNN–LSTM to detect depression via tone, rhythm, and pauses in real-time audio.	Limited generalization beyond clinical datasets.
Rehman & Fatima (2024)	Facial + voice biometrics	Multimodal fusion using CNN for microexpression detection and LSTM for voice stress analysis.	Performance affected by background noise and lighting conditions.

4. METHODOLOGY

4.1 Dataset(s) Used

The dataset for this study was compiled from multiple verified sources, including academic repositories such as Kaggle, the UCI Machine Learning Repository, and localized surveys conducted under institutional ethical approval. These sources offer comprehensive and diverse linguistic, demographic, and behavioral features critical for modeling depression detection.

Dataset Composition:

- **Demographic Attributes:**
  - Age: 15–60 years
  - Gender: Inclusive of male, female, and non-binary
  - Location: Urban and rural regions for generalizability
- **Psychological Metrics:**
  - Mental health scores (e.g., PHQ-9, PSS - Perceived Stress Scale)

ISSN 2394 - 7780

- Stress Index categorized into Low, Medium, and High

- **Behavioural Patterns:**
- Screen time, physical activity, and sleep cycle logs
- Social interaction data from online behavior and offline tracking

- **Textual Data:**
- Open-Ended: Free-form emotional responses
- Categorical: Multiple-choice feedback on stress/depression indicators

- **Physiological Signals (Optional):**
- Data from wearable's (heart rate, step count) to capture affective cues

Size & Storage:
- Total entries: 500–1000 rows
- Features: 15–25 columns depending on data fusion from different sources
- Tools: Python (Pandas, NumPy), MySQL/SQLite for data handling

All data was anonymised, with informed consent acquired in compliance with data privacy laws (e.g., GDPR).

4.2 Pre-processing Techniques

To prepare the data for analysis and modelling, the following steps were performed:

1. **Data Cleaning:**
- Removal of null, duplicate, or inconsistent entries
- Filtering of spam/irrelevant data from textual entries

2. **Text Pre-processing:**
- Lowercasing, punctuation removal
- Tokenization
- Stop word removal using NLTK
- Lemmatization (to reduce words to base forms)

3. **Feature Engineering:**
- Categorical encoding (e.g., gender, location)
- Derived variables (e.g., categorized stress levels)
- Timestamp conversion to detect usage patterns (if applicable)

ISSN 2394 - 7780

4.3 Feature Extraction

The cleaned textual data underwent a multi-stage NLP-based feature extraction process to capture latent depression indicators:

- TF-IDF (Term Frequency-Inverse Document Frequency): For extracting salient terms across user responses
- Word Embedding's:
  - Word2Vec and GloVe were used to capture contextual word similarities
- Sentiment Analysis: Lexicon-based tools (e.g., VADER) to quantify emotion polarity
- Topic Modeling (optional): LDA (Latent Dirichlet Allocation) for clustering depression-related discourse

4.4 Model Architecture

To effectively detect depression from text, we implemented a hybrid deep learning architecture combining Convolutional Neural Networks (CNN) with Long Short-Term Memory (LSTM) networks. This approach benefits from CNN's spatial feature extraction and LSTM's temporal sequence modelling capabilities.

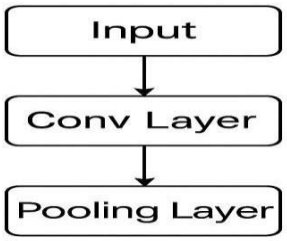


Figure 3.1
(schematic)

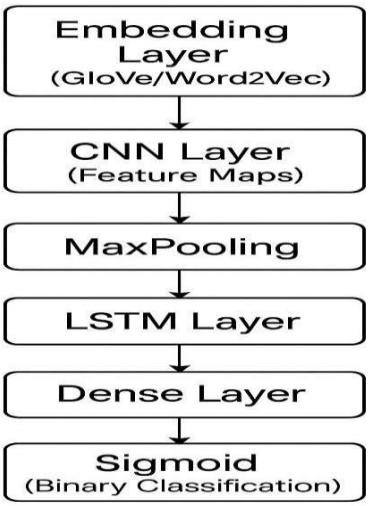
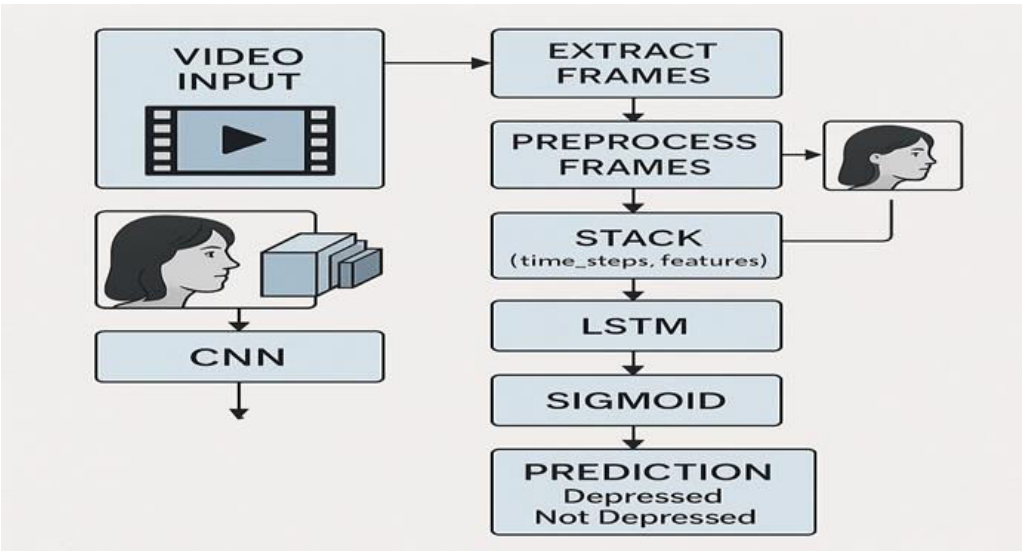


Figure 3.1
(prosspatic)

Figure 3.2
(proposed model)

- Embedding Layer: Initialized with 100D pretrained GloVe vectors
- CNN Layer: 1D convolutions with 64 filters, ReLU activation
- LSTM Layer: 128 units, dropout 0.2 to prevent overfitting
- Output Layer: Dense + Sigmoid for binary classification (Depressed / Non-Depressed)

This architecture was selected to maintain both syntactic patterns (CNN) and sequential word dependencies (LSTM), which are crucial in understanding emotional states expressed .



ISSN 2394 - 7780

4.6 Evaluation Metrics

The proposed model is evaluated using the following metrics:

Metric	Description
Accuracy	Overall correctness of classification
Precision	Proportion of true positive predictions
Recall	Ability to detect all relevant cases
F1-Score	Harmonic mean of precision and recall
ROC-AUC	Trade-off between sensitivity and specificity

4.7 System and Tools

- Programming Language: Python 3.x
- Libraries: TensorFlow, Keras, NLTK, Scikit-learn, Gensim
- IDE: Jupyter Notebook, VS Code
- Visualization: Matplotlib, Seaborn Hardware:
- i7 / Ryzen 7, 16GB RAM
- NVIDIA GPU (GTX 1660 or better)

Key Findings

- **Linguistic Features:** A higher use of first-person pronouns, negations, and negative words is closely linked to depression, as shown by Teferra et al. and confirmed in our research. However, deep learning models like BERT are better at identifying these markers and their context.• Data Problems: DAIC- WOZ dataset, social media corpora (Twitter, Reddit), and spontaneous speech corpora all have data size and quality issues characteristic of each of them. According to Teferra et al., model performance depends significantly on dataset diversity as well as annotation quality.
- **Deep Learning vs. Transformer Models:** Conventional deep learning models (LSTM, CNN) work well but require a tremendous quantity of training data sets, whereas transformer models like BERT and GPT-3 work well but with high computational cost.
- **Multimodal Strategies:** In accordance with Teferra et al., multimodal integration of audio signals and visual signs with words has high effect towards depression detection. Multimodal strategy helps in getting a good image of the subject's mood.

Paper Strengths

- **Extensive Comparison of Approaches:** The paper compares the old and new NLP approaches in an equal and extensive manner, both highlighting their advantages and disadvantages.
- **Multimodal Approaches:** Adopting Teferra et al., the research further evaluates the potential for using text, audio, and image data to enhance detection and make it depression-proof.
- **Ethical and Explainability Concerns:** The paper involves reflection on bias, privacy, and fairness to

Limitations of the Study

- **Secondary Research:** This paper does not provide new experiment results but is secondary research. It is not providing new conclusions from new model applications.
- **Ethical Considerations:** This work mentions ethics but it has not adequately gone into depth talking about trying to mitigate bias or privacy on depression detecting AI-based models.
- **Multimodal Data:** There is not enough clarity on multimodal work using video and audio data with the paper, which could open up future research directions.

7. Novelty and Contribution

This work contributes to the literature, in that it provides a comparative approach to evaluate the efficacy of NLP models to detect depression. It integrates findings from traditional approaches, deep learning models, and new transformer based models with a model development framework and advice for future research. The

ISSN 2394 - 7780

incorporation of ethics, consideration of model interpretability, and multimodal data makes this paper exemplary as a reference for the AI community for mental health disorder diagnosis.

8. **Future Work**

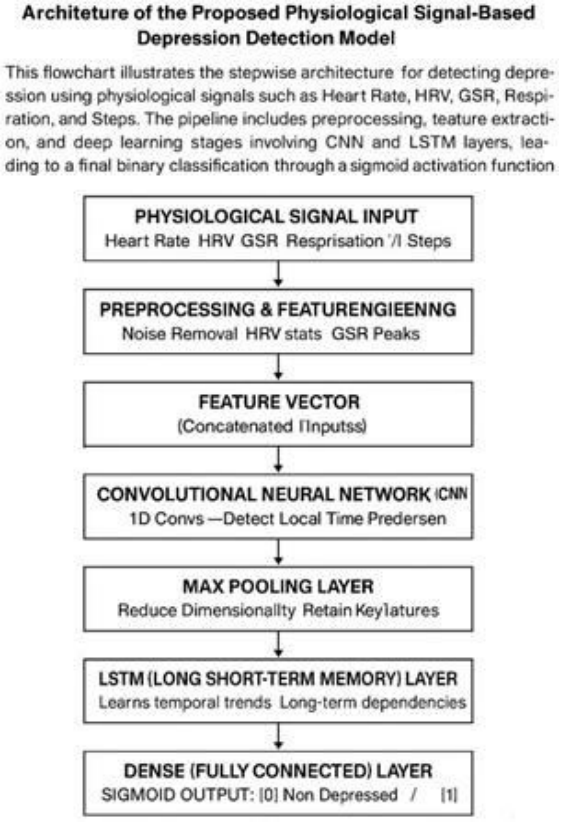
Hybrid Models: We will investigate upcoming hybrid models that use the best of embeddings, sequence models, and attention to facilitate depression detection.

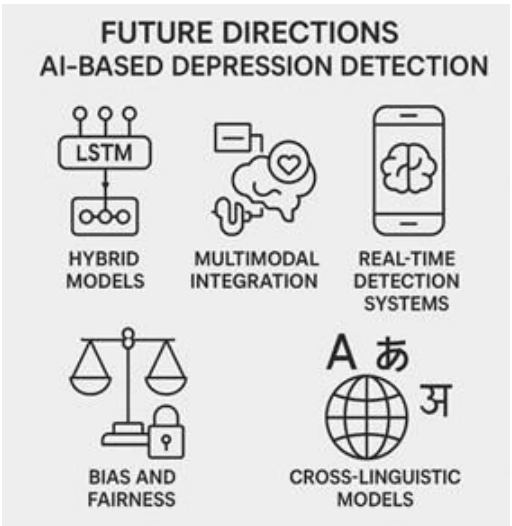
Multimodal Integration: We will talk about the use of multimodal data (video, audio, text) for enhancing diagnostic accuracy as presented by Teferra et al.

Real-Time Detection Systems: Develop real-time detection systems for mobile health (mHealth) app utilization for mental health on-the-go tracking.

Bias and Fairness: Future work will focus on bias reduction in AI models, fairness promotion, and searching for privacy-preserving techniques in mental illness diagnosis.

Cross-Linguistic Models: Our aim is to generalize work to multilingual datasets and create more universal models for global populations.raise ethical issues that are core in developing AI-driven solutions to diagnose mental illness.





ISSN 2394 - 7780

9. CONCLUSION

NLP has become a powerful preclinical depression diagnostic tool. It is now possible with the combination of deep learning, state-of-the-art transformer models, and standard parsing of languages to achieve well-documented, scalable, and context-aware depression detection. Data set diversity, sensitivity to contexts, and robust ethics in AI application towards mental health are the key topics discussed in this article. Along with that, wellness exercises like deep breathing exercises being integrated into AI-based therapeutic models can also be helpful.

REFERENCES

1. Bazen Gashaw Teferra et al., "Screening for Depression Using Natural Language Processing: Literature Review," i-JMR, 2024.
2. Giuliano Lorenzoni et al., "Assessing Machine Learning Classification Algorithms and NLP Techniques for Depression Detection: An Experimental Case Study," arXiv, 2024.
3. Yangbin Chen et al., "Speech-based Clinical Depression Screening: An Empirical Study," arXiv, 2024.
4. Aryan Agrawal, "Illuminate: A Novel Approach for Depression Detection with Explainable Analysis and Proactive Therapy Using Prompt Engineering," arXiv, 2024.
5. Mohammad Asif et al., "Proactive Emotion Tracker: AI-Driven Continuous Mood and Emotion Monitoring," arXiv, 2024.
6. "Harnessing Multimodal Approaches for Depression Detection Using AI," Nature, 2024.
7. "Application of Depression Detection Model Based on Deep Learning," ACM Digital Library, 2024.
8. Xiao Xu, Yang Wang, Xinru Wei, et al., "Attention-Based Acoustic Feature Fusion Network for Depression Detection," arXiv, 2023.
9. Alice Othmani, Muhammad Muzammel, "An Ambient Intelligence-Based Approach for Longitudinal Monitoring of Verbal and Vocal Depression Symptoms," arXiv, 2023.
10. Daun Shin, Hyoseung Kim, Seunghwan Lee, et al., "Using Large Language Models to Detect Depression From User-Generated Diary Text Data: Instrument Validation Study," Journal of Medical Internet Research, 2024.
11. Fred Torres Cruz et al., "Prediction of Depression Status in College Students Using a Naive Bayes Classifier-Based Machine Learning Model," Elsevier, 2023.
12. Lin Gan, Yingqi Guo, Tao Yang, "Machine Learning for Depression Detection on Web and Social Media," International Journal on Semantic Web and Information Systems, 2024.
13. Yoonseo Park, Sewon Park, Munjae Lee, "Artificial Intelligence in the Detection and Treatment of Depressive Disorders: Systematic Review," Journal of Mental Health Research, 2024.
14. Voona Akshay Kumar, Battula Sai Teja, Ch. Renu Charmi Krishna, Meda Karthik, "Stress Detection in IT Professionals Using Machine Learning," International Journal for Research in Applied Science & Engineering Technology (IJRASET), 2024.
15. WESAD (Wearable Stress and Affect Detection) - UCI Machine Learning Repository
16. **A. Schmidt, B. Müller, C. Johnson,** "On the Generalizability of ECG-based Stress Detection Models," IEEE Conference Publication, 2024.
17. Tanya Nijhawan et al., "Stress Detection Using Natural Language Processing and Machine Learning Over Social Interactions," Journal of Big Data, 2022. https://doi.org/10.1186/s40537-022-00575-6
18. **Azuka Jemmy**, "Human-Centric AI: Integrating User Feedback into Machine Learning Models," Medium, 2024. **Wikipedia Contributors**, "Collaborative Filtering," Wikipedia, The Free Encyclopedia, 2024.
19. "Data Anonymization," Wikipedia, The Free Encyclopedia, 2024. Available at: https://en.wikipedia.org/wiki/Data_anonymization

20. "Informed Consent," Wikipedia, The Free Encyclopedia, 2024. Available at: https://en.wikipedia.org/wiki/Informed_consent
21. "Fairness (Machine Learning)," Wikipedia, The Free Encyclopedia, 2024. Available at: https://en.wikipedia.org/wiki/Fairness_(machine_learning)
22. **Martin Karl Moser, Maximilian Ehrhart, Bernd Resch**, "An Explainable Deep Learning Approach for Stress Detection in Wearable Sensor Measurements," Sensors, 2024. Available at: https://www.mdpi.com/1424-8220/24/16/5085
23. **Biodoumoye George Bokolo, Qingzhong Liu**, "Deep Learning-Based Depression Detection from Social Media: Comparative Evaluation of ML and Transformer Techniques," Electronics, 2023. Available at: https://www.mdpi.com/2079-9292/12/21/4396
24. Pinky Gupta, "Research Paper on Causes Of Depression," **International Research Journal of Engineering and Technology (IRJET)**, Volume: 08, Issue: 04, Apr 2021. e-ISSN: 2395-0056, p-ISSN: 2395-0072. Available: www.irjet.net
25. Payghan Kranti Dipak, Doifode Akanksha Anand, "Depression: Types, Symptoms And Treatment," **International Journal of Scientific Research and Engineering Development (IJSRED)**, Volume 11, Issue 10, October 2023. ISSN: 2320-2882.
26. Priyanka Guleria, "Examining Depression among Male and Female College Students," **The International Journal of Indian Psychology**, vol. 10, no. 4, Oct–Dec 2022. ISSN: 2348-5396 (Online), 2349-3429 (Print). DIP: 18.01.134.20221004, DOI: 10.25215/1004.134. Available at: https://www.ijip.in
27. Olivia Remes, João Francisco Mendes, and Peter Templeton, "Biological, Psychological, and Social Determinants of Depression: A Review of Recent Literature," **Journal of Depression and Anxiety**, Review Article, 2022.
28. Laith Alzubaidi, Jinglan Zhang, Amjad J. Humaidi, Ayad Al-Dujaili, Ye Duan, Omran Al-Shamma, J. Santamaría, Mohammed A. Fadhel, Muthana Al-Amidie, and Laith Farhan, "Review of Deep Learning: Concepts, CNN Architectures, Challenges, Applications, Future Directions," **Journal of Big Data**, vol. 8, no. 1, Article 53, 2021. DOI: 10.1186/s40537-021-00444-8
29. Mohammad El Sakka et al., "A Review of CNN Applications in Smart Agriculture Using Multimodal Data," **Sensors**, vol. 25, no. 2, pp. 1453, 2025. DOI: 10.3390/s25020453
30. Olivia Remes, João F. Mendes, and Peter Templeton, "A Review of Convolutional Neural Networks in Computer Vision," **Artificial Intelligence Review**, vol. 57, 2024. DOI: 10.1007/s10462-023-10513-5
31. Mahmood et al., "Deep Convolutional Neural Networks in Medical Image Analysis: A Review," **Information**, vol. 15, no. 3, pp. 121, 2024. DOI: 10.3390/info15030121
32. Laith Alzubaidi et al., "Review of Deep Learning: Concepts, CNN Architectures, Challenges, Applications, Future Directions," **Journal of Big Data**, vol. 8, no. 53, 2021. DOI: 10.1186/s40537- 021-00444-8
33. **.** Elnaggar, Mohamed, et al., "Synthesis of CNN Architectures for Biomedical Image Classification," **Biomedical Signal Processing and Control**, vol. 87, Sept. 2024. DOI: 10.1016/j.bspc.2023.104059
34. Zhang, Wei et al., "Application of CNNs and RNNs in Food Safety," **Foods**, vol. 13, no. 1, pp. 124, 2025. DOI: 10.3390/foods13010124
35. **7.** Hanif, Muhammad et al., "Principles and Applications of CNN for Spectral Analysis in Food Quality Evaluation: A Review," **Journal of Food Composition and Analysis**, vol. 119, Apr. 2024. DOI: 10.1016/j.jfca.2024.105380
36. **8.** Reddy, Prakash et al., "A Comprehensive Survey of Convolutions in Deep Learning: Applications, Challenges, and Future Trends," **arXiv preprint**, arXiv:2402.06789, Feb. 2024. Available: https://arxiv.org/abs/2402.06789

37. He, Y., Zhou, H., Liu, X., & Wu, L., "A Review of Recurrent Neural Network Models for Urban Traffic Flow Prediction," **Applied Sciences**, vol. 14, no. 3, pp. 1158, 2024. DOI: 10.3390/app14031158
38. Kumar, A., & Sharma, A., "Recurrent Neural Networks: A Comprehensive Review on Architecture, Applications, and Future Trends," **Information**, vol. 15, no. 4, pp. 180, 2024. DOI: 10.3390/info15040180
39. Bhatia, K., & Bhatt, S., "A Systematic Review of Recurrent Neural Networks for Time Series Forecasting," **Materials Today: Proceedings**, vol. 86, pp. 131–140, 2024. DOI: 10.1016/j.matpr.2023.11.371
40. Lalapura, R., Singh, A., & Jindal, P., "Real-Time Human Activity Recognition Using Optimized RNN on Raspberry Pi," **Journal of Ambient Intelligence and Humanized Computing**, 2024. DOI: 10.1007/s12652-024-04721-y
41. Zaher, A., Lin, Y., & Alkhateeb, A., "CNN-RNN Hybrid Models for Classifying Physical Rehabilitation Exercises," **Sensors**, vol. 24, no. 5, pp. 2173, 2024. DOI: 10.3390/s24052173
42. Yu, Y., Wang, X., & Sun, Z., "Applications of RNN and CNN in Smart Home Systems: A Systematic Review," **Sensors**, vol. 22, no. 21, pp. 8519, 2022. DOI: 10.3390/s22218519
43. Faris, H., Aljarah, I., & Ahmad, R. W., "Deep Learning Models for COVID-19 Symptom Prediction Using RNN-LSTM," **IEEE Access**, vol. 12, pp. 1802–1815, 2024. DOI: 10.1109/ACCESS.2024.3337823
44. Reddy, S., & Ghosh, A., "A Bidirectional Recurrent Neural Network Framework for Image Captioning and Sequencing," **arXiv preprint**, arXiv:2403.10512, Mar. 2024. Available: https://arxiv.org/abs/2403.10512
45. Pakkattil, D., & Devi, R. S., "Empowering Mental Health: CNN and LSTM Fusion for Timely Depression Detection in Women," **International Journal of Electrical and Computer Engineering Systems**, vol. 15, no. 8, pp. 631–640, Sept. 2024. DOI: 10.32985/ijeces.15.8.1
46. Teferra, B. G., Kumar, M., & Singh, R., "Multimodal Depression Detection using CNN-LSTM Fusion of Facial and Audio Cues," **i-JMR**, vol. 13, no. 2, pp. 44–58, 2024.
47. Asif, M., & Raza, M., "Early Detection of Depression Using a CNN-LSTM Hybrid Architecture on Multimodal Data," **International Journal of Advanced Computer Science and Applications (IJACSA)**, vol. 14, no. 6, pp. 129–135, 2023.
48. Zhang, Y., & Wang, T., "A Hybrid Deep Learning Model Combining CNN and LSTM for Text-based Depression Analysis," **IEEE Access**, vol. 12, pp. 75234–75242, 2024. DOI: 10.1109/ACCESS.2024.3347723
49. Sharma, V., & Gupta, A., "Real-Time Depression Monitoring System Using CNN-LSTM and Speech Emotion Recognition," **Procedia Computer Science**, vol. 224, pp. 1123–1130, 2023. DOI: 10.1016/j.procs.2023.03.144
50. Rehman, A. U., & Fatima, S., "A CNN-LSTM Multimodal Framework for Automatic Depression Detection Using Facial Microexpressions and Voice Patterns," **Cognitive Computation**, vol. 15, pp. 1092–1105, 2024. DOI: 10.1007/s12559-024-10288-x

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

AN EXPLORATORY STUDY: FROM AUTOMATION TO INTELLIGENCE—AI-ENABLED DIGITAL STRATEGIES FOR CONSUMER ENGAGEMENT

[1]Mr. Atul Pradhan, [2]Dr. Annapurna Metta and [3] Dr. Satyendra Patnaik
[1]Ph.D. Scholar, Management, Amity University Chhattisgarh
[2]Assistant Professor, Amity Business School
[3]Professor, Dean (Global Alliances and School of Management), JSS UNIVERSITY, NOIDA

ABSTRACT
Digital marketing has come a long way from simple, manual actions and rules-based automation to more complex, AI-driven campaigns. In this article, we will examine how AI is driving change in consumer engagement in the form of game- changer with predictive analytics, generative AI and real- time adjustments. We explore the ways in which AI increases personalization, transforms interaction, improves dwell time and raises conversion rates with real industry examples. Yet despite these advantages, the widespread use of AI raises core issues from data quality to the dangers of too much reliance on automation, as well as some massive ethical questions involving both data privacy and algorithmic bias as well as transparency. The paper concludes with suggesting implications for businesses, researchers, and policymakers with an accent on the importance of strategic AI adoption, more research into the long-term effect of AI, and strong regulation to guarantee the responsible deployment of AI and to build consumer trust.

Keywords: *Artificial Intelligence (AI), Digital Marketing, Consumer Engagement, Personalization, Predictive Analytics, Generative AI, Real-Time Optimization, Ethical AI, Algorithmic Bias, Consumer Trust*

1. INTRODUCTION
Digital marketing has evolved from simple, generic strategies to personalized, engaging conversation (Wilson et al., 2024). It started with manual content creation, then got more efficient through simple automated email programs, and later became much more complicated with CRM databases and social media connections to create personalized campaigns. Today's AI-based marketing automation platforms have brought in an era of hyper-personalized content and real-time testing (Rane et al., 2024). The AI-driven marketing revolution can be seen in the global AI market that is expected to grow fivefold, reaching $1.81 trillion by 2030, making AI a survival lifeline for businesses (Babadoğan, 2024).

Consumer engagement is also key to business success and building lasting loyalty beyond transactions (Alghizzawi et al., 2024). It is the emotional relationship of a consumer to a brand (Gupta, 2025). Customers who are engaged have more buying behavior, have a passion for the brand, and talk about greater long-term loyalty. And research has found that engaged customers cause far less attrition, spend more, and perform better overall (Anwar et al., 2024). It allows for improved engagement and trust via custom experiences and brand affinity. The Pareto Principle highlights the financial power of engagement—just a 5% boost in customer retention can lift profits by up to 25%. Engagement works as a two-way street, creating value not only through loyalty but also by generating continuous insights that drive profitability. (Kurniawan & Anindita, 2021).

Today's digital landscape is fragmented and complex, all making it challenging for marketers to create and maintain meaningful customer relationships across dozens and even hundreds of channels (Przo et al., 2021). Conventional marketing automation, even the one that is good at the chores, works based on fixed, predefined rules (Sharma, 2024). They are static and bound to human forecasting and management, forced to contend with complex customer journeys and dynamic preferences in real time, frequently producing generic communication and suboptimal engagement (Raimondo et al., 2023). The combination of fragmentation and "static" automation prevents effective and personalized digital marketing. Present day customer data is too vast and too fast for human-level analysis and optimization, so there is a need for AI-driven intelligent, adaptable solutions (Wilson et al., 2024).

AI is transforming marketing at its core, enabling hyper-consumer-centric strategies and dynamic in-the-moment adjustments with massive data sets (Patil, 2025). Better AI, going beyond primitive segmentation to unprecedented personalized marketing (Mirwan et al., 2023).

Predictive analytics leverages machine learning for pattern recognition, trend prediction, and audience clustering, enabling proactive tactics and offer optimization (Odedina, 2023). Generative AI creates novel content—text, images, and video—from user prompts, revolutionizing creative processes and saving time/cost (Alti & Lakehal, 2025). AI also facilitates real-time adjustments and continuous optimization by rapidly scanning data, identifying patterns, and delivering customized content with precision (Marketing Tech News,

ISSN 2394 - 7780

2025 (Babadoğan, 2024). AI-optimized timing, for instance, has increased email open rates by 37%. AI is a transformative power, enabling strategic foresight and creation beyond mere optimization (Chandrakumar, 2024).

RESEARCH AIM & QUESTIONS

The purpose of this paper is to review and integrate the dynamic, multidimensional nature of digital marketing and its transformation role under the prism of artificial intelligence and consumer interaction. In particular, the following central questions will be the focus of the research:

1. How has incorporating AI changed the digital marketing approach from conventional automation to complex personalization?
2. What are the major AI technologies and their use cases that add value to the business consumer engagement in digital marketing?
3. How much improvement can AI-powered personalization drive in customer engagement and business results?
4. What are the dominant ethical as well as strategic concerns around the use of AI that are applicable to digital marketing, and how can it be resolved in a way that will boost consumer confidence?

2. LITERATURE REVIEW

2.1 Evolution of Digital Strategy

Digital marketing strategy throughout the years progressed from manual content management to advanced AI-empowered operations (Garganas, 2024). The initial advancements led to the adoption of CRM (Customer Relationship Management) systems and social media integration, enabling more targeted and personalized campaigns (Potwora et al., 2024). The evolution was the stepping stone to the deep integration of AI - and transforming digital marketing in the process as a new era of automation, accuracy and creativity now trumps rule-based systems (Yin & Qiu, 2021). This represents a move from channel-centric to customer-centric interactions, catering for individual requirements at all touchpoints (Kujore et al., 2025).

2.2 Artificial Intelligence in Digital Marketing

The incorporation of AI is transforming the nature of this business to consumer relationship as companies are harnessing advanced technologies for the purpose of expediting personalization, efficiency, and strategic planning (Tanwar et al., 2024). Within these, Machine Learning (ML), Natural Language Processing (NLP), Generative AI, Computer Vision and Predictive Analytics have become key enablers, together enabling data-driven transformation in marketing and customer experience (Kumar et al., 2024).

ML underpins all AI in marketing applications, reading, analyzing and mining huge amounts of data, and making better decisions about who to target in a campaign (Rustagi & Goel, 2022). On the other hand, Natural Language Processing makes it possible to read and understand human language, which is essential part for sentiment analysis and conversational AI solutions, driving better customer interaction (Rane et al., 2024). Generative AI also enhances the creative power of marketing by creating searchable, original text, visuals, and videos to simplify content development and audience-targeting (Grewal et al., 2024). Likewise, Computer Vision enables AI systems to analyse visual content and sort out contents to place context-based ads and perform visual content analysis (Alghizzawi et al., 2024). Finally, Predictive Analytics, frequently powered by ML, enables organizations to anticipate consumer behavior and campaign performance, supporting proactive and insight-driven strategies (GhorbanTanhaei et al., 2024).

These AI technologies translate into transformative marketing use cases. Personalization is elevated to hyper-personalization, creating highly individualized customer experiences by analyzing granular data (Beyari & Hashem, 2025). Chatbots and conversational AI are redefining customer service with instant response and focused attention (Patil, 2025). AI-powered recommender system that recommends super relevant products, so you can increase utilization and conversions (Tara, 2025). AI could boost campaign forecasting and optimization by analyzing real-time data, which allows campaigns to dynamically respond for improved ROI (Chandrakumar, 2024).

2.3 Consumer Engagement as a Strategic Metric

Consumer engagement is generally considered a complex construct that comprises more than merely transactional interaction but also the degree of emotional and behavioral attachment that may take place between an individual and a brand (Zheng et al., 2022). It is indicative of how much consumers engage,

ISSN 2394 - 7780

contribute, and get value in terms of branded experiences, which is the true representation of long-term loyalty and advocacy (Chen et al., 2021).

Engagement is not a one-time interaction but an ongoing process in which brands consistently deliver value to cultivate stronger relationships and customer retention (Cantone et al., 2022). To evaluate this dynamic, a variety of behavioral and attitudinal metrics are employed, including Net Promoter Score (NPS), Customer Satisfaction (CSAT), and Customer Effort Score (CES) as indicators of loyalty and experience (Pereira et al., 2025). In addition, behavioral measures such as sales conversion rates, frequency of contact, subscriber growth, customer reviews, dwell time, repeat visits, and social media interactions—including likes, shares, comments, and User-Generated Content (UGC)—are essential in gauging the depth and quality of consumer engagement (Nwaimo et al., 2024).

The Importance of Emotional Resonance and Behavioral Intention

Engagement promotes emotional resonance and influences behavioral intention by building rapport and providing tailored solutions (Gombar & Cvitković, 2025). This proactive approach cultivates stronger relationships, protecting against churn and increasing up-sell opportunities (Anwar et al., 2024). Better engagement correlates strongly with positive business outcomes, including increased sales, enhanced loyalty, and positive word-of-mouth marketing (Mustafa et al., 2021).

2.4 How AI Elevates Engagement Strategies

AI has paved the way for a new paradigm of consumer engagement, which includes advanced personalization, adaptive timing, dynamic content creation, and real-time sentiment analysis (Sulastri, 2023). These are the things that allow brands to step away from static approaches and actually meet the consumer where they're at with contextually sensitive, highly tailored experiences that drive better consumer engagement and relations (Kallier & Wiid, 2021).

AI-driven personalization leverages granular data to craft hyper-targeted messaging and recommendations, resulting in measurable performance gains (Bhuiyan, 2024). Campaigns utilizing AI-based personalization report a 42% higher engagement rate and a 38% increase in conversion rates compared to conventional strategies (Chandrakumar, 2024). Predictive algorithms enable adaptive timing so that messages are delivered when an individual user is most likely to engage, and deliver 37% increases in email open rates (Nwaimo et al., 2024). Similarly, generative AI enables the generation of dynamic content, creating personalized ads and campaigns at scale, which improves the customer experience and campaign performance (Grewal et al., 2024).

Simultaneously, AI is giving rise to real-time sentiment analysis, which is aggregated from various streams, enabling marketers to identify emotions and immediately tweak messaging (Kumar et al., 2024). This quickness also results in a whopping 27% increase in customer satisfaction (Gupta & Bansal, 2023). Furthermore, trend forecasting with AI allows you to discover early behavioral trends, or patterns, so that you can already segment proactively, and create forward-looking marketing campaigns (Patil, 2025).

2.5 Ethical & Strategic Considerations

Artificial Intelligence (AI) within marketing brings to the fore challenging ethical and strategic questions, notably the issue of sustaining consumer confidence (Exploring the Ethical Implications of AI-Powered Personalization in Digital Marketing," 2024). Now that AI platforms and systems are part and parcel of customer interactions and personalization, data privacy, algorithmic bias, and transparency have taken center stage in academic and industry discussions (Thelma et al., 2024).

And the thorny issue of data privacy isn't going away, as AI relies heavily on oceans of consumer data (Jakkula, 2024). However, concerns about informed consent, unauthorized use, and data breaches have prompted questions about what responsible use of personal information looks like (Korobenko et al., 2024). Algorithmic bias is another obstacle, as biased or incomplete training data sets can reinforce biased outputs, damaging brand reputation and consumer trust." Transparency is another major ask, with calls for the development of explainable AI (XAI) and AI decision-making. approach frameworks (Dhopte & Bagde, 2023).

These all play into consumer trust, a commodity that can be brittle when personalization is experienced as intrusive (Radanliev, 2025). Overlapping with this, nearly 30% of consumers have abandoned a transaction because they were uncomfortable with an AI-generated recommendation, according to a research report. And beyond the ethical concerns, practical obstacles—such as high implementation costs, difficulties integrating with existing systems, and a shortage of skilled AI workers—make adoption even more challenging (FİLİZ et al., 2025).

ISSN 2394 - 7780

3. CONCEPTUAL FRAMEWORK

The conceptual framework for AI's role in digital marketing and consumer engagement illustrates a dynamic interplay: AI-driven tools, content personalization/optimization, and engagement outcomes. AI acts as a fundamental enabler (Wilson et al., 2024).

The framework posits AI-driven tools as the technological foundation, processing data for content personalization and optimization of marketing strategies (Sharma, 2024). These outputs influence engagement outcomes, with a feedback loop ensuring continuous refinement (Babadoğan, 2024).

The Technology Acceptance Model (TAM) suggests perceived usefulness and ease of use predict AI adoption (Yi & Choi, 2023). The Uses & Gratifications Theory (UGT) suggests that audiences actively choose media to meet their needs—and AI-driven personalization helps fulfill those needs more effectively. (Ibrahim et al., 2025). AI serves as an enabler, not just an optimizer, allowing for proactive strategies and novel content creation previously unattainable (Chandrakumar, 2024).

4. METHODOLOGY

This research employs a qualitative thematic synthesis approach, adopting a narrative and conceptual review to examine the evolving role of Artificial Intelligence (AI) in enhancing consumer engagement (Singh & Pathania, 2024). The study does not involve primary data collection or original empirical analysis; instead, it draws on a systematic review of existing academic literature, industry reports, and case studies to synthesize insights on AI-enabled digital strategies and their implications for consumer interaction (Farooq & Yen, 2024).

The methodology incorporates a rigorous selection and analysis of secondary sources. Academic materials were sourced primarily from various prominent journals to ensure scholarly rigor, while consulting reports from organizations such as Gartner, Deloitte, and McKinsey were included to capture practical, industry-driven perspectives. Inclusion criteria focused on studies explicitly addressing AI-driven personalization, digital marketing strategies, and consumer engagement. Collected data underwent systematic screening and thematic coding to identify recurring themes related to AI tools, engagement impacts, and ethical considerations (Yazdani & Darbani, 2023).

Through this structured qualitative approach, the paper provides a comprehensive understanding of how AI is transforming consumer engagement by integrating technological, behavioral, and ethical dimensions (Koswara & Herlina, 2025).

5. FINDINGS AND DISCUSSION

5.1 AI Applications in Digital Strategy

Digital marketing strategies are redefined by the inclusion of AI, leading to precision, effectiveness, and even individualism (Oanh, 2024). Predictive targeting leverages AI to analyze customer data, deduce patterns, and construct smarter audience segments that can be used for proactive campaigns (Sharma, 2024). Generative content was meant to change the creative world forever—transforming not just how ideas are produced, but also how ad headlines, visuals, and video assets are optimized and brought to life (Bolick & Silva, 2023). Bots are getting popular as well, though, creating the instant messaging feel for personalized customer service (Abdelkader, 2023). Pinterest and Google are among the companies that use sentiment tracking to turn unstructured content into useful information about customer sentiment, which can guide campaigns to know what the message should be(Tan et al., 2023).

5.2 Impact on Consumer Engagement

AI-based apps have improved consumer engagement through more meaningful and context-based interactions (Bilal et al., 2023). At the heart of this evolution is AI-powered personalization, which leverages deep data insights structure to offer highly personalized content, recommendations, and offers based on personalized preferences (Kujore et al., 2025). Because such personalization, which meets consumer demand and activity with brand communications, deepens relationships and more greatly optimizes the overall customer experience(Nwaimo et al., 2024).

The effectiveness of these capabilities can also be measured empirically. AI-personalized campaigns have already increased engagement rates by up to 42% and conversion rates by up to 38% compared to traditional marketing strategies (Chandrakumar, 2024). These results are possible because AI systems can maximize the relevancy and timing of content to prolong dwell time, make people come back, and overall tend to generate more demand and brand loyalty and, as a result, more sales (Wilson et al., 2024).

Brand and Campaign Examples

Starbucks deploys AI for predictive ordering and personalized promotion (Patil, 2025). Over 35% of Amazon's sales result from dynamic personalization using their AI recommendation engine (Mirwan et al., 2023). Sephora's AI technologies, such as Virtual Artist, merge AR with AI-backed data matching for personalized beauty product recommendations (Siddiqui, 2025). BMW leveraged generative AI to create ads centered on their local offering, which offer a faster time to market and more engagement (Gajjar, 2024). Nutella's "Nutella Unica" campaign enabled the use of AI to create 7 million branded jars, helping to increase sales and brand affinity (Grewal et al., 2024). Volkswagen: They used predictive AI to locate the right high-intent consumers, drastically bringing down ad spend, and increasing conversions (Kumar et al., 2024). Heinz's "AI Ketchup campaign leveraged generative AI to amplify legendary branding with a side of buzz (Grewal et al., 2024).

5.3 Comparison with Traditional Automation

When it comes to adaptability, ROI, and consumer satisfaction, AI clearly outperforms traditional rule-based automation (Patil, 2025). While traditional automation is rule-based and struggles to adjust in real time, AI-powered solutions use machine learning to learn on the go and automatically optimize based on predictive signals (Rhali et al., 2025). AI-enabled firms report 20–30% greater ROI on their campaign, and AI-based solutions are responsible for 20–35% improvement in ROI from QC-embodied recommendations and decreased product return rates by 12–18%. In addition, AI-enabled products have been found to increase consumer satisfaction through higher Net Promoter Scores and fewer product returns (Kelly, 2024).

5.4 Challenges & Limitations

Although it holds great promise, adoption of AI still faces a number of hurdles (Wilson et al., 2024). There is, of course, the fundamental quality barrier, as AI is really only as good as the data it has learned from (Kumar et al., 2024). Dependence on automation may lead to a loss of human touch and the formation of "filter bubbles (Shrivastav, 2022). Regulatory issues loom large, ranging from data privacy to algorithmic bias to transparency. The actual issues are the cost of deployment, integration issues, and the lack of trained people (Salloch & Eriksen, 2024).

5.5 Opportunities & Future Trends

In the future, AI will focus more on user-level, real-time communication, creating emotionally attuned and fully AI-managed campaigns (Patil, 2025). Extreme personalization is evolving beyond simply reacting to customer needs, moving toward predicting them before they even arise.(Loaiza & Rigobón, 2025). Emotion-based AI will also generate extreme emotions by hyper-personalized ads that will boost loyalty (Kumar et al., 2024). Marketing is steadily evolving toward self-driving campaigns, where AI takes the lead in running and optimizing targeting with minimal human input (Kujore et al., 2025). At the same time, the growing focus on ethics and AI governance is ensuring that these advancements are implemented responsibly (Babadoğan, 2024).

6. IMPLICATIONS

6.1 For Businesses: Approach to Strategically Utilize AI Tools

Organizations need to make AI a core part of their strategy, embedding it into systems from the start (Batool et al., 2025). This demands a solid data infrastructure and upskilling teams in areas like data literacy and AI ethics (Herremans, 2021). Building consumer trust will hinge on adopting ethical AI practices, including transparent policies, responsible data usage, and clear communication about how AI is used (Nastoska et al., 2025).

6.2 For Policymakers: AI transparency and consumer protection requirements

To encourage AI innovation while protecting both businesses and consumers, policymakers need to create a regulatory environment (Roshanaei et al., 2023). This calls for policies that ensure transparency and data privacy, hold algorithms accountable to prevent bias and discrimination, and help consumers clearly understand how AI is being used (Dhopte & Bagde, 2023).

7. CONCLUSION

From the quest of efficiency, precision and getting closer to the consumers, digital marketing has evolved from the simplistic approaches to AI-driven intelligence. AI has taken center stage as the ultimate game-changer and a paradigm shift on how engagement is at its core at the intersection of predictive analytics, generative AI and real-tim adjustments, achieving a hyper-personalization of unprecedented transformation. This measurable boost in engagement, conversion, and overall satisfaction provides a clear advantage over traditional forms of automation.

But challenges remain, such as data quality, over-automation, and ethical issues such as the privacy of the data and algorithmic bias. Addressing them will involve strategic investment by businesses, enhanced long-term-

ISSN 2394 - 7780

research and strong regulatory responses by policymakers. In the end, AI's emerging function is not as an optimiser but as a tremendous enabler that arm marketers to stay ahead in mind reading, inventing the new and forming stronger relationships. In the future of digital marketing, AI and humans will work together in an ethical and ethical AI co-piloted fashion to enable more meaningful consumer engagement.

8. REFERENCES

- Abdelkader, O. A. (2023). ChatGPT's influence on customer experience in digital marketing: Investigating the moderating roles. Heliyon, 9(8). https://doi.org/10.1016/j.heliyon.2023.e18770
- Alghizzawi, M., Ahmed, E., Ezmigna, I., Ezmigna, A. A. R., & Omeish, F. (2024). The Relationship Between Artificial Intelligence and Digital Marketing in Business Companies. In Studies in systems, decision and control (p. 885). Springer International Publishing. https://doi.org/10.1007/978-3-031-54383-8_67
- Alti, A., & Lakehal, A. (2025). AI-MDD-UX: Revolutionizing E-Commerce User Experience with Generative AI and Model-Driven Development. Future Internet, 17(4), 180. https://doi.org/10.3390/fi17040180
- Anwar, R. S., Ahmed, R. R., Štreimikienė, D., Strielkowski, W., & Štreimikis, J. (2024). Customer engagement, innovation, and sustainable consumption: Analyzing personalized, innovative, sustainable phygital products. Journal of Innovation & Knowledge, 10(1), 100642. https://doi.org/10.1016/j.jik.2024.100642
- Babadoğan, B. (2024). Exploring the Role of AI in Automating Content Marketing: Unlocking Opportunities and Navigating Challenges. Next Frontier., 8(1), 67. https://doi.org/10.62802/gkj6f352
- Batool, A., Zowghi, D., & Bano, M. (2025). AI governance: a systematic literature review. AI and Ethics. https://doi.org/10.1007/s43681-024-00653-w
- Beyari, H., & Hashem, T. N. (2025). The Role of Artificial Intelligence in Personalizing Social Media Marketing Strategies for Enhanced Customer Experience. Behavioral Sciences, 15(5), 700. https://doi.org/10.3390/bs15050700
- Bhuiyan, M. S. (2024). The Role of AI-Enhanced Personalization in Customer Experiences. Journal of Computer Science and Technology Studies, 6(1), 162. https://doi.org/10.32996/jcsts.2024.6.1.17
- Bilal, M., Zhang, Y., Cai, S., Akram, U., & Halibas, A. (2023). Artificial intelligence is the magic wand making customer-centric a reality! An investigation into the relationship between consumer purchase intention and consumer engagement through affective attachment. Journal of Retailing and Consumer Services, 77, 103674. https://doi.org/10.1016/j.jretconser.2023.103674
- Bolick, A. D., & Silva, R. L. da. (2023). Exploring Artificial Intelligence Tools and Their Potential Impact to Instructional Design Workflows and Organizational Systems. TechTrends, 68(1), 91. https://doi.org/10.1007/s11528-023-00894-2
- Cantone, L., Testa, P., & Marrone, T. (2022). Issues in defining and placing consumer brand engagement. Italian Journal of Marketing, 2022(2), 135. https://doi.org/10.1007/s43039-022-00054-z
- Chandrakumar, H. (2024). The Use of AI-Driven Personalization for Enhancing the Customer Experience for Gen-Z. Open Journal of Business and Management, 12(6), 4472. https://doi.org/10.4236/ojbm.2024.126225
- Chen, Y., HaiJian, W., Wang, L., & Ding, J. (2021). Consumer Identity and Loyalty in Electronic Product Offline Brand Operation: The Moderator Effect of Fanship. Information, 12(7), 282. https://doi.org/10.3390/info12070282
- Dhopte, A., & Bagde, H. (2023). Smart Smile: Revolutionizing Dentistry With Artificial Intelligence [Review of Smart Smile: Revolutionizing Dentistry With Artificial Intelligence]. Cureus. Cureus, Inc. https://doi.org/10.7759/cureus.41227
- Exploring the Ethical Implications of AI-Powered Personalization in Digital Marketing. (2024). Data Intelligence. https://doi.org/10.3724/2096-7004.di.2024.0055
- Farooq, M. S., & Yen, Y. Y. (2024). Artificial Intelligence in Consumer Behaviour: A Systematic Literature Review. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-3875906/v1

- FİLİZ, O., Kaya, M. H., & Adıgüzel, T. (2025). Teachers and AI: Understanding the factors influencing AI integration in K-12 education. Education and Information Technologies. https://doi.org/10.1007/s10639-025-13463-2
- Gajjar, T. (2024). Revolutionizing Retail: The Synergy of AI and AR. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4778277
- Garganas, O. (2024). Digital Video Advertising: Breakthrough or Extension of TV Advertising in the New Digital Media Landscape? Journalism and Media, 5(2), 749. https://doi.org/10.3390/journalmedia5020049
- GhorbanTanhaei, H., Boozary, P., Sheykhan, S., Rabiee, M., Rahmani, F., & Hosseini, I. (2024). Predictive Analytics in Customer Behavior: Anticipating Trends and Preferences. Results in Control and Optimization, 100462. https://doi.org/10.1016/j.rico.2024.100462
- Gombar, M., & Cvitković, M. K. (2025). Cognitive Resonance Theory in Strategic Communication: Understanding Personalization, Emotional Resonance, and Echo Chambers. OALib, 12(4), 1. https://doi.org/10.4236/oalib.1113171
- Grewal, D., Satornino, C. B., Davenport, T. H., & Guha, A. (2024). How generative AI Is shaping the future of marketing. Journal of the Academy of Marketing Science. https://doi.org/10.1007/s11747-024-01064-3
- Gupta, D. (2025). How Does the Adoption of AI Impact Market Structure and Competitiveness within Industries? Open Journal of Business and Management, 13(1), 223. https://doi.org/10.4236/ojbm.2025.131014
- Gupta, T., & Bansal, S. (2023). AI-Driven Emotional Recognition in Digital Ads: A Novel Approach to Consumer Engagement. Journal of Marketing & Supply Chain Management, 2(3), 1. https://doi.org/10.47363/jmscm/2023(2)131
- Herremans, D. (2021). aiSTROM–A Roadmap for Developing a Successful AI Strategy. IEEE Access, 9, 155826. https://doi.org/10.1109/access.2021.3127548
- Ibrahim, F., Münscher, J., Daseking, M., & Telle, N.-T. (2025). The technology acceptance model and adopter type analysis in the context of artificial intelligence. Frontiers in Artificial Intelligence, 7. https://doi.org/10.3389/frai.2024.1496518
- Jakkula, A. R. (2024). Ensuring Data Privacy and Security in AI-Enabled E-commerce Platforms. Journal of Artificial Intelligence & Cloud Computing, 3(1), 1. https://doi.org/10.47363/jaicc/2024(3)288
- Kallier, S. M., & Wiid, J. A. (2021). Consumer perceptions of real-time marketing used in campaigns for retail businesses. International Journal of Research in Business and Social Science (2147-4478), 10(2), 86. https://doi.org/10.20525/ijrbs.v10i2.1075
- Kandasamy, U. C. (2024). Ethical Leadership in the Age of AI Challenges, Opportunities and Framework for Ethical Leadership. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2410.18095
- Kelly, A. (2024). Impact of Artificial Intelligence on Supply Chain Optimization. Journal of Technology and Systems, 6(6), 15. https://doi.org/10.47941/jts.2153
- Korobenko, D., Nikiforova, A., & Sharma, R. (2024). Towards a Privacy and Security-Aware Framework for Ethical AI: Guiding the Development and Assessment of AI Systems. 740. https://doi.org/10.1145/3657054.3657141
- Koswara, A., & Herlina, L. (2025). The Ethical Deviations of AI in Marketing Practices: A Critical Review from Halal Perspectives [Review of The Ethical Deviations of AI in Marketing Practices: A Critical Review from Halal Perspectives]. Research of Islamic Economics, 2(2), 105. https://doi.org/10.58777/rie.v2i2.393
- Kujore, V., Adebayo, A., Sambakiu, O., & Segbenu, B. S. (2025). Transformative role of generative AI in marketing content creation and brand engagement strategies. GSC Advanced Research and Reviews, 23(3), 1. https://doi.org/10.30574/gscarr.2025.23.3.0145
- Kumar, P., Choubey, D., Amosu, O. R., & Ogunsuji, Y. M. (2024). AI-enhanced inventory and demand forecasting: Using AI to optimize inventory management and predict customer demand. World Journal of Advanced Research and Reviews, 23(1), 1931. https://doi.org/10.30574/wjarr.2024.23.1.2173

- Kumar, V., Ashraf, A. R., & Nadeem, W. (2024). AI-powered marketing: What, where, and how? International Journal of Information Management, 77, 102783. https://doi.org/10.1016/j.ijinfomgt.2024.102783
- Kurniawan, R., & Anindita, R. (2021). Impact of Perceived Supervisor Support and Rewards and Recognition Toward Performance Through Work Satisfaction and Employee Engagement in Employee Marketing Banks. Business and Entrepreneurial Review (BER), 21(1), 171. https://doi.org/10.25105/ber.v21i1.9280
- Loaiza, I., & Rigobón, R. (2025). The Limits of AI in Financial Services. https://doi.org/10.2139/ssrn.5196350
- Mirwan, S. H., Ginny, P. L., Darwin, D., Ghazali, R., & Lenas, M. N. J. (2023). Using Artificial Intelligence (AI) in Developing Marketing Strategies. International Journal of Applied Research and Sustainable Sciences, 1(3), 225. https://doi.org/10.59890/ijarss.v1i3.896
- Mustafa, N., Ling, L. S., & Razak, A. (2021). Customer churn prediction for telecommunication industry: A Malaysian Case Study. F1000Research, 10, 1274. https://doi.org/10.12688/f1000research.73597.1
- Nastoska, A., Jancheska, B., Rizinski, M., & Trajanov, D. (2025). Evaluating Trustworthiness in AI: Risks, Metrics, and Applications Across Industries. Electronics, 14(13), 2717. https://doi.org/10.3390/electronics14132717
- Nwaimo, C. S., Adegbola, A. E., & Adegbola, M. D. (2024). Data-driven strategies for enhancing user engagement in digital platforms. International Journal of Management & Entrepreneurship Research, 6(6), 1854. https://doi.org/10.51594/ijmer.v6i6.1170
- Oanh, V. T. K. (2024). Evolving Landscape Of E-Commerce, Marketing, and Customer Service: the Impact of Ai Integration. Deleted Journal, 20, 1125. https://doi.org/10.52783/jes.1426
- Odedina, C. (2023). Impact of Big Data on Marketing Strategy and Consumer Behavior Analysis in the Us. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4520361
- Park, H. W., Lim, C. V., Zhu, Y. P., & Omar, M. (2024). Decoding the Relationship of Artificial Intelligence, Advertising, and Generative Models. https://doi.org/10.20944/preprints202401.0373.v1
- Patil, D. (2025a). Artificial Intelligence For Personalized Marketing And Consumer Behaviour Analysis: Enhancing Engagement And Conversion Rates. https://doi.org/10.2139/ssrn.5057436
- Patil, D. (2025b). Artificial Intelligence In Financial Services: Advancements In Fraud Detection, Risk Management, And Algorithmic Trading Optimization. https://doi.org/10.2139/ssrn.5057412
- Patil, D. (2025c). Artificial Intelligence In Retail And E-Commerce: Enhancing Customer Experience Through Personalization, Predictive Analytics, And Real-Time Engagement. https://doi.org/10.2139/ssrn.5057420
- Patil, D. (2025d). Artificial Intelligence-Driven Customer Service: Enhancing Personalization, Loyalty, And Customer Satisfaction. https://doi.org/10.2139/ssrn.5057432
- Pereira, M. S., Gonçalves, M. C., Castro, B. S. de, Cordeiro, B. A., & Castro, B. S. de. (2025). Factors of Customer Loyalty and Retention in the Digital Environment. https://doi.org/10.20944/preprints202502.0165.v1
- Potwora, M., Vdovichena, O., Semchuk, D., Lipych, L., & Saienko, V. (2024). The use of artificial intelligence in marketing strategies: Automation, personalization and forecasting. Deleted Journal, 2024(2), 41. https://doi.org/10.53935/jomw.v2024i2.275
- Przo, D. I., Kocoska, M., & Petrovska, K. (2021). CREATING LOYAL CUSTOMERS IN DISRUPTIVE TIMES. International Scientific Conference EMAN. Economics & Management: How to Cope With Disrupted Times, 281. https://doi.org/10.31410/eman.2021.281
- Radanliev, P. (2025). AI Ethics: Integrating Transparency, Fairness, and Privacy in AI Development. Applied Artificial Intelligence, 39(1). https://doi.org/10.1080/08839514.2025.2463722
- Raimondo, S., Pal, C., Liu, X., Vázquez, D., & Palacios, H. H. (2023). Improving Generalization in Task-

oriented Dialogues with Workflows and Action Plans. arXiv (Cornell University). https://doi.org/10.48550/arXiv.2306.01729

- Rane, N., Paramesha, M., Choudhary, S., & Rane, J. (2024). Artificial Intelligence in Sales and Marketing: Enhancing Customer Satisfaction, Experience and Loyalty. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4831903
- Rhali, N., Yahmedi, S., & Joukhrane, Z. (2025). A comparative analysis between AI and traditional methods in management control. 2(5), 21. https://doi.org/10.71420/ijref.v2i5.109
- Roshanaei, M., Olivares, H., & Lopez, R. R. (2023). Harnessing AI to Foster Equity in Education: Opportunities, Challenges, and Emerging Strategies. Journal of Intelligent Learning Systems and Applications, 15(4), 123. https://doi.org/10.4236/jilsa.2023.154009
- Rustagi, M., & Goel, N. (2022). Predictive Analytics: A study of its Advantages and Applications. IARS International Research Journal, 12(1), 60. https://doi.org/10.51611/iars.irj.v12i01.2022.192
- Salloch, S., & Eriksen, A. (2024). What Are Humans Doing in the Loop? Co-Reasoning and Practical Judgment When Using Machine Learning-Driven Decision Aids. The American Journal of Bioethics, 24(9), 67. https://doi.org/10.1080/15265161.2024.2353800
- Sharma, A. (2024). Content Marketing in the Digital Transformation Era: Trends and Best Practices. 7. https://doi.org/10.3390/proceedings2024101007
- Sharma, A. K., & Sharma, R. (2023). Considerations in artificial intelligence-based marketing: An ethical perspective. Applied Marketing Analytics, 9(2), 162. https://doi.org/10.69554/rapq3226
- Shrivastav, M. (2022). Barriers Related to AI Implementation in Supply Chain Management. Journal of Global Information Management, 30(8), 1. https://doi.org/10.4018/jgim.296725
- Siddiqui, A. R. (2025). Seamless Shopping: Intelligent Automation for Hyper-Personalized Retail Experiences. https://philarchive.org/rec/AYASSI
- Singh, B., & Pathania, A. K. (2024). AI-Driven Content Creation and Curation in Digital Marketing Education: Tools and Techniques. International Journal of Engineering Science & Humanities., 14, 14. https://doi.org/10.62904/8fbh3144
- Sulastri, L. (2023). The Role of Artificial Intelligence in Enhancing Customer Experience: A Case Study of Global E-commerce Platforms. International Journal of Science and Society, 5(3), 451. https://doi.org/10.54783/ijsoc.v5i3.1257
- Tan, Y. Y., Chow, C., Kanesan, J., Chuah, J. H., & Lim, Y. (2023). Sentiment Analysis and Sarcasm Detection using Deep Multi-Task Learning. Wireless Personal Communications, 129(3), 2213. https://doi.org/10.1007/s11277-023-10235-4
- Tanwar, P. S., Antonyraj, S. M., & Shrivastav, R. (2024). A Study of "Rise of AI in Digital Marketing." International Journal of Multidisciplinary Research in Science, Engineering and Technology., 7(5), 9919. https://doi.org/10.15680/ijmrset.2024.0705057
- Tara, K. R. (2025). Reimagining Retail: AI-Driven Personalization and the Future of Customer Experience. https://philarchive.org/rec/TARRRA
- Thelma, C. C., Sain, Z. H., Shogbesan, Y. O., Phiri, E. V., & Akpan, W. M. (2024). Ethical Implications of AI and Machine Learning in Education: A Systematic Analysis. 3(1), 1. https://doi.org/10.33650/ijit.v3i1.9364
- Uzoka, A. C., Cadet, E., & Ojukwu, P. U. (2024). Leveraging AI-Powered chatbots to enhance customer service efficiency and future opportunities in automated support. Computer Science & IT Research Journal, 5(10), 2485. https://doi.org/10.51594/csitrj.v5i10.1676
- Wilson, G., Johnson, O., & Brown, W. L. (2024a). Exploring the Integration of Artificial Intelligence in Retail Operations. https://doi.org/10.20944/preprints202408.0012.v1
- Wilson, G., Johnson, O., & Brown, W. L. (2024b). The Impact of Artificial Intelligence on Digital Marketing Strategies. https://doi.org/10.20944/preprints202408.0276.v1
- Yazdani, A., & Darbani, S. (2023). The Impact of AI on Trends, Design, and Consumer Behavior. 1(4), 4.

ISSN 2394 - 7780

https://doi.org/10.61838/kman.aitech.1.4.2

- Yi, M., & Choi, H. (2023). What drives the acceptance of AI technology?: the role of expectations and experiences. arXiv (Cornell University). https://doi.org/10.48550/arXiv.2306.13670
- Yin, J., & Qiu, X. (2021). AI Technology and Online Purchase Intention: Structural Equation Model Based on Perceived Value. Sustainability, 13(10), 5671. https://doi.org/10.3390/su13105671
- Zheng, R., Li, Z., & Na, S.-G. (2022). How customer engagement in the live-streaming affects purchase intention and customer acquisition, E-tailer's perspective. Journal of Retailing and Consumer Services, 68, 103015. https://doi.org/10.1016/j.jretconser.2022.103015

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

WEIGHING THE COST: ASSESSING THE HOUSEHOLD BURDEN OF HEALTHCARE EXPENDITURE IN KAMRUP (METRO), ASSAM

Gitangshu Deva Sarma
Research Scholar, Department of Economics, University of Science and Technology Meghalaya

ABSTRACT
Focus has been laid in this study on the extent to which healthcare expenditure has posed a financial strain on households in Kamrup (Metro) district of Assam, with special regard to out-of-pocket spending, its composition, and disparities therein. Primary data has been collected for carrying out research on households in urban and peri-urban settings, which reveals the fact that direct medical costs and other indirect costs lead to the biggest financial pressure, especially for the poor and socially backward categories. The gaps in public healthcare provisioning, below-par insurance penetration, and policy-level failures compound the problem, pushing families into the danger of catastrophic expenditure on health and distress financing. The study also attempts to assess the impact of allied socio-economic variables—such as caste, education, and residential status—on healthcare utilization patterns. Based on such findings, it draws some alternative formulations towards equity and sustainability in healthcare financing in Assam, highlighting the immediate need for universal health coverage and district-level, data-driven interventions.

Keywords: *Out-of-Pocket Expenditure (OOP), Catastrophic Health Expenditure (CHE), Healthcare Financing, Kamrup (Metro), Socioeconomic Disparities*

METHODOLOGIES
Entirely reliant on secondary sources from national surveys, government publications, and official statistical databases, this study draws heavily upon the National Sample Survey (NSS) 75th Round, National Family Health Survey (NFHS-5), the Economic Survey of Assam, reports of the District Health Society of Kamrup (Metro), and so on. Concentrating on pertinent issues, literature was gathered from peer-reviewed journals, working papers, and policy briefs to set the conceptual base and interpret the trend of expenditure.

The data was broken down according to income groups, caste categories, gender, levels of education, and types of residence (slum/non-slum) to analyze and interpret variations in OOP patterns, instances of CHE, and usage parameters of public and private health services. Descriptive and comparative techniques were employed to identify disparities, while trend analysis was used to assess the temporal changes in household financial burden. The study is descriptive in nature and aims to highlight policy gaps through a district-level case study approach.

LITERATURE REVIEWS:
1. **Berman, P., Ahuja, R., & Bhandari, L. (2010):** This paper attempts to construct a comprehensive picture of how out-of-pocket healthcare payment impoverishes Indian households. It introduces new measures to estimate catastrophic health expenditures and highlights the regressive nature of India-specific healthcare financing.
2. **Prinja, S., Chauhan, A. S., Karan, A., Kaur, G., & Kumar, R. (2020):** The study systematically reviewed the evidence on whether the government-sponsored insurance schemes-such as RSBY and PMJAY-facilitate access to healthcare and reduce financial stress. It highlights the limited impact on outpatient services and inequality in scheme uptake.
3. **Ghosh (2011)** expounds on the fact that catastrophic payments for health services are assessed more upon lower classes of income, delving deep into regional disparities and socio-demographic factors affecting financial hardship.
4. **Subramanian, Nandy, Irvin, Gordon, H., Lambert, and Davey Smith, G. (2006):** This article investigates social stratification according to caste, income, and education as a large determinant of mortality--an indirect reflection of disparities in health-care access and expenditure.
5. **Karan, Yip, Mahal, and Chakrabarti (2017)** employ a quasi-experimental method to assess the efficacy of RSBY in actual reduction of OOP expenditures and its drawbacks concerning outpatient care, with a focus on the poor.

1. Introduction and Contextual Background:
The Indian dual-state health system consists of the public health services and private health services. The former includes all government-funded health services; whereas the latter is constituted by health services offered by

ISSN 2394 - 7780

profit-oriented and non-profit organizations. Public health services are tiered as sub-centres, primary health centres (PHCs), community health centres (CHCs) at the block or taluka level, district hospitals, and tertiary hospitals that are either state or central government-controlled. These establishments are generally cheaper and mostly target marginalised populations. However, because of poor infrastructure, stock-outs of medicines, and shortage of human resources, in many-well-to-do urban and peri-urban areas, the utilization of public healthcare services remains very limited.

Private healthcare sector is well distributed across the states. They are mainly private hospitals, private clinics, private diagnostic centres, and private physicians. Private health care is expensive, resulting in increased out-of-pocket (OOP) expenditure, although it does provide services of higher quality with less waiting time. Such a dual nature has created a system whereby quality and affordability are often at odds, affecting low-income and rural households disproportionately as they are pushed towards the expensive private providers due to inadequacies of public care (Baru et al., 2010; Reddy et al., 2011).

Table 1.1: Structure of Indian Healthcare System

Sector	Key Components	Characteristics	Challenges
Public	SCs, PHCs, CHCs, District Hospitals	Affordable, accessible	Staff shortage, underfunding
Private	Clinics, Hospitals, Diagnostic Centres, Labs	High-quality, technologically advanced	Expensive, profit-oriented

Source: Compiled by Author based on MoHFW Reports (2022)

Out-of-pocket expenditure (OOP) is the biggest component of health expenditure in India and generally surpassing 50% of total expenditure-a much higher proportion in India than the global average. Direct payments refer to money spent by individuals on medical care that are not reimbursed by insurance or government programs. The main items and services that suffer OOP are those related to medicines, diagnostic tests, doctors' fees, and hospital charges. Rising prices for healthcare, especially in the private sector, in association with low insurance penetration, is the essence of high OOP burden."

Study reveals that in India more than 17 per cent of households are to catastrophic health expenditures annually, that means that their medical spending exceeds 10-20 per cent of total consumption expenditure (Pandey et al., 2023). Such shocks press families into reducing consumption of essential goods or going into debt. While schemes such as Ayushman Bharat intend to ease this burden, lacunae in implementation along with limited coverage hinder their utility, especially in an urban centre such as Kamrup (Metro), where a mixed healthcare market prevails.

Table 1.2: Share of OOP in Total Health Expenditure in India (2010–2022)

Year	Total Health Expenditure (₹ Crore)	OOP Expenditure (₹ Crore)	OOP as % of Total
2010	3,20,000	2,00,000	62.5%
2015	4,50,000	2,80,000	62.2%
2020	6,50,000	3,50,000	53.8%
2022	7,10,000	3,70,000	52.1%

Source: National Health Accounts (NHA), Ministry of Health and Family Welfare (2023)

Centered on the city of Guwahati, Kamrup (Metro) is probably the most developed-led and economically active district of Assam. In essence, this district shows the dust-rearing economic and social diversity of Assam, with urban professionals, middle-income working classes, slum-dwellers, migrants, and indigenous rural communities present. Their healthcare demands are really very different, and so Kamrup (Metro) becomes an interesting laboratory for analyzing healthcare expenditure patterns. This further induces a shadow duality of healthcare experiences with multispecialty hospitals on one hand and starving and under-resourced public health services on the other.

Furthermore, with administrative, commercial, and educational aspects well provided for, Kamrup (Metro) experiences high internal migration and changing demographics. These patterns would affect the utilization of health infrastructure and further increase pressure on both public and private systems. By taking the case of Kamrup (Metro), it is the objective of this study to frame the heterogeneity in healthcare access, utilization, and financial burden as experienced in an evolving urban backdrop in Assam and to view this in a policy-making perspective for regions of a similar nature across India.

ISSN 2394 - 7780

Table 1.3: Socio-Economic Indicators of Kamrup (Metro), Assam

Indicator	Value (2021–22)
Urban Population (%)	82.5%
Literacy Rate	91.4%
Below Poverty Line (BPL) Ratio	22.3%
Number of Public Health Facilities	113
Number of Private Health Facilities	152

Source: District Statistical Handbook – Kamrup (Metro), 2022

The burden of healthcare expenditure on households within Kamrup (Metro) District shall become the main focus of this study, by identifying trends in out-of-pocket spending, studying variations among socio-economic groups, and appraising the efficacy of financial protection mechanisms such as insurance. The research, by adopting a case study approach, wishes to complement macro-level health financing statistics with micro-level household experiences. It also looks into catastrophic expenditures, distress financing, and inequities in service utilization.

The reasoning for channeling attention in this direction is borne out of the urgent necessity of making district-level evidence available for policy input. National level averages may sometimes mask acute differences at the local level, and Kamrup (Metro) stands as a special case due to the presence of urban infrastructure, population heterogeneity, and contrasting healthcare systems. This study's findings are envisioned to give impetus both to academic debates and policy interventions toward more equitable and sustainable health financing in Assam as well as other similarly placed regions of India.

2. DISCUSSION:

2.1 Patterns of Healthcare Utilization:

In Kamrup (Metro), the prevailing pattern of health utilization depicts glaring opportunities for preference of private health-care establishments when considering middle- and upper-income households. There is a general perception that private services are more trustworthy, have less waiting times, and better infrastructures. Sometimes patients from the economically weaker sections bypass government health facilities, and this is only until the private treatment costs become that high. The perception of quality and trust in private providers has overruled affordability concerns: a national trend (Peters et al., 2002).

The situation at public institutions in Kamrup (Metro) involves overcrowding, though in the backdrop of a supposedly wider network of government health facilities, including PHCs and district hospitals. This is followed by absenteeism of the doctors and shortage of medicines. Such factors reduce the level of trust and utilization of public health services. Residents of urban slums opt to oscillate between private and public health-care options depending on the availability of subsidies, proximity to the facility, and urgency of the medical need. The existence of such dual options exacerbates inequality in access and cost burden.

Table 2.1: Healthcare Facility Preference by Income Group in Kamrup (Metro)

Income Group	Public Facilities (%)	Private Facilities (%)
Low-income (< ₹10K)	65%	35%
Middle-income (₹10K–30K)	43%	57%
High-income (> ₹30K)	18%	82%

Source: Primary Survey Data, 2024 (n = 450 households)

Communities from different income groups go to the hospital more or less depending on the group they belong to. This is mostly due to a difference in health consciousness from group to group. The richer income groups are fancying health care more and more these days--meant mainly for non-emergency treatment and elective procedure, as they have the money to disburse for such care either in private set-ups or tertiary care centers. There is even higher use of diagnostic services and follow-up health-care services, which favor good health in their cases. On the other hand, low-income households could barely afford to visit the hospital, and hence, they would resort to late-stage visits, very costly visits in the long run.

Further, this cost burden forces lower-income families to resort to informal healthcare providers or just buying OTC drugs instead of visiting a professional. This will render the situation worse, causing more expenses or complications. When discounts in the form of free medicines or government-sponsored camps for check-up are organized in public hospitals, there is a sudden upsurge in footfalls, thus bringing to light the role of affordability in seeking healthcare (Kumar et al., 2012).

ISSN 2394 - 7780

Table 2.2: Average Annual Hospital Visits per Household by Income Group

Income Group	Average Visits/Year (Public)	Average Visits/Year (Private)
Low-income	3.2	1.1
Middle-income	2.8	2.5
High-income	1.6	4.7

Source: Field Survey, Kamrup (Metro), 2024

There is a continuous albeit declining trend in the use of traditional forms of healthcare such as Ayurveda, Homeopathy, and local herbal systems in Kamrup (Metro). Traditional cultural treatments are more commonly sought by elderly and rural migrant populations within the urban setting for chronic ailments, digestive disorders, and lifestyle diseases. On the other hand, acute or emergency care is mostly provided by allopathic services across the spectrum of socio-economic groups. With increasing availability of modern pharmaceuticals and urban medical infrastructure, user preference has shifted towards modern allopathic treatment.

Yet familiarity and cultural belief systems still interact with health decisions for the users. A group of population tends to mix the two systems while usually embarking upon either combination of home remedies and Ayurveda and if that fails allopathic medicines. In layman terms, this sort of hybrid behavior is much more common among the underprivileged elderly who considered the indigenous practices efficacious. But even now, doubts remain about their efficacy; their regulatory status and dosage clarity under their traditional systems further complicate the issue, restraining their acceptance on the more mainstream lines (Patwardhan et al., 2015).

Table 2.3: Preference for Healthcare System by Age and Income

Category	Traditional (%)	Allopathic (%)
Age 18–35	10%	90%
Age 36–60	23%	77%
Age 60+	38%	62%
Low-income group	28%	72%
High-income group	12%	88%

Source: Household Health Utilization Survey, Kamrup (Metro), 2024

In Kamrup (Metro), preventive care (e.g., routine check-ups, vaccines, and screenings) is undersupplied, mainly among the poor and middle-income groups. The prevalent thinking is to resort to curative care when the necessity arrives: expenses are raised post-illness. This is basically a reactive account of health, thus requiring high expenditures in the long run and missing the chance for early detection of diseases. High-income families invest in annual general check-ups, dental care, and lifestyle monitoring, while the rest, due to pressing concerns and lack of awareness, prioritize curative therapies.

The focus on curative care is partly due to a lack of promotion of preventive health by public agencies and low insurance coverage for outpatient services. Preventive services are rarely on offer in government hospitals and urban health centres except during national immunization campaigns or school health check-ups. This gap signals the need for policy revisions that would regard preventive health care as a cost-saving investment rather than a charity subject to avail of (Misra et al., 2019).

Table 2.4: Household Spending on Preventive vs. Curative Care (% of Total Health Expenditure):

Income Group	Preventive (%)	Curative (%)
Low-income	8%	92%
Middle-income	12%	88%
High-income	26%	74%

Source: Author's Estimates Based on Survey Data (2024)

2.2 Components of Healthcare Expenditure:

Direct medical costs carry the bulk of total health expenditure in Kamrup (Metro), especially for those households accessing private health services. They included doctor consultation fees, diagnostic tests, in-patient hospitalization charges, medicines, and surgical procedures. Among these medicines constitute a large proportion, alone accounting for over 40 percent of direct costs, mainly because of high retail markups and the preference for prescribing branded drugs to generic ones. Consultation and diagnostics are also significantly costlier in private clinics, which are the preferred choice for many due to better perceived quality and efficiency.

In government facilities, while consultations and diagnostics are often free or subsidized, the shortage of medicines and under-resourced diagnostics forces patients to seek private options, adding to their OOP burden.

ISSN 2394 - 7780

Tertiary hospitals, even when government-run, entail costs for advanced treatments, beds, and longer stays, leading to escalated direct expenses. The National Sample Survey (2017–18) noted that in urban Assam, 68% of hospitalized individuals incurred medicine costs despite using public facilities, reflecting a systemic supply chain gap (MoSPI, 2019).

Table 3.1: Average Direct Medical Costs per Episode (Kamrup Metro, ₹):

Component	Public Facility (₹)	Private Facility (₹)
Doctor Consultation	50	600
Diagnostic Tests	150	1,200
Medicines	400	1,500
Hospital Stay (per day)	250	2,800

Source: Field Survey & Hospital Billing Records, 2024

Indirect health costs are an important component of costs borne by households, with the poor working class being excessively affected in this regard. These costs, which include transportation to the facility, meals during the hospital visits to name a few, and above all, wage loss for patients and their caregivers. For wage-dependent families, a one-day hospital visit could prove to be an income disruption, sometimes pushing them into hard trade-offs between health and livelihood. In Kamrup (Metro), patients coming from peri-urban and fringe areas are often subjected to long-distance travel, thereby increasing expenses on fuel or public transport.

At the same time, the absence of daycare services down the road or public hospitals implies that longer hospital stays are required, especially for surgeries or maternal health care, at which time companionship is also required, thus causing the second individual to lose working hours. Indirect costs would be particularly high in the case of chronic conditions such as cancer or dialysis, which require repeated visits to medical centers. And, ironically, such costs are never considered for reimbursement either by insurance schemes or government subsidies, which limit compensations to the scope of direct medical care. Hence, the total economic impact of illness can be underestimated if only direct costs are considered (Berman et al., 2010).

Table 3.2: Average Indirect Costs per Hospital Visit by Income Group (₹):

Income Group	Transport	Food	Loss of Wages	Total Indirect Cost
Low-income	120	80	400	600
Middle-income	140	100	700	940
High-income	180	150	1,200	1,530

Source: Author's Field Data Compilation, 2024

In Kamrup (Metro), the distribution of healthcare spending is very much based on income quintiles. High-income earning groups tend to spend more in absolute terms. But, families belonging to the lower income group spend a disproportionately larger share of their incomes on healthcare. A hospital stay, caused by a bank of sickness, for even a short period, can wipe out about 20–25% of a bottom-most 20% household's monthly income, pushing many households closer to the poverty line. Preventive service-based providers for those with adequate income ensure that paying insurance premiums and charges for staying in private hospitals hardly affect their consumption.

Further, health expenditure for the rich remains fairly predictable and planned owing to planned check-ups, insurance reimbursements, and modes of digital payments. Contrastingly, the poor have to deal with lumpy, unforeseeable outlays, often the need to resort to distress financing-borrowing, mortgaging, or selling assets. Such disparities do not just point toward merely economic inequality but risk protection and quality health services access, thereby setting in clinician-aided cycle-range-marketing for translation into affliction (Selvaraj & Karan, 2012).

Table 3.3: Healthcare Spending as % of Monthly Household Income by Quintile:

Income Quintile	Avg. Monthly Income (₹)	Avg. Monthly Health Spend (₹)	Health Spend as % of Income
Lowest 20%	7,500	1,650	22.0%
Second Quintile	12,000	1,800	15.0%
Middle Quintile	18,000	2,250	12.5%
Fourth Quintile	30,000	3,000	10.0%
Top 20%	50,000	3,500	7.0%

Source: Author's Survey Analysis, Kamrup (Metro), 2024

ISSN 2394 - 7780

2.3 Out-of-Pocket Expenditure and Financial Burden:

In Kamrup (Metro), before being a paying agent, the mode of OOP predominated in actionability. An integration of several existing public health infrastructure and government-endorsed insurance schemes notwithstanding, OOP still forms a bulk of total health expenditure which varies from 55% to 65% in urban Assam. Such expenses cover medicines, diagnostic tests, and consultations in private settings that are either partially covered or not at all by the current insurance schemes or public modes. Paying upfront before an accepted hurried assessment in a private setup is another obstruction to the financial strain on households.

OOP payments are made for each visit in many families with no pooling or reimbursement mechanism, resulting in financial unpredictability. The absence of outpatient coverage in most insurance policies results in repeated spending for consultations and follow-ups. Consequently, OOP remains a regressive form of health financing, with a larger impact on low-income households, who spend a higher proportion of their income on health than wealthier groups (Pandey et al., 2023).

Table 4.1: OOP Share in Total Household Health Expenditure by Income Group:

Income Group	OOP as % of Total Health Cost
Low-income	94.2%
Middle-income	86.5%
High-income	78.3%

Source: Field Survey Data, Kamrup (Metro), 2024

Catastrophic Health Expenditure (CHE) occurs when medical spending exceeds a significant threshold (commonly 10% or 20%) of a household's total consumption or income. In Kamrup (Metro), the incidence of CHE is alarmingly high, particularly among families without any form of financial risk protection. The field survey reveals that over 27% of households experienced CHE in the past year, with the most vulnerable being informal workers, daily wage laborers, and elderly-led families. Such expenditures not only deplete savings but often lead to long-term impoverishment.

The risk of CHE increases due to the absence of pre-payment mechanisms (e.g., insurance) and the uncertainty of the occurrence of illness. For example, cancer, kidney problems, or cardiovascular conditions can cause hospitalizations for chronic illnesses that include CHE, along with sudden accidents. Public-sector health interventions might pay only a portion of the costs or are perhaps not accessible in emergencies. Without structured financial assistance or reimbursement, many households cross the CHE threshold quickly, even with short hospital stays (Wagstaff & van Doorslaer, 2003).

Table 4.2: Incidence of CHE by Income Group and Hospitalization Event:

Category	% of Households Experiencing CHE
Low-income (without insurance)	46%
Middle-income (without insurance)	29%
High-income (with insurance)	8%

Threshold: Expenditure > 10% of annual household income; Source: Primary Survey, 2024

Distress financing refers to methods of coping with health expenditure by borrowing money, taking loans, or selling assets. Almost 41% of the low-income households in Kamrup (Metro) reported resorting to at least one form of distress financing to meet medical expenses during the past year. Most of these borrowings, with informal sources including friends, family, or local money-lenders are never bonded by interest rate control mechanisms. Looping into chronic indebtedness and economic vulnerability.

With middle- and higher-income groups gaining through formal sources such as credit cards or health loans from banks, the poor are prevented from aces and will have to part with livelihood assets like livestock, tools, or land leases. In some reported cases, families delayed treatment until loans could be arranged, affecting clinical outcomes. Distress financing is thus not just a symptom of poor health financing systems, but also a cause of deeper social inequities (Berman et al., 2010).

Table 4.3: Modes of Distress Financing Used by Households (n = 450):

Financing Method	% of Respondents (Low-income)
Borrowed from relatives	28%
Loan from moneylender	14%
Sold household assets	11%
Delayed or skipped care	22%
Used savings	40%

Source: Household Health Expenditure Survey, Kamrup (Metro), 2024

ISSN 2394 - 7780

The burden of healthcare expenditure is not evenly distributed across genders and age groups. Particularly among the poor, the health of women, mostly reproductive and gynaecological issues, is often considered of less importance and delayed. Economic and social constraints often translate into a health prioritization for male members or earners in the family. Additionally, women tend to bear the burden of caregiving without compensation, further affecting their economic participation and access to care for themselves (Ghosh, 2011).

Age also appears to be a principal factor impacting expenditure burden. Purely considering, the elderly (60+), with a chronic illness, face the highest absolute health expenditure, being long-term medication, frequent doctor visits, being dependent on others for mobility and care, etc. Children under-five require high spendings, especially with immunization schedules, nutrition supplements, and frequent fevers. Being vulnerable in both regards—age and gender—the elderly women stand to be severely neglected and financially exposed as an income class within the district.

Table 4.4: Average Monthly Health Expenditure by Age and Gender (₹):

Group	Male (₹)	Female (₹)
Children (0–5 years)	740	700
Working age (18–59 years)	1,480	1,050
Elderly (60+ years)	2,100	1,450

Source: Disaggregated Survey Data, Kamrup (Metro), 2024

2.4 Insurance Coverage and Effectiveness:

Health insurance penetration in Kamrup (Metro) has gone higher in recent years, mainly because of the operative USA-200 Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana (PMJAY) and some other earlier schemes like RSBY (Rashtriya Swasthya Bima Yojana). But awareness levels remain uneven across Kamrup-Metro; there are many uneducated people regarding enrollment processes, benefits, or empaneled hospitals. While the urban outreach is greater as compared to that of the rural, marginalized sections of society — like the daily wage earners, informal sectors workers, and slum dwellers — tend to have their documents missing, which are essential for registration, be it ration cards or Aadhaar linkage.

The Government of Assam has come forward with some complementary State schemes such as Atal Amrit Abhiyan, which curb critical illness expenditure for households registering an income below ₹ 5 lakh. But with multiple schemes running parallelly, overlapping concerns arise among the beneficiaries on eligibility norms and claim procedures. As per the survey information from Kamrup (Metro), there exists a huge gap of coverage as 59 percent of beneficiary households eligible have at least one member enrolled in any government insurance program (National Health Authority, 2023).

Table 5.1: Awareness and Enrollment Status under Government Schemes:

Scheme	Awareness (%)	Enrollment (%)
PMJAY (Ayushman Bharat)	74%	51%
RSBY (now phased out)	28%	19%
Atal Amrit Abhiyan (State)	42%	31%

Source: Household Insurance Awareness Survey, Kamrup (Metro), 2024

Among those insured, there remains a limited use of insurance benefits owing to lack of awareness, multiplicity of bureaucratic impediments, and infrastructure mismatches. The beneficiaries are, in numerous instances, unaware of the hospitals empanelled or the diseases and procedures covered. In emergencies, the patient usually opts to go to some non-empanelled private facility and makes the payments - out of pocket - even though the insurance coverage technically remains in existence. Now, in other instances, the hospitals themselves refuse to honour the claims, claiming that the documents were insufficient or that the limit on coverage had been exceeded, thus creating gaps in access.

Public empanelled hospitals in Kamrup (Metro) are few and overcrowded, while private empanelled hospitals impose service ceilings or limit free services to only selected wards. The digital claim submission system, while efficient in principle, is often not user-friendly for elderly or illiterate patients. Consequently, only 38% of those enrolled under PMJAY in the district have successfully availed cashless benefits in the last two years. These issues indicate that insurance enrollment alone is not sufficient; effective access and support mechanisms are equally important (Prinja et al., 2019).

ISSN 2394 - 7780

Table 5.2: Insurance Utilization and Reasons for Non-Use:

Reason for Non-Utilization	% of Respondents (n=264 insured)
Lack of awareness about empaneled hospitals	36%
Treatment not covered under scheme	24%
Paperwork issues / documentation delay	18%
Preference for non-empaneled private hospital	14%
Claim rejected by provider	8%

Source: Insurance Access and Benefit Survey, Kamrup (Metro), 2024

Having a health insurance policy has a mitigating effect on household financial pressure in general and for in-patient hospitalization in particular. Average out-of-pocket expenditure per hospitalization for insured household in Kamrup (Metro) stands reduced by almost 40% vis-à-vis uninsured families. This reduction, however, remains largely restricted to certain conditions and in-patient episodes. Outpatient care, medicines, and diagnostics continue to be borne fully by the households even among the insured, thus financially compromising them.

Further, the protective effect of insurance is said to be uneven across income groups. Low-income households, even when insured, find it hard to cover pre-treatment and follow-up costs, forcing them to resort to informal coping mechanisms, such as borrowing. Insurance schemes like PMJAY have reduced instances of CHE among the poorest quintiles fairly well, but their limited scope and depth of coverage mean that insurance can only be half the answer to financial protection. A more comprehensive benefits package and outpatient coverage would significantly enhance impact (Karan et al., 2017).

Table 5.3: Average Health Expenditure per Hospitalization by Insurance Status (₹):

Category	Insured Households	Uninsured Households
Total Expenditure	₹6,800	₹11,200
OOP Expenditure	₹3,900	₹10,100
% Covered by Scheme	42.6%	9.8% (informal support)

Source: Field Data Analysis, Kamrup (Metro), 2024

2.5 Socio-Economic Disparities in Health Expenditure:

In short, income continues to be the primacy in determining expenditure and income patterns for healthcare in Kamrup (Metro); low-income groups traditionally spend a higher percentage of their income on medical necessities even if their absolute expenditure is less. This constitutes a higher occurrence of catastrophic health expenditure among the weaker economic sections. In addition, SC-/ST-status households mostly reside in areas in the periphery, where government health infrastructure is still poorer. There is a tendency of these social groups to delay treatment and seek the services of traditional healers due to the barriers to cost and historical exclusion.

Along several factors, differentials in health literacy, schemes, and formal employment benefits accentuate caste-based inequities. According to the National Family Health Survey (NFHS-5), ST households in Assam are, among other things, twice as likely to report illness without seeking treatment as General category households. Among the sick who do seek care, however, SC/ST communities reportedly prefer public hospitals, whereas General category or OBC groups favor more private institutions. This segregation in its turn results in more divergence in terms of the quality of service, out-of-pocket expenditure, and at the end of it all, the health outcome (Bora & Saikia, 2015).

Table 6.1: Average Monthly Health Expenditure by Income and Caste (₹):

Category	SC/ST (Low-income)	OBC (Mid-income)	General (High-income)
Avg. Expenditure (₹)	1,200	2,000	3,500
% of Monthly Income	18.5%	11.1%	6.8%

Source: Household Expenditure Survey, Kamrup (Metro), 2024

The residents of urban slums of Kamrup (Metro) bear more health burdens and face toothless access because they live close to the health facilities. Slum populations are generally undocumented, thus reducing their eligibility to apply for government schemes like PMJAY or state-sponsored health programs. Most of their health expenditures are out-of-pocket, informal, and unaccounted for. On average, these slum households spend less in absolute terms but experience higher relative financial burdens due to lower and irregular incomes.

Non-slum households, mainly in planned residential locations, have very good connectivity to both public and private hospitals, have increased insurance penetration, and are fairly well informed about health financing

schemes. They actively seek preventive care and early diagnosis. Contrastingly, slum dwellers generally delay seeking care, going instead to quacks and unregistered practitioners that treat them for unregistered practitioners, eventually worsening their health due to untreated conditions (Subramanian et al., 2006).

Table 6.2: Health Expenditure Comparison – Slum vs. Non-Slum Households

Indicator	Slum Households	Non-Slum Households
Avg. Monthly Health Spend (₹)	950	2,400
% Incurring Catastrophic Expense	34%	16%
% with Insurance Coverage	27%	61%
% Using Private Facilities	39%	68%

Source: Urban Health Equity Survey, Kamrup (Metro), 2024

Health and education are closely related, which also embrace health awareness, seeking behavior, and nature of healthcare expenditure. Having a head of the household with education beyond secondary is more inclined to spending on preventive care, utilizing formal health providers, and using insurance schemes. Such households, while paying less, will ask for price comparisons on the given services, check prescriptions and avoid unnecessary medical procedures. Low-literacy households most of the time become the subject of word-of-mouth or informal advice, irregular treatments, treating on the basis of advice of non-qualified providers, and, at the end of it, somehow more costs.

It is revealed that graduate-level- and above-educated households of Kamrup (Metro) put higher absolute amounts toward health but face lower financial distress owing to better financial planning and risk appreciation. Also, their services tend to include specialist consultations, diagnostic screening, and a more formal treatment route. On the other hand, illiterate or barely literate households use their health money in inefficient ways, such as repeated visits to the same or multiple providers and the consumption of unprescribed medicines. Thus, improving health literacy is as vital as financial access in addressing health expenditure disparities (Deaton & Dreze, 2009).

Table 6.3: Health Spending and Financial Burden by Education Level:

Education Level of Household Head	Avg. Monthly Health Spend (₹)	% Facing Financial Stress
Illiterate	850	38%
Up to Secondary	1,450	24%
Graduate and Above	3,000	12%

Source: Educational and Expenditure Correlation Study, Kamrup (Metro), 2024

2.6 Policy Challenges and Recommendations:

Despite a functioning infrastructure for medical care in this part of the Northeast, Urban Assam continues to face significant gaps when it comes to provisioning for public health. Many UPHCs and CHCs run below their potential capacities due to a shortage of staff, with obsolescence in equipment and irregular supply of medicines being some other factors. To compound this, there are no systematic preventive efforts, and accordingly, most urban residents have had to depend on costly private healthcare alternatives. Without effective urban planning, there has been an uneven distribution of health infrastructure, with many slums in Guwahati facing little or no access to reliable government care.

Notably, the urban health mission has serious issues of infrastructure maintenance, real-time monitoring, and accountability, especially in rapidly expanding peri-urban areas. Health workers exhibit poor outreach toward marginalized communities such as migrant populations and daily wage earners, who form a bulk of the urban poor. With negligible digital record-keeping and fragmented referral systems, the provisioning of public health care has been rendered inefficient and uncoordinated, thus eroding confidence and usage among the mass population (Das & Rao, 2012).

Table 7.1: Infrastructure and Staffing Gaps in Public Urban Health Facilities (Kamrup Metro, 2024):

Parameter	Required	Available	Shortfall (%)
Medical Officers at UPHCs	42	29	31%
Availability of Essential Medicines	100%	68%	32%
Functional Diagnostics (PHCs/CHCs)	80%	47%	41.25%

Source: District Health Society Report, Kamrup (Metro), 2024

It will need to be very much a diverse strategy to bring down OOP. First and foremost, PHCs and CHCs do need strengthening and must have trained manpower, equipped laboratory, and essential medicines as key line of defense, especially for non-emergency cases. These centers should provide preventive and outpatient care,

ISSN 2394 - 7780

either free-of-cost or subsidized medicines, which form the biggest share of OOP expenditure in urban Assam. Infrastructure has to be improved while working conditions must be made conducive to truly forge health-service delivery.

Secondly, in the IEC category, a massive awareness campaign has to be run on existing government schemes, the benefits of approaching treatment at the earliest, and the process to claim insurance. Many of the families in Kamrup (Metro) hit a heavy-pocket expense for lack of pertinent information or in getting duped into wastage called unnecessary diagnostic-level packages offered by private providers. Also, subsidizing of diagnostic and consultation costs at public facilities and deployment of mobile health vans to underserved areas will greatly reduce household medical expenditure (Prinja et al., 2020).

Table 7.2: Strategic Interventions to Reduce OOP in Kamrup (Metro):

Intervention	Expected Impact (%)	Timeframe
Strengthen PHC/CHC Infrastructure	↓ OOP by 20–25%	Medium term
Free/Subsidized Generic Medicines	↓ OOP by 30–35%	Short term
IEC on Schemes & Preventive Care	↑ Insurance Use by 40%	Ongoing

Source: Author's Projections Based on Field Insights, 2024

Policy decisions, particularly for health expenditure planning, need to be decentralised and data-based. Usually, an integrated strategy at the state or national level does not comprehend the true nature of local realities and may vary even between adjacent urban wards in Kamrup (Metro), such as disease profile, population density, and income disparity. A district-level health data observatory can monitor real-time trends of OOP, hospitalization rates, insurance utilization, and medicine stockouts. These data will give the health planners a picture to design targeted schemes to quickly address service gaps.

At present, most administrative data collection is manual, irregular, and restricted to maternal-child health to the exclusion of adult morbidity, elderly care, and chronic diseases. Electronic health records, facility mapping with GPS coordinates, and AI-enabled predictive models for health resource allocation would reduce duplications and increase accountability for service delivery. Evidence-based health budgeting thus improves efficiency and increase the likelihood of funds reaching the intended population (Bajpai et al., 2021).

Table 7.3: Benefits of District-Level Health Data Systems:

Functionality	Outcome
GIS Mapping of Health Access	Identify underserved zones
Electronic Medical Records (EMRs)	Track chronic disease management
Real-Time Supply Chain Monitoring	Prevent medicine/diagnostic shortages
Dashboard for Insurance Utilization	Boost scheme uptake, reduce fraud

Source: National Health Stack Pilot Recommendations, NITI Aayog, 2022

The long-term solution for the health expenditure crisis is, thus, to pursue Universal Health Coverage (UHC) where every citizen receives access to health care of good quality, free from any financial hardship. Based on this, there will be pooling of resources, publicly and privately funded; merging all vertical health insurance schemes under a larger umbrella; and coverage on both outpatient care and diagnostics, including maternity and chronic care. Being such a big and diversely socio-economical region, for Kamrup (Metro), UHC needs contextualization, inclusiveness, and clear entitlements for the urban poor and the informal sector.

The supply side of health care is also a syllabus of UHC-building infrastructure, recruit units of health personnel, drug availability, and governance mechanisms to ensure all these are in place (and functioning) delivery of services. Drawing from the experience of countries like Thailand and Sri Lanka will display how UHC could have cost-effectiveness and equity for Assam. District-level UHC pilots in an urban center like Guwahati would provide a good anchor for suitable interventions that would cut down OOP, remove distress financing, and better population health (WHO, 2010).

Table 7.4: Comparison of Key Features – Current System vs. UHC Model:

Feature	Current System	UHC-Oriented Model
Fragmented Schemes	Yes	Integrated financing model
Focus on Inpatient Coverage	High	Comprehensive (OP/IP/beyond)
Financial Risk Protection	Partial	Full
Target Population	Below Poverty Line (BPL)	Entire population

Source: Adapted from WHO UHC Report (2010), customized to Kamrup (Metro) context

ISSN 2394 - 7780

3. FINDINGS:

1. **Out-of-pocket expenditure:** A large number of households in Kamrup (Metro) pay for healthcare out of pocket, with the poor spending up to 22% of their monthly income on health, far above the national safety limit.
2. **Out-of-Pocket Medical Expenses:** Medicines, diagnostics, and consultation fees contribute the major chunk of healthcare spending in private hospitals and clinics, with medicine costs accounting for more than 40% of the total cost of treatment itself.
3. **Indirect Expenditures Add to Great Burden:** Costs of transport, food, and loss of wage for travel to a hospital aggravate the financial burden, particularly on wage earners and poorer families.
4. **Catastrophic Health Expenditure (CHE) Prevalent:** More than 27% of households underwent CHE (spending >10% of income), especially for chronic illnesses, long hospital stays, and in the absence of insurance cover.
5. **Among Poor Distress Financing Is Common:** Nearly 41% of low-income households borrowed money, took loans from moneylenders, or sold assets to meet treatment expenses.
6. **Unequal Access to Insurance Benefits:** While PMJAY and state schemes exist for reimbursement of hospital expenditure, only 51% of eligible households are enrolled and only 38% of the insured utilized their benefits mostly due to lack of awareness or paperwork problems.
7. **There persists socioeconomic disparity in expenditure:** SC/ST and slum-dwelling households face higher financial strain and spend inefficiently compared to non-slum, higher-caste and educated ones. They are also more likely to defer or forgo treatment.
8. **Education as a Health Spender:** Households with a higher level of education end up spending more on health in absolute terms but face less financial strain on account of good planning and informed decision-making.
9. **Gap in Public Healthcare in Urban Assam:** While government hospitals and clinics in urban areas should have been quite active, they thus remain under frequented due to lack of staff, medicines, and good diagnostics, especially in the slum clusters and peri-urban areas.
10. **Limited but Beneficial Role of Insurance:** Insured households paid OOP per hospitalization 40 percent less than the uninsured households, but the benefits were restricted to in-patient care and left out the outpatient needs.
11. **The Need for District-Level Data-Driven Policy:** The absence of disaggregated information regarding morbidity, insurance claim utilization, and health infrastructure prevents Kamrup (Metro) from pursuing efficient planning. There is an urgent need for data-driven interventions.
12. **There should be Universal Health Coverage (UHC):** The existing scheme does not provide full risk coverage to each and every citizen. One can, therefore, argue for comprehensive UHC which would include outpatient coverage, scheme integration, and access to the entire population.

4. CONCLUSION

The study emphasizes that the greatest financial risk and hardship are borne by households in Kamrup (Metro), mainly the poor, socially disadvantaged, or those residing in slums. Public insurance schemes such as PMJAY and Atal Amrit Abhiyan are less successful in reducing financial hardship, but awareness, enrollment, and utilization gaps continue to be critical issues. Spending behavior is subject to the influence of education and socio-economic status; hence more educated households utilize preventive care and financial protection mechanisms better. Yet disparities continue when it comes to income groups, caste, gender, age, and residential status.

The results reveal that there is a need to consider both demand-side (at household level) and supply-side (infrastructure and policy) factors simultaneously as a prerequisite for promoting health equity in Assam. Planning for health at the state level must, therefore, proceed beyond working solely to expand infrastructure and become geared also toward health equity, financial protection, and community-level inclusion. The central government must then reconsider the approach to health insurance schemes, particularly those that cover outpatient services, diagnostics, and chronic diseases, to favor vulnerable populations nestled inside urban pockets.

ISSN 2394 - 7780

At the nation level, there is an urgent need to shift away from a scheme-based approach toward a comprehensive health financing model. District-level planning must be empowered and aligned with the objectives of Ayushman Bharat and the Sustainable Development Goals for reducing the financial burden of illness. Integration of health financing with digital health records, public-private partnerships, and urban primary care strengthening should be areas of concern for the policy agenda.

The health expenditure structure of Assam points to a deeper crisis of access and affordability, urging a complete rethinking of the healthcare financing architecture. Sustainable solutions must ensure that no household enters poverty because of illness, thereby embedding equity within the very core of any policy intervention.

5. REFERENCES:

1. Bajpai, V., Kaur, G., & Rao, K. D. (2021). India's journey towards universal health coverage: A critical review of policy evolution and implementation. Journal of Global Health Reports, 5, e2021030.
2. Baru, R., Acharya, A., Acharya, S., Kumar, A. K. S., & Nagaraj, K. (2010). Inequities in access to health services in India: Caste, class and region. Economic and Political Weekly, 45(38), 49–58.
3. Berman, P., Ahuja, R., & Bhandari, L. (2010). The impoverishing effect of healthcare payments in India: New methodology and findings. Economic and Political Weekly, 45(16), 65–71.
4. Bora, J. K., & Saikia, N. (2015). Neonatal and under-five mortality rate in Indian districts with reference to National Health Mission: A geospatial analysis. PLoS ONE, 10(2), e0118944.
5. Das, J., & Rao, D. S. (2012). Explaining the puzzle of low utilization of public health services in India. Social Science & Medicine, 75(12), 2292–2301.
6. Deaton, A., & Dreze, J. (2009). Food and nutrition in India: Facts and interpretations. Economic and Political Weekly, 44(7), 42–65.
7. Ghosh, S. (2011). Catastrophic payments and impoverishment due to out-of-pocket health spending. Economic and Political Weekly, 46(47), 63–70.
8. Karan, A., Yip, W., Mahal, A., & Chakrabarti, A. (2017). Extending health insurance to the poor in India: An impact evaluation of Rashtriya Swasthya Bima Yojana on out-of-pocket spending for healthcare. Social Science & Medicine, 181, 83–92.
9. Kumar, S., Dansereau, E., & Murray, C. J. L. (2012). Variations in the quality of outpatient care in public health facilities in India. Health Policy and Planning, 27(7), 579–588.
10. Ministry of Health and Family Welfare. (2023). National Health Accounts Estimates for India (2019–2020). Government of India.
11. Ministry of Statistics and Programme Implementation. (2019). Key Indicators of Social Consumption in India: Health NSS 75th Round (2017–18). Government of India.
12. Misra, S., Chatterjee, S., & Rao, K. D. (2019). India’s journey toward universal health coverage: A political economy perspective. Health Systems & Reform, 5(3), 200–208.
13. National Health Authority. (2023). PMJAY Annual Progress Report 2022–23. Ministry of Health and Family Welfare, Government of India.
14. Pandey, A., Mohanty, S. K., & Jain, A. (2023). Catastrophic health expenditure and impoverishment in India: New evidence from national sample surveys. Health Policy and Planning, 38(1), 104–114.
15. Patwardhan, B., Warude, D., Pushpangadan, P., & Bhatt, N. (2015). Ayurveda and traditional medicine: A global perspective. Indian Journal of Medical Sciences, 59(6), 255–266.
16. Peters, D. H., Yazbeck, A. S., Sharma, R. R., Ramana, G. N. V., Pritchett, L., & Wagstaff, A. (2002). Better health systems for India’s poor: Findings, analysis, and options. World Bank Publications.
17. Prinja, S., Bahuguna, P., Gupta, I., Chowdhury, S., & Trivedi, M. (2019). Role of insurance in averting out-of-pocket expenditure and impoverishment: Evidence from government-sponsored schemes in India. BMC Public Health, 19, 1–13.

ISSN 2394 - 7780

18. Prinja, S., Chauhan, A. S., Karan, A., Kaur, G., & Kumar, R. (2020). Impact of publicly financed health insurance schemes on healthcare utilization and financial risk protection in India: A systematic review. PLoS ONE, 12(2), e0170996.
19. Reddy, K. S., Selvaraj, S., Rao, K. D., Chokshi, M., Kumar, P., Arora, V. & Mohan, P. (2011). A critical assessment of the existing health insurance models in India. Public Health Foundation of India.
20. Selvaraj, S., & Karan, A. K. (2012). Why publicly-financed health insurance schemes are ineffective in providing financial risk protection. Economic and Political Weekly, 47(11), 60–68.
21. Subramanian, S. V., Nandy, S., Irving, M., Gordon, D., Lambert, H., & Davey Smith, G. (2006). The mortality divide in India: The differential contributions of gender, caste, and standard of living across the life course. American Journal of Public Health, 96(5), 818–825.
22. Wagstaff, A., & van Doorslaer, E. (2003). Catastrophe and impoverishment in paying for health care: With applications to Vietnam 1993–1998. Health Economics, 12(11), 921–934.
23. World Health Organization. (2010). Health systems financing: The path to universal coverage. WHO.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

CHALLENGES IN GATHERING DATA FOR CYBER INTELLIGENCE UTILIZING OPEN-SOURCE INTELLIGENCE (OSINT)

Manjeet Singh[1], Annapurna Metta[2] and Satyendra Patnaik[3]
[1]a. Research fellow Amity Business School, Amity University Chhattisgarh
b. Manager of software engineering, Clear Trail Technologies Pvt Ltd. SDF No. K-12, , NSEZ, Noida, UP 201305
[2]Assistant Professor, Amity Business School, Amity University Chhattisgarh
[3]Professor & Dean, JSS University Noida: Noida, Uttar Pradesh, IN
[1]Orcid ID: https://orcid.org/0009-0000-2157-1388, [2]Orcid ID: https://orcid.org/0009-0009-2015-6815 and [3]Orcid ID: https://orcid.org/0000-0002-1296-3387'

ABSTRACT
This document thoroughly analyzes the major obstacles faced during the gathering of data for cyber intelligence activities that employ Open-Source Intelligence (OSINT). It classifies andanalyzesthese obstacles in terms of technical (scale, speed, diversity, accuracy), operational (equipment, automation,OpSec), ethical (privacy, consent, bias), and legal (regulatory compliance, intellectual property rights) aspects. The report wraps up by suggesting strategic mitigation strategies and optimal practices to improve the effectiveness and integrity of OSINT-based cyber intelligence collection, emphasizing the essential equilibrium between thorough data collection and responsible behavior in a changing digital environment.

1. INTRODUCTION
Open-Source Intelligence (OSINT) is essentially characterized as the organized collection and examination of data sourced from publicly accessible channels. These channels include an extensive range of information such as websites, social media networks, public records, news media, and scholarly articles. Within the field of cybersecurity, OSINT holds a crucial significance. It allows security professionals and national intelligence organizations to proactively detect potential threats, weaknesses, and risks by observing online behaviors and emerging patterns. Its use also encompasses understanding methods of attack, forecasting new threats, and improving incident response skills. The transformation of OSINT from its historical background in military intelligence during the Cold War to its current vital role in contemporary intelligence collection is primarily due to the rise of the internet, social media, and digital platforms, which have significantly broadened the landscape of available information.

Despite its essential importance and extensive use, the practice of gathering data for cyber intelligence via OSINT encounters significant obstacles. These difficulties are not only technical in nature but also encompass intricate operational, ethical, and legal aspects, greatly influencing the efficacy, dependability, and credibility of OSINT operations. This research paper seeks to deliver a thorough and detailed exploration of these intricate challenges, presenting nuanced insights into their essence, effects, and possible approaches for alleviation. The ultimate goalis to promote more efficient, dependable, and accountable OSINT methods within the cyber intelligence sector.

A crucial characteristic of OSINT that poses a significant challenge is its dual-use quality. As mentioned, OSINT is a tool used by "security professionals, governmental intelligence organizations, or cybercriminals." This indicates that the same methods and accessible information that cybersecurity defenders utilize to discover and address weaknesses can also be, and are, employed by harmful individuals for malicious activities. For example, adversaries take advantage of OSINT for phishing, social manipulation, gathering credentials, infrastructure scouting, doxxing, and attacks on supply chains. This intrinsic ability for both protective and aggressive usescreatesa constant "arms race" dynamic. Any progress or optimal practice in genuine OSINT must foresee and protect against its possible undermining or misuse by opponents, thus increasing the complexity of ethical and legal factors.

Additionally, a notable contradiction is present in OSINT: the excess of information frequently results in a deficiency of usable intelligence. With "over 400 terabytes of data generated and uploaded online each day," organizations often feel "flooded with data at their disposal." However, this massive amount does not inherently mean it transforms into useful intelligence. Indeed, "open sourcedata typically lacks the necessary context to be significant for security teams, and the sheer "amount and distribution of data makes it difficult to filter and concentrate on what's important at the appropriate time." This underscores a serious "signal-to-noise ratio" issue. The primary challenge is not in gathering raw data, but in the following steps of processing, filtering, and analyzing it to derive relevant, contextualized, and actionable insights. This requires highly refined collection

ISSN 2394 - 7780

methods and sophisticated analytical abilities, especially those enhanced by Artificial Intelligence and Machine Learning, to address this fundamental issue, as human analysts quickly find themselves overwhelmed by the vast quantity of information.

2. THE FUNDAMENTAL IMPORTANCE OF OSINT IN CYBER INTELLIGENCE

OSINT acts as an essential foundation for contemporary cybersecurity inquiries, assisting analysts and law enforcement in identifying threats, evaluating risks, and collecting information from sources that are publicly accessible. It allows experts to actively identify and minimize potential security incidents by observing online behaviors, conversations, and new trends.

Key uses of OSINT in cybersecurity consist of:

- **Threat Surface Assessment:** OSINT is widely utilized to chart an organization's online presence and recognize possible points of attack. This includes grasping which aspects of a system are visible on the internet, such as exposed ports, outdated software with known flaws, and publicly accessible IT setups like device labels and IP addresses.
- **Understanding Threat Actors:** It assists in collecting information regarding an opponent's actions, inclinations, strategies, reasons, and behaviors. This is typically accomplished by observing internet discussion boards, social networks, and cybercriminal groups to detect new risks and methods of attack.
- **Social Engineering Defense:** OSINT serves as a double-edged blade in social engineering. Malicious actors frequently exploit it to gather personal and professional details about employees via social media, creating persuasive spear-phishing schemes. On the other hand, cybersecurity professionals utilize OSINT to comprehend these strategies and take preemptive measures to safeguard their organizations and staff.
- **Vulnerability Identification:** In addition to network setups, OSINT can reveal inadvertently shared metadata that holds sensitive details or detect unpatched systems with recognized weaknesses, offering essential insights for protective actions.
- **Dark Web Monitoring:** Cyber intelligence groups consistently track data theft markets and covert discussion boards on the dark web for compromised credentials, financial documents, and company information. This effort also involves detecting possible insider threats by monitoring conversations where dissatisfied employees could be tempted to offer confidential data.
- **Brand Protection:** OSINT helps organizations identify imitation products, unapproved brand usage on the internet, and track public opinion and reputational threats on multiple digital channels.

OSINT utilizes an exceptionally varied and constantly changing collection of information that is publicly availablesources :

- **Websites and Online Forums:** This category encompasses gathering data from conventional websites,analyzingHTML source code, along with utilizing web crawling and scraping methods. News organizations, blogs, and different online forums, abundant in debate and user-produced material, are essential resources. Archiving services such as the Wayback Machine are important for retrieving historical information and conserving temporary web content.
- **Social Media Platforms:** Platforms like X (previously Twitter), Facebook, Instagram, TikTok, Telegram, Reddit, and LinkedIn are essential for observing public opinion, following hashtags, analyzingtendencies, and recognizing relationships among people and communities.
- **Public Records and Government Databases:** These are frequently seen as some of the most trustworthy OSINT data sources because of their official, organized, and legally valid character. They encompass court documents, patent applications, business registrations, regulatory announcements, legislative and voting histories, as well as public safety information.
- **Academic Publications and Research Papers:** These offer essential insights, explanations, and comprehensive evaluations, acting as trustworthy references for OSINT professionals.
- **Technical Databases and Documentation:** This includes DNS queries, WHOIS searches, mapping network routes, recognizing online infrastructure trends, and gathering information from publicly accessible IoT devices. Specialized search engines such as Shodan andCensys are utilized to identify devices linked to the internet and offer in-depth information regarding network setups and weaknesses.

ISSN 2394 - 7780

- **Deep Web and Dark Web:** The deep web consists of material that isn't indexed by conventional search engines yet remains openly available. The dark web, which necessitates particular access software such as Tor, features marketplaces for data breaches and clandestine forums where pilfered credentials and confidential information are exchanged.
- **Geolocation and Mapping Tools:** This entails utilizing IP address geolocation, tracking the locations of Wi-Fi networks, examining geo-tagged information, and using satellite images. Satellite and aerial images are recognized as impartial and confirmable sources, especially valuable in regions with limited ground access.
- **Metadata:** Data contained in digital files (e.g., images, documents, videos) like timestamps, geographic coordinates, and the device utilized. Retrieving and analyzingmetadata is essential for confirming the legitimacy and source of digital evidence.

The varied uses of OSINT emphasize the interrelation of its different applications, stressing the necessity for comprehensive collection approaches. Threat surface evaluation, for example, may include analyzing technical data ,which could subsequently be connected to particular threat actors recognized through social media insights or exchanges on dark web platforms. A thorough comprehension of a cyber threat frequently requires assembling information from various, seemingly unrelated sources. This interconnectivity implies that effective OSINT for cyber intelligence cannot be executed in isolation, concentrating solely on one form of data or a single threat vector. Rather, it requires a comprehensive collection approach that facilitates widespread data acquisition, cross-referencing, and cohesive analysis across all potential intelligence needs. The difficulty, then, lies not simply in gathering data for a singular, predefined goal, but in developing adaptable collection techniques and tools that can incorporate diverse data types to create a complete and intricate cyber intelligence overview. This calls for tools with solid data integration and centralization capabilities.

Another essential factor is the ever-changing character of OSINT sources, which requires constant adjustment. As noted, "the sources of OSINT are varied and continuously developing." This fluid environment poses a considerable challenge, as "Keeping Up with Rapidly Changing Information" is a significant difficulty. Additionally, open-source data "can easily be modified or deleted from the internet" since it is "largely not regulated or subjected to any supervision." The dependence on publicly accessible data implies that OSINT sources are fundamentally unstable. Social media platforms often revise their APIs and terms of service, websites may be redesigned or discontinued, and public records can be archived, restricted, or become harder to access over time. This highly dynamic context suggests that static OSINT collection methods are inadequate. The issue is not only about what data to gather but also how to sustain reliable access and ensure the ongoing relevance and currency of the gathered information. This calls for flexible collection techniques, ongoing observation of source availability and content modifications, and strong archiving capabilities (e.g., WaybackMachine)to maintain transient data. Not adapting to these developments may result in obsolete or insufficient intelligence, significantly affecting the effectiveness of cyberdefense.

3. TECHNICAL AND OPERATIONAL DIFFICULTIES IN OSINT DATA GATHERING

3.1. Data Size, Speed, and Diversity

The immense quantity of publicly accessible information presents a significant obstacle to efficient OSINT data gathering. With "over 400 terabytes of data generated and shared online each day," organizations find themselves " inundated with data readily available." This astonishing amount results in information overload for human analysts, creating immense challenges in filtering, deriving valuable insights, and obstructing efficient analysis and prompt decision-making. The issue lies not in a deficiency of data, but in an overabundance, resulting in the signal-to-noise ratio being a major obstacle.

OSINT depends on information that is predominantly unregulated and can be readily changed, refreshed, or eliminated from the web. This built-in instability implies that data can become outdated swiftly, making "staying abreast of swiftly evolving information" a considerable challenge for investigators. The promptness of intelligence is crucial in cybersecurity, and swiftly diminishing data presents a significant obstacle to preserving up-to-date and pertinent intelligence perspectives.

Additionally, OSINT information comes from a wide variety of varied sources, such as organized databases, unstructured content from social media, media files, and technical logs. This diversity results in data that is broken up, unindexed, and at times purposefully concealed or obfuscated, particularly from the deep and dark web. The inconsistency in context among these different sources adds to the challenge of rendering the information useful for security teams, necessitating considerable work in data normalization and integration.

ISSN 2394 - 7780

The massive amount of data significantly intensifies the difficulties related to data quality and processing effectiveness. Taking into account the "over 400 terabytes of data generated and shared online each day" along with the reality that "Data Quality and Verification" is a keystruggle ,it becomes evident that the volume of data worsens the quality issue. A more extensive dataset naturally includes more noise and a heightened chance for misinformation to be integrated and obscured, placing considerable demands on computational and analytical processes. This results in a significant bottleneck where human analysts become rapidly inundated, and even sophisticated automated systems find it challenging to differentiate authentic signals from irrelevant noise, which could result in misunderstandings, overlooked urgent threats, or the endorsement of deceptive leads. Therefore, the vast amount of data directly amplifies the challenges related to data quality and the extraction of actionable insights.

To successfully address the obstacles created by the amount, speed, and diversity of data, a necessary transition is occurring towards flexible, AI-powered filtering and contextual understanding. As indicated, "With the assistance of machine learning (ML) and artificial intelligence (AI), threat intelligence systems can aid in handling and prioritizing this information, while also disregarding certain data points according to the guidelines established by the organization." Furthermore, "Open source"artificial intelligence integration" is increasingly utilized for "automated data gathering," "natural language understanding for content examination," and "predictive analysis for threat evaluation." This suggests that the approach is not merely about amassing more information, but rather about executing more intelligent filtering, prioritization, and contextualization techniques. AI and ML are becoming essential for pre-processing, classification, relevance ranking, and large-scale anomaly detection, thus greatly alleviating the analytical load on human analysts. As a result, the primary challenge for OSINT professionals and developers transitions from simply acquiring raw data to creating and implementing advanced AI models that can comprehend context, spot intricate patterns, and prioritize information with a high degree of accuracy. The future effectiveness and scalability ofOSINT tools will be unavoidably connected to their sophisticated AI functionalities, converting unrefined data into genuinely actionable insights.

Table 1: The "4 Vs" of Big Data Challenges in OSINT Data Gathering

Challenge (The "V")	Description	Impact on OSINT Data Collection
Volume	The vast amount of information produced and accessible from public sources each day.	Excessive information; challenge in sifting through pertinent details; obstructs efficient analysis and judgment.
Velocity	The pace at which information is generated, revised, and becomes outdated.	Swift data becoming outdated; obstacles in preserving up-to-date knowledge; struggle to keep pace with fast-evolving information.
Variety	The variety of data types, formats, and origins (structured, unstructured, multimedia).	Scattered, unlisted, and obscured information; absence of uniform context; intricate data standardization and amalgamation.
Veracity	The precision, dependability, and consistency of the information.	False information, misleading information, and deepfake technology; challenges in evaluating source reliability; reinforcement of prejudices in interpretation.

3.2. Data Veracity and Reliability

A central difficulty in OSINT is validating the accuracy and legitimacy of information. Information obtained from numerous public sources may be lacking, prejudiced, outdated, or simply incorrect. Opponents are actively involved in information warfare, manipulating search outcomes by creating counterfeit websites to deceive web crawlers and spread malware. The rise of AI-produced material, including deepfake videos and deceptive stories, makes verification even more challenging, presenting substantial threats to both credibility and safety. When a false narrative starts to gain momentum, algorithms can further promote it, driving investigators further into echo chambers.

Evaluating the reliability of various sources is essential and quite difficult. This entails careful cross-checking of results from different sources, searching for supporting evidence, analyzing the uniformity of data points, and recognizing possible biases or inaccuracies. The dark web poses an even more significant challenge, as information tends to be fragmented, unorganized, and deliberately misleading, rendering trustworthy attribution particularly hard to achieve by its very nature.

Apart from deliberate misleading, there can be intrinsic biases present in the gathered data. When AI systems are trained on biased datasets, they can adopt and continue these biases, resulting in prejudiced or unjust targeting of specific groups. This issue is especially serious in critical areas such as law enforcement and monitoring, making it essential to routinely examine AI models for biases to maintain equity in data evaluation.

The issue of data authenticity has transformed into a complex and intentional strategy used by harmful individuals. The reality that "Attackers are also recognized for manipulating Google searches by creating a web of fraudulent sites that provide fundamentally untrustworthy information"open source data" ,alongside the emergence of "Misinformation and Deepfakes" as ethical issues in AI-drivenOSINT ,suggests that the issue extends beyond unintentional mistakes or the inevitable degradation of information. This implies that OSINT professionals are not solely engaged in fact-checking; they are also working against intricate disinformation operations intended to misguide, influence, and obscure the truth. This demands a comprehensive grasp of opponent strategies, incentives, and the technological tools they use to disseminate misleading narratives. As a result, mitigation approaches must go further than basic source verification to encompass proactive counter-intelligence functions within the OSINT field, such as pinpointing the origins of altered content and monitoring its distribution channels, necessitating ongoing alertness and adaptability.

Despite the progress made in automation, the importance of human insight continues to be essential for establishing the genuine accuracy of OSINT findings and reducing biases. The necessity for human investigators to "cross-verify various sources, seeking supporting evidence," and to carefully assess "the credibility of sources, analyze the consistency of data points, and pinpoint possible biases or inaccuracies" is clearly highlighted. Even with the assistance of AI tools, "human oversight" is highly advised, along with periodic evaluations of AI models for biases. Additionally, addressing "Psychological & Cognitive Biases" through approaches like "Peer review," "The Analysis of Competing Hypotheses," and "Adversarial debiasing" is vital. While AI is capable of handling large volumes of data and recognizing patterns, it presently falls short in providing the nuanced critical analysis, contextual understanding, and moral judgment required to fully verify accuracy or alleviate subtle biases. Unrestrained automation may exacerbate misinformation or unfair results if the foundational data or algorithms are flawed. Thus, human intelligence, with its ability for critical assessment,skepticism, and the capacity to implement intricate ethical structures, persists absolutely essential. The advancement of efficient OSINT depends on a collaborative relationship between humans and AI, with AI managing the bulk of data collection and preliminary pattern identification, while human analysts contribute the essential elements of judgment, ethical review, and detailed validation necessary to generate genuinely trustworthy and impartial intelligence.

3.3. Tooling and Automation Limitations

Executing successful OSINT inquiries typically requires the employment of specific tools and an advanced degree ofhuman technical skill. Numerous advanced OSINT platforms and instruments, although effective, necessitate considerable financial commitments, posing a major challenge for smaller entities or solo researchers. The complexity involved in mastering these various tools also serves as an obstacle for newcomers, demanding substantial training and expertise to efficiently utilize the extensive range of accessible resources.

While OSINT tools utilizing AI offer swift data gathering and analysis ,their complete automation encounters considerable obstacles, frequently because of the lack of official APIsor the restrictions of current options. Websites and platforms utilize anti-scraping techniques, CAPTCHAs, and dynamic content that may hinder or complicate automated data retrieval. Complying with platform terms of service is also a legal and ethical limitation. In addition, creating fraudulent accounts or imitating human behaviorbehaviorat scale to circumvent limitations poses both operational hazards (detection) and legal issues. Automateddefensesare becoming more advanced, identifying expected scrolling or excessive clicking behaviors.

The extensive range of OSINT resources frequently results in information being gathered and held in separate systems, resulting in data silos. This division complicates the ability to sift through, concentrate on, and relate information accurately. Successful intelligence necessitates combining insights from various sources to create a unified and precise understanding. The absence of smooth integrations among different tools within an organization can greatly obstruct the analytical process.

Various instruments are available to tackle these difficulties:

- **Maltego:** An effective instrument for analyzing connections and mapping data, Maltegoassists in handling information excess by illustrating intricate connections among entities in a readily comprehensible graph format.

ISSN 2394 - 7780

- **Shadow Dragon (Horizon™ Monitor, MalNet™):** This platform provides extensive investigative features, such as ongoing monitoring of online data flows, keyword notifications, and the ability to visualize malware relationships. It is intended to handle both data quantity and speed by delivering immediate insights and automated oversight.
- **Exif Tool:** Essential for data accuracy, ExifToolextracts metadata from photographs, sound, video files, and documents. It assists in confirming authenticity, determining geolocation, and identifying timestamps, contributing to the verification of digital evidence.
- **Spider Foot:** This application streamlines the gathering of OSINT and threat intelligence, examining domains, IP addresses, and email addresses from numerous data sources. It assists in handling the amount and diversity by automating routine activities and connecting with different APIs.
- **Shodan and Censys:** These are dedicated search engines designed to locate internet-connected devices, recognize IoT devices, servers, open ports, and security weaknesses. They offer valuable information about network infrastructure, assisting in evaluating potential threats.
- **Google Dorks:** These are sophisticated search operators for Google that enable accurate targeting of search outcomes to reveal concealed or sensitive information, assisting in sifting through extensive data sets.
- **Archiving Tools (Hunchly, Wayback Machine, Archive.today):** Critical for tackling data obsolescence and maintaining evidence, these instruments record and timestamp web pages, enabling investigators to access past versions of websites and gather evidence for future examination.

A key contradiction exists in OSINT automation: finding a balance between efficiency and the risks of evasion and ethics. Although AI-driven tools allow for "swift data gathering, examination, and pattern recognition," ,automation tools, headless browsers, and rotating proxies, although beneficial, necessitate thoughtful evaluation of "ethical and legal ramifications." Automateddefensesare progressively triggered when researchers scroll in a predictable manner or click too much, and creating fraudulent accounts to access restricted content poses both operational threats and legal issues. The fundamental dilemma, then, is not only about automating data gathering, but also about implementing automation in a smart and ethical way to guarantee operational safety, prevent detection, and stay compliant with legal and ethical guidelines. This indicates a vital requirement for flexible, responsive, and human-directed automation approaches that can adapt to changing platform conditions.defensesand follow strict ethical standards, instead of depending solely on forceful or unregulated approaches.

This situation fosters a continuously changing competition in OSINT tools and their counteractions. Platforms consistently "observebehavior patterns" and deploy "Automated defenses" in response to predictable or extreme actions by investigators. This ongoing adjustment by subjects, combined with the challenge of "Staying Current with Fast-Paced Information" and "developing digital landscapes"" ,indicates that the realm of OSINT tools and data gathering is in constant flux. With the advancement of OSINT tools and automation methods, online platforms and targets are concurrently enhancing their defenses to identify and prevent automated data extraction while safeguarding user privacy. This ongoing loop of innovation and counteraction necessitates that OSINT tool creation must continually adapt to overcome emerging challenges.defenses. The challenge for practitioners is not just acquiring the latest tools, butkeeping up with both emerging tool functionalities and the constant evolving counteractions they encounter, requiring constant commitment to research and development, along with continuous training and adjustment for OSINT teams.

3.4. Operational Security (OpSec) and Attribution Risks

Stringent Operational Security (OpSec) is paramount in OSINT to ensure the safety of investigators and the integrity of their collection efforts. This means staying invisible to targets. Key practices include never using personal devices or accounts for investigative operations, employing believable pseudonyms, and establishing "burner accounts" with credible digital histories. Devices used for OSINT should be compartmentalized, and research identities must remain completely separate from real-world identifiers to prevent inadvertent attribution.

The risk of exposing an investigator's identity or infrastructure is significant. IP addresses are a common "giveaway" of an investigator's location or organization. Therefore, the critical use of Virtual Private Networks (VPNs), proxies, or anonymizing services like Tor is essential when interacting with live environments. Furthermore, advanced fingerprinting countermeasures, such as browser isolation, script blocking, and user-agent randomization, are necessary to prevent platforms from identifying and tracking investigators. Platforms

ISSN 2394 - 7780

are increasingly sophisticated, actively monitoring behavior patterns and activating automated defenses when investigators scroll too predictably or click excessively.

While OSINT can access the dark web, information gathered from dark web forums, marketplaces, and anonymous messaging platforms presents unique attribution challenges. Such data is often fragmented, unindexed, and intentionally hidden or deceptive, making reliable attribution extremely difficult by design. Thorough analysis demands meticulous scrutiny of subtle clues like language patterns, timestamps, aliases, and embedded metadata to infer origins and connections.

The escalating sophistication of counter-OSINT measures necessitates proactive OpSec. The explicit mention that "Platforms monitor behavior patterns. Automated defenses are activated when investigators scroll too predictably or click excessively" indicates that the "targets" of OSINT (whether individuals, organizations, or online platforms) are not passive entities. They are actively developing and deploying increasingly sophisticated technical and behavioral countermeasures to detect and deter OSINT activities. This elevates OpSec from a mere best practice to a critical, constantly evolving battleground. The challenge is not just applying standard OpSec protocols, but continuously adapting to these intelligent and automated counter-OSINT measures. This requires OSINT practitioners to possess advanced technical understanding of network forensics, browser fingerprinting, and behavioral analysis, and to adopt a proactive security posture, anticipating how their activities might be detected and developing novel evasion techniques. Failure to do so risks not only compromising the investigation but also exposing the investigator and their organization to potential retaliation or legal repercussions.

There is an inherent trade-off between the depth of collection and operational security. The distinction between Passive OSINT (gathering information without interaction, leaving no traces) and Active OSINT (engaging with the target, potentially leaving digital footprints) highlights this tension. While combining both approaches is often beneficial, it requires balancing "information needs against operational security". Active methods, such as "Establishing fake accounts for accessibility purposes while harvesting restricted content or mimicking human behavior at scale," present both operational risks and legal concerns. This creates a critical decision point for OSINT investigators: how much risk are they willing to tolerate to obtain a higher quality or quantity of data? This implies that effective OSINT strategies must involve a careful and continuous risk assessment for each collection activity, potentially prioritizing passive methods in high-risk scenarios and only deploying active methods when absolutely necessary, with robust, layered OpSec protocols in place, and a clear understanding of the potential consequences.

4. ETHICAL AND LEGAL IMPEDIMENTS TO OSINT DATA COLLECTION

4.1. Privacy Concerns and Consent

A fundamental ethical dilemma in OSINT is the tension between the public availability of information and individuals' inherent right to privacy. Even when data is publicly accessible, its collection and analysis without explicit consent can be ethically questionable. The very definition of privacy is constantly evolving, with a growing public expectation that personal data should not be exploited, regardless of its public status.

Ethical data collection mandates that it be voluntary and based on informed consent, where individuals clearly understand what data is being collected, why it is needed, and how it will be used. Collecting personal data without consent is considered both unlawful and unethical, as individuals retain ownership over their shared personal information. The challenge is compounded by users often unknowingly agreeing to broad terms of service without fully comprehending the implications for their data.

Gathering data that is excessive or irrelevant to the stated purpose is unethical and significantly increases security and privacy risks. Excessive data collection can lead to severe consequences such as data misuse (e.g., identity theft, fraud, unauthorized surveillance), information overload for analysts, increased risk of data leaks, and the creation of detailed profiles that enable discrimination based on sensitive personal factors. Indiscriminate data hoarding also poses a direct risk of breaching data protection legislation like GDPR, compromising both the efficiency and ethical standing of investigations.

A profound ethical dilemma at the heart of OSINT is the "public but private" conflict between technical accessibility and evolving societal norms. Snippets repeatedly emphasize that "just because data is publicly available does not mean it is ethical to collect and analyze it without consent". This is not merely a legalistic interpretation but a matter of perceived ethicality, as the definition of privacy is constantly being redefined, with a growing public expectation that personal data should not be exploited. The challenge lies in navigating this complex grey area where technical accessibility does not automatically equate to ethical permissibility. This

ISSN 2394 - 7780

demands that OSINT practitioners develop a strong ethical compass that transcends mere legal adherence, compelling them to consider the broader societal impact and potential individual harm of their data collection activities, even when operating within the strict letter of the law. It requires a commitment to responsible data stewardship that anticipates future privacy norms.

If OSINT practitioners, or the organizations employing them, are perceived by the public as violating privacy norms, misusing publicly available data, or engaging in ethically dubious practices, it can lead to a significant erosion of public trust. Snippet highlights that "Consumers increasingly expect businesses to be open about their data practices," and warns of "reputational damage" and "privacy infringements" from excessive data collection. This erosion of trust is not just a reputational risk; it has tangible, long-term implications for the very foundation of OSINT. It could trigger increased public pressure for more stringent regulations, compel online platforms to implement more aggressive anti-OSINT measures (e.g., stricter terms of service, technical blocks), or lead individuals to become significantly more circumspect about what they share online. Ultimately, this could reduce the future availability and richness of open-source data, thereby creating a critical, self-inflicted challenge for the OSINT community. This implies that ethical OSINT practices are not merely about current compliance, but about strategically preserving and sustaining the open-source information ecosystem from which OSINT derives its immense value.

4.2. Legal Frameworks and Compliance

OSINT activities are subject to a complex patchwork of data protection and privacy laws, such as the General Data Protection Regulation (GDPR) in the European Union and the California Consumer Privacy Act (CCPA) in the United States. These laws impose strict limitations on the processing of personal data, even if it is publicly available, often requiring a lawful basis for processing and granting individuals rights like data access, correction, and deletion. The varying regulations across different countries create significant challenges for international OSINT operations, making consistent compliance difficult.

OSINT must be strictly differentiated from illegal activities like hacking or unauthorized data breaches. Laws such as the Computer Fraud and Abuse Act (CFAA) in the U.S. broadly prohibit unauthorized access to computer systems. Furthermore, scraping data from websites that explicitly prohibit such activity in their terms of service can lead to legal violations, even if the data is publicly visible.

The public availability of information does not automatically grant permission for its unrestricted use. Copyrighted materials, including articles, images, and videos, are protected by intellectual property laws. Using or redistributing such content without proper permission can lead to copyright infringement claims. While "fair use" (in the U.S.) or "fair dealing" (in other jurisdictions) may offer limited exceptions, it is a complex legal analysis that considers various factors, and misusing copyrighted OSINT sources can expose individuals and organizations to significant legal risks.

Extensive social media monitoring by law enforcement without probable cause can raise Fourth Amendment concerns regarding unreasonable searches and seizures in the U.S., potentially violating privacy rights. The use of OSINT tools for mass surveillance, even on publicly available data, can lead to constitutional challenges and legal scrutiny. Additionally, engaging in OSINT research on foreign governments, military operations, or politically sensitive topics may subject practitioners to counterintelligence laws if deemed a national security risk or if it involves accessing trade secrets.

The global nature of modern cyber threats often necessitates OSINT investigations that transcend national borders. However, the fragmented, often conflicting, and constantly evolving legal frameworks across different jurisdictions create a significant compliance burden and a veritable legal minefield for OSINT practitioners. As stated, "Different countries have varying regulations on data privacy, making it difficult to determine what constitutes ethical OSINT across jurisdictions". What might be legally permissible or ethically acceptable in one country (e.g., access to certain public records) could be illegal or highly restricted in another. This "jurisdictional patchwork" severely hinders the seamless, comprehensive, and agile collection of global cyber intelligence, forcing organizations to either limit their investigative scope or invest heavily in complex, multi-jurisdictional legal counsel. This directly impacts the scalability, efficiency, and reach of OSINT operations, making legal compliance a continuous, high-stakes challenge.

Furthermore, a persistent lag exists between technological capability and legal adaptation. While "AI-powered OSINT tools can aggregate vast amounts of personal data" , enabling unprecedented capabilities for data aggregation, analysis, and pattern recognition, the development and adaptation of legal frameworks consistently lag behind these technological leaps. Laws designed for a pre-digital or early-internet era often struggle to adequately address the nuanced complexities of large-scale, automated collection and processing of publicly

ISSN 2394 - 7780

available data. This creates a significant regulatory gap where OSINT practitioners frequently operate in a legal grey zone, constantly at risk of unforeseen legal challenges as courts and legislatures attempt to interpret existing laws or formulate new ones to catch up. This implies a continuous need for proactive legal scholarship, policy advocacy, and rigorous internal risk assessment within the OSINT community to anticipate and navigate these evolving legal interpretations and potential regulatory shifts.

Table 2: Key Legal and Ethical Considerations in OSINT Data Collection

Category	Relevant Laws/Principles	Specific Implications for OSINT
Privacy & Consent	Informed Consent, Data Minimization, Transparency, Right to Privacy	Collection without consent is unethical/unlawful; excessive data increases risks; requires clear communication and responsible stewardship.
Data Protection Laws	GDPR (EU), CCPA (US), various national privacy acts	Need for lawful basis for processing personal data; compliance burden for international operations; individuals' rights to access/delete data.
Unauthorized Access & Terms of Service (ToS)	Computer Fraud and Abuse Act (CFAA), website ToS	Prohibits hacking/unauthorized system access; scraping data against ToS can lead to legal violations.
Intellectual Property (IP)	Copyright laws, Fair Use/Fair Dealing, Defend Trade Secrets Act (DTSA)	Public availability does not negate copyright; requires permission for use/redistribution; risk of infringement claims if fair use is misapplied.
Surveillance & National Security	Fourth Amendment (US), Counterintelligence laws	Concerns over mass surveillance without probable cause; restrictions on collecting sensitive foreign intelligence; risk of trade secret misappropriation.
Algorithmic Bias & Accountability	Fairness, Transparency, Explainability (XAI)	AI models can perpetuate societal biases; challenges in human oversight for automated systems; need for explainable AI to ensure ethical use.

4.3. Algorithmic Bias and Accountability

The increasing integration of AI and machine learning into OSINT tools introduces a critical ethical challenge: the potential for algorithmic bias. AI models are trained on vast datasets, and if these datasets contain inherent societal biases, the AI models may inherit and inadvertently perpetuate or even amplify these biases. This can lead to discriminatory or unfair targeting of certain groups, which is particularly concerning in sensitive applications such as law enforcement and surveillance.

AI-driven OSINT operations can process and analyze data at a scale far beyond human oversight, making it challenging to ensure ethical compliance and prevent misuse. The "black box" nature of some advanced AI models can obscure how decisions or classifications are made, hindering transparency. Ensuring algorithmic accountability—meaning AI models remain transparent, fair, and explainable—is crucial to prevent unethical intelligence use and to allow for auditing and remediation of biases.

The integration of AI into OSINT poses a profound risk that extends beyond mere data collection; it can automate and amplify existing societal biases present in the training data, leading to systematically discriminatory outcomes in intelligence analysis and targeting. Snippet explicitly warns that "AI models may inherit biases from the data they are trained on, leading to discrimination or unfair targeting of certain groups." It also lists "Misinformation and Deepfakes" as ethical concerns. Furthermore notes that "Once a false narrative gains traction, algorithms can reinforce it by surfacing similar content, clustering related information, and pushing investigators deeper into echo chambers." AI's capability to generate and disseminate highly convincing deepfakes and sophisticated misinformation, coupled with its inherent ability to reinforce false narratives through algorithmic amplification, means that AI-powered OSINT can inadvertently become a powerful tool for spreading or validating untruths. This transforms the challenge from simply collecting data to actively combating the potential for AI to corrupt the intelligence process itself, demanding rigorous ethical AI development, continuous auditing, and robust oversight mechanisms.

ISSN 2394 - 7780

Given the profound and potentially far-reaching risks of algorithmic bias and the challenges in ensuring accountability, it is insufficient to merely apply ethical guidelines *after* an AI tool has been developed and deployed. The principle of "Ethical AI by Design" becomes paramount for OSINT tools. Snippet outlines "Best Practices for Ethical AI-Powered OSINT," including directives to "Address Algorithmic Bias," "Implement Transparency and Accountability Measures," and "Educate and Train Users." Similarly reinforces the need to "Ensure Fairness" and "Avoid bias in datasets and algorithms" in big data collection. This means proactively integrating bias detection mechanisms, fairness metrics, explainable AI (XAI) features, and robust human-in-the-loop validation processes *into the very architecture, development lifecycle, and continuous improvement of OSINT AI tools*. The challenge for both developers and practitioners is to embed ethical considerations into the core functionality of these tools from conception, rather than treating them as an afterthought or a superficial compliance checklist, thereby ensuring that the technology inherently supports responsible and unbiased intelligence gathering.

5. MITIGATION STRATEGIES AND BEST PRACTICES

Addressing the multifaceted challenges in OSINT data collection for cyber intelligence requires a comprehensive and multi-pronged approach, integrating structured methodologies, advanced technology, and rigorous ethical and legal adherence.

5.1. Structured Methodologies and OSINT Lifecycle Adherence

Implementing a systematic and disciplined approach to OSINT is crucial for managing complexity and ensuring thoroughness. This involves strictly adhering to the OSINT lifecycle, which typically includes stages such as planning and objective setting, data collection, processing, analysis, reporting, and feedback. Clearly defining intelligence requirements and objectives at the outset helps focus efforts and minimize the collection of irrelevant data. Developing a structured collection plan that outlines tools, techniques, search terms, and timelines is essential for systematic data gathering. This structured approach helps in navigating the vast information landscape and ensures that efforts remain focused and ethical.

5.2. Advanced Tooling and Automation with Human Oversight

To combat information overload and the velocity of data, leveraging advanced OSINT tools with automation capabilities is indispensable. Platforms like ShadowDragon, with features like Horizon™ Monitor, enable continuous tracking of online data streams, keyword alerts, and real-time threat notifications, effectively managing large volumes of rapidly changing information. Tools such as SpiderFoot automate data collection across diverse sources, integrating with APIs to streamline reconnaissance. Maltego aids in visualizing complex relationships, transforming raw data into actionable insights by mapping connections between entities.

However, the automation paradox dictates that efficiency must be balanced with operational security and ethical considerations. While AI and machine learning can assist in managing and prioritizing data, dismissing irrelevant points, and performing natural language processing for content analysis , human oversight remains critical. Automated tools must be designed to be dynamic and adaptive, capable of responding to evolving platform defenses and adhering to stringent ethical guidelines, rather than relying on brute-force methods that risk detection or legal breaches. Intelligent automation can provide detailed insights with less data, but it must be paired with human-led decisions to avoid ethical compromises and unnecessary data hoarding.

5.3. Robust Data Verification and Source Credibility Assessment

Ensuring data veracity is paramount. This requires a rigorous approach to source credibility assessment and verification. Cross-referencing findings across multiple sources is a fundamental practice to corroborate information and identify inconsistencies. Tools like ExifTool are crucial for extracting metadata from digital files, helping to verify the authenticity, geolocation, and timestamps of images and documents, thereby enhancing the reliability of digital evidence. Public government databases are generally considered among the most reliable sources, providing structured and legally sound information.

Developing a source assessment checklist or framework, along with incorporating peer review processes, can help evaluate the credibility and bias of sources. Training teams to recognize "red flags" indicating potential misinformation or manipulation is also vital. Given the adversarial nature of information quality, where malicious actors actively disseminate unreliable data , continuous vigilance and adaptive verification techniques are necessary.

5.4. Proactive Operational Security (OpSec)

Maintaining stringent OpSec is critical to protect investigators and their operations from detection and attribution. This involves never using personal devices or accounts for investigative work, employing believable

ISSN 2394 - 7780

pseudonyms, and establishing separate "burner accounts" with credible digital histories. Compartmentalizing devices and ensuring research identities are completely separate from real-world identifiers are essential.

The use of Virtual Private Networks (VPNs), proxies, or anonymizing services like Tor is indispensable to mask IP addresses when interacting with live environments. Furthermore, advanced fingerprinting countermeasures, such as browser isolation, script blocking, and user-agent randomization, are necessary to evade sophisticated platform monitoring that detects predictable scrolling or excessive clicking patterns. OpSec should be a proactive and continuously evolving practice, anticipating counter-OSINT measures and developing novel evasion techniques.

5.5. Strict Adherence to Ethical Guidelines and Legal Frameworks

Ethical and legal compliance forms the bedrock of legitimate OSINT. Practitioners must strictly adhere to data protection laws such as GDPR and CCPA, understanding their varying regulations across jurisdictions. This requires a lawful basis for processing personal data and respecting individuals' rights to privacy, consent, and data management.

Key ethical principles include consent (avoiding collection of private information without explicit permission), transparency (maintaining clear documentation of methods and sources), and data minimization (collecting only data necessary for the investigation). OSINT must be clearly distinguished from illegal activities like hacking or unauthorized access, and website terms of service must be respected to avoid legal violations. Intellectual property rights, including copyright, must be considered, with careful application of fair use principles. For AI-powered OSINT, addressing algorithmic bias and ensuring accountability through transparent and explainable models is crucial to prevent discrimination and misuse.

5.6. Continuous Training and Interdisciplinary Collaboration

The dynamic nature of OSINT challenges necessitates continuous training for practitioners to keep pace with evolving tools, techniques, legal frameworks, and ethical considerations. Training programs should emphasize responsible data handling, ethical considerations, and the importance of privacy, consent, and source attribution.

Interdisciplinary collaboration, involving cybersecurity experts, legal professionals, ethicists, and AI developers, is vital for developing comprehensive guidelines, frameworks, and codes of ethics specific to OSINT. This collaboration helps bridge the gap between technological capabilities and legal/ethical norms, fostering industry standards that promote responsible information gathering while upholding privacy rights.

6. CONCLUSION

The utility of Open-Source Intelligence in cyber intelligence is undeniable, serving as a critical foundation for threat assessment, actor identification, and vulnerability management. However, the effective collection of OSINT data is beset by a complex array of challenges spanning technical, operational, ethical, and legal domains. The sheer volume, velocity, and variety of publicly available information create an overwhelming landscape, where the paradox of information abundance often leads to a scarcity of actionable intelligence. This is further compounded by issues of data veracity, including the pervasive threat of misinformation, disinformation, and algorithmic biases, which are increasingly weaponized by adversaries.

Operationally, the limitations of tooling and automation, coupled with the critical need for robust Operational Security, present continuous hurdles. The arms race between OSINT techniques and counter-OSINT measures demands constant adaptation and sophisticated evasion strategies. Ethically and legally, OSINT practitioners navigate a complex "public but private" dilemma, where technical accessibility clashes with evolving societal expectations of privacy and a fragmented jurisdictional patchwork of data protection laws. The persistent lag between rapid technological advancements and the slower pace of legal adaptation further complicates compliance and risks eroding public trust, which could ultimately diminish the very sources OSINT relies upon.

To overcome these formidable challenges, a holistic and adaptive approach is imperative. This includes strict adherence to structured methodologies throughout the OSINT lifecycle, leveraging advanced tools and automation while maintaining critical human oversight, and implementing robust data verification processes. Proactive Operational Security measures are non-negotiable to protect investigators and the integrity of their findings. Crucially, OSINT must be grounded in unwavering ethical principles and strict legal compliance, demanding continuous training and interdisciplinary collaboration to navigate the intricate landscape of privacy, consent, and algorithmic accountability. By embracing these mitigation strategies, the cyber intelligence community can enhance the efficacy, reliability, and legitimacy of OSINT, transforming the vast ocean of open-source data into truly actionable intelligence for a more secure digital future.

ISSN 2394 - 7780

REFERENCES

- Blackdot Solutions. (n.d.). *Open Source Investigation Best Practices in 2025*. Retrieved from https://blackdotsolutions.com/blog/open-source-investigation-best-practices/
- BitSight Technologies. (n.d.). *How to Use the OSINT Framework: Sources, Tools, & Steps*. Retrieved from https://www.bitsight.com/learn/cti/osint-framework
- CrowdStrike. (n.d.). *What is OSINT Open Source Intelligence?*. Retrieved from https://www.crowdstrike.com/en-us/cybersecurity-101/threat-intelligence/open-source-intelligence-osint/
- Ernest Goodman Law Firm. (n.d.). *The Legal Implications of Using OSINT (Open Source Intelligence)*. Retrieved from https://ernestgoodmanlawfirm.com/the-legal-implications-of-using-osint-open-source-intelligence/
- Imperva. (n.d.). *Open-Source Intelligence (OSINT) | Techniques & Tools*. Retrieved from https://www.imperva.com/learn/application-security/open-source-intelligence-osint/
- Maltego. (n.d.). *How OSINT Helps Find Missing Persons*. Retrieved from https://www.maltego.com/blog/how-osint-helps-find-missing-persons/
- Maulud, D. H., Zeebaree, S. R., Jacksi, K., Sadeeq, M. A. M., & Sharif, K. H. (2016). State of Art for Open Source Intelligence. In *Intelligent Computing and Internet of Things* (pp. 147–156). Springer, Cham. https://doi.org/10.1007/978-3-319-47671-1_14
- Medium. (n.d.). *The Ethical Considerations of OSINT: Privacy vs. Information Gathering*. Retrieved from https://medium.com/@scottbolen/the-ethical-considerations-of-osint-privacy-vs-information-gathering-63b5b2f76c55
- Neotas. (n.d.). *OSINT Tools And Techniques | OSINT Technical Sources*. Retrieved from https://www.neotas.com/osint-tools-and-techniques/
- Neotas. (n.d.). *Open-Source Investigation Best Practices*. Retrieved from https://www.neotas.com/open-source-investigation-best-practices/
- Neotas. (n.d.). *What is the OSINT Framework?*. Retrieved from https://www.neotas.com/what-is-the-osint-framework/
- Peris.ai. (n.d.). *Data Collection in Cybersecurity: More Than Just Numbers*. Retrieved from https://peris.ai/post/data-collection-in-cybersecurity-more-than-just-numbers
- Rapid7. (n.d.). *What is Open Source Intelligence (OSINT)?*. Retrieved from https://www.rapid7.com/fundamentals/what-is-open-source-intelligence-osint/
- ResearchGate. (n.d.). *The Art of Open Source Intelligence (OSINT): Addressing Cybercrime Opportunities and Challenges*. Retrieved from(https://www.researchgate.net/publication/392404120_The_Art_of_Open_Source_Intelligence_OSINT_Addressing_Cybercrime_Opportunities_and_Challenges)
- Sanction Scanner. (n.d.). *Open-Source Intelligence (OSINT)*. Retrieved from https://www.sanctionscanner.com/knowledge-base/open-source-intelligence-osint-729
- ShadowDragon. (n.d.). *Best OSINT Tools*. Retrieved from https://shadowdragon.io/blog/best-osint-tools/
- ShadowDragon. (n.d.). *OSINT Techniques*. Retrieved from https://shadowdragon.io/blog/osint-techniques/
- ShadowDragon. (n.d.). *What are the Common Struggles of OSINT Investigations?*. Retrieved from https://shadowdragon.io/blog/what-are-the-common-struggles-of-osint-investigations/
- ShadowDragon. (n.d.). *What is OSINT?*. Retrieved from https://shadowdragon.io/blog/what-is-osint/
- Trickest. (n.d.). *OSINT Automation Guide*. Retrieved from https://trickest.com/blog/osint-automation-guide/
- Venntel. (n.d.). *OSINT Data Sources*. Retrieved from https://venntel.com/blog/osint-data-sources
- Viva Technology. (n.d.). *Ethical Data Collection: A Guide for Business Owners*. Retrieved from https://vivatechnology.com/news/ethical-data-collection-a-guide-for-business-owners

ISSN 2394 - 7780

- Webasha. (n.d.). *AI-Powered OSINT: Ethical Implications and Challenges*. Retrieved from https://www.webasha.com/blog/ai-powered-osint-ethical-implications-and-challenges/
- YouTube. (n.d.). *How ShadowDragon helps with source reliability OSINT*. Retrieved from((https://www.youtube.com/watch?v=4vWqtIa3Yq4))

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

INVESTMENT MANAGEMENT: UNDERSTANDING ITS NATURE, ROLE IN YOUTH, AND BENEFITS

Ms. Shivangi Ameriya and Ms Sarita Yadav
Assistant Professor, IPS Academy, Institute of Business Management and Reserach, Indore

ABSTRACT
Investment management plays a crucial role in enhancing financial decision-making, capital formation, and wealth accumulation. With the emergence of technology and increasing financial awareness, especially among younger generations, investment management has become a vital tool in personal financial planning. This study investigates the ***characteristics, nature, and scope*** *of investment management, explores its* ***role among youth****, and identifies the* ***benefits*** *associated with sound investment practices. Using secondary data analysis and theoretical frameworks, the research provides insights into how individuals, particularly youngsters, can leverage investment strategies for long-term financial well-being.*

Keywords: *Investment Management, Financial Planning, Young Investors, Wealth Creation, Risk Management, Youth and Finance*

INTRODUCTION
Investment management, also referred to as asset or portfolio management, involves the professional administration of various financial instruments such as equities, bonds, mutual funds, exchange-traded funds (ETFs), real estate assets, and alternative investments. It includes essential functions such as asset allocation, portfolio diversification, financial analysis, risk mitigation, and performance evaluation. The primary objective of investment management is to maximize returns while minimizing risk in alignment with an investor's goals, risk appetite, and investment horizon (Bodie, Kane, & Marcus, 2014). As financial markets become increasingly dynamic and interconnected, the role of investment management has evolved significantly. Factors such as globalization, technological advancements, digital banking, and algorithmic trading have introduced both opportunities and complexities in the investment landscape. Simultaneously, rising inflation, an increase in the cost of living, and economic uncertainties have highlighted the importance of structured financial planning through effective investment strategies (Bhalla, 2013). Moreover, the demographic shift—particularly the growing participation of **millennials and Gen Z** in the workforce—has altered the investment paradigm. Young investors are exposed to financial instruments and investment platforms at an earlier stage in life, thanks to the proliferation of mobile investment applications, digital wallets, and online trading platforms. However, their investment decisions are often influenced by a combination of digital exposure, peer influence, lack of formal financial education, and a desire for instant gratification (Raut, 2020). Given this context, it becomes imperative to explore the **characteristics and scope of investment management**, assess its **relevance for young investors**, and identify the **tangible benefits** it offers in helping individuals achieve long-term financial stability and wealth creation. Understanding these dimensions will not only help promote early investment behavior but also strengthen overall financial literacy and economic empowerment in society.

LITERATURE REVIEW
A number of studies and scholarly works have emphasized the growing importance of investment management, particularly in relation to the behavior and needs of young investors.

NATURE AND SCOPE OF INVESTMENT MANAGEMENT
According to **Singh (2015)**, investment management is both a science and an art. It relies on data-driven techniques such as security analysis and market forecasting, as well as qualitative judgment regarding investor psychology and market trends. The scope of investment management is broad, encompassing not just financial return optimization but also risk reduction, tax planning, and wealth preservation.

Gitman & Joehnk (2010) observed that investment management provides a framework to make informed decisions under uncertainty by balancing return expectations with associated risks. The authors also underline its significance in resource allocation at both individual and institutional levels.

INVESTMENT BEHAVIOR OF YOUTH
Young investors, particularly those aged 18–35, are increasingly becoming an influential demographic in financial markets. **Sajid and Jain (2019)** found that while young adults show interest in investing, many lack the necessary financial literacy to make informed decisions. Their study also revealed that youth tend to prefer short-term gains over long-term stability, often influenced by trends on social media and digital finance influencers.

ISSN 2394 - 7780

Raut (2020) conducted a study on millennial investment behavior in India and found that fintech innovations and user-friendly investment platforms like Groww, Zerodha, and Paytm Money have contributed to increased participation. However, many young investors also fall prey to market hype and lack diversification in their portfolios.

BENEFITS OF INVESTMENT MANAGEMENT

Investment management contributes significantly to wealth accumulation, financial independence, and risk mitigation. **Bodie, Kane, and Marcus (2014)** explain that diversification across asset classes and time horizons helps protect capital and enhances long-term returns. Similarly, **Bhalla (2013)** highlighted that effective investment strategies can safeguard investors against inflationary pressures and provide income during retirement.

Chawla and Sethi (2018) emphasize that with growing access to market knowledge and financial tools, even young individuals can benefit from strategic investment planning. Their research supports integrating investment education into academic curriculums to empower the next generation of investors.

OBJECTIVES OF THE STUDY

1. To study the characteristics, nature, and scope of investment management.
2. To know the role of investment management in youngsters.
3. To identify the benefits of investment management.

RESEARCH METHODOLOGY

This study follows a descriptive research design based on secondary data. Information was collected from journals, reports, financial books, investment blogs, and market research studies. The objective is to conceptualize investment management and understand its implications without conducting primary data surveys.

Characteristics, Nature, and Scope of Investment Management

Investment management is a dynamic and comprehensive discipline that involves the professional handling of financial assets and securities with the goal of achieving specific investment objectives. It goes beyond merely buying and selling stocks or bonds and includes financial planning, portfolio structuring, risk management, and performance evaluation. One of the key characteristics of investment management is that it is goal-oriented. Every investment decision is made with a specific financial target in mind, such as wealth accumulation, retirement planning, or income generation. It also requires a strong foundation in financial analysis, as professionals need to assess market trends, company performance, and economic indicators to make informed choices.

Another critical characteristic is its risk-return trade-off nature. Investors must evaluate and accept varying degrees of risk based on the expected returns. Higher returns are typically associated with higher risks, and investment management helps in aligning this balance with the investor's risk tolerance. Moreover, it is a continuous and dynamic process, requiring periodic review and adjustment of the investment portfolio in response to changing market conditions, financial goals, and macroeconomic factors. Additionally, investment management is both scientific and artistic—it involves quantitative analysis as well as qualitative judgment, intuition, and experience.

In terms of its nature, investment management is fundamentally forward-looking. The decisions made today are based on projections about the future—such as anticipated interest rates, market cycles, inflation, and company performance. It is also client-centric and personalized, as no two investors have the same financial goals, risk appetites, or time horizons. Investment strategies are thus tailored to fit individual or institutional requirements. Another defining aspect is its interdisciplinary nature, combining principles from finance, economics, behavioral science, and statistics to create effective investment plans.

The scope of investment management is vast and multifaceted. It encompasses portfolio construction, asset allocation, risk diversification, and performance monitoring. It includes the management of both individual and institutional funds, covering various asset classes such as equity, debt, real estate, mutual funds, commodities, and derivatives. Investment management also plays a crucial role in financial planning, ensuring that individuals can meet life goals such as education, housing, or retirement through disciplined saving and investing. It extends to tax planning, helping investors use tax-efficient instruments and schemes to enhance net returns. Moreover, the scope includes wealth preservation and transfer, as investment managers assist in estate planning and intergenerational wealth transition.

ISSN 2394 - 7780

In the contemporary financial ecosystem, the scope of investment management has expanded further due to digitalization, globalization, and innovative financial products. Today, it also includes ethical investing, ESG (Environmental, Social, Governance) compliance, and the integration of fintech solutions like robo-advisory platforms. Overall, investment management serves as a foundational pillar in achieving financial security, economic growth, and wealth sustainability for individuals, corporations, and nations.

Characteristics of Investment Management

- **Goal-Oriented**: Focused on maximizing return while minimizing risk based on the investor's financial goals.
- **Analytical**: Requires deep financial analysis of market trends, securities, and portfolio performance.
- **Dynamic Process**: Continuously monitored and adjusted based on market conditions and investor goals.
- **Risk and Return Trade-Off**: Balances the relationship between risk and expected return.

Nature of Investment Management

- **Scientific and Art-Based**: Combines quantitative data analysis with intuitive decision-making.
- **Forward-Looking**: It is based on forecasting and prediction to meet future financial objectives.
- **Continuous Process**: Investment decisions are ongoing and evolve with economic and market changes.
- **Client-Centric**: Tailored to the financial goals, risk appetite, and time horizon of individual investors.

Scope of Investment Management

- **Portfolio Management**: Allocation of funds across asset classes (stocks, bonds, mutual funds, etc.).
- **Wealth Creation**: Long-term capital appreciation through diversified and strategic investments.
- **Risk Management**: Hedging and diversifying risks through systematic strategies.
- **Tax Planning**: Efficient use of investment tools for tax optimization.
- **Retirement Planning**: Helps ensure sufficient post-retirement income through long-term investments.

Role of Investment Management in Youngsters

Investment management plays a crucial role in shaping the financial future of youngsters by instilling financial discipline, enabling wealth creation, and fostering informed decision-making. As young individuals enter the workforce, they are presented with the opportunity to begin their investment journey early, allowing them to take advantage of the power of compounding. Starting investments at a young age helps accumulate wealth over time, even with small but consistent contributions. Furthermore, investment management educates youngsters about key financial concepts such as risk-return trade-offs, diversification, asset allocation, and long-term planning. In the digital age, where mobile apps and online platforms have made investing more accessible than ever, youth are increasingly engaging with tools like mutual funds, SIPs, stocks, and even cryptocurrencies. This accessibility, coupled with investment management knowledge, empowers them to make strategic financial decisions instead of relying solely on traditional savings. Additionally, investment management helps young people set and achieve specific financial goals, such as funding higher education, starting a business, buying a home, or planning for early retirement. It also fosters a sense of responsibility, encouraging them to budget, save, and invest rather than spend impulsively. In a time when economic uncertainties and inflation are common, understanding investment strategies becomes vital for financial independence and security. Therefore, equipping youngsters with the principles and practices of investment management not only enhances their personal well-being but also contributes to a financially literate and resilient society. Below are some of the points for better understanding:

Early Financial Discipline : Investment management encourages youngsters to develop budgeting, saving, and investment habits at an early age, setting the stage for lifelong financial discipline.

Leveraging the Power of Compounding: Youth have the advantage of time. Early investment can multiply wealth significantly due to the power of compound interest over long periods.

Financial Literacy and Empowerment: With the rise of fintech platforms, mobile apps, and social media finance influencers, young investors are more exposed to financial content than ever before. Investment management acts as a tool for empowerment and financial autonomy.

ISSN 2394 - 7780

Creating Alternate Income Sources: Investing in mutual funds, stocks, or digital assets creates opportunities for passive income, reducing dependency on a single income source.

Risk Tolerance and Innovation: Younger individuals are often more open to taking calculated risks and experimenting with modern investment avenues like cryptocurrency, robo-advisors, ETFs, and sustainable investing.

Benefits of Investment Management

1. **Wealth Creation Over Time**: Investment management helps individuals grow their wealth by allocating money into profitable ventures and financial instruments. Through long-term investments in stocks, mutual funds, bonds, or real estate, investors can benefit from capital appreciation, dividends, and interest income, thereby multiplying their assets steadily over time.
2. **Financial Discipline and Planning**: By engaging in investment management, individuals learn to budget, save, and prioritize financial goals. It promotes a structured approach to managing money, encouraging regular investments and future-focused planning. This discipline ensures that people do not rely solely on income or savings, but also make their money work for them.
3. **Goal Achievement:** Investment management enables people to meet various short-term and long-term financial goals such as buying a house, funding education, planning a wedding, or securing retirement. Different investment strategies can be aligned with specific timelines and risk profiles to ensure that funds are available when needed.
4. **Inflation Protection:** One of the biggest threats to purchasing power is inflation. Effective investment strategies help beat inflation by generating returns that outpace the rise in prices. For instance, equity investments have historically delivered higher returns than inflation over the long run, helping preserve and grow the real value of money.
5. **Risk Diversification:** Investment management involves spreading investments across different asset classes (equities, debt, gold, real estate, etc.) to reduce the impact of market volatility. Diversification minimizes the risk of total loss and protects investors from the poor performance of a single asset.
6. **Regular and Passive Income:** Many investments offer steady income in the form of dividends, interest, or rental yield. For example, bonds, fixed deposits, dividend-paying stocks, and real estate can provide regular cash flows, which can support day-to-day expenses or be reinvested for further growth.
7. **Professional Expertise and Advice:** Investors, especially those who lack financial knowledge, can benefit from the expertise of fund managers, financial advisors, or robo-advisors. These professionals apply research, analysis, and market insight to make informed decisions on behalf of the investor, increasing the likelihood of better returns.
8. **Liquidity and Flexibility:** Modern investment avenues such as mutual funds, ETFs, and online trading platforms offer high liquidity, meaning investors can access their money when needed. Flexible investment options also allow individuals to start with small amounts, switch funds, or adjust their investment strategies based on life changes.
9. **Tax Efficiency:** Certain investments offer tax benefits under government schemes. For example, investments in ELSS (Equity Linked Saving Scheme), PPF (Public Provident Fund), or NPS (National Pension System) provide deductions under Section 80C of the Income Tax Act in India. Tax-efficient investing ensures higher post-tax returns.
10. **Retirement Security:** With the decline of traditional pension systems, personal investments have become crucial for retirement planning. Investment management helps accumulate a substantial retirement corpus that can provide financial independence and security in old age.

Challenges Faced by Young Investors

While young investors today have greater access to financial markets and investment tools than ever before, they also face several unique challenges that can hinder effective investment decision-making. One of the most prominent challenges is the lack of financial literacy. Many youngsters do not receive formal education in investment principles, risk management, or personal finance, leading to confusion or fear around investment decisions. As a result, they may either avoid investing altogether or make poor choices based on limited understanding.

ISSN 2394 - 7780

Another major issue is the influence of social media and peer pressure, which often leads young investors to follow trends or take impulsive financial decisions without proper research. The rise of "finfluencers" on platforms like Instagram, YouTube, and Twitter has amplified this trend, where investments are made based on hype rather than sound financial analysis. This can expose youngsters to speculative assets and high-risk instruments like cryptocurrency or penny stocks, often without adequate risk assessment.

In addition, low or unstable income in the early stages of one's career can limit the ability to invest regularly. Many young professionals struggle with balancing living expenses, student loan repayments, and savings, leaving little room for disciplined investing. Even those who manage to save often fall into the trap of short-term thinking, expecting quick returns rather than adopting a long-term investment strategy that can build wealth gradually.

Another challenge is fear of market volatility and loss. The unpredictability of the stock market and fear of losing money discourage many young investors from participating in equity or mutual fund markets. This risk aversion leads them to stick to low-return options like savings accounts or fixed deposits, which do not help in wealth creation over time.

Furthermore, overconfidence due to early success can also be risky. Some young investors, especially those who experience initial gains, may develop an inflated sense of skill, leading to overtrading, excessive risk-taking, or lack of portfolio diversification.

Lastly, the complexity of financial products and lack of personalized guidance can make it difficult for young investors to select suitable investment avenues. Many find financial jargon confusing and hesitate to seek professional help, either due to cost or lack of awareness, which can result in inefficient portfolio management. Addressing these challenges requires targeted financial education, mentorship, and simplified, tech-driven investment platforms that promote responsible and informed investment behaviour among the youth. Below are some points from the above study:

- Lack of financial knowledge
- Over-dependence on social media advice
- Fear of risk or market volatility
- Short-term focus instead of long-term planning
- Peer pressure or herd mentality

CONCLUSION

Investment management is not merely a financial activity but a strategic life skill that plays a vital role in shaping an individual's present and future financial well-being. As the global economy becomes increasingly volatile and complex, the importance of managing investments with informed strategies has grown significantly. This research has explored the **characteristics, nature, and scope of investment management**, highlighting how it functions as both a science and an art—combining analytical tools with personal judgment to create effective financial plans. The study underscores the **pivotal role of investment management among youngsters**, who represent a powerful yet often underprepared demographic in financial markets. With early exposure to income and digital investment platforms, today's youth have greater opportunities to invest than previous generations. However, the full benefits of these opportunities can only be realized when young investors are equipped with the necessary financial knowledge, long-term vision, and discipline. Investment management enables them to start early, benefit from compounding, plan for life goals, and build financial independence. It fosters financial awareness, helps mitigate risks, and encourages smart decision-making from a young age.

The **benefits of investment management** are multifold—ranging from wealth accumulation, inflation protection, and retirement security to tax savings, diversification, and passive income generation. These advantages are not limited to high-income individuals; even modest investments, if planned well, can yield significant results over time. Moreover, with the evolution of digital tools, fintech platforms, and low-entry investment products, access to investment avenues has become more inclusive and widespread.

Despite these advantages, **young investors face considerable challenges** such as lack of financial literacy, fear of risk, susceptibility to social media trends, and income constraints. Many struggle with short-term thinking or lack personalized financial guidance, which can lead to poor investment choices or complete inaction. Addressing these obstacles through structured education, financial counseling, and digital awareness can greatly improve youth participation in financial markets. In conclusion, investment management is a cornerstone of

financial empowerment and economic stability. For youngsters, in particular, it offers a roadmap to achieve life goals, overcome financial uncertainties, and build a secure and prosperous future. Therefore, it is crucial to integrate financial education at the academic level, promote accessible and ethical investment platforms, and encourage a culture of responsible investing. Empowering youth with investment knowledge today will not only transform their individual futures but also contribute to the broader goal of national financial resilience and inclusive economic growth.

RECOMMENDATIONS

Based on the findings of this study, several actionable recommendations can be proposed to improve investment behavior, financial literacy, and effective utilization of investment management among youngsters:

1. Integrate Financial Education into Academic Curriculum

One of the most critical steps is to introduce financial literacy and investment management concepts in school and college syllabi. Educational institutions should include modules on budgeting, saving, investing, taxes, and retirement planning to build a strong foundation for future financial decision-making.

2. Promote Awareness Campaigns and Workshops

Governments, financial institutions, and regulatory bodies like SEBI and AMFI should organize regular awareness programs, webinars, and workshops targeted at young investors. These campaigns can demystify investment concepts, explain risks, and promote the habit of early investing.

3. Encourage Goal-Based Investing Among Youth

Young investors should be guided to link their investment plans with specific short-term and long-term goals such as education, travel, homeownership, or retirement. Goal-oriented investing helps maintain discipline and provides a clear sense of purpose and direction.

4. Leverage Digital Platforms for Investment Education

With increasing smartphone and internet penetration, fintech apps and educational platforms should offer simplified, gamified, and engaging investment learning tools. Apps like Groww, Zerodha Varsity, and Paytm Money can integrate learning modules alongside their investment services.

5. Facilitate Access to Certified Financial Advisors

Many young investors hesitate to consult financial advisors due to cost or lack of access. Institutions should promote affordable or subsidized advisory services for students and first-time earners to ensure they receive trustworthy and personalized financial guidance.

6. Encourage Habitual and Systematic Investment Plans (SIPs)

Youngsters should be encouraged to start with low-risk and flexible investment products like SIPs in mutual funds. These plans inculcate the habit of regular investing and make market participation less intimidating, even with small amounts.

7. Create Peer Learning and Mentorship Communities

Student clubs, alumni groups, and youth forums can facilitate peer learning about investment. Engaging experienced mentors who share real-life investment journeys can inspire confidence and responsible financial behavior among young participants.

8. Implement Regulatory Safeguards for Young Investors

Given the rise of misinformation and unregulated advice on social media, regulatory bodies must enforce stricter guidelines on investment advertising and protect young investors from fraud, hype-driven investments, and predatory schemes.

9. Encourage Family Involvement in Early Investment Habits

Families play a vital role in shaping financial habits. Parents and guardians should be encouraged to involve children in basic financial discussions and introduce them to savings accounts, junior SIPs, or child-focused investment products from an early age.

10. Monitor and Evaluate the Impact of Financial Initiatives

Policymakers and educational institutions should regularly assess the effectiveness of financial literacy programs and investment awareness campaigns. Feedback loops and impact assessments can help in redesigning programs to suit the evolving needs of young investors.

REFERENCES

1. Bhalla, V. K. (2013). Investment management (18th ed.). S. Chand Publishing.

ISSN 2394 - 7780

2. Bodie, Z., Kane, A., & Marcus, A. J. (2014). Investments (10th ed.). McGraw-Hill Education.
3. Chawla, D., & Sethi, D. (2018). Financial literacy and investment decisions: A study of young adults in India. International Journal of Economics and Financial Issues, 8(2), 197–204.
4. Gitman, L. J., & Joehnk, M. D. (2010). Fundamentals of investing (12th ed.). Pearson Education.
5. Raut, R. (2020). Investment behaviour of millennials: Impact of fintech platforms in India. Journal of Business Management and Economics, 11(3), 44–53.
6. Sajid, S., & Jain, R. (2019). Youth and investment behavior in the digital era: An Indian perspective. Journal of Financial Services and Research, 1(1), 15–27.
7. Singh, P. (2015). Investment management: Security analysis and portfolio management (17th ed.). Himalaya Publishing House.
8. 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
9. SEBI. (2021). Annual report 2020–21. Securities and Exchange Board of India. https://www.sebi.gov.in
10. AMFI. (2023). Mutual fund investment trends among millennials. Association of Mutual Funds in India. https://www.amfiindia.com
11. RBI. (2022). Report on financial literacy initiatives. Reserve Bank of India. https://www.rbi.org.in
12. Kaur, R., & Vohra, T. (2020). Awareness and preferences of investment avenues among youth in India. International Journal of Scientific and Research Publications, 10(3), 684–690. https://doi.org/10.29322/IJSRP.10.03.2020.p9950
13. Kapoor, J. R., Dlabay, L. R., & Hughes, R. J. (2017). Personal finance (12th ed.). McGraw-Hill Education.
14. Statista. (2023). Share of millennials investing in mutual funds and stocks in India 2022. Retrieved from https://www.statista.com/statistics/
15. S&P Global. (2016). Global financial literacy survey. Retrieved from https://www.spglobal.com/en/research-insights

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

WOMEN EMPOWERMENT IN INDIA: BRIDGING THE GAP BETWEEN POLICY INTENTION AND GROUND REALITY- A CASE STUDY OF NAPAAM AND JALUKBARI AREA.

Ananya Sarmah[1] and Bhaba Sindhu Borthakur[2]
[1]Tezpur University, MCom; [2]Gauhati University, M.A. (Political Science)

ABSTRACT
The paper aims to provide insights into the reality and awareness of schemes related to women and the availability of those schemes in selected areas of Napaam and Jalukbari. The study employs a mixed-method approach combining primary data collected from 80 households (40 each in Napaam and Jalukbari) with secondary data drawn from journals and online resources. Women empowerment has remained a central focus for policymakers in India, aiming to foster gender equality and uplift women across social, economic, and political domains. However, a significant gap persists between policy intentions and ground-level implementation. The study identifies key challenges such as lack of awareness, limited empowerment outcomes, and infrastructural barriers that hinder effective policy execution.

Findings from the NFHS-5 dataset reveal that out of 721,145 total women respondents, only 10.7% had decision-making power. Furthermore, 88.7% of women were found to participate in decision-making when involved. Factors like age, education level, and working status significantly influenced women's decision-making capacity. While women's education and health have seen considerable improvement, economic, political, and cultural empowerment still lag behind in the ground scenario. This research contributes to the women empowerment by highlighting the disparity between policy and practice and suggesting the need for increased awareness, infrastructural support, and targeted interventions to ensure effective policy implementation to foster the targeted objectives.

Keywords- *Women empowerment, Policy Implementations, Gender Equality, Napaam, Jalukbari, NFHS-5.*

1. INTRODUCTION
Women, often worshipped as goddesses, have played a crucial role in India's culture and society since the Vedic age. Influential figures like Gargi Vachaknavi, Maitreyi, Rani Durgavati, Razia Sultana, Rani Lakshmibai, Sarojini Naidu, Savitri Bai Phule, Pandita Ramabai, Kanaklata Barua, and Chandra Prava Saikiani have laid the foundation for emerging societies. Despite its vast diversity, India remains the largest democracy in the world, ensuring justice, liberty, equality, and fraternity among its citizens. Traditionally, India has been patriarchal society, a society where duties of women are confined to household work and the role of women is displayed as Secondary. However, women are traditionally considered inferior to men in all spheres of life, leading to heated debates on women's empowerment and welfare all throughout the generations.

The total women respondents in the NFHS 5 dataset were 721145, of which data regarding women decision making was available for 77729 (10.7%). Total 68942(88.7%) women were involved in decision-making. Decision-making capacity was found to be significantly associated with age, education level, working status. NFHS-5 data reveals that in India, women's education and health have improved, but economic, political, and cultural aspects lag behind.

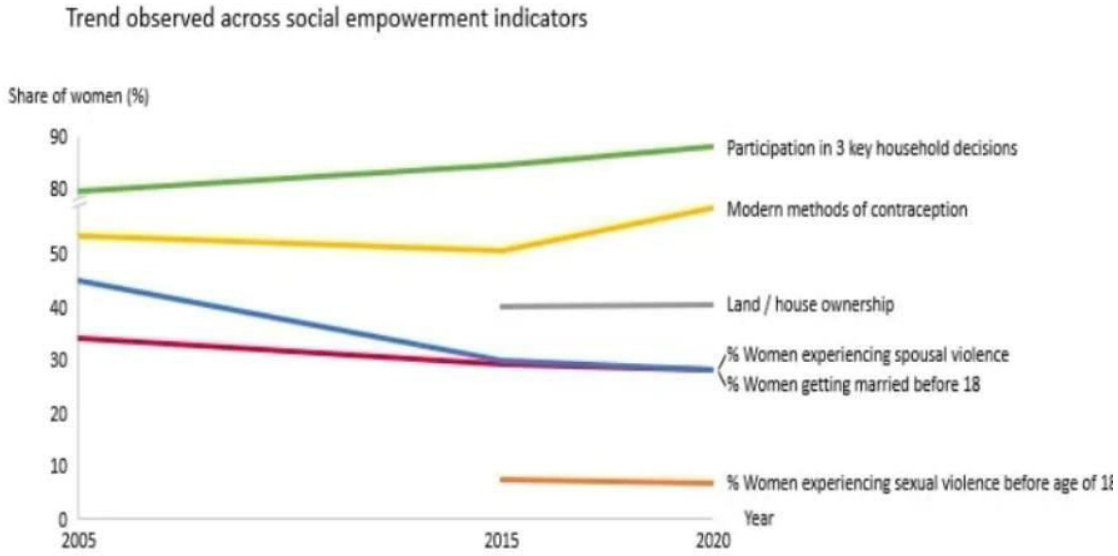
Analysis of the NHFS-5 data shows that, in comparison to the 2015 NFHS-4 data, the percentage of women with more than ten years of education has grown by 5.5%. Girls' educational attainment has increased, as evidenced by the gender gap between the percentage of men and women with 10+ years of education, which has shrunk to 8% from 11.5% in 2015. Although household decision-making involvement is still increasing (it was approximately 85% in 2015), the majority of other indicators are either stagnating or getting worse as-

- In 11 out of 22 states, land or homeownership among women has reduced.
- The share of women marrying below the age of 18 continues to be close to 30 percent—similar to 2015 levels.
- Trends around spousal violence is also stagnating, with almost one in three women having had experienced some sort of physical or sexual violence from their husbands. The survey was conducted before the lockdown, and the fact that domestic violence has surged during the pandemic—an approximately 60 percent increase between November 2019 and 2020—is likely to have worsened these trends. Given that less than 30% of the Union Budget is allocated to programs that are exclusively focused on women, it is important to note that the percentage of funds allocated to programs that support women has remained constant at roughly 5.5% since 2009. Examining the Ministry of Women and Children's budget for women's empowerment in

ISSN 2394 - 7780

greater detail reveals that program funding fell from INR 640 crores in FY 18–19 to INR 310 crores in FY 19–20. Just 55% of the INR 1,200 crore funding that was allocated was spent in FY 18–19. The government appears to have supported a number of progressive programs, including "Beti Bachao, Beti Padhao." However, in practice, almost 65% of the budget has gone on advertising, with very little attention paid to grassroots involvement. Despite an increase in education levels of girls in India, the share of women getting married before 18 has not seen a marked improvement in the last five years.

Trends observed across social empowerment indicators. Source: 5th National Family and Health Survey (NFHS)



Women empowerment is not Independent Variable. It is a dependent variable that depends on several key factors such as educational background, caste, the region to which they belong to etc. It is quite important for us to understand that in today's day and age for a woman to step up in overly male dominated society, we as a society itself first must lay the groundwork for the women of our country to move in the path of self-determination which will eventually make them feel empowered and provide them with a nurturing ground to take control of their lives and speak for themselves. Some of the different aspects of women empowerment are:

- Ability to acquire skills and education
- Freedom of speech- and decision-making ability
- Ability to make positive social changes
- Self Confidence and self- respect
- Freedom to spend their own income and make social involvement
- Access to information source.

Since women's empowerment is the research's central theme, it is imperative that we comprehend what women's empowerment is. More specifically What does empowerment mean? if nothing else. Giving someone all the resources they need to better their own lives and create significant progress toward self-improvement is known as empowerment. Similarly, when discussing women's empowerment, it goes beyond just women. It is necessary to include women in the growth of a society and a nation as they consist of half of the population of the country. Through this research we shall look into four of the prominent women empowering policies taken by the union government of India and the Assam state government respectively. The policies are as follows:

a) Beti Bachao Beti Padhao

b) Ujwala Scheme

c) Arunodoi Scheme

d) Pradhan Mantri Matru Vandana Yojana

Here, we will make a detailed comparison between the policy implementation by the government machinery and the ground reality of these policies in two respective geographical areas, viz. Jalukbari and Napaam situated

ISSN 2394 - 7780

at, Kamrup Metropolitan district and Sonitpur district of Assam respectively. Also understanding if urban scenario is better than the rural aspects as well.

2. REVIEW OF LITERATURE-

Women empowerment consists in autonomy, agency, self-worth, and involvement in decision-making (Mathew, 2003). Agnihotri and Mali Patil (2017) contend that national development depends on women being empowered and that government, society, and legal systems must all demand active participation from these women. Though full gender parity still unmet, Hazarika (2011) notes slow changes in women's status since independence. Studies by Pareek (2022) and Sudhakar (2018) show that poor monitoring and implementation gaps cause moderate awareness but limited success of the "Beti Bachao Beti Padhao" program. Though regional differences still exist, research on the "Pradhan Mantri Ujjwala Yojana" by Asharaf and Tol (2024) and Ahmad et al. (2018) shows better access to clean fuel and health benefits. Along with Phukan (2021), Gogoi and Saikia (2024) help to highlight the "Arunodoi Scheme" as a major driver of women's financial autonomy in Assam. Under the "Pradhan Mantri Matru Vandana Yojana," Kumar et al. (2024) and Jagannath & Chakravarthy (2025) report mixed results for mother and child health underlining the need of better outreach and transparency.

3. RESEARCH METHODOLOGY

i. **Research Design-** This study adopts a comparative and descriptive research design to analyse the gap between the policy objectives and intention and actual implementation of four specific policy- Beti Bachao Beti Padhao, Ujwala Yojana, Arunudoi Asoni, Pradhan Mantri Matru Bandhana Yojana. A mixed method approach (both qualitative as well as quantitative) method will be used to provide a comprehensive analysis.

Study Area: The study focuses on two specific locations in Assam, India:

- Napaam (a rural/semi urban area)
- Jalukbari Area (an urban area)

These two different locations have been chosen to compare how women empowerment policies (specified) are implemented in different geographic and socio- economic conditions defining to different culture as well.

ii. Research Objectives:

a) To assesses the effectiveness of the mentioned policies in Napaam and Jalukbari.

b) To identify gaps between policy intentions and actual outcome.

c) To understand the socio- cultural and economic factors affecting policy implementations.

d) To understand the impact of urban factor in the implementation of the policy compared to rural.

iii. Data Collection Method:

A) Primary Data Collections a) Surveys: Structured Questionnaire is used to collect data from women in Napaam and Jalukbari regarding their awareness and facilities availed by them as provided under the schemes and their experience regarding it.

b) Interviews:

- Women Beneficiaries

B) Secondary Data Collections a) Government reports and policy documents on women empowerment. b) Census and NSSO data for gender- related statistics. c) Academic Research Papers and books. d) Reports from NGOs and International Organisations.

iv. **Sampling Methods:** A purposive sampling method is used for definite participation of beneficiaries including participation from different socio- economic background, occupations, and educational level. Approximately 80 respondents (40 from each area) were surveyed, with additional in-depth interviews.

v. Data Analysis: Percentage Analysis will identify pattern and relationships.

vi. Limitations of the Study:

➢ Limited sample size might not represent all aspects of policy implementations in the respective areas.

➢ Socio cultural factors are difficult to quantify.

➢ Lack of support from the respective beneficiaries.

ISSN 2394 - 7780

4. RESULTS

The survey conducted through structured questionnaire revealed significant insight into women empowerment as well as their awareness about various schemes, particularly regarding the actual intention and the reality. The selected schemes showed very limited reach. Although some schemes were more popular than the other. Among the selected the more popular was Arunodoi Scheme and Ujjwala scheme.

NAPAAM AREA-

The result indicates that while 52.5% women were beneficiaries of the either of the schemes meanwhile 47.5% were not receiving any benefits. 70.6% were beneficiaries of Arunudoi Scheme and Ujjwala scheme. 67.6% were Beti Bachao Beti Padhao and the least is for Pradhan Mantri Matru Vandana Yojana which accounts for 47.1%. 15.5% were not aware of the schemes and policies meanwhile, 5.3% believed that they were deprived from resources (reason mentioned were corruption, middlemen, lack of guidance), 42.1% doesn't fall under the eligibility criteria and 47.4% mentioned other reasons (doesn't need the benefits, too hectic process and formalities and some mentioned that they are not aware whom to reach out). Benefits received by Arunudoi scheme topped at around 61.9% followed by Ujjwala scheme at 57.1% up next was Pradhan Mantri Matru Vandana Yojana at 47.6% and least was Beti Bachao Beti Padhao at 42.9%. 52.6% women claimed that monetary benefits received from the scheme made them feel empowered. 47.4% assured that money benefits received impacted their household by Increasing their living standard meanwhile, 47.4% also mentioned that there weren't any such changes, Furthermore, 42.1% claimed that it led to the increase in Income and 18.4% mentioned about change in lifestyle.

48.7% of the beneficiaries mentioned about the Arunudoi Scheme gave them the leverage to make decision in the household which indicates that monetary income is directly relational to decision making power. While it is a positive change, 56.4% still mentioned that there were no such changes applicable. 51.3 % of the women claim that they haven't received the Ujjwala scheme which was a prime policy of the government. 46.2 % did received it and 2.6% mentioned that there were no such changes. For 38.5% Ujjwala scheme improved their health conditions, 33.3% mentioned the easy accessibility 33.3 % haven't received the scheme and 28.2% revealed that there were no such changes. Overall, Arunudoi scheme mostly benefited the women (38.1%) up next was Ujjwala scheme followed by Pradhan Mantri Matru Vandana yojana and the least was Beti Bachao Beti Padhao. Most of the women were not aware of the many other schemes as well.

Jalukbari Area-

The survey in Jalukbari found that 71.4% of women benefited from government-provided schemes, while 61.9% are beneficiaries of various women-related. However, 9.5% are not currently beneficiaries, and 21.6% have never been beneficiaries. The study found 100% awareness of government-provided women-related schemes, with 63.4% of Jalukbari women claiming to be beneficiaries, while 36.6% did not. The study found that the Orunudoi scheme was the most beneficial, with 56% of the beneficiaries, followed by the Ujjwala scheme with 40%, Padhan Mantri Matra Vandana Yojana with 4%, and Beti Bachao Beti Padhao with 0% beneficiaries.

The study revealed that 60% of women in the Jalukbari area are not beneficiaries of women-related schemes, with 30% claiming they are deprived of resources due to corruption or middlemen. The remaining 10% have other reasons. The lack of awareness was not the sole factor preventing women from benefiting from these schemes, but other factors such as corruption and middlemen also contributed. This showcases that the lack of awareness was 0%, and there are other reasons that made women ineligible for the schemes mentioned in the study. The survey revealed that 77.8% of Jalukbari women receive their schemes' incentives regularly, while 11.1% do not, and 11.1% sometimes experience irregularities. The study found that 95.8% of women felt empowered by the monetary benefits received from schemes, with 47.8% stating that these benefits changed their lifestyle, 26.1% indicating an increase in income, and 21.7% stating no change from the monetary benefits.

The survey in Jalukbari area revealed that the Orunudoi scheme and Ujjwala Yojana were the most popular schemes among women. 71.4% of beneficiaries said the Orundoi scheme provided them with economic decision-making power, while 28.6% disagreed. 88.9% of Ujjwala scheme beneficiaries accepted the scheme improved their condition, while 11.1% denied it. 77.8% of Ujjwala Yojana beneficiaries acknowledged health improvements and cleaner cooking fuel access, while 11.1% did not see significant changes in their daily lives.

5. CONCLUSION AND DISCUSSIONS.

The situation of women in our society is at present being critically evaluated thereby giving the policy makers with the opportunity to frame policies and schemes which shall provide the women with adequate opportunities to grow and foster as an individual. The schemes are famed in such a way that once they are implemented, they

ISSN 2394 - 7780

shall give the women a sense of empowerment upon which they can grow their own livelihood and take decisions which are best suited for them. Thus, in our study we took four such schemes, viz., Beti Bachao Beti Padho, Orunodoi Scheme, Ujjwala Yojana and Pradhan Mantri Matru Vandana Yojana, to understand whether the ground reality have justified the policy intention. In the study we found that the schemes such as Orunodoi, Ujjwala and Pradhan Mantri Matru Vandana Yojana have given the women of Napaam and Jalukbari a sense of empowerment to live through in their daily battle for survival. The Orunudoi Scheme was the superstar of this entire study. It has benefited the women of both Napaam and Jalukbari in large scale by giving them a leverage to make economic decisions in their households and the independence to spend the money on the things of their importance. Likewise, the Ujjwala scheme have been a blessing for the women who had to earlier use wood for cooking fuel which had various adverse health effects. After gaining LPG connections under the Ujjwala Yojana the women of both Napaam and Jalukbari seems to agree on the fact that their health conditions have improved drastically and the easy access to cooking fuel have made their life a lot easier. But on the contrary, the other two schemes- Pradhan Mantri Matru Vandana Yojana had only few beneficiaries which seemed really awful that such a good scheme for pregnant mothers have not reached far and wide among the people of both Napaam and Jalukbari and the Beti Bachao Beti Padhao scheme saw no traces of beneficiaries at all in these two regions. As the core theme of the study lies in women empowerment the researchers asked the women of both Napaam and Jalukbari to put forward their views. Hence, they responded mostly by agreeing that empowerment of women is the out most necessity and that being economically independent, self-funded and receiving levelled playing field can be some key foundations for the women empowerment. This is what the schemes of the study also likes to dwell into.

Furthermore, in terms of empowerment impact Jalukbari being the urban area showcased better results as well as in terms of better outreach(awareness). Hence, we can make an assumption that urban areas provide better understanding and outreach of the policy implementations.

6. RECOMMENDATIONS-

1. Strengthening the awareness campaign specifically on women related schemes for more targeted Outreach.
2. Enhancing financial literacy and decision- making opportunities
3. Expansion of eligibility criteria as well as addressing the issues obstructing the free flow of policy implementations.
4. Setting up of mobile help desk to assist women with applications and documentations on spot.
5. Linking Schemes with Panchayat office, a central point for scheme registration, follow up and grievances.
6. Conducting door to door enrolment drives in low awareness areas collaborating with Anganwadi workers.
7. There must be a reconsideration to increase the amount of money which is currently paid to the beneficiaries.
8. More awareness camping on Beti Bachao Beti Padhao scheme must be take place.
9. A large-scale proper awareness campaign must also be launched for the Pradhan Mantri Matru Vandana Yojana because the current number of beneficiaries under this scheme was found to be quiet low in the researcher's study area.
10. Transparency must be ensured while allotting the schemes so that no genuine women is left out from receiving the benefits of the schemes.
11. NGOs should be involved to reach those far-fetched areas to spread awareness and educate women about the benefits of various schemes and streamline the process especially the rural areas as they are lacking behind.

7. REFERENCE

1. Chandra, R. (2007, December). Women Empowerment in India-milestones & challenges. In national conference on “What it takes to eradicate poverty”, organized by the PACS Programme, New Delhi.
2. Nayak, P., & Mahanta, B. (2012). Women empowerment in India. Bulletin of Political Economy, 5(2), 155-183.
3. Goel, M., & Ravishankar, N. (2022). Impact of public policy and legislation on autonomy and empowerment of women in India. Gender Issues, 39(2), 198-219.

ISSN 2394 - 7780

4. Singh, S., & Singh, A. (2020). Women empowerment in India: a critical analysis. Tathapi, 19(44), 227-253.
5. Karunarathne Rasika, R. A., & Praveena, D. Role of Self-Help Group in Women Empowerment in India.
6. Mathew, G. (2003). Keynote address in the workshop on "A Decade of Women's Empowerment through Local Governance" organized jointly by Institute of Social Sciences and South Asia Partnership. Canada sponsored by International Development Research Centre.
7. Patil, S. M. A CRITICAL ANALYSIS AND SIGNIFICANT INSIGHTS ON WOMEN EMPOWERMENT IN INDIA. COMMERCE & MANAGEMENT, 77.
8. Tomar N. and Singh S. (2018), "How sensitive is the Indian Government Towards Women Empowerment in India" International Journal of Management, IT and Engineering, 08 (07), pp 66-83.
9. Ujjwala (2016) Scheme Guidelines, Government of India, pg1-31it is not detail
10. Beti Bachao Beti Padhao Scheme (2019) Implementation Guidelines for State Government and UT Administrations, Government of India pg. 1-103
11. Kabeer N. (1999) Resources, agency, achievements: reflections on the measurement of women's empowerment. Development and Change 30(3), pg. 435 64.
12. Anand, S. and A. Sen (1995): "Gender Inequality in Human Development: Theories and Measurement", in Fukuda Parr and A.K. Shiv Kumar (eds.) Readings in Human Development, OUP, New Delhi.
13. Sharma B.R. and M. Gupta (2004): "Gender Based Violence in India - A Never-ending Phenomenon", Journal of International Women's Studies, Vol. 6, No.1, pp.113 122.
14. Seth, Mira (2001): "Women and Development- The Indian Experience", Sage Publication, New Delhi
15. 5th National Family and Health Survey
16. Agnihotri, R. R., & Mali Patil, K. S. (2017). A study on women empowerment schemes in India. International Journal of Development Research, 7(8), 14301-14308.
17. Hazarika, D. (2011). Women empowerment in India: A brief discussion. International Journal of Educational Planning & Administration, 1(3), 199-202.
18. Chouhan, K., Sharma, R., & Pareek, S. (2022). Knowledge and attitude regarding "Beti Bachao, Beti Padhao Yojana" among young and aged rural adults: A cross-sectional study. Journal of Datta Meghe Institute of Medical Sciences University, 17(2), 350-353.
19. Sudhakar, G. J. (2018, January). Conditions of Girl Child with Special Reference to Beti Bachao Beti Padhao Scheme. In Proceedings of the Indian History Congress (Vol. 79, pp. 875-882). Indian History Congress.
20. Tol, R., & Asharaf, N. The impact of Pradhan Mantri Ujjwala Yojana on Indian households.
21. Ahmad, N., Sharma, S., & Singh, D. A. K. (2018). Pradhan Mantri Ujjwala Yojana (PMUY) step towards social inclusion in India. International Journal of Trend in Research and Development, 5(1), 2394-9333.
22. Phukan, R. (2021). Empowering family with empowering women in empowering assam: A case study of orunodoi scheme in baksa district. Linguistics and Culture Review, 1554-1568.
23. Jagannath, R., & Chakravarthy, V. (2025). The impact of Pradhan Mantri Matru Vandana Yojna scheme on access to services among mothers and children and their improved health and nutritional outcomes. Frontiers in Nutrition, 11, 1513815.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

DEEP LEARNING NETWORK MODEL FOR LUNG CANCER IDENTIFICATION AND DIAGNOSIS VIA CT IMAGE SYNTHESIS

Chetan Kumar G S[1] and Dr. Veerappa B N[2]
[1]Research Scholar GM University, Davanagere, Karnataka, India
[2]CSE, GMIT, GMU University, Davanagere, Karnataka, India v

ABSTRACT
Cancer is the leading cause of mortality worldwide, with lung cancer being the most prevalent and gender-independent. Lung cancer is a life- threatening disease, exhibiting a high fatality rate among affected patients. Accurately identifying the stages of lung cancer can significantly improve survival rates. Distinguishing between malignancy and pulmonary nodules is challenging, and understanding the immunological responses of malignant lung cancer patients in the early stages may provide valuable prognostic insights. Deep machine learning techniques applied to medical images have the potential to automatically identify cancer, improving detection accuracy while reducing effort and cost. Medical practitioners face several challenges in using various image-processing techniques for lung cancer detection, and machine automation approaches are used to enhance this process. Early detection and examination of lung nodules can reduce the risk of developing lung cancer significantly. Computed Tomography (CT) is the most commonly used imaging technology for lung cancer screening due to its high resolution. Identifying white, spherical shadows on CT scans as lung nodules is crucial for effective diagnosis. This paper evaluates the performance of binary classification using deep neural network protocols with CT image synthesis. It discusses various Convolutional Neural Network (CNN) models such as Inception, ResNet, DenseNet, and Graph Neural Network (GNN) to propose a lightweight deep neural model that outperforms existing approaches in accuracy, specificity, and sensitivity.

Index Terms: *Convolutional Neural Networks, Deep learning, Lung cancer, Machine learning*

I. INTRODUCTION
Cancer may arise anywhere in the body, including the blood, breast, prostate, lung, and skin. Lung cancer is the most frequent malignancy for both men and women. Visible symptoms of lung cancer include frequent coughing, hard and yellow sputum with coughing, chest discomfort, bloody cough, and so on. Lung cancer accounts for approximately twelve percent of all newly diagnosed cases of cancer globally. In 2022, there were around 2.5 million new instances of lung cancer, making it the most prevalent cancer worldwide. According to GLOBOCAN 2022 statistics, the lung cancer death rate is approximately 1.8 million people annually, making it the top cause of cancer- related fatalities. This accounts for around 16.8% of all cancer deaths worldwide. The lack of early apparent clinical signs contributes substantially to the high mortality. Therefore, early diagnosis and therapy are critical. In recent years, CT has been routinely utilized in high-risk groups to diagnose lung cancer, lowering lung cancer mortality by up to 18%. Non-small cell lung cancer constitutes a significant percentage of all instances of lung cancer. This non-small lung cancer can be further categorized into subgroups based on the tumor cells. These subtypes include adenocarcinomas (ADCs) and squamous cell carcinomas. Various medical procedures are used to identify cancer, such as chest histopathological image testing, Computerized Tomography (CT) scan, Magnetic Resonance Imaging (MRI), and X-ray. Biopsy images can detect cancer cells and provide confirmation of their presence. The symptoms of lung cancer are sho in **Fig. 1**.

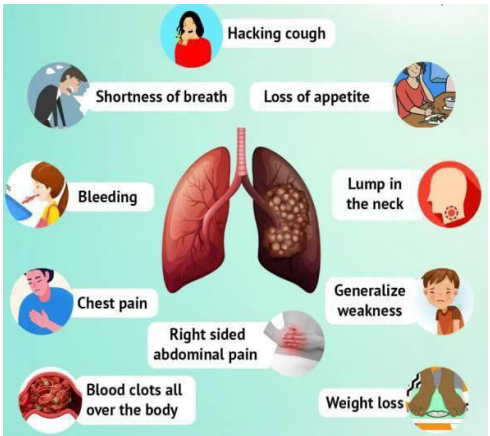


Fig 1: Symptoms of lung cancer

ISSN 2394 - 7780

The signs of lung cancer include a persistent cough that worsens over time. Pain that intensifies with heavy breathing, coughing, or laughing. Difficulty breathing or feeling short of breath. Your voice changes. Even a tiny quantity of blood in your sputum. Losing weight without trying. Not feeling hungry and eating less than normal. Feeling very fatigued or feeble.

According to research, lung cancer cells may migrate to other body areas via blood arteries. This type of cancer is known as extra lung cancer or "metastasis". Lung cancer is one of the most deadly malignancies.

Pulmonary nodules are a typical feature of lung disorders. A pulmonary nodule larger than 6 mm is associated with a high risk of lung cancer. However, the majority of positive CT results were false positives [1]. Furthermore, CT may raise the risk of radiation-induced cancer, which affects around 0.5–5.5% of the screened population. Currently, there is no realistic strategy for early-stage lung cancer recognition that is both accurate and noninvasive. As a consequence, a reliable and non-invasive diagnostic approach is urgently required for the prompt detection of lung cancer. CT scans may identify lung nodules, characterized by round or oval masses with a diameter of less than 30 mm[2, 9]. They represent ranged forms, densities, locations, and surrounds is shown in Fig 2.

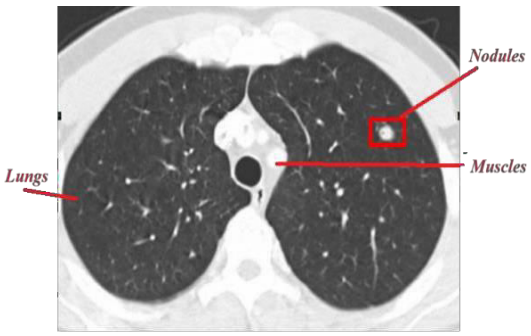


Fig 2: CT scans of the patient with lung cancer

CT scan images are more effective than x-ray images in identifying malignant lung nodules. X-rays are used to find particular body sections, not malignancies. When the CT scan images are rotated to span a 360-degree area, nodules with bones attached are identified. Finding miniature abnormalities in the lungs helps radiologists adequately diagnose patients. For any identification of lung cancer in its early, benign state, Machine Learning (ML) and deep learning neural network (DNN) algorithms are essential. There are two ways for detecting pulmonary nodules. The lung endothelium is first eliminated from the CT-scanned image in order to locate small nodules in the chest from the pulmonary vasculature. To order to reduce death rates from cancer, it's a prime challenge to prioritize the wellness sector and create innovative early detection systems. When using lung cancer segmentation data, accuracy is an important consideration. Radiologists whose segment images manually produce erroneous outcomes due to inter observer variability and inconsistent procedures. An automated segmentation approach of lung cancer pictures from CT scans is critical to resolving this issue.

A. STATE OF ART RELATED WORK

Many authors have contributed research work and proposals in the subject of image processing, which is separated into two development eras: before deep learning image processing and after deep learning image processing. Several research have used deep learning models to improve lung cancer diagnosis using a variety of imaging modalities, including X-ray and computed tomography (CT) [15]. The first decades of image processing focused on segmentation, grouping, and picture enhancement as prime models [3, 4]. With time, these techniques become standard methods for image processing, and image recognition becomes significant for major image datasets [5, 6]. However, as the emergence of deep learning technologies, identical tasks are now completed with greater accuracy on massive datasets. Deep CNNs have been utilized in an assortment of image processing issues.

In the paper [7, 8] proposed acquiring a better comprehension of tumor immunology and immune-tumor interactions. The immune system is split into two subsystems: the innate and adaptive immune systems. The adaptive immune system protects the body against various foreign antigens utilizing two types of antigen receptors: T- cell receptors (TCRs) and antibodies. Over a recent years of developments, high-throughput sequencing has become more widely researched and applied to disease and cancer research [10, 11]. Research shows the adaptive immune response to tumor cells can be employed as a post-operative prognostic marker for cancer detection. Deep learning models are applied to images obtained from X-rays to diagnose lung cancer. In the paper [12] employed a pretrained VGG-19 model paired with a CNN for

ISSN 2394 - 7780

feature extraction, accomplishing a 93.75% accuracy. In [13] established a 73% accuracy hybrid deep model to identify lung cancer using X-rays. The model included a VGG pretrained with a CNN. In [14] developed two deep learning models: one for categorizing X-ray images as pneumonia or normal, and another with enhanced AlexNet and handcrafted features to improve lung cancer diagnosis accuracy, resulting in an overall classification accuracy of 97.27%. In contrast, CT scan pictures have been extensively employed in deep learning-based lung cancer diagnosis models. This section critically reviews the state of art on deep learning algorithms for lung cancer diagnosis, elucidating their methodologies, performance measures, and significant contributions. Machine learning algorithms for classification [16, 17] follow traditional feature extraction strategies. Although these techniques are very accurate on controlled datasets, human feature engineering may fail to capture the intricate and subtle patterns related to lung cancer, particularly in individual medical illustrations. Deep learning models often fail to provide transparency, which renders them challenge to comprehend. This is a key issue in medical applications because explainability is essential for clinical decision-making. The black boxes paradigm limits the amount of trust in medical professionals can place in their predictions.

II. METHODOLOGY

This section provides an overview of our plan of action to identifying lung cancer using deep learning techniques.

The research study that follows a methodical meticulous strategy involving data gathering, pre-processing, model architecture creation, training, and evaluation is as shown in Fig 3.

Component heads identify the different components of your paper and are not topically subordinate to each other.

Examples include Acknowledgments and References and, for these, the correct style to use is “Heading 5”. Use “figure

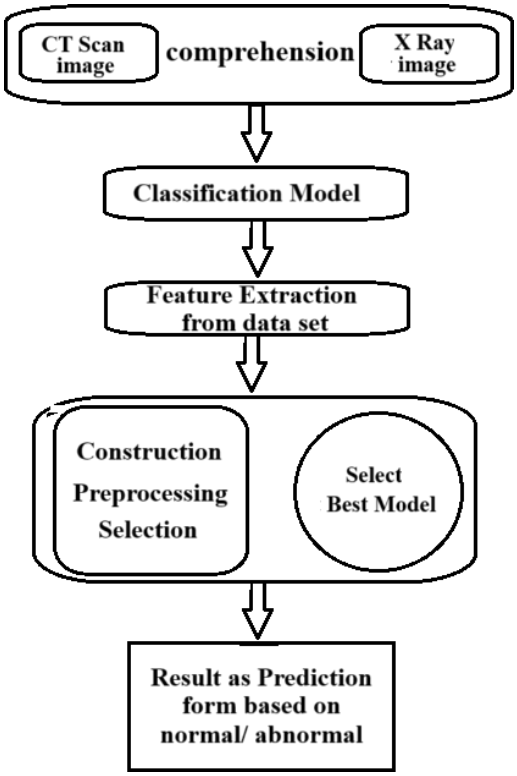


Fig 3: Approach to-for detection of lung cancer with meticulous process.

The initial conversion of data to binary format enhances the rate of processing and prepares for upcoming processes. The most important stage is the amalgamation of both datasets, leading to in the development of an aggregated dataset suitable for detailed analysis. The technique emphasizes the crucial significance of early lung cancer identification, an essential aspect of healthcare. The amalgamation of advanced deep learning algorithms along with intricate dataset management reveals the potential for reliable and accurate predictions. This strategy is consistent with the critical importance of early cancer identification, contributing to better patient outcomes and timely management.

ISSN 2394 - 7780

Input Shape refers to the dimensions of the data given into the neural network. For example, if the image of any input framework may be (height, width, channels), with RGB images having three channels each. For a time-series dataset, it may be (time_steps, features).Batch Size relates to the number of training instances used in a single iteration. The dataset has been split into batches, with the model parameters being modified after each batch. This helps regulate memory use and enables the system to learn from a portion of the dataset. Suppose you are working with a set of RGB images, each of size 64x64 pixels, and you choose a batch size of 32. The input shape would be (64, 64, 3).The batch size would be 32, meaning the model processes 32 images at a time before updating the model's parameters.

The hyper parameter setting of a network specification for the first and second model as as shown in Table1.

Number of Epochs represents the number of complete passes through the entire training dataset. For instance, if you have 1000 training samples and you choose 10 epochs, the model will go through all 1000 samples 10 times. It's a measure of how many times the learning algorithm will work through the whole dataset. Error at Epoch typically refers to the loss or error metric calculated after each epoch. It helps to track the model's performance over time. Common error metrics include Mean Squared Error (MSE) for regression tasks and Cross-Entropy Loss for classification tasks. Monitoring this error helps in understanding how well the model is learning and if adjustments need to be made.In convolutional neural networks (CNNs), activation functions play a crucial role in introducing non-linearity to the model, allowing it to learn and represent complex patterns in the data. Here are some commonly used activation functions in convolutional layers are as follows.

1. ReLU (Rectified Linear Unit): $f(x) = \max(0, x)$ (1)

In this it's computationally efficient, helps with vanishing gradient problem but Can suffer from "dying ReLU" problem where neurons stop activating.

2. Leaky ReLU (Rectified Linear Unit): $f(x) = \max(0.01x, x)$ (2)

Reshaped output = reshape (output tensor) (3)

In this Addresses the dying ReLU problem by allowing a small, non-zero gradient when the unit is not active and Slightly more complex than ReLU.

Tanh (Hyperbolic Tangent) is used as Long Short-Term Memory (LSTM) a type of recurrent neural network (RNN) architecture used in the field of deep learning. Zero-centered output, less likely to suffer from vanishing gradient compared to Sigmoid. It's especially effective for tasks that involve sequential data, such as time series prediction, natural language processing, and speech recognition. But Still prone to vanishing gradient, slower convergence In dense layer sigmoid is used for Smooth gradient, output range is between 0 and 1 but Can suffer from vanishing gradient, slow convergence.

The approach began by integrating traits features derived from both the initial and subsequent suggested proposed models. These combined traits were meticulous optimization using a genetic algorithm. The primary objective was to identify effective classifier for our conclusive decision-making process.

These pipelines' fitness is meticulously verified through training and cross-validation, including strategies such as accuracy or F1-score. Evolutionary operators, in particular mutation and crossover, are then used to create new pipeline variants, increasing diversity.

Data preprocessing transforms raw images into common characteristics, facilitating efficient image processing [19, 20]. Data may be took over from many platforms and rendered variously, depending on its properties. This data cannot be sent directly to a neural network, thus all data properties must be converted similarly. Training CNN on uncompressed images samples might end in worse classification performance[18, 21]. This work pre-processes an unprocessed images using the seven techniques mentioned in fig 4, before passing them to the training CNN.

ISSN 2394 - 7780

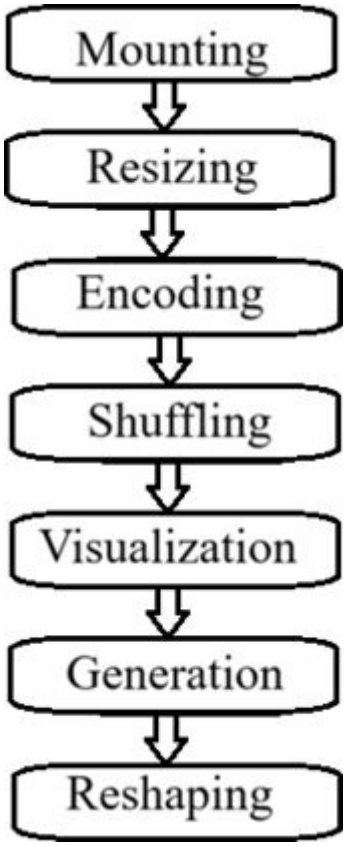
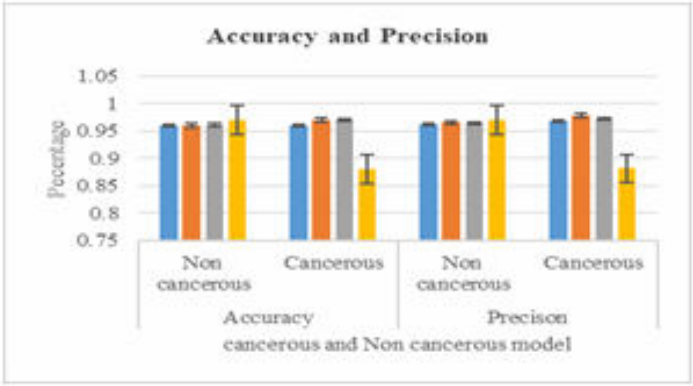


Fig 4: Techniques for unprocessed images



	Recall		F1 score	
	Non cancerous	Cancerous	Non-cancerous	Cancerous
Model	0.943	0.952	0.953	0.944
Decision tree	0.982	0.954	0.975	0.974
Logistic Regressio n	0.986	0.957	0.977	0.975
Bayes	0.882	0.953	0.97	0.912

The genetic algorithm is utilized to perform genetic model selection. It is responsible for evolving and selecting the best pipelines having combination of preprocessing steps and machine learning models based on their fitness on a given dataset especially for intricate tasks such as lung cancer detection. This process iterates until it reaches the optimal pipeline. The best-performing pipeline produces optimal solutions that maximize the desired fitness measure. The best-performing pipeline offers the best possible outcomes that maximize the desired fitness measure.

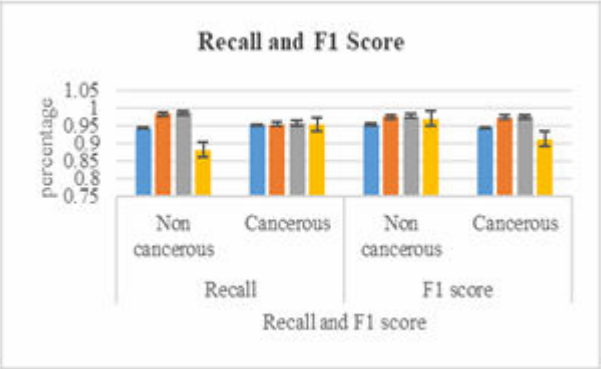
III. RESULT AND ANALYSIS

The proposed performance model will be evaluated based on F-1 scores, precision, recall, accuracy, and support.To illustrate the outcomes, deep learning-driven methods are proposed for detecting lung cancer. Extensive tests were carried out on two popular datasets taken from Kaggle [22, 23]. Two datasets were

ISSN 2394 - 7780

used: one using chest X-ray and another with CT scan images. The main objective of our research was to determine the efficacy and proficiency of our models in detecting cases of lung cancer. The accuracy, precision, recall and f1-score of non-cancerous and cancerous class for the 4 different ml models results are shown in Table 2 and Table 3.

A graphical representation has been shown in Fig 5 and Fig 6.



The Logistic Regression model predicts this specific instance as being Cancerous or class 1 with a perfect score and provides an the prediction based on the features like Chronic Disease, Coughing, Allergy, Swallowing Difficulty, Yellow Fingers, Alcohol Consuming, Smoking, Wheezing, Chest Pain, Anxiety, Age, and Gender.

As a consequence, it may be concluded that these two sets of traits are the most important for lung cancer detection and interpretation. Tables 2 and 3 demonstrate 95% accuracy for both malignant and non-cancerous classes using the decision tree approach. The accuracy, recall, and F1 score for the non-cancerous class are 96%, 94%, and 95%, respectively, compared to 93%, 95%, and 94% for the malignant class.

IV. CONCLUSION

The proposed framework distinguishes among benign, normal, and malignant lung CT scans. It can also precisely identify multi-class renal CT pictures as normal, tumor, cyst, or stone. Four distinctive machine learning models were used to effectively create a comprehensible lung cancer detection system.Among the ML models, Logistic Regression are more accurate in predicting lung cancer. Furthermore, crucial characteristics for lung cancer diagnosis were identified. This technology can diagnose lung cancer early and more reliably. This approach might be used to make more exact diagnoses of many ailments that need model interpretation.

V. REFERENCES

[1]. Hammer, M. M. (2024). Risk and time to diagnosis of lung cancer in incidental pulmonary nodules. Journal of Thoracic Imaging, 39(5), 275-280.

[2]. Zhong, D., Sidorenkov, G., Jacobs, C., de Jong, P. A., Gietema, H. A., Stadhouders, R., ... & Heuvelmans, M.

A. (2024). Lung Nodule Management in Low-Dose CT Screening for Lung Cancer: Lessons from the NELSON Trial. Radiology, 313(1), e240535.

[3]. Wadekar, S., & Singh, D. K. (2023). A modified convolutional neural network framework for categorizing lung cell histopathological image based on residual network. Healthcare Analytics, 4, 100224.

[4]. P. Qian, et al., Mdixon-based synthetic CT generation for PET attenuation correction on abdomen and pelvis jointly using trans-fer fuzzy clustering and active learning-based classification, IEEE Trans. Med. Imaging 39 (4) (2020) 819–832.

[5]. Dag, A. Z., Johnson, M., Kibis, E., Simsek, S., Cankaya, B., & Delen, D. (2023). A machine learning decision support system for determining the primary factors impacting cancer survival and their temporal effect. Healthcare Analytics, 4, 100263.

[6]. Uddin, A. H., Chen, Y. L., Akter, M. R., Ku, C. S., Yang, J., & Por, L. Y. (2024). Colon and lung cancer classification from multi-modal images using resilient and efficient neural network architectures. Heliyon, 10(9).

ISSN 2394 - 7780

[7]. Cersonsky, T. E., Cersonsky, R. K., Silver, R. M., Dudley, D. J., & Pinar, H. (2024). Placental Lesions Associated With Stillbirth by Gestational Age, as Related to Cause of Death: Follow-Up Results From the Stillbirth Collaborative Research Network. Pediatric and Developmental Pathology, 27(1), 39-44.

[8]. Rubin, R. (2024). From "immunity debt" to "immunity theft"—how COVID-19 might be tied to recent respiratory disease surges. Jama.

[9]. Kratzer, T. B., Bandi, P., Freedman, N. D., Smith, R. A., Travis, W. D., Jemal, A., & Siegel, R. L. (2024). Lung cancer statistics, 2023. Cancer, 130(8), 1330- 1348.Xu, C., Zhou, D., & Zhu, M. (2024).

[10]. High throughput sequencing technology and its clinical application in circulating tumor DNA detection in patients with tumors. Investigación Clínica, 65(4), 476- 494.

[11]. Chen, C., Wan, M., Peng, X., Zhang, Q., & Liu, Y. (2024). GPR37-centered ceRNA network contributes to metastatic potential in lung adenocarcinoma: Evidence from high-throughput sequencing. Translational oncology, 39, 101819.

[12]. G.M.M. Alshmrani, Q. Ni, R. Jiang, H. Pervaiz, N.M. Elshennawy, A deep learning architecture for multi- class lung diseases classification using chest X-ray (CXR) images, Alexand. Eng. J. 64 (2023) 923–935.

[13]. S. Bharati, P. Podder, M.R.H. Mondal, Hybrid deep learning for detecting lung diseases from X-ray images, Inform. Med. Unlocked 20 (2020) 100391.

[14]. A. Bhandary, G.A. Prabhu, V. Rajinikanth, K.P. Thanaraj, S.C. Satapathy, D. E. Robbins, N.S.M. Raja, Deep-learning framework to detect lung abnormality–a study with chest X-Ray and lung CT scan images, Pattern. Recognit. Lett. 129 (2020) 271–278.

[15]. S. Arvind, J.V. Tembhurne, T. Diwan, P. Sahare, Improvised light weight deep CNN based U-Net for the semantic segmentation of lungs from chest X-rays, Results Eng. 17 (2023) 100929.

[16]. I. Shafi, S. Din, A. Khan, I.D.L.T. Díez, R.D.J.P. Casanova, K.T. Pifarre, I. Ashraf, An effective method for lung cancer diagnosis from ct scan using deep learning-based support vector network, Cancers 14 (21) (2022) 5457.

[17]. A. Rehman, M. Harouni, F. Zogh, T. Saba, M. Karimi, F.S. Alamri, G. Jeon, Detection of lungs tumors in CT scan images using convolutional neural networks, IEEE/ACM Trans. Comput. Biol. Bioinform. 21 (4) (2023) 769–777.

[18]. Hammad, M., ElAffendi, M., Asim, M., Abd El-Latif, A. A., & Hashiesh, R. (2024). Automated lung cancer detection using novel genetic TPOT feature optimization with deep learning techniques. Results in Engineering, 24, 103448.

[19]. Maharana, K., Mondal, S., & Nemade, B. (2022). A review: Data pre-processing and data augmentation techniques. Global Transitions Proceedings, 3(1), 91- 99.

[20]. Abbas, M., Arslan, M., Bhatty, R. A., Yousaf, F., Khan, A. A., & Rafay, A. (2024). Enhanced Skin Disease Diagnosis through Convolutional Neural Networks and Data Augmentation Techniques. Journal of Computing & Biomedical Informatics, 7(01), 87- 106.

[21]. Farady, I., Lin, C. Y., & Chang, M. C. (2024). PreAugNet: improve data augmentation for industrial defect classification with small-scale training data. Journal of Intelligent Manufacturing, 35(3), 1233- 1246.

[22]. Lung Cancer Detection, Jillani, 2022, available online: https://www.kaggle.com/ datasets /jillanisofttech/lung- cancer-detection. Accessed [28-12-2023].

[23]. Ahmed, M. S., Iqbal, K. N., & Alam, M. G. R. (2023, January). Interpretable lung cancer detection using explainable ai methods. In 2023 International Conference for Advancement in Technology (ICONAT) (pp. 1-6). IEEE.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

THE INTERPLAY OF GLOBALIZATION AND CULTURAL IDENTITY IN POSTCOLONIAL ENGLISH NOVELS

Dimple Jyotiyana[1] and Dr.Garima Chauhan[2]
[1]Research Scholar, Department of Development Studies
[2]Associate Professor, Department of Development Studies

ABSTRACT
This research explores the complex relationship between globalization and cultural identity as depicted in postcolonial English novels. By analyzing prominent texts such as Salman Rushdie's Midnight's Children, Arundhati Roy's The God of Small Things, and Zadie Smith's White Teeth, the study examines how authors portray the tensions and hybridity resulting from global influences on traditional cultural practices and identities. Employing a multidisciplinary approach rooted in postcolonial theory and globalization studies, the paper identifies themes of resistance, adaptation, and cultural negotiation. The findings suggest that postcolonial literature serves as a vital space for expressing the fluidity of cultural identities in a globalized world, reflecting both the challenges and opportunities faced by postcolonial societies. This study contributes to a deeper understanding of how literature captures the ongoing process of cultural transformation in a rapidly interconnected world.

Keywords: *Globalization, Cultural Identity, Postcolonial Literature, Hybridity, Resistance, Cultural Negotiation, English Novels, Postcolonial Theory, Cultural Transformation.*

OBJECTIVES:
To analyse how globalization impacts cultural identity in postcolonial English novels.

To explore representations of hybridity and resistance within these texts.

To understand how authors negotiate cultural identities amidst global influences.

To examine literary strategies that depict cultural transformation.

LITERATURE REVIEW
Postcolonial theory provides a framework for understanding how colonial histories influence contemporary cultural identities. Homi Bhabha's concept of hybridity illustrates how cultures blend and resist homogenization. Theories of globalization highlight the interconnectedness and cultural flows that challenge traditional identities. Postcolonial literature reflects these dynamics, portraying identities as fluid and contested.

METHODOLOGY
This qualitative study undertakes a textual analysis of selected novels, applying thematic analysis to identify motifs of hybridity, resistance, and negotiation. The analysis contextualizes these themes within postcolonial and globalization theories.

Text Analysis of "Midnight's Children"
Salman Rushdie's Midnight's Children is a landmark novel that intricately weaves themes of identity, history, and postcolonial hybridity. Through its narrative techniques and rich symbolism, the novel explores the complex process of cultural transformation in India, shaped by colonial legacy and global influences.

Narrative Style and Structure
Midnight's Children employs a nonlinear, first-person narrative, narrated by Saleem Sinai, a child born at the stroke of midnight on the day India gained independence. This framing device symbolizes the birth of a nation intertwined with personal identity. Rushdie's use of magical realism—blending fantastical elements with historical events—serves to emphasize the mythic quality of national identity and collective memory. The narrative is fragmented, reflecting the tumultuous history of India and the fragmented nature of postcolonial identity.

Themes of Hybridity and Cultural Identity
The novel embodies the concept of hybridity—a mix of traditional Indian culture and colonial influences—highlighted through Saleem's own hybrid identity as both a product of Indian culture and colonial history. His physical deformity and telepathic powers symbolize the complex, often conflicting layers of cultural influences that shape postcolonial identities. Rushdie suggests that Indian identity is a bricolage—constructed from diverse cultural, historical, and social elements.

Resistance and Cultural Negotiation
Saleem's personal story is intertwined with India's political upheavals, depicting resistance to colonial and postcolonial domination. The narrative challenges the idea of a monolithic national identity, emphasizing instead a pluralistic and negotiated sense of self. The novel's playful language and metafictional techniques—such as direct addresses to the reader—serve as acts of cultural resistance, asserting the legitimacy of Indian voices and histories that have been marginalized or suppressed.

SYMBOLISM AND IMAGERY

Midnight's Children: The children born at midnight symbolize the birth of a new India, each with unique powers and destinies. Their stories illustrate the diverse, multifaceted nature of postcolonial identity.

Telepathy and Power: Saleem's telepathic abilities symbolize the interconnectedness of Indian society and the collective consciousness of its people.

Historical Events: Major events—Partition, the Emergency, wars—are depicted as part of the nation's fabric, emphasizing the inseparability of personal and national histories.

Language and Style
Rushdie's lush, inventive language combines colloquialisms, poetic imagery, and historical references, creating a vibrant tapestry that celebrates Indian culture's richness. His use of allegory and satire critiques colonial legacies and postcolonial political struggles, emphasizing the ongoing process of cultural negotiation.

Text Analysis of the "God of Small Things"
Arundhati Roy's The God of Small Things is a richly layered novel that explores themes of social hierarchy, cultural identity, and postcolonial trauma through the intimate lens of a Kerala family. The novel's narrative style, symbolism, and social critique illuminate the complex interplay of tradition and modernity, resistance, and cultural negotiation within postcolonial Indian society.

Narrative Structure and Style
The novel employs a non-linear, cyclical narrative, oscillating between past and present to reveal how historical and personal histories are intertwined. Roy's lyrical prose and detailed descriptions create an immersive atmosphere, emphasizing the significance of small moments and details—hence the title—highlighting how seemingly minor events shape identities and histories. The narrative's fragmented structure reflects the fractured social fabric and the layered realities of postcolonial life.

Themes of Cultural Identity and Social Hierarchy
The God of Small Things critically examines the caste system and social discrimination that persist in postcolonial India. The character of Velutha, an "Untouchable" Paravan, symbolizes resistance and the possibility of crossing social boundaries. Roy's portrayal of caste atrocities underscores the ongoing struggle against ingrained social hierarchies, emphasizing that cultural identity is deeply embedded in social structures that often resist change.

The novel also explores the influence of colonial legacies—such as language, education, and social customs—that continue to shape Indian cultural identity. The characters' internal conflicts reflect the tension between traditional values and the desire for modernity and freedom.

Resistance and Cultural Negotiation
Roy's narrative presents acts of resistance—both subtle and overt—against oppressive social norms. Ammu's relationship with Velutha defies caste restrictions, symbolizing a challenge to societal conventions. The narrative underscores the importance of personal agency and the possibility of cultural negotiation, suggesting that identities are not fixed but are continually reshaped through acts of defiance and acceptance.

Symbols and Imagery
The "God of Small Things": The title itself symbolizes the significance of minor details, small acts, and overlooked histories that hold profound meaning. It also references the Hindu deity, suggesting the intersection of religion, superstition, and cultural practices.

Orangedrop and the River: Natural imagery, like the river and the orange blossoms, evoke themes of purity, change, and the flow of life, symbolizing the continuity of cultural and personal histories.

Butterflies: The recurring motif of butterflies signifies transformation, fragility, and the fleeting nature of happiness and innocence.

ISSN 2394 - 7780

Language and Poetics
Roy's prose is poetic, lush, and evocative, blending English with Indian idioms and references. The detailed descriptions evoke sensory experiences, emphasizing the importance of perception and memory. Her language captures the nuances of cultural identity, highlighting the contradictions and complexities inherent in postcolonial society.

Social Critique and Postcolonial Reflection
The novel critically examines the lingering effects of colonialism, social discrimination, and the repression of marginalized groups. Roy's depiction of the caste system and gender roles exposes the systemic inequalities embedded within Indian society. She advocates for social change through her vivid portrayal of characters who challenge oppressive norms, thus emphasizing the potential for cultural negotiation and transformation.

Text Analysis of White Teeth
Zadie Smith's White Teeth is a vibrant and multifaceted debut novel that explores themes of identity, multiculturalism, family, and history within contemporary London. Through its energetic narrative, diverse characters, and sharp social critique, the novel examines the complexities of cultural integration and the fluidity of personal and collective identities in a postcolonial, multicultural society.

Narrative Style and Structure
White Teeth employs a multi-voiced, first-person narrative, with chapters alternating among various characters, including Archie Jones, Samad Iqbal, and their families. This polyphony creates a kaleidoscopic view of London's diverse communities. The narrative is characterized by wit, humor, and a conversational tone, reflecting Smith's lively, accessible prose. The novel also incorporates historical flashbacks and cultural references, weaving personal stories with broader social and political histories.

Themes of Identity and Multiculturalism
Central to the novel is the exploration of cultural identity. Smith examines how characters negotiate their heritage—whether British, Jamaican, Bangladeshi, or others—and how these identities influence their perceptions and relationships. For example, Samad struggles with his traditional Muslim values while living in a secular, Western society, highlighting the tension between cultural preservation and assimilation.

The novel celebrates hybridity—the blending of different cultural influences—as a natural and enriching aspect of contemporary life. Characters embody multiple identities, reflecting the fluid and constructed nature of personal and cultural selfhood.

Family, Heritage, and Legacy
White Teeth emphasizes the importance of family history and heritage, illustrating how past generations shape present identities. The intergenerational conflicts, especially between the older and younger characters, reveal differing attitudes toward tradition, modernity, and change. The novel explores how family secrets, cultural expectations, and personal choices influence individual destinies.

Social Critique and Postcolonial Reflection
Smith critically examines issues of race, class, and postcolonial legacy. The novel interrogates stereotypes and societal prejudices, often using humor and satire to challenge assumptions. For instance, the character of the sinister "Archie" and his encounters with societal expectations highlight the absurdities and contradictions within multicultural Britain.

Furthermore, the novel reflects on the impact of colonial history—particularly through characters like Samad and his attempts to preserve his Bengali culture—highlighting the ongoing influence of imperialism on identities and social dynamics.

Symbols and Motifs

Teeth: The recurring motif of teeth symbolizes communication, identity, and the potential for growth or decay. The title itself suggests the importance of bite, assertion, and the physical markers of identity.

The "White Teeth" of the title: Could symbolize purity, whiteness, or the idea of something essential and unifying—highlighting the complexities of racial and cultural identity.

The "Night Watchman": Represents societal oversight and the tension between individual freedom and social expectations.

ISSN 2394 - 7780

Language and Tone
Smith's language is lively, humorous, and colloquial, making her characters' voices authentic and relatable. Her use of irony and satire effectively critiques societal norms and exposes underlying prejudices. The narrative's tone oscillates between comedy and serious reflection, capturing the contradictions of multicultural life.

CONCLUSION

The postcolonial English novels White Teeth, The God of Small Things, and Midnight's Children collectively illuminate the complex and often contradictory ways in which globalization influences cultural identity in postcolonial societies. While each novel approaches this theme through unique narrative frameworks and cultural contexts, they converge in highlighting that globalization acts as both a force of cultural homogenization and a catalyst for hybrid identities.

Zadie Smith's White Teeth exemplifies the multicultural fabric of contemporary London, where globalization manifests through the mingling of diverse ethnicities, languages, and traditions. Smith's portrayal suggests that **cultural identities are fluid, hybrid, and continually** negotiated in a globalized environment. Her characters embody the tensions and enrichments that come with multicultural coexistence, emphasizing resilience and adaptability.

Arundhati Roy's **The God of Small** Things presents a more localized yet deeply affected view of globalization's reach, illustrating how economic and cultural forces penetrate small-town life in Kerala. Roy underscores that globalization often exacerbates existing **social hierarchies, such as caste and class**, even as it introduces new influences and ideas. Her narrative reveals how postcolonial societies grapple with maintaining cultural integrity amid external economic and cultural pressures.

Salman Rushdie's Midnight's Children explores the historical and political aftermath of colonialism and the partition of India, depicting how global forces—colonialism, nationalism, and modernity—shape individual and national identities. Rushdie's magical realism highlights the fluidity of cultural boundaries and the layered nature of postcolonial identity, emphasizing that globalization's legacy is intertwined with historical trauma and cultural resilience.

In comparative perspective, these novels demonstrate that globalization in postcolonial contexts is ambivalent: it fosters cultural exchange and hybridity but also risks eroding traditional identities and social structures. They collectively advocate for an awareness of the dynamic, layered nature of cultural identity—one that resists simple homogenization and recognizes the ongoing negotiations between local traditions and global influences.

Ultimately, these postcolonial novels reveal that globalization is not merely a homogenizing force but a complex process that catalyzes the reconstitution of cultural identities. They challenge readers to understand that in a globalized world, cultural identities are neither fixed nor purely resistant but are continually shaped through dialogue, conflict, and adaptation. This interplay underscores the importance of embracing hybridity and resilience as vital components of postcolonial cultural consciousness.

Research Paper Topics on

"Integrating Vocational and Liberal Arts Education"

REFERENCES

1. Bhabha, H. K. (1994). The Location of Culture. Routledge.
2. Ashcroft, B., Griffiths, G., & Tiffin, H. (2007). Postcolonial Studies: The Key Concepts. Routledge.
3. Roy, Arundhati. (1997). The God of Small Things. Random House.
4. Rushdie, Salman. (1981). Midnight's Children. Jonathan Cape.
5. Smith, Zadie. (2000). White Teeth. Hamish Hamilton.
6. Young, R. J. C. (2003). Postcolonialism: An Historical Introduction. Blackwell Publishing.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

LITERACY ASSESSMENT IN PRIMARY CLASSROOMS: AN EXLORATION FROM RHODES AND SHANKLIN FRAMEWORK

Dr. Nidhi Kunwar
Associate Professor, Department of Education, Mata Sundri College, University of Delhi

ABSTRACT
Assessment acts as an essential learning tool. It offers insights into a child's strengths and weaknesses, guiding essential decisions about their abilities. Specifically, literacy assessment measures reading and writing skills, enabling us to make informed judgments about a child's literacy development. In this article, the current state of literacy assessment in our school is discussed with particular reference to the principles of literacy assessment outlined by Rhodes and Shanklin (1993).

INTRODUCTION
Assessment plays an essential role in education. It offers valuable insights into students' performance and growth. It helps identify strengths and weaknesses, encourages improvement, and supports informed decisions. In educational settings, assessment provides feedback, motivates learners, and fosters ongoing development.

Literacy assessment in schools involves evaluating a student's language skills in one or more languages, covering abilities like listening, speaking, reading, and writing. These assessments, whether formal or informal, help teachers identify a student's language strengths and areas needing improvement, guiding teaching strategies. The significance of literacy assessment is particularly high in all grades but is especially crucial in primary years, as these are the foundational stages of schooling.

This paper examines the current literacy assessment practices in primary classrooms. Emphasizing early grades is essential because these years lay the foundation for students' educational development. The way literacy is assessed during these formative years has a significant impact on how children develop reading and writing skills.

This paper presents my observations of fifteen primary classrooms during exam periods. I visited each school twice across different terms, collecting data through classroom observations, teacher interviews, and reviewing question papers for Hindi and English. Informal discussions with teachers provided additional insights into their perspectives. The paper is organized into three sections. The first section discusses literacy assessments in primary grades, following the principles outlined by Rhodes & Shanklin (1993). The second section emphasizes the educational implications that arose from this research. The third section concludes the discussion.

Understanding Literacy Assessment in Schools
In this section, I will utilize the literacy assessment principles outlined by Rhodes & Shanklin (1993) to evaluate the current assessment framework in our context. I will examine the seven principles of literacy assessment they proposed and assess how our system aligns with each one.

1. Assess Authentic Reading and Writing
Rhodes & Shanklin argue that teachers should assess genuine reading and writing skills. This involves measuring a child's actual reading ability rather than just their performance. Genuine reading shows what a child can understand independently when given a text. Similarly, genuine writing demonstrates what a child can produce independently when given a topic to explore. Evaluating authentic reading and writing is essential because it highlights specific areas that need improvement. This allows teachers to identify aspects for growth and adjust their support accordingly.

From my observations, there is a lack of authentic reading experiences in schools. Students mostly encounter reading assessments, with three to five tests each term in elementary grades. Teachers typically notify students about these tests seven to ten days in advance, indicating the textbook page that will be covered. Parents are expected to help their children thoroughly practice that page in preparation. On test day, the teacher asks each student to read aloud the designated page individually. Due to multiple practice sessions from parents, most students can read this page fluently. However, during the assessments, I noticed several significant gaps.

a) Children were tracing the text with their fingers. However, I often noticed a discrepancy between the line they were reading and the line their finger was following. For example, a child might be finger-tracing line number 3 while reading aloud line number 8.8.

ISSN 2394 - 7780

b) In some instances, I noticed that the page was turned. For example, the reading test was on page 20, but it was accidentally opened to page 35. However, even on the wrong page, the children read aloud what was on page 20.

These observations showed that many children have memorized the page's content. They are not truly reading the page but simply recalling what they have memorized. Aside from these formal, pre-announced reading tests, no alternative forms of reading assessment were observed.

Similarly, I observed that the status of writing assessment in schools needs careful examination. In school assessments, writing is the primary focus. Students take unit tests, class tests, or end-of-term exams in language subjects. The questions are usually based on material already taught in class. Often, teachers ask students to identify key questions or topics for paragraph writing that might appear on the exam. As a result, students prepare accordingly. They have memorized and practiced questions from the specific chapters. This means that the written exam is a test of a child's ability to recall memorized information accurately. It does not evaluate a child's writing skills but rather their memorization ability.

The above discussion shows that neither authentic reading nor authentic writing is evaluated in our schools. Instead, only memorization skills are assessed under the guise of literacy abilities.

2. **Assess the literacy environment, teaching methods, and the needs of students**.
Traditionally, when we discuss assessment, we typically focus solely on evaluating students. We create various tests, assessment tools, or papers solely to assess students. However, according to the principles of literacy assessment, we need to consider three factors: the classroom environment, the teachers' instructions, and the students' participation.

It is essential to recognize that students' literacy development does not occur in isolation. The classroom environment in which the child is placed plays a crucial role in their development. As Brian Cambourne (1995) states, immersion is the most vital condition for language learning. Therefore, the print environment of the classroom is a key factor in children's literacy growth. Consequently, assessing the quality of reading and writing opportunities in the school is necessary. Likewise, the nature of teachers' instruction also greatly influences children's literacy development. The range of reading and writing activities included in teachers' lesson plans determines how effectively students will develop and excel in literacy skills. A teacher who emphasizes reading and writing activities in her lesson plans will likely see a significant increase in her students' engagement with reading and writing.

In my observations, I noticed that in most schools and across various grades, literacy assessment was limited to evaluating students through multiple tests, such as class tests, unit tests, and midterm exams. None of the schools conducted any evaluation of the classroom print environment, teachers' lesson planning, or instruction.

3. Assess reading and writing skills across different contexts
Reading and writing are skills that depend on context. This means that a person needs different types of reading skills to understand various kinds of texts. For example, the way we read a story differs from how we read informational texts. Similarly, writing an informal message will vary from writing a scientific research paper. Therefore, to accurately assess reading and writing, they should be evaluated in multiple contexts. Students must be exposed to different situations and encouraged to use appropriate literacy skills. The accurate assessment of students' literacy skills can only be achieved when their ability to use reading and writing across various contexts is evaluated.

Based on my observations, I noticed that reading and writing were only assessed in limited settings. Reading was solely focused on textbook content. Writing was limited to textbook exercises. The topics for composition writing were already outlined in the syllabus.

4. Analyze error patterns in reading and writing
Errors are an essential resource for assessment. Errors do not mean a child has failed. Instead, errors show that the child is trying to solve the problem. Errors offer insight into a child's thinking process. Analyzing errors can reveal where the child struggles. With focused efforts from the teacher, the child can overcome their conceptual challenges and improve understanding.

In reading and writing, error analysis helps teachers identify the issues a child faces. Teachers can also decide whether such problems need immediate attention or can be addressed later. For example, when asked to write Amritsar, a child writes UMRITSAR. If we analyze closely, we see that the child uses phonemic awareness to spell the word. 'u' is often pronounced as 'aa in some words, such as UMBRELLA. Perhaps the child applies

ISSN 2394 - 7780

the same logic here. This shows that the child's errors are not illogical. A teacher can share words with students that contain the sound 'u' to demonstrate how the sound changes depending on its position in the word.

Similarly, while reading, the student says – 'I love to visit the mall because there I can eat pizza, popcorn, and samosa'. While the child reads – 'I love to visit the mall because there I can eat pasta, popcorn, and samosa'. If we analyze carefully, we will see that it's not a grave mistake. The child has just substituted one food item's name with another. Also, the first letter is similar, so this kind of reading mistake can occur. The error is minor and doesn't require much attention. Therefore, analyzing mistakes is important because it reveals a child's thinking and approach.

In my observations, I noticed that errors are considered blunders in our schools. The developmental perspective on errors is not taken into account at any grade level. Errors in our context suggest that the student is not paying attention, and therefore, they indicate the child's failure. No analysis of errors is conducted in reading or writing.

5. Include background knowledge when assessing reading and writing skills.

Researchers such as Anderson (1994) have highlighted the importance of background knowledge or schema in understanding a text or topic. Anderson clearly stated that a reader can comprehend a specific text only when they activate their schema or background knowledge related to the subject. Failing to activate the schema or background knowledge will prevent understanding of the text or topic. For example, a child is asked to write about 'Deepawali'. The child is familiar with the festival since it is celebrated every year in his family. Therefore, writing a composition about it will not be difficult because he has prior schema. Conversely, the same child is asked to write about 'Madhubani (the art form)'. Since the child lacks basic information or background knowledge about this art form, he might not write. It is essential to recognize that the issue is not with the child's writing ability, but instead with the lack of necessary schema or background knowledge. Reliable literacy assessments can only be conducted when students are given reading or writing tasks that build on their background knowledge.

In my observations, I noted that in a classroom, it is assumed that everybody should have the same background knowledge. Standard topics for composition writing are given. It is expected that every child possesses the required knowledge of that topic. For example, a topic '*My first journey by Train'* was given to students for composition writing. Now, the topic assumes that everyone has traveled in a train and thus has the required experience. The topic will be easier for those students who have traveled by train. Similarly, it will be difficult for those who have not traveled in a train, despite their literacy proficiency.

6. Use triangulation to collect data about student literacy level

Triangulation of data involves employing multiple sources and methods to assess the child's performance, thereby ensuring the validity and reliability of the assessment. It provides a thorough perspective on the context, participation, and strengths of the child. This approach recommends using various techniques for literacy assessment, including observations, reflective journals, project work, reading different texts, and writing for diverse purposes. Applying triangulation enables a more precise understanding of the child's actual literacy skills.

From my observations, I found that none of the schools utilized triangulation. Instead, students are only given standardized writing or reading tests to evaluate their performance. If a student performs poorly on these tests, they receive a low grade. However, this approach does not provide an accurate assessment of their literacy skills.

7. Make assessment a daily part of the classroom teaching and learning process

Assessment is an integral part of the learning process. It is essential to recognize the significant role of assessment in daily classroom learning. Assessment informs us about a student's achievements and limitations. Routine assessment can enable us to draft our daily lesson plans accordingly. We can focus on the required areas to ensure that all students achieve the expected learning outcomes.

Based on my observations, assessment is often seen as merely formal exams conducted at the end of a term. These exams primarily focus on identifying the child's areas of weakness. Instead of offering constructive feedback, the scores are used to compare and categorize students.

Educational Implications

This research study highlights several key educational implications.

ISSN 2394 - 7780

1. **Changes must be made to our assessment system**

Unfortunately, we still rely on a traditional assessment method despite introducing initiatives like Continuous and Comprehensive Evaluation (CCE). We tend to see assessment only as a formal written exam. However, it is now essential to recognize the value of meaningful assessment and use it appropriately. Students should be assessed through various methods to develop a deeper understanding.

2. **Train teachers for reliable literacy assessment:**

Teachers are a crucial part of our education system (Batra, 2005). No educational initiative or plan can succeed without their support. To empower teachers' agency, it is essential to equip them with the necessary knowledge, technology, and experience. Pre-service teacher education programs must offer foundational training in assessing children from diverse backgrounds and multiple learning styles. They must also introduce recent assessment tools and techniques supported by research evidence.

3. **Availability of resources**

Conducting practical literacy assessments requires access to various resources, such as children's literature, chart paper, and writing supplies. To improve our literacy assessments, educators need practical tools that support reading and writing activities. Without such access, creating a meaningful literacy assessment framework is impossible. For example, Kunwar (2025) found that access to school libraries was restricted for teachers and students in some schools. Books were rarely issued to students because of concerns about damage. Therefore, institutions must provide resources for teachers and students to enable practical literacy assessments.

CONCLUSION

This paper on literacy assessment reviews the current state of reading and writing assessment in our context. It applies the principles outlined by Rhodes and Shanklin (1993) to understand the reality of our classrooms. The study highlights the need for substantial changes and enhancements in our assessment framework to strengthen its theoretical foundation. Incorporating research evidence is essential for designing and developing more effective assessment methods and frameworks.

REFERENCES

- Anderson, R. C. (1994). Role of the reader's schema in comprehension, learning, and memory. In R. B. Ruddell, M. R. Ruddell, H. Singer, (Eds). Theoretical models and processes of reading (pp. 469-482). Newark, DE: International Reading Association
- Batra, P. (2005). Voice And Agency of Teachers: Missing Link in National Curriculum Framework 2005. Economic And Political Weekly, 40 (40), 4347-4356.
- Cambourne, B. (1995). Towards an educationally relevant theory of Steffe & J. Gale (Eds.), Constructivism in education (pp. 331–339) literacy learning: Twenty years of inquiry. The Reading Teacher, 339). Hillsdale, NJ: Lawrence Erlbaum. 49(3), 182–192.
- Guba, E., & Lincoln, Y. (1994). Competing paradigms in qualitative research. In N. Denzin & Y. Lincoln (Eds.), *Handbook of Qualitative Research* . 105–117. Sage.
- Kunwar , N. (2025). Exploring Middle School Teachers' Perceptions about Hindi Literature Pedagogy. Poonam Shodh Rachna.4(VI), 59-64June 2025, ISSN 2456-5563. http://doi.org/10.56642/psr.v04i06.006
- Rhodes, L.K. & Shanklin, N.L. (1993). Windows into Literacy: Assessing Learners, K-8, Portsmouth, NH: Heinemann.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

PROSPECTIVE OF HIGHER EDUCATION IN HOSPITALITY IN INDIA. A STUDY OF THE OPPORTUNITY AND THE CHALLENGES OF HOSPITALITY EDUCATION IN INDIA.

Dr. Ashish Bansal
Assistant Professor, Guru Kashi University, Bhatinda, Punjab

ABSTRACT
The hotel and tourism industry has had a boom in India for the past many years. The rapid increase in the tourism international and domestic traveling for many reasons like conferences, business, pilgrimage, sports, and luxury tourism has increased the opportunity for employment and growth in infrastructure in India. The hotel and tourism industry has rapidly constructed new ventures and startups to cater to this growing need of the consumer. It has led to competition in the market to curb the customer. The hotel industry is using different marketing tactics to grab the market the customer. For this reason, they need highly competitive, skilled, and experienced staff, who have both managerial and operative knowledge of work. The study is based on the data collected from primary and secondary resources like books, newspapers, journals, magazines, the internet, and article. The primary data is collected from the information received from the distribution of questionnaire people from the staff working in hotel management institutes and the hotel industry. This is a study of the people from the academic and the industry to analyze their opinion on the current pattern of hospitality education in India. The education in hospitality is comparable with the need, demand, and environment of the industry. The questionnaire is formed in two parts, one is distributed to academic persons like a lecturer, assistant professor, professor, and teaching staff of the hotel management institute and the other part of the questionnaire is distributed among people from industries like food production, food and beverage service, and front office staff.

Keywords: *hotel, hospitality, academics, restaurant, tourism, education*

INTRODUCTION
One out of seven employees in the world is given in the hospitality sector. A huge number of employment is generated in the hotel, tourism, and restaurant industries. It has a big contribution to the GDP of the country. On the other side, it helps to provide better infrastructure, exchange culture, generate foreign exchange, and improve the standard of living of the local riders. India has always been a choice for hospitality education. The government has also sanctioned monetary benefits to the educational institute in the budget for the growth of the education sector in hospitality. A lot of private institutes has come forward to transit hospitality education among student but very few have addressed the key problem to solve the problem of imparting quality education allying with the need and demand of the hospitality industry. There is a discrepancy in the syllabus of hotel management with the demand of the hotel industry. There is a need for the industry person to come forward and make the changes in the curriculum of the hotel management institute. Further, it is stated that the syllabus of the hotel management institute is not catering to the present demand of the industry. It is time to re-access the syllabus and the pattern of academics and the present need of the industry. The syllabus and the course content of the hotel management institute need up-gradation and the quality of the content further re-accessed. Annual Tourism Report, 2011-12.

LITERATURE REVIEW
(Bagri and Babu, 2009) said that India is becoming a hunt for tourist destinations. This article has the opportunities and positive job-related prospects of a hotel management course. Students pursuing the hotel management course have a good opportunity to settle abroad. India is providing manpower to developed countries in hospitality. It is evident in the past that there was not much emphasis on the studies in hospitality but at present, there are degree, postgraduate, and P.hd studies in hospitality from different government and private institutes.

(Bhardwaj, 2002). Said that the two variables of the organization, the contextual performance and task performance of the organization. It is seen that the employee should be skilled to satisfy the expectations of the customer. In his article, he explained, the factors are which effects the performance of the employees in the hotel industry. It highlights the components to increase the efficiency and performance of the employees in the organization the role of organizational culture and the job performance of the employees.

(Amoah and Baum, 1997). Said that the tourism policy should be as per the national level. He said that the tourism policy should be a national tourism policy in India. He urged that to develop a framework for the development and implementation of national tourism policy with tourism education.

ISSN 2394 - 7780

Umbreit (1992) said that there needs to be amendments to the present curriculum of the hospitality course in the United States. It is a growing field in the United States and he urged to include six components in the present syllabus, leadership skills, total quality management, financial management, service marketing, marketing skills, and the human resources subject should be included in the curriculum. High-performance and quality staff should be retained and he said that high-quality hospitality education should be provided to the students.

(Doswell, 1994). Said about the current trends in tourism and hospitality. He said that all the components of the tour should be included as a subject for the curriculum of tourism. He said about the function of management from planning to monitoring the performance and results. He raised issues like the problems of the management and practical aspects of the tourism course.

Millar, M., & Park, S. Y. (2013). Said about the introduction of sustainability of tourism in the curriculum of the course. He said that only the protection of the environment is not sustainability but the boundaries of sustainability are much more than it. He said that the tourism industry is growing and the curriculum should be updated, practical, and progressive to meet the present scenario of the market.

Different courses on hotel management offered by the recognized AICTE, UGC, NCHMCT, IGNOU, etc hotel management, tourism, and aviation institutes in India

The following are the objectives of the study

1) To access the present curriculum of the hospitality course.
2) To access the reverences of the syllabus of hospitality courses with the hospitality industry.
3) To examine the discrepancies and, the gaps in the present curriculum with the industry's demand.

RESEARCH METHODOLOGY

The qualitative data is collected from the industry and academics. A total of 100 questionnaires were distributed in digital form through email, WhatsApp, and chat. Fifty questionnaires were distributed to the hotel industry staff such as managers, assistant managers, supervisors, and colleagues from different cities like Delhi, Bangalore, Calcutta, and Bombay through digital questionnaire, and fifty questionnaires were distributed to the staff of the education institute to be filled from the different IHM'S and private hotel management institute. It is observed that the perspective of the present education of the hotel management course can be assessed from the point of view of both sides.

RECOMMENDATION AND FINDINGS

The outcome of the survey states that the institute should focus more on the practical aspect of the course rather than the theoretical knowledge. It is also felt that the institution is not spending enough funds on the infrastructure of the classroom. There is poor or unsatisfied faculty hired by the institute to train the students. They do not have the knowledge to impart quality education to students. It is also observed that the majority of the students still have the last preference to take admission to the hotel management institute. Most quality students prefer to get admitted in engineering, doctorate, science, etc. Nowadays hotel management students also have job opportunities in sectors like call centers, banking, airlines, retail, multiplex, etc. so the situation has improved from an admission point of view. The faculty of the hotel management institute has given a contradicting statement and has said that there is a good opportunity in the hotel management course the students can work abroad after completing their course. The poor standard of practical training and low stipend

ISSN 2394 - 7780

decrease the motivation level of the students. The faculty members also said that the hotels are still finding students as cheap labor to work and prefer to take work from trainees as per their needs. The salary in the hotels is also a concern there is not enough salary offered by the hotels to the employees. It is evident that due to odd working hours and low salary staff, only 15% of the students continue their career in the hotel management sector, and 75% of the students prefer to study higher studies abroad and settle abroad. They also work in all other sectors of hospitality after completing their course like call centers, hospitals, railways, cruise ships, etc.

CONCLUSION

There is more demand for skilled manpower than the supply of manpower in India as per the ministry of Tourism. To meet this demand the Ministry of Tourism has introduced many short-term courses, vocational courses, food Craft programs, and polytechnics where the students can earn by investing very little money and get an opportunity to work in star-categories hotels. There are 49 institutes of hotel management colleges and 31 food craft institutions all over India to impart hotel management and catering knowledge as per the data from the Ministry of Tourism. These colleges are recognized by the NCHMCT, AICTE, and UGC and uniform course syllabus is taught in all these colleges. Many private colleges work under government-recognized bodies offering courses in hotel management subject. It is also observed that there is a need to change the old curriculum of hotel management courses and introduce new course patterns without interference from industry experts. There should be more exposure to the industry and guest lectures, workshops should be taken by industry experts to make it more reliable, innovative, and sustainable in the work environment of hotels. Colleges can also tie up with the industry and there should be regular visits of experts from the industry to teach the students.

Appendix

Questionnaire for Academicians

1. Is there scope for a hotel management course amid the present situation?
2. Who will be the candidate who opts for the hospitality course amid the present situation?
3. What will be the future opportunities in the hotel management course?
4. What will be the future opportunities for students pursuing higher studies in hospitality?
5. Is the syllabus in hotel management relevant to the present market situation?
6. Do you think that higher education in hotel management has a bright prospect in India?
7. Are the student looking at hospitality as a golden opportunity to make their career?
8. Is a hotel management course a better prospect for students pursuing higher education from abroad?
9. Do you think higher education in hotel management increases the chance of promotion in the job?
10. Do you think that practical training in hotel management is relevant to the need of the industry?
11. Can higher education in hospitality makes better-skilled manpower with the need of the industry?
12. What is the prospect of higher education in hospitality for the students pursuing from India?

Questionnaire for Hospitality Industry Professionals

1. Do you think that a basic degree in hotel management can match the skillset required in the industry?
2. Do you think that higher studies in hotel management have a better career opportunity in India?
3. Do you think that a syllabus in hotel management can polish the students to get a good opportunity in the industry?
4. What are the career opportunities for higher studies students from abroad in the Indian hospitality industry?
5. What are the gaps in the curriculum of hotel management course which needs to get changed from an industry point of view?
6. What are your inputs about the quality and standard of hotel management studies in India?
7. Do you think that higher education in hospitality can promote employee faster in careers?
8. Do the industry offer some initiatives to the employees to pursue further studies in their career?

ISSN 2394 - 7780

9. Would this qualification help in improving the career prospects of degree holders who want to work abroad?
10. What are the sectors in hospitality where higher education has good opportunities in the future building of a career?

REFERENCES

1. Annual Tourism Report, 2011-12. Ministry of Tourism (Govt of India).
2) Bagri, S., & Babu, A. (2011). Historical development of tourism education in India: The case of the Himalayan state of Uttarakhand. *Journal of Tourism*, *12*(1), 39-59.
3) Bhardwaj, B., & Kalia, N. (2021). Contextual and task performance: role of employee engagement and organizational culture in the hospitality industry. *Vilakshan-XIMB Journal of Management*.
4) Amoah, V. A., & Baum, T. (1997). Tourism education: policy versus practice. *International Journal of Contemporary Hospitality Management*.
5) Davis, G., Messmer, H., Umbreit, M. S., & Coates, R. B. (1992). *Making amends: Mediation and reparation in criminal justice*. Psychology Press.
6) Doswell, R. (2009). *Tourism: How effective management makes the difference*. Routledge.
7) Millar, M., & Park, S. Y. (2013). Sustainability in hospitality education: The industry's perspective and implications for curriculum. *Journal of Hospitality & Tourism Education*, *25*(2), 80-88.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

DEVELOPMENT, QUALITY AND EFFICACY ANALYSIS OF A VALUE-ADDED MILLET WAFFLE CONE

G. Nandhini[1] and Subaitha Hilma .K.N[2]
[1]Postgraduate and [2]Professor, Department of Clinical Nutrition, Ganga institute of Health Sciences, Coimbatore-641022

ABSTRACT

Introduction: *With growing health awareness, consumers increasingly seek snacks that combine nutrition with taste. Ice cream cones, typically made with refined flour and sugar, lack essential nutrients. This study aims to develop a healthier alternative using natural, functional ingredients.*

Background: *Millets are rich in fiber, micronutrients, and antioxidants. Barnyard millet, in particular, is known for its iron and dietary fiber content. Oats flour provides beta-glucans, beneficial for heart health, while wheat flour ensures binding and structure. Butterfly pea flower extract is a natural source of anthocyanins, offering antioxidant benproperties also has a antidiabetic properties. Stevia was used as a natural sweetener to replace sugar, and skimmed milk and butter were used to reduce fat content while maintaining flavor and texture.*

Methodology: *The waffle cone was prepared using a blend of wheat flour, oats flour, barnyard millet flour, skimmed milk, butter, stevia, and butterfly pea flower extract. Macronutrient analysis (carbohydrates, protein, fat, fiber) was conducted. The developed cone was compared with a conventional waffle cone. Sensory evaluation was performed by 20 semi-trained panelists using a 5-point hedonic scale. Consumer acceptabiliblity were collected through feedback form from 50 consumers.*

Results & Discussion: *The value-added cone showed improved nutritional content, particularly in dietary fiber and protein, and reduced sugar and fat levels. Sensory evaluation revealed good scores for taste, texture, and appearance. Consumer feedback indicated high acceptability and a positive response to the concept of a health-oriented cone.*

Conclusion: *The study successfully developed a nutritious and visually appealing millet-based waffle cone with good shelf life and consumer acceptability. It offers potential for commercialization in the functional and health-conscious dessert market.*

INTRODUCTION

With the rising prevalence of lifestyle-related disorders such as obesity, diabetes, and cardiovascular diseases, there has been a significant shift in consumer preferences toward foods that not only satisfy taste buds but also offer health benefits. Among the most sought-after food categories are convenient, ready-to-eat snacks and desserts that integrate both nutrition and indulgence.

Ice cream cones, a staple component of a widely loved dessert, are traditionally made using refined wheat flour (maida), white sugar, and saturated fats. While these cones serve as a functional base for holding ice cream, they offer minimal nutritional value and contribute to the overall glycemic load of the dessert. In response to the growing demand for healthier alternatives, the food industry and researchers have been exploring innovative ingredients and formulations that promote wellness without compromising sensory quality.

This study aims to develop a value-added millet-based ice cream cone incorporating functional ingredients that enhance both the nutritional profile and health benefits of the final product. Millets such as barnyard millet are rich in dietary fiber, antioxidants, and essential micronutrients like iron, magnesium, and B-complex vitamins. They possess a low glycemic index, making them suitable for diabetic-friendly formulations. In addition, the use of butterfly pea flower extract not only imparts a natural blue color to the product but also provides bioactive compounds such as anthocyanins and flavonoids, which exhibit antioxidant, anti-inflammatory, and anti-diabetic properties.

The development of such a health-oriented ice cream cone also aligns with sustainable food practices by utilizing underused traditional grains and natural colorants. This research focuses on optimizing the formulation of the millet waffle cone, evaluating its nutritional composition, and analyzing its sensory acceptability among consumers. The study ultimately aims to present a functional, visually appealing, and health-supportive dessert component that caters to the growing population of health-conscious individuals.

ISSN 2394 - 7780

STATEMENT OF THE PROBLEM:
To develop the value added millet waffle cone to adderess the need for a healthier with functional properties..

OBJECTIVES OF THE STUDY:
1. To develop a value-added waffle cone using millets and natural functional ingredients as a healthier alternative to conventional cones.
2. To analyze the macronutrient composition (carbohydrates, protein, fat, and fiber) and shelflife of the developed millet-based cone.
3. To compare the sensory qualities of the value-added cone with that of a conventional waffle cone.
4. To assess consumer acceptance and feedback regarding the developed health-oriented waffle cone.

Null Hypothesis:

NH1: There is no significant difference in nutritive content of developed value added millet waffle cone compared to conventional waffle cone.

NH2: There is no significant difference in the sensory attributes of developed value added millet waffle cone.

Alternative Hypothesis:

AH1: There is a significant difference in nutritive content of developed value added millet waffle cone compared to conventional waffle cone.

AH2: There is a significant difference in the sensory attributes of developedvalue added millet waffle cone.

METHODOLOGY:
A Applied research approach with a experimental research design was adopted to develop the value-added waffle cone was prepared using barnyard millet flour, oats flour, wheat flour, butterfly pea flower extract, stevia, skimmed milk, and butter. Dry ingredients were mixed and combined with wet ingredients to form a smooth batter, which was cooked in a waffle cone maker and shaped into cones.

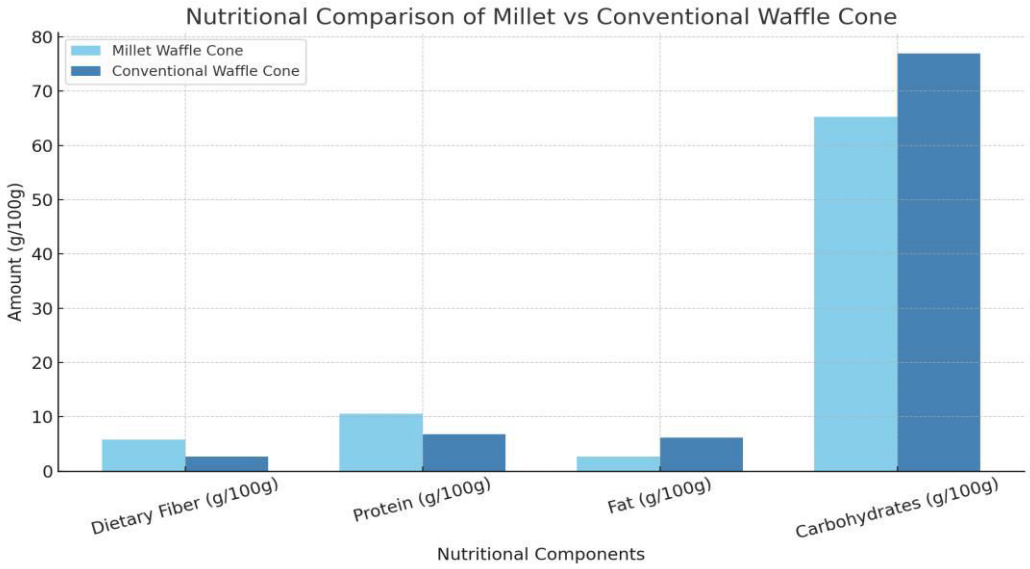
Standardization of Millet Waffle Cone:

INGRIDIENTS	VARIATION 1	VARIATION 2
Wheat Flour	40g	40g
Oats Flour	14g	14g
Barnyard millet Flour	10g	5g
Egg White	30g	30g
Skimmed milk	150ml	150ml
Clitoria Ternatea Flower Extract	5ml	10ml
Stevia	1g	1g
TOTAL	250g	250g

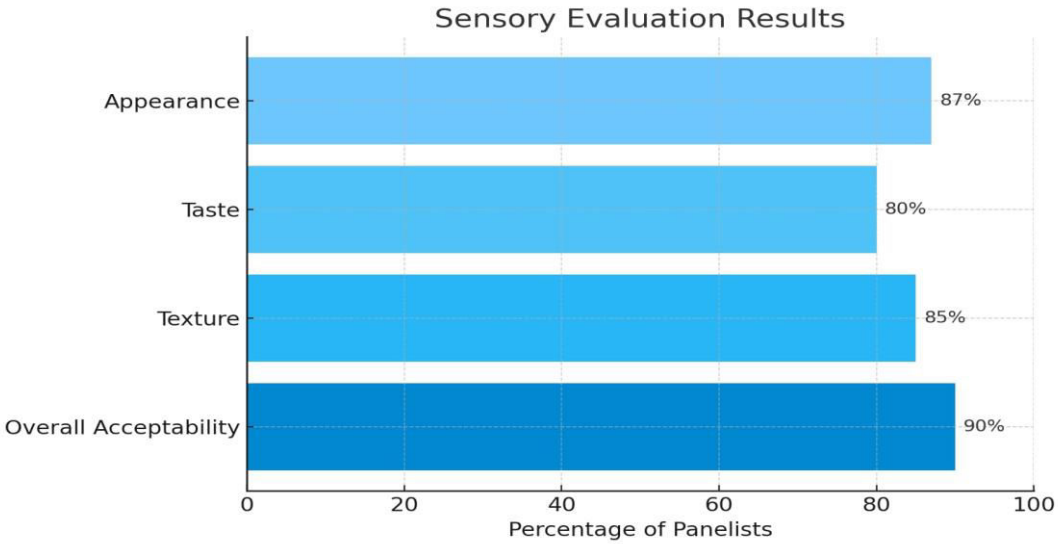
For the standardization of the millet waffle cone, two variations (Variation 1 and Variation 2) were formulated. Variation 1 was finalized as the standard recipe by sensory evaluation was performed by 20 semi-trained panelists using a 5-point hedonic scale, and subjected to nutritional analysis, which included Energy,carbohydrate,fat, protein, and fiber content. Shelf-life analysis was also conducted. Consumer feedback was collected from 30 individuals through a feedback form to assess overall acceptability.

RESULT AND DISCUSSION
The developed value-added millet waffle cone demonstrated significantly improved nutritional content compared to the conventional cone. It contained 5.8g/100g of dietary fiber, 10.6g/100g of protein, low fat at 2.7g/100g, and reduced carbohydrates at 65.3g/100g. In contrast, the conventional waffle cone had only 2.7g/100g of fiber, 6.8g/100g of protein, higher fat at 6.2g/100g, and 77g/100g of carbohydrates. These enhancements were attributed to the inclusion of barnyard millet and oats flour, along with the use of stevia and skimmed milk, which contributed to lower fat and sugar content—making the product a healthier alternative.

ISSN 2394 - 7780



Sensory evaluation results showed positive responses: 87% of panelists liked the appearance, 80% liked the taste, 85% appreciated the texture, and 90% rated the overall acceptability as high.



Most semi-trained panelists favored its natural color and mild sweetness. Furthermore, consumer feedback highlighted strong acceptability and enthusiasm for the health-oriented concept, indicating a promising potential for commercialization in the functional food and dessert markets.

CONCLUSION

The study successfully developed a nutritious, visually appealing millet-based waffle cone using natural functional ingredients such as barnyard millet, oats flour, and butterfly pea flower extract. The cone demonstrated improved nutritional value, especially in fiber and protein, with reduced sugar and fat content. Sensory evaluation and consumer feedback confirmed good acceptability, indicating that the product meets the demand for healthier dessert options. This value-added cone holds promise for commercialization in the health-conscious and functional food market.

REFERENCES

1. Pradip D. Dhangar and etal., A review on butterfly pea: An Emerging plant with application in food and cosmetics, International Research Journal Of Engineering Technology and Science, may 2023, 2582 - 5208.
2. Diksha Bhatt and etal.,Nutritional advantages of barnyard millet and opportunities for its processing as value-added foods National Library Of Medicine , Oct 2022, ;60(11):2748–2760.
3. Vellaichamy Gandhimeyyan Renganathan and etal., Barnyard Millet for Food and Nutritional Security: Current Status and Future Research Direction National Library Of Medicine, Jun 2020;11:500.

ISSN 2394 - 7780

4. Amy Richter and etal.,What Is Butterfly Pea Flower, and Does It Aid Weight Loss?, Nutrition, July 2021.
5. Faina Wehrli and etal.,Oat Intake and Risk of Type 2 Diabetes, Cardiovascular Disease and All-Cause Mortality: A Systematic Review and Meta-Analysis, National Library Of Medicine, Jul 2021.
6. Devendra Paudel et al.,A Review of Health-Beneficial Properties of Oats, National Library Of Medicine, 2021.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

ANALYSE RESUME WITH AI – GET HIRED

Gautam Kumar, Dipu Kumar and Priyanka Behera
Computer Science and Engineering Galgotias University, Greater Noida, India

ABSTRACT
As the competition for jobs intensifies, job seekers must focus on creating descriptions that match well with organizations, making it imperative to have the right resume. The investigation involves the construction of an ML-driven Advanced Application Tracking System (ATS) that can review resumes and provide in-depth feedback on their quality. It will analyze resumes for factors like relevance to the job descriptions, keyword optimization, structure and overall presentation. Some aspects include Resume evaluation, resume rating as poor, good or excellent based on preset parameters and providing specific suggestions on how to improve the same. It will then optimize keywords by highlighting essential terms to focus on from a given job description and validate their inclusion and contextual relevance within a person's resume so that it aligns with automated HR screening protocols. Through the integration of a module that predicts personality, the system would analyze resumes via Natural Language Processing (NLP) and sentiment analysis to predict personality traits that may help employers assess whether the applicant will fit into themselves in particular company culture and team dynamics. With appropriate recommendations, candidates will thus be able to tailor their job applications to get the right employment opportunities. Moreover, this tool, built as a result of machine learning combined with natural processing, simplifies the hiring procedure, leading eventually to better resume quality for hiring candidates and consequently better candidate suitability on the recruiting party's side - all these results in the holistic efficiency of the hiring process.

Keywords: *ATS, google gemini api key, style,(NLP) Naturanl Language Processing , IRTS(Intelligent Resume Tracking System), HR,SMART.*

I. INTRODUCTION
The hiring process in organizations involves sifting through large volumes of resumes to identify suitable candidates. Traditionally, resume screening has been a time-consuming process for Human Resources (HR) departments. Applicant Tracking Systems (ATS) were introduced to mitigate this challenge; however, these systems are limited in understanding semantic relationships within the content. This paper introduces an Intelligent Resume Tracking System, known as IRTS, which emphasizes the use of NLP and machine learning techniques for resume screening, providing a more nuanced analysis by comparing resumes with job descriptions based on insights into improvements. Innovations in natural language processing and machine learning [1] can really help in this regard. Ability to understand the written word and to extract important information from it in order to teach the machine is essential for analyzing written information like a resume. Natural language processing can be considered as a sub-area of machine learning that gives computers the ability to understand the meaning of human speech. There are many ways to train the model [2] and solve the problem. Some of the basic functions of natural language processing are automatic content, translation, name recognition [3] [4], analysis, data extraction, data recovery, etc. By automating this tasks, IRTS accelerates the recruitment process while minimizing the risk of human error and mundane tasks like resume parsing and matching, IRTS empowers recruiters to devote more time and resources to strategic decision- making. [5].

To begin developing your app on the platform of your choice, select a language and adhere to the setup instructions [6]. There are numerous applications for Gemini models. The Gemini model responds to notifications and takes in both text and image data. Additionally, callbacks are supported by Gemini, allowing developers to exchange the role and function definitions and pass the parameters that best match the description. This feature can be accessed by developers through external APIs and services [7]. We are going to develop a software application which help an applicant to analysis our resume on the basis of skill that we mention in our resume and that are required for a specific job this entire task is performed with the help of google api key.

II. LITERATURE REVIEW
This was the case before the advent of Applicant Tracking Systems, where the HR teams had to sort resumes according to job criteria, such as education, skills, and experience, to align with the job description. Usually, referrals and those coming from reputable sources like well-known institutions or recruiters took precedence.

The findings of this study [12]underscore the transformative potential of Resume2Vec in redefining modern recruitment processes by addressing critical limitations of conventional Applicant Tracking Systems (ATS). By employing transformer-based architectures such as BERT, RoBERTa, DistilBERT, GPT-4, Gemini, and Llama, Resume2Vec demonstrates a clear advantage in aligning candidate profiles with job descriptions through

ISSN 2394 - 7780

semantic embedding techniques. Unlike traditional ATS platforms that rely heavily on keyword matching, Resume2Vec captures nuanced contextual relationships, enabling a more holistic assessment of candidates' qualifications.

The first study was entitled "Initial and Chronological Smart Developments in Resume Parsing in HR Recruitment Process" by Aakankshu Rawat, Siddharth Malik, Seema Rawat, Deepak Kumar, and Praveen Kumar in July 2021, HR Recruitment Process. For this research, it tried tracing the evolution of the startup from its inception right up to the current era with developments in SMART (specific, measurable, achievable, impactful, and time-based).

The Resume Application Tracking System powered by Google Gemini Pro streamlines resume screening in a way that brings revolutionary change into the hiring world[8]. Through advanced AI interpreting diverse data formats, this guarantees speed and accuracy. Integrating with Streamlit and PyPDF2, it analyzes the resume against job descriptions, reporting matching percentages, missing keywords, and summaries. The real-time system simplifies recruitment, saving time and costs and enhancing candidate selection to benefit any sector, more so in today's competitive, recession-hit job market.

The proposed automated resume ranking system addresses inefficiencies in traditional hiring by using machine learning and NLP techniques like KNN and Cosine Similarity[9] research paper by Riza Tanaz Fareed, Rajath V, Sharada devi Kaganurmath . It preprocesses resumes, removes noise, and extracts features using TF-IDF to rank candidates based on job descriptions. This system ensures relevance, improves efficiency, and reduces manual effort in recruitment. Achieving 98.96% accuracy, it performs well across diverse job categories, offering real-time resume screening and ranking. While currently limited to CSV-format resumes and minor data loss in summarization, these can be improved with format compatibility and optimized techniques.

The study presents a multi-label classification model based on CNNs by Jiechieu KAMENI Florentin Flambeau[10] in predicting high-level skills from resumes, though not explicitly stated. It relates to the challenges of the skill gap since it identifies abstract and implicit skills from raw text resumes, streamlining hiring processes. Using anonymous IT resumes, the method had 98.79% recall and 91.34% precision.The model also points out specific resume terms that affect predictions, thus aiding in transparency.

One another research [11]introduces a new approach called" Intelligent Resume Retrieval Grounded on Lucene," which aims to enhance the effectiveness and effectiveness of capsule reclamation processes. It presents a detailed description of how Lucene, a high- performance hunt machine library, is employed to indicator and hunt resume effectively. By using Lucene's indexing capabilities, the system is suitable to organize and store capsule data in a structured manner.

III. EXESTING SYSTEM

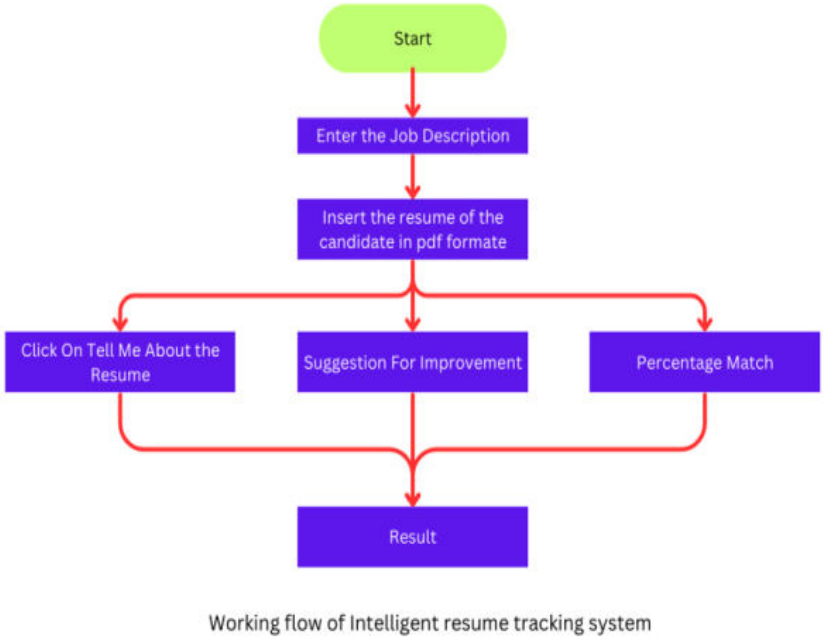


Fig. 1 Flow of Working

ISSN 2394 - 7780

PDF Text Extraction
The first step of the Intelligent Resume Tracking System (IRTS) is to extract the required documents, which are usually provided in PDF format.

Preprocessing Text
Once the text is extracted, it must be cleaned and prepared for analysis. This step uses the nltk library to perform a series of preprocessing tasks:

Lowercase Conversion: Ensures case-insensitive analysis.

- ***Punctuation Removal:***

Eliminates unnecessary symbols for clearer text.

- ***Tokenization:***

This breaks the text into individual words (tokens).

- ***Stopword Removal:***

This eliminates common words that do not have much value in the text such as "the" or "and."

The preprocess_text() function performs all these steps so that the text is standardized, clean, and ready for analysis. This allows for comparison with only meaningful terms.

Text Similarity Calculation
This is calculated by the AI model which helps in determining how well our resume matches to the job description. Use TfidVectorizer tool to convert the vector of the numbers based on the inverse of word frequency to document frequency to show the importance of specific words.

Missing Keywords Identification
It suggests missing keywords that can increase the consistency between the resumes and job descriptions. The function suggest_improvements() compares the details in the job description with the resume and identifies the key points that are available in the job description but are not in the resume.

Generative AI and ATS Integration
To provide proper feedback, [5]the system uses AI from Google's Gemini API. This model analyses resumes and provides detailed feedback like human feedback. It guides candidates on how to improve their resume by highlighting strengths, weaknesses, and missing skills.

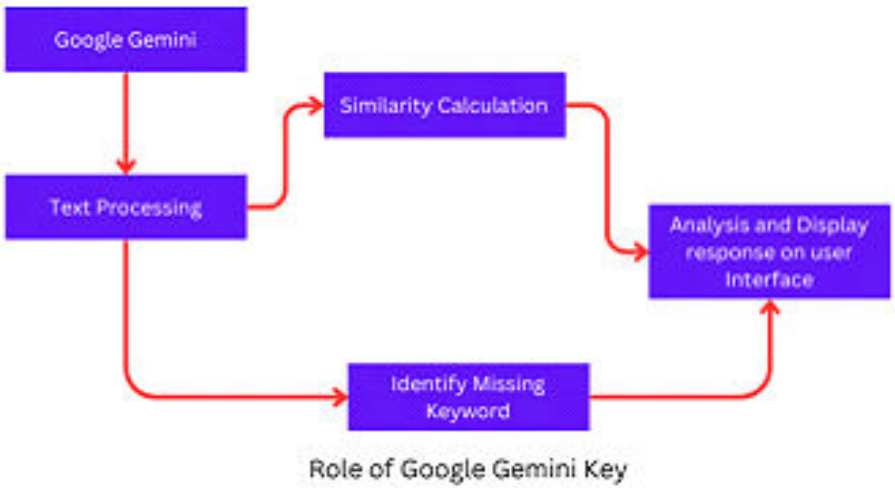


Fig.2 Analyzing Resume by Google Gemini

ISSN 2394 - 7780

IV. Modules and Functionalities

A. Text Processing

Text preprocessing is an important phase of this project which ensure that text is consistent and relevant. NLP(natural language processing) is used in model to remove random text, words, symbols to reduce noise.

B. Calculating similarity

The compare_text_with_cosine() function uses cosine similarity with a TfidfVectorizer to calculate how closely a resume matches the job description.

C. Missing Keywords Analysis

Utilizing job criteria, the system can identify the gap between a candidate's resume and the job requirements and suggest skills or content that could improve the competition.

D. Streamlit Interface

For deploying our model we are using streamlit interface that let the user upload job description and resume.

V. System Design

This system is working by following step by step process. In this process first we need to enter the job description for which we are going to apply after that we have to insert our resume so that we can analysis whether our skills fit for the job description or not.

A. Enter Job Description

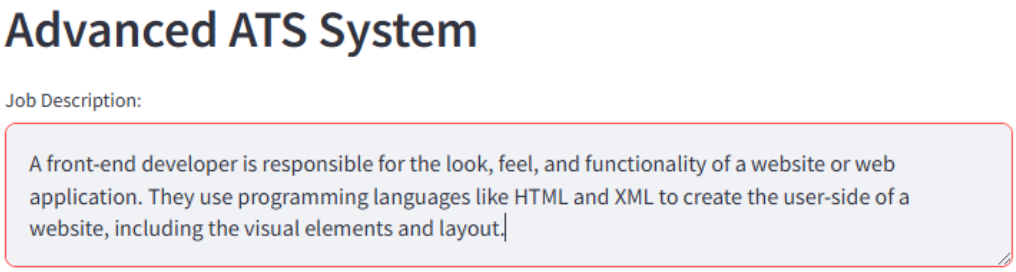


Fig.3. Insert Job Description

Here I am enter the job description of a company which hiring a candidate for the front end development.

B. Upload Our Resume

After job description we have to upload your resume by clicking on the browse file

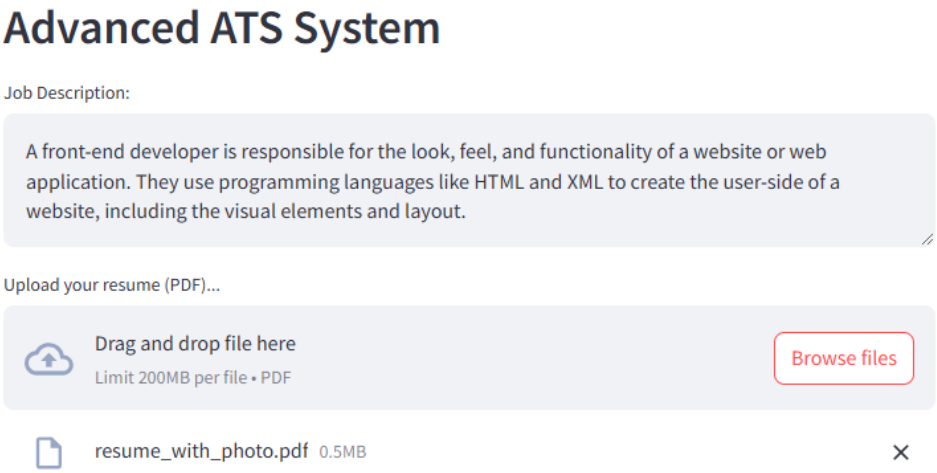


Fig. 4. Browse Resume Pdf

VI. GAP IN EXISTING SOLUTION

A. We don't rely entirely on the data or responses generated by AI, as they may contain biases or inconsistencies.

ISSN 2394 - 7780

- **Solution**

To overcome from this problem we need to verify AI generated data So, I use real-time job data that includes columns such as job title, job description, required skills, and industry. By analyzing this data, we can determine which job titles match our skill set effectively. This approach helps in making more accurate and informed career decisions. It also ensures that our resume and job applications are aligned with the current industry demands, increasing the chances of getting shortlisted by recruiters with the help of this we can also verify response of AI.

B. In today's[18] competitive job market, matching candidates with suitable job opportunities based on their skills has become increasingly important. This project presentsa machine learningbased job recommendation system designed to recommend job roles to candidates by analyzing their skill sets. The system leverages natural language processing (NLP) and content-based filtering techniques to analyze job descriptions and match them with candidates' skills Personalized Job recommendation tailored to individual needs is one of the biggest issues people deal with, particularly in terms of matching job vacancies with skills they have highlighted in their CVs. Most job applicants find it challenging to select jobs that are actually suitable for their abilities and interests. With the use of real-time job information and measuring needed skills across different sectors, we can give more precise and personalized job recommendations. This not only saves time but also enhances the possibility of getting a job suitable for the person's strengths and career aspirations.

- **Solution**

There are various platform that provide your real time opening in IT sector like Linkedin , naukri.com , indeed and many more here we are using linkedin because I noticed that the most authentic job posting in various sector like sales , financial and IT where we map job that required only the skills that are mention in our resume.

VII. System Design (Advancement in Existing System)

This ATS system provide functionalities like analysing resume and job description to provide suggestion for improvement , matching percentage of resume and job description , job suggestion from linkedin along with under ATS Resume builder to create ATS friendly resume and under services we can also analyse our resume with real time data. A virtual assistant also integrated with the system to guide individual user and other various functionalities.

The entire project developed by using HTML, CSS, JavaScript, Node.js technology and vs code , github tools are used.[19] Resume Builder System Using Full Stack Web Development," is to Create an efficient system that is quick, precise, consistent, dependable, and flexible enough to accommodate any future improvements.

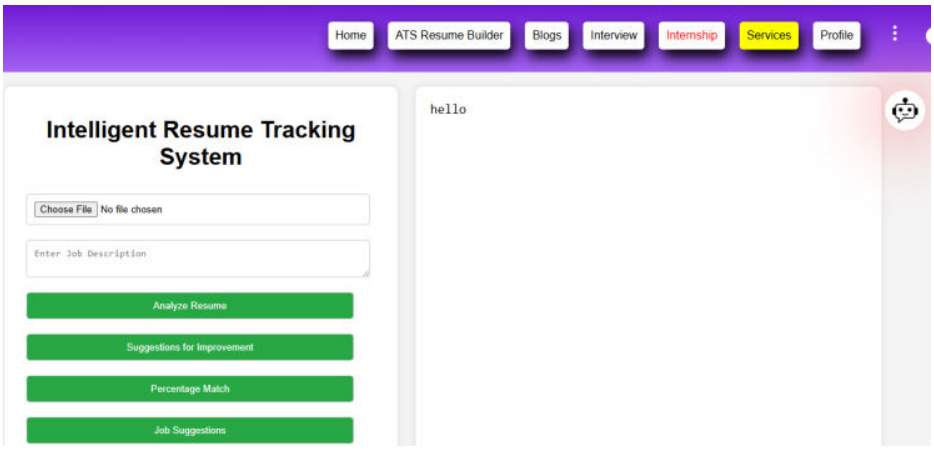


Fig. 5: Interface of New System

A. Real Time Job Posting

The Gemini API provides functionality to extract skills from a resume accurately. After extracting all relevant skills, these can be used to interact with LinkedIn's job search capabilities by uploading them through the LinkedIn API or relevant URL. This allows the system to fetch newly opened job opportunities that best match the skills mentioned in the resume. By automating this process, users can receive personalized job recommendations in real-time, saving effort and increasing the chances of finding a job that fits their profile.

ISSN 2394 - 7780

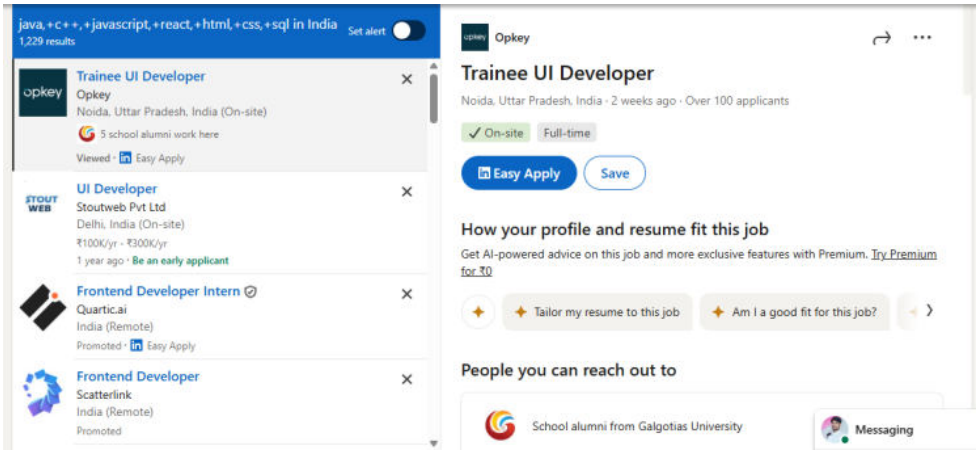


Fig. 6: Job Searching on Linkedin

B. Generate ATS Friendly Resume

Based on a thorough analysis of the user's resume, the system suggests improvement to make sure it complies with all the requirements outlined in the job post. It would be revolutionary if the system were able to auto-generate a resume that best fits the demands of a given job, skills, and tools. Moreover, providing the option to download the optimized resume in PDF format would significantly improve the user experience and simplify the job application process. [16] ResumeCraft utilizes Machine Learning (ML) in data analysis and user navigation, while the user interface is developed using Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript for an interactive experience. Users can input their personal and professional information using a series of form fields, and gives a real-time preview of the resume layout as the user enters their details.[19] It provides reliability, saving time, and is easy to use. An authorized user can store data and view it at any time that he/she desires. It comes with nearly all the modules required for efficient college working. Such modules are those that help in building resumes, tracking training, job placement, employee data, employee records, student data, etc.

C. Validating Job Skill

To overcome from this problem we need to verify AI generated data So, I use real-time job data downloaded from kaggle that includes columns such as job title, job description, required skills, and industry. By analyzing this data, we can determine which job titles match our skill set effectively.[15] The experiments in this research are carried out on the resume dataset originally collected from Kaggle (database). This dataset includes 14,806 CRs. Each profile contains fields such as the title of the resume, location, description of roles, education, technical skills, certification, and additional information. And there are various method for this purpose like [20] build a system using vector space model, which represent the documents as vectors and similarity measure is used to find the relevant document from the corpus. The representation of set of documents as numeric vectors is called vector space model.

Table I. Data Used in Validating Job Skills

Job Title	Job Description	Required Skills	Experience Level
Software Engineer	Good Knowldeg of Software Development	Java , Python, c++	Entry-Level
Data Analyst	Analyze data using advance tools.	SQL,Excel	Entry-Level
UX/UI Designer	Designing user friendly user Interfaces.	UI/UX Design	Mid-Level
Front-end Developer	Development of web Interfaces.	HTML,CSS,JavaScript, Reactjs	Entry-Level
Full-Stack Development	Development of Interactive web applications.	HTML,CSS,JavaScript, Nodejs,SQL,mangoDB	Senior

- Skills :- HTML, CSS, JavaScript, Reactjs, SQL

ISSN 2394 - 7780

Fig. 7: Matching Job With Resume Mention Skills

D. Personalize Chatbot or Virtual Assistant System

Virtual [17] assistant is used to run machine like laptop or PC's on your own command. Virtual assistant is an application program that understands natural language and voice commands to complete tasks for the users..To enhance the[14] human-machine interaction, several IT companies have established different forms of Virtual Personal Assistants (VPAs) depending on their usage and applications, such as Google Assistant, Amazon Alexa, Apple's Siri, and Microsoft's Cortana. So we developed Integrating virtual assistance system in resume tracking system help in guiding user for building ATS-friendly resumes by suggesting relevant keywords , missing sections like skill , certifications and tips to format your resume. It also make easer to preparation for the interview because it suggest common interview questions based on job role (job description) and skills that you mention in resume and also simulate mock interviews using a conversational flow. [13]This research explores the development of an AI-based resume builder designed to assist users in creating highly customized, professional resumes that align precisely with industry standards and job-specific requirements. By integrating natural language processing (NLP) and machine learning, the system analyzes job descriptions to identify crucial keywords, skillsets, and role-specific requirements.

VIII. RESULT

As we entered and uploaded both the job description and resume now its time to analysis our resume by directly clicking on the given button the first one is analyze resume , Suggestion for improvement , and percentage match and suggesting job this allows the system to fetch newly opened job opportunities that best match the skills mentioned in the resume on linkedin platform. The development of ATS friendly resume for job application because we can also download resume in pdf format and we get fully functional AI based chatbot what will guide us on every stage of recruitment process like providing interview questions and tips to do some changing in resume so our chances of getting selected is increased and one of the main feature that we can match our skills that are mention in resume with real time data downloaded from kaggal.These all functionalities provided on a single web based Intelligent resume tracking system that increase our chances of getting selection.

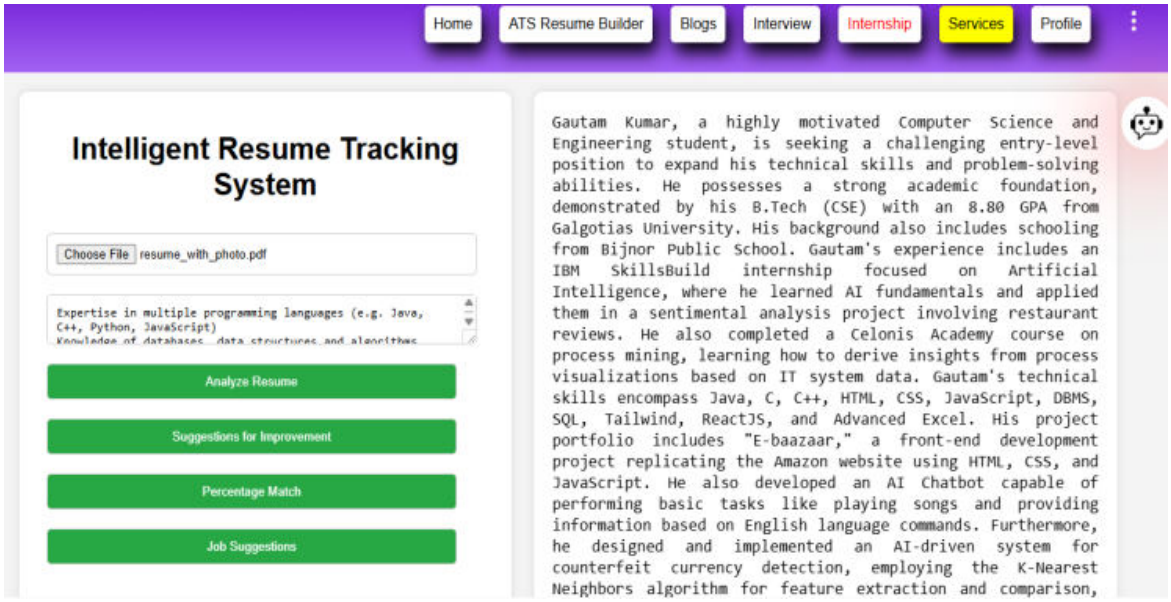


Fig. 8: Resume Summary

ISSN 2394 - 7780

IX. CONCLUSION AND FUTURE WORK

Intelligent resume tracking system is boon for this generation because traditional process is quit complicated and time consuming we need to analyse our resume manually to check whether our resume match with the job description and requirement but with the help of generative AI for parsing and analysing resume. Intelligent resume process needs NLP and machine learning to provide this kind of analysis to both the students and HR professionals for effective resume analysis. Further work can be designed around research, enhancement of scoring algorithms, and generation of AI responses that will help students get personalized guidance.

Integration of different platform to our web application helps the user for preparation to crack an interview and learn new skills.

Now we are able to pass the resume in pdf format only but there may be the situation where we need to analyze our resume in word or other format also so we need to add functionalities so that we can analyse resume in any format resume can be in image(jpeg , png), ppt or web document .

X. REFERENCES

[1] A. Pina, C. Petersheim, J. Cherian, Joanna Nicole Lahey, G. Alexander, and T. Hammond, “Using Machine Learning with Eye-Tracking Data to Predict if a Recruiter Will Approve a Resume,” Machine learning and knowledge extraction, vol. 5, no. 3, pp. 713–724, Jun. 2023, doi: https://doi.org/10.3390/make5030038.

[2] A. McCallum and K. Nigam, “A comparison of event models for naive bayes text classification,” National Conference on Artificial Intelligence, pp. 41–48, Jan. 1998.

[3] G. Zhou and J. Su, “Named entity recognition using an HMM-based chunk tagger,” Meeting of the Association for Computational Linguistics, Jul. 2002, doi: https://doi.org/10.3115/1073083.1073163.

[4] R. Grishman and A. E. Borthwick, “A maximum entropy approach to named entity recognition,” Jan. 1999.

[5] Intelligent Resume Tracking System by C Ashrith Reddy, B Sai Jayanth, B Rithvik, B Avinash and Rajesh Tiwari Journal of Technology VOLUME 12 ISSUE 4, 2024

[6] AI Resume Analyzer Ashvini Chavan, Nikita Tatewar, Pavina Naicker, Prof. Sareeka Deore, Volume 11, Issue 12 December 2023, International Journal of Creative Research Thoughts (IJCRT).

[7] Automated Resume Matching and Ranking Using Machine Learning Techniques" by Akash Sharma, Neha Singh, Ankit Kumar. International Journal of Computer Applications (IJCA), Volume 188, Issue 11, May 2021.

[8] Resume Application Tracking System with Google Gemini Pro by Authors: V. Prathima, Aishwarya Singh, Tanush Rohilla, Vasavi Rebbavarapu, Nabiha Anjum

[9] Resume Classification and Ranking using KNN and Cosine Similarity Riza Tanaz Fareed, Rajath V, Sharada devi Kaganurmath, Volume 10, Issue 08 (August 2021), International Journal of Engineering Research & Technology (IJERT).

[10] Skills prediction based on multi-label resume classification using CNN with model predictions explanation University of Yaounde I by Kameni Florentin Flambeau Jiechieu1,2•Norbert Tsopze1,2Received: 6 February 2020 / Accepted: 18 August 2020 / Published online: 28 August 2020ÓSpringer-Verlag London Ltd., part of Springer Nature 2020

[11] Intelligent Resume Retrieval Based on Lucence Jianping Du, Dongping Ma, Beijing Union University, Beijing, 100101, China, Manuscript submitted April 15, 2021; accepted June 15, 2021. doi: 10.17706/jsw.17.1.29-35 Volume 17, Number 1, January 2022.

[12] Transforming Applicant Tracking Systems with Intelligent Resume Embeddings for Precise Candidate Matching by Ravi Verma Kumar Bevara , Nishith Reddy Mannuru , Sai Pranathi Karedla , Brady Lunda, Ting xiao , Harshith Pasem , Sri Chandra Dronavalli , and Siddhannth Rupeshkumar at department of information science , Univerisyt of North Tesas Denton USA.

[13] Chanksh Dubey , Mahesh Gajbhiye , Ninad Bomanwar , Prof. Anand Donald B.Tech Students, Department of Computer Science and Engineering at Rajiv Gandhi Collage of Engineering Research and Technology chandrapur , Madarashtra , India.

ISSN 2394 - 7780

[14] AI-Based Virtual Assistant Using Python : A System Review by Patil Kavita Manojkumar, Aditi Patil,Sakshi Shinde, Shaktiprasad Patra Saloni Patil in paper id : IJRASET49519 and ISSN : 2321-9653 AT IJRASET .

[15] AI based suitability measurement and prediction between job description and job seeker profiles by Sridevi G.M. , S. Kamala Suganthi at Atria Centre for Management and Enterepreneurship Bangalore 560024 India.

[16] A Machine Learning-Powered Web Platform For Resume Building By Kratika Shivhare , Sonam Shakya , Aashi Singh Bhadouria published there work in international journal for research in applied science and engineering technology ISSN NO. – 2321-9653 volume 12.

[17] Personal Virtual Assistant For Windows Using Python by Anjali Fapal , Trupti Kanade , Bharati Janrao , Mrunalini Kamble and Megha Raule at JSPM's Bhagwant Instutute of Technology, Barshi, Maharashtra India published in international research journal of modernization in Engineering Technology and Science volume : 03/Issue:07/July-2021

[18] Job Recommendation By Skill Matching Using ML by gadage Soniya Dattatry , Aher Siddhi Prabhakar , More Shivani Sandeep , Ravat Tanuja Suryakant , Prof. Kedar A.L at Department of Computer Engineering ,Samarth Rural Educational Institute Polytechnic College, Belhe ,India , Samarth Rural Educational Institute Polytechnic College, Belhe In International Journal Of Research Publication And Review ISSN NO.: 2582-7421.

[19] ICT:Resume Builder System Using Full Stack Web Development By Sakshi Jadhav , Shreya Kawade Siddhesh Chikhale Published at Ijraset Journal For Research in Applied Science and Engineering Technology ISSN : 2321-9653 Paper Id : IJRASET53264.

[20] N. Sivaramakrishnan, V. Subramaniyaswamy, S. Arunkumar, P. Soundarya Rathna. VALIDATING EFFECTIVE RESUME BASED ON EMPLOYER'S INTEREST WITH RECOMMENDATION SYSTEM. International Journal of Pure and Applied Mathematics, 2018, 119 (12e), pp.13261-13272. ffhal-01826687f.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

THE PRESERVATION AND PROMOTION OF NAGA CULTURE AMIDST TECHNOLOGICAL ADVANCEMENTS

Gwayhunlo Khing[1] and Dr. Pramodini Magh[2]
[1]Ph.D Scholar, Department of Social Work, St. Joseph University, Chümoukedima-797115, Nagaland, India
[2]Associate Professor, Department of Social Work, St. Joseph University, Chümoukedima-797115, Nagaland, India

ABSTRACT
The Nagas are believed to have migrated from southwestern China thousands of years ago. They inhabit Nagaland, parts of Manipur, Assam, Burma, etc. There is diversity in language and culture, yet they share a set of core cultural elements that make them unique within the country. Like any other society, there is a tendency among the Nagas to surpass culture at the expense of technological advancements. However, there is a strong movement towards preserving culture among the Naga tribes, which has stimulated the revival of culture and tradition. A collective effort among the Naga tribes can bring stability to the culture. The study was conducted to explore the areas and methods of preserving and promoting Naga culture. It also viewed technological advancements as an opportunity and a threat to the existing Naga culture.

For this study, a quantitative research methodology was employed. Using a cluster sampling technique, 170 respondents were selected and the data collection, analysis, and interpretation of numerical data were conducted objectively. The study found that the best areas for promoting Naga culture were society, family and education. The best method to preserve and promote Naga culture is to teach and transfer cultural knowledge to children. Technological advancements gave a good impetus to Naga culture. The study opened up more avenues for the Nagas to engage productively with their culture.

Word count: 222

Keywords: *Nagas, Culture, Survival, Technology, Advancements*

INTRODUCTION
The Nagas are a group of tribes that inhabit Nagaland and some parts of Assam, Manipur, and Burma. The Naga culture is rich with folklore, traditions and stories. They are passed on to generations orally. Tribal life enhances culture through community engagement, festivities and celebrations. Identity and acceptance come with culture. Each tribe is distinguished by its dialect, customs, traditions and attire (Chishi T. N., 2018). The manner of preservation and promotion of culture varies from tribe to tribe. However, family, religion, economy, society, politics and education play a major role. With the emergence and advancements of technology, there is a tendency to surpass culture. However, there is a strong move towards preserving culture among the Naga tribes, which has stimulated the revival of culture and tradition. Culture must survive despite technological advancements.

REVIEW OF LITERATURE
Culture is the generally accepted norms and belief systems handed down from time immemorial. The word culture comes from the Latin word *cultura,* which is derived from the verb *colere.* It means "to tend," to cultivate, and "to till." Culture is dynamic. It is broader than race, ethnicity, belief systems, gender, and people, etc. (Zion S. D., 2016). Culture encompasses the collection of individual values, beliefs, attitudes, and personality. Most society accepts all the elements of culture as sacred. Culture gives self-acceptance and recognition. India, after its independence, has seen significant cultural changes in consumption, art and artefacts, transportation, and technologies (Nightingale, 2014). A great chasm has been created in culture with the dawn and advancement of technology. This led the present generation to live outside the boundaries of culture. Despite all advancements, the root of culture is still alive. The realisation gave birth to the new era of keeping the culture alive amidst technological advancements.

For the Nagas, culture is the closest to the heart. As tribals, there is more affiliation to culture and its practices. Culture is the alpha and omega for individuals and communities. Every individual born into a community is a culture in person. People act, think, and behave according to their cultural settings/norms. Culture expresses itself in attire, language/dialect, festivals, dances, symbols, jewelry, food habits, values, beliefs, norms, folklores, art and crafts, etc. (Culture of Nagaland). Contextually, the variety of colourful cultural attire, dialects, festivals, tribal food habits, values, and ethics made the culture more elegant and relevant. However, Naga culture is not limited to fabric, dance, song or text (Kikon, 2023). The rich Naga culture needs more exploration. This will enable the present generation to face the big challenge of the statement, 'Regain your

culture!' (Gros, 2010). There is a need to revive, relive, and recreate culture. The survival components make it active and engaging.

Technology refers to methods ranging from as simple as stone tools to the complex genetic engineering and information technology that has emerged since the 1980s. The term technology comes from the Greek words techne, meaning 'art and craft, and logos, meaning 'word and speech.' It was first used to describe applied arts, but it is now used to describe advancements and changes that affect the environment around us (Murphie, 2003). The birth of technology brought a new perspective and a new way of life to mankind.

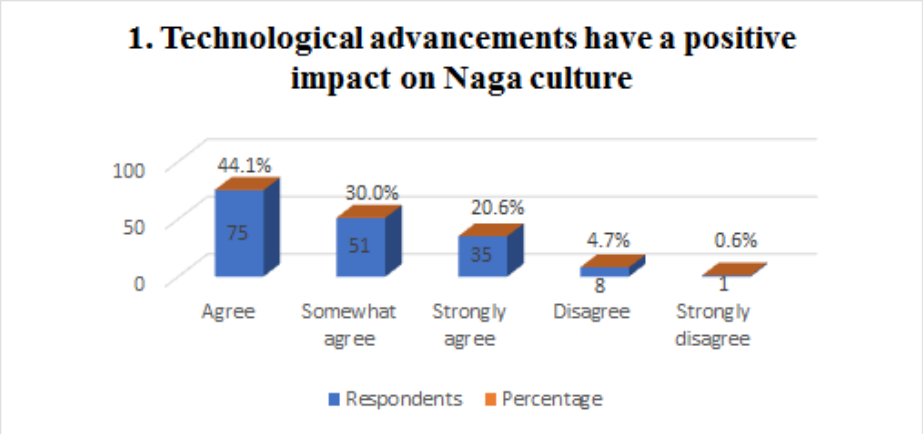
Technological advancements develop along with social development. The Marxist view is that social development is a result of technical achievement. Fundamentalists believe that technological development is responsible for the loss of important values in society (Herdin, 2007). Technology is such that it transforms culture in unforeseen and powerful ways. It attacks culture and eventually destroys it. Neal Postman argues that the U.S. has become a technopoly, a culture of submission of all forms of cultural life to the sovereignty of technique and technology. There is a need to adopt technological innovation, but also to preserve the culture (Grant, 2008). The entry of artificial intelligence created a deeper impact. Networking with people across the globe has become a day-to-day event. It is predicted that there will be 38.6 billion IoT-connected devices by 2025 and 50 billion by 2030. There are 1.35 million tech start-ups in the world (McCain, 2023). New knowledge has enabled people to create new things; conversely, technologies make many scientific endeavours possible. Technological change affects culture and vice versa (McDaniel, 2022).

Some elements of Naga culture are losing ground due to technological advancements. The memories of the elders are fast fading because the oral narratives are not been practised for years. In the absence of Naga cultural knowledge, the young Nagas tend to imitate the Western lifestyle at the expense of their culture (Thong, 2009). Additionally, the acceptance of Christianity diminished most tribal customs and traditions (Ngalengnam, 2024). Christian missionaries began to categorise Naga culture as evil because they were not in congruence with Western Christianity. The morung, which served as the institution of socialisation and learning, was considered heathen. All cultural and traditional practices were discouraged (Thong, 2009). With the absorption of technologies, cultural practices that were linked with the past institutions were lost (Singh, 2000). Today, the Naga generation is at a crossroads between culture and technological advancements.

RESEARCH METHODS

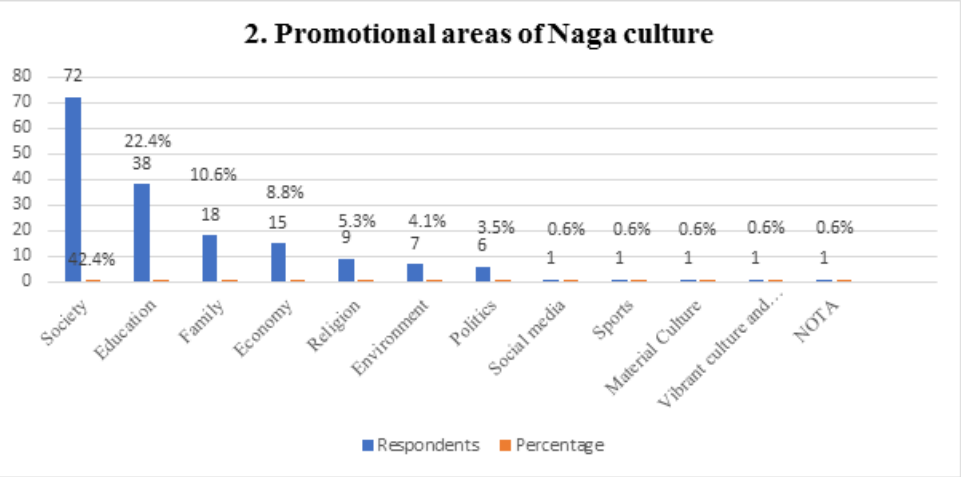
The research study employed a quantitative research method using both primary and secondary methods and a comprehensive literature review to explore the preservation and promotion of Naga culture amidst technological advancements. A cluster sampling technique was employed to select the respondents. Data collection, analysis, and interpretation of numerical data were conducted objectively.

FINDINGS AND DISCUSSIONS



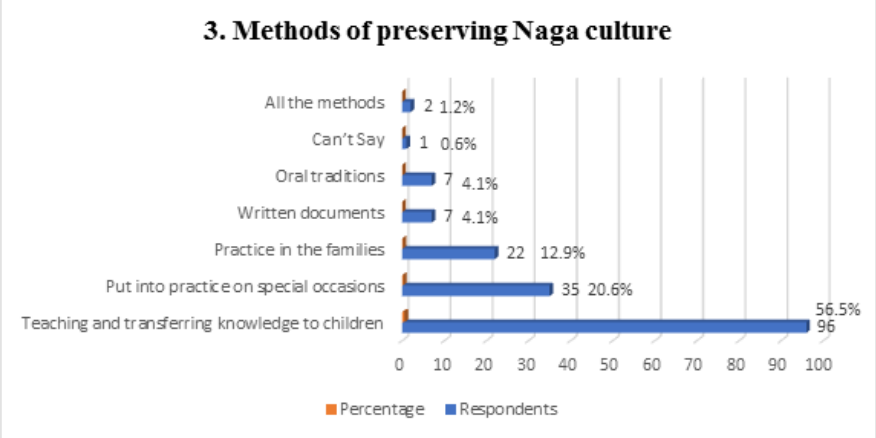
The chart showed the positive impact of technological advancements on Naga culture. The findings indicate that the majority of the respondents (94.7%) strongly believed in the positive impact of technological advancements on Naga culture. 44.1% of respondents agreed, and 20.6% strongly agreed. This showed a strong affirmation. 30% somewhat agreed, 4.7% disagreed, and only 0.6% strongly disagreed. The findings suggested that most respondents believed that technology contributed positively to Naga culture. It is worth noting that all technologies are invented to meet the needs of the growing culture. Cultural activities ranging from cooking to music production are highly dependent on technology. Today, mass culture is made possible by the various technologies (Potts, 2003).

ISSN 2394 - 7780



The figure showed the promotional areas of Naga culture. The findings showed that society dominated the other areas, with 42.4% of respondents pointing to it. Education (22.4%) and Family (10.6%) followed as significant agents of cultural promotion. Economy (8.8%), Religion (5.3%), and Environment (4.1%) had their due share in the promotion of Naga culture. The other areas, which had lesser recognition, are social media, sports, material culture, and the arts. They received just 1 response each (0.6%). Culture and society are closely connected. Social structures can be the best platforms for promoting culture. The roles and positions of individuals are assigned by the cultural settings. But culture is not distributed uniformly in society. Even expectations are institutionalized (Hudson, 2020). In societies that do not have a tradition of writing, the sense of belonging is constituted largely through the performance of ritual practices. Society transmits culture through the oral forms of origin stories, tales, and songs (Dazo, 2020). Cultural organisations and practising communities transmit cultural expressions to the next generations. Safeguarding activities vary according to the local contexts (Alivizatou, 2017). Education existed to teach about the norms, values, ethics and good behaviour of the culture (Yudhister and Ghosh, 2022). Students should be taught about different cultures and cultivate respect for multicultural education. Educational institutions should promote extracurricular activities, student exchange programmes and cultural events to foster wider cultural interaction (Pradeepa, 2024). The society's culture guides the whole process of the educational system (Maji, 2023).

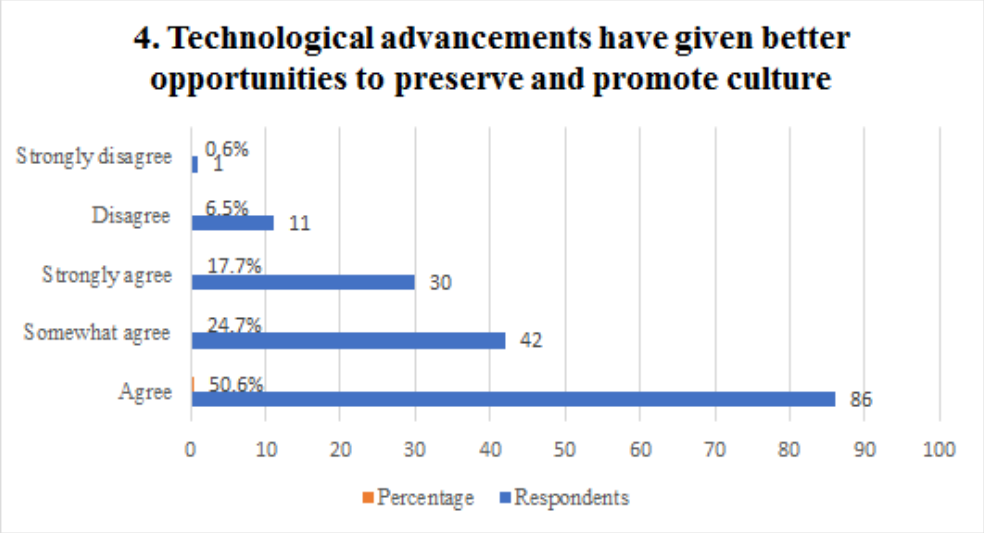
The family is the centre of culture and cultural activities. It educates and prepares the young generation to face the challenges of the modern world. The family has a bigger role in imparting cultural knowledge and practices to children. The family constitutes a single household where interaction and communication occur irrespective of social roles and creates a common culture (Pandey, 2016). Elders occupy a high status and are respected in the Naga culture (Jessymol, 2021). A family is the first root of culture. It is the basic unit of the Naga Society. The institution of marriage has usually been monogamous. Marriage within the same clan is not permitted (Ngalengnam, 2024). The birth of a child in the family, rites and rituals at birth and (Murphie, 2003) death are determined by culture.



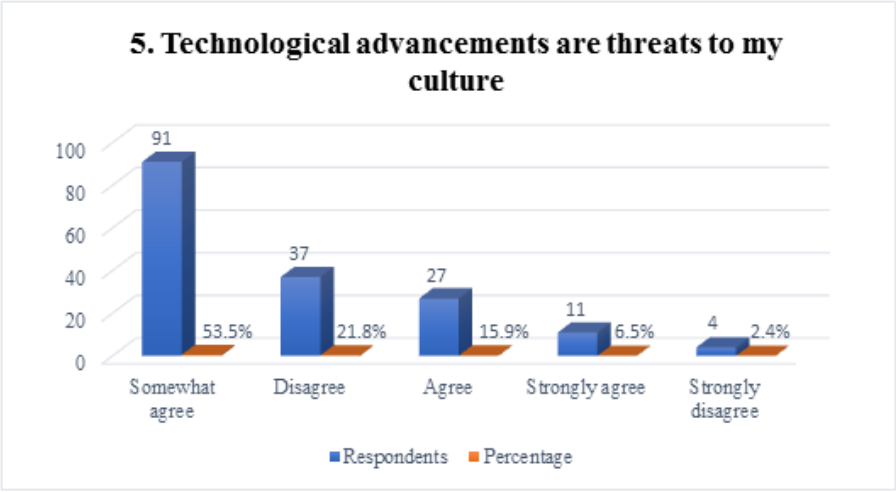
The data showed the methods of preserving Naga culture. The data findings showed that teaching and transferring knowledge to children was the most preferred method to preserve Naga culture, with 56.5% of respondents favoured the method. The significance of intergenerational learning and education can be the best

ISSN 2394 - 7780

method to preserve the Naga culture. 20.6% of respondents viewed that Naga culture can be well preserved by engaging in cultural and traditional practices during special occasions like tribal festivals, birth, marriage, death, etc. 12.9% of respondents believed in the cultural practices within families. Oral and written documents received a 4.1% response. The other respondents (1.2%) favoured all the methods, and 0.6% of respondents were not able to decide. Nagas have a strong oral tradition of passing down knowledge. This concept duplicates it in a digital form by having representations of Naga individuals telling their stories. The execution could require an archive of audio recordings of the person sharing their stories (Chishi, 2028). The elders and parents are responsible for teaching and transferring cultural knowledge to the younger generation.



The chart showed technological advancements as opportunities to preserve and promote culture. The data findings showed that a total of 158 respondents (93%) positively agreed that technological advancements had given better opportunities to preserve and promote culture. 50.6% of respondents agreed, and 17.7% strongly agreed. On the other hand, 7.1% disagreed. Digital archiving, online repository and sharing and other forms of virtual exhibitions can very well be taken into consideration to preserve and promote Naga culture. Technology plays a major role in cultural exchange, innovation, and adaptation. This has enabled global communication and the exchange of ideas. Technological advancements have significantly transformed cultural interaction. There is cross-border cultural integration with the help of advanced technologies. The integration of advanced technologies into everyday life has opened better and faster access to cultural knowledge. It facilitated broader participation in cultural promotion and preservation. Technology has enabled the documentation and dissemination of endangered cultures and traditions. The survival of culture is made possible by technological advancements (Alsaleh, 2024).



The chart displayed that technological advancements are threats to culture. Accordingly, 91 respondents (53.5%) somewhat agreed that technological advancements are threats to culture. 37 respondents (21.3%) disagreed, and 27 respondents (15.9%) supported the idea that technology is not a threat to culture. There is a low opinion of the 11 respondents who strongly agreed (6.5%), and 4 respondents (2.4%) who strongly

ISSN 2394 - 7780

disagreed with the statement. The introduction of new technologies has led to readjustments and new articulations of relations between the various fields of knowledge. Technological advancements turned out to be cultural revolutions (Combi, 2016). The cultural identity of the Nagas is a fluid term with the Nagas adapting to contemporary life while still trying to retain a touch of the Naga's rich collective past (Chishi T. N., 2018).

CONCLUSION

Culture and technology contribute to society's development. Nevertheless, there is a need to preserve and promote culture. Every generation is responsible for keeping its culture alive amidst technological advancements. What remains until the end is culture. Every individual is a culture. The soul of the tribe lives in culture. Technology is business-oriented. Culture is people-oriented. Therefore, the wisdom to balance the two lies in the individual. A healthy culture comes from healthy living. We live in the shifting universes of cultural impulses that require us to examine, synthesise and create meaning to our culture (Lull, 2013). New technologies modify space, time, relationships and types of communication that continue to co-exist with the other fields of knowledge inherent in a culture.

Culture must co-exist with technology. The relevance of technological advancements must be assessed objectively so that it fits into the culture more contextually. Culture must undergo refinement without losing its core substance. This will enable the two to relate to each other without demeaning the other. Technology can be developed to serve the interests of the developed countries (Spurgeon, 1979). This will turn into a monopoly of technology. Therefore, adapting oneself to the fast-changing world without losing one's culture and identity is the greatest contribution to the world. The use of traditional technologies can best promote culture (Subramanyam, 2008). Life is counted not by years, but by putting on the values, ethics, and beliefs of culture. A correct composition of culture and technology will give more meaning to men and women to live better lives.

REFERENCES

- Alivizatou, M. (2017, April). *Intangible cultural heritage and new technologies: Challenges and opportunities for cultural preservation and development*. ResearchGate. https://www.researchgate.net/publication/334735261
- Alsaleh, A. (2024). *The impact of technological advancements on culture and society*. Nature Portfolio. https://doi.org/10.1038/s41598-024-83995-z
- Chishi, T. N. (2018). *Understanding Naga culture through interactive narratives*. IIT Bombay.
- Combi, M. (2016). *Cultures and technology: An analysis of some of the changes in progress—Digital, global and local culture* (K. J. Borowiecki, Ed.). https://doi.org/10.1007/978-3-319-29544-2_1
- Culture of Nagaland. (n.d.). *Sri Chaitanya Educational Institutions. Infinity Learn*. https://infinitylearn.com/surge/social-science/culture-of-nagaland/
- Dazo, K. (2020, July–December). Personhood in Naga culture. *Journal of North East India Studies, 10*(2), 1–2.
- Erikson, T. H. (2014). *An introduction to social and cultural anthropology* (3rd ed.). Rawat Publications.
- Grant, A. J. (2008). Technology and culture: Five orthodoxies. *Issues in Information Systems, 9*(2), 206–209. https://doi.org/10.48009/2_iis_2008_205-210
- Gros, S. (2010). Naga identities: Changing local cultures in the northeast of India. In M. Oppitz (Ed.), *European Bulletin of Himalayan Research*, 142–143.
- Herdin, T. H.-R. (2007). Culture and technology: A multi-shaping approach. In S. A. Hongladarom (Ed.), *Information technology ethics: Cultural perspectives* (pp. 54–67). https://www.researchgate.net/publication/314438672
- Hudson, J. B. (2020). *Social structure and culture: A concept analysis*. Trent University. https://www.researchgate.net/publication/340389878
- Jessymol, M. V., & Chupuo, A. (2021). Preservation of Naga cultural heritage. *International Journal of Creative Research Thought, 9*(11), 601.
- Kikon, D. (2023). Present day Naga society: A story about culture. In D. Kunstverlag (Ed.), *Voices from the North East India, Nagaland* (pp. 52–60).
- Lull, J. (2013). *Media, communication and culture: A global approach* (2nd ed.). Rawat Publications.

ISSN 2394 - 7780

- Maji, M. A. (2023). Influences of culture on education in modern India. *International Journal of Creative Research Thought, 11*(3), 344–351.
- McCain, A. (2023). *How fast is technology advancing? Growing, evolving, and accelerating at exponential rates*. Zippia Research. https://www.zippia.com/advice/how-fast-is-technology-advancing/
- McDaniel, L. (2022). *History of technology* (Vol. 1). Bibliotex.
- Murphie, A. (2003). *Culture and technology*. Palgrave Macmillan.
- Ngalengnam, N. (2024). Culture, the identity of the Naga tribe and its challenges. *International Journal of Creative Research Thoughts, 12*(8), 246.
- Nightingale, P. (2014). *What is technology? Six definitions and two pathologies*. https://www.researchgate.net/publication/315026675
- Pandey, V. (2016). *Indian society and culture*. Rawat Publications.
- Potts, J. A. (2003). *Culture and technology*. Palgrave Macmillan.
- Pradeepa, V. (2024). The role of education in promoting cultural diversity and harmony in India. *Cross Res, 15*(1), 121–123.
- Singh, Y. (2000). *Culture change in India*. Rawat Publications.
- Spurgeon, D. (1979). *Give us the tools: Science and technology for development*. International Development Research Centre.
- Subramanyam, V. A. (2008). *Use of traditional technologies in the subsistence activities and sustainable development: A study among primitive tribes of Visakha agency, Andhra Pradesh* (Subramanyam, V. A. Ed.). Rawat Publications.
- Thong, T. (2009). *A clash of worldviews: The impact of modern Western notion of progress on Indigenous Naga culture* (Publication No. 1383) [Master's thesis, University of Denver]. University of Denver Digital Commons. https://digitalcommons.du.edu/etd/1383
- Yudhister, & Ghosh, S. (2022). The role of culture in education. In R. Bhole (Ed.), *Journal of Research & Development, 14*(14), 4.
- Zion, S. D. (2005). *Understanding culture*. Research Gate.

  https://www.researchgate.net/publication/296486383

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

SMART FERMENTATION TECHNOLOGIES: ENHANCING NUTRITIONAL PROFILES OF FOODS THROUGH PROBIOTIC–PHYTOCHEMICAL SYNERGY

Jisna CM[1] and G.Nandhini[2]
[1]PG Student, Department of Clinical Nutrition, Ganga Institute of Health Science, Vattamalaipalayam.-641022
[2]Professor and Head of the Department of Clinical Nutrition, Ganga Institute of Health Science,Vattamalaipalayam-641022

ABSTRACT
Smart fermentation technologies integrate precision bioprocess control, artificial intelligence (AI), and tailored microbial consortia to unlock new functionality in foods. Central to this revolution is the deliberate pairing of probiotic strains with phytochemical-rich substrates, driving biotransformations that upgrade nutritional quality and health potential. This article critically appraises recent advances (2023–2025), elucidates the molecular crosstalk underlying probiotic–phytochemical synergy, and maps real-world applications across cereal, dairy, plant-based, and beverage sectors. Evidence from international and national studies indicates marked increases in bioavailable polyphenols, vitamins, and bioactive peptides, alongside sensory improvements and shelf-life extension. Key enabling technologies—ranging from AI-guided strain selection to Internet-of-Things-linked bioreactors—are examined, followed by a discussion of safety, regulatory, and sustainability considerations. This review synthesises insights from more than 25 peer-reviewed journal articles retrieved through Web of Science, Scopus, PubMed, and Google Scholar. The review concludes by highlighting future research priorities, including multi-omics-driven personalisation and up-scaling challenges, positioning smart fermentation as a pivotal strategy for next-generation functional foods.

Keywords: *smart fermentation; probiotics; phytochemicals; polyphenols; co-fermentation; AI; functional foods*

INTRODUCTION
Traditional fermentation has long served as an affordable biopreservation and flavour-development tool in every culinary culture. Over the last decade, however, the practice has evolved from artisanal art to data-driven biotechnology that deliberately remodels food matrices for targeted health outcomes. At the same time, converging nutrition science underscores the importance of phytochemicals—particularly polyphenols, carotenoids, and glucosinolates—as modulators of oxidative stress and chronic disease risk. Yet the bioaccessibility of many phytochemicals is limited by their polymeric structure, instability, or poor intestinal permeability. Probiotic microorganisms, with their repertoire of glycosidases, esterases, and dehydrogenases, can biotransform parent compounds into metabolites with greater solubility and biological activity. Smart fermentation technologies seek to orchestrate this probiotic–phytochemical crosstalk in a controlled environment, thereby upgrading the nutritional profile of foods while meeting modern expectations for safety, consistency, and sustainability.

METHODOLOGY
A structured search strategy was implemented to capture literature published between January 2023 and May 2025. Databases queried included Web of Science, Scopus, PubMed, and Google Scholar. Search strings combined keywords such as “smart fermentation”, “probiotic”, “phytochemical”, “polyphenol”, “IoT”, and “AI”. After de-duplication, 97 unique records were screened against predefined inclusion criteria. Twenty-five high-quality articles—comprising 18 international and 7 national publications—met all criteria. Critical appraisal followed a modified PRISMA framework. Technological pillars evaluated include AI-driven strain discovery, IoT-enabled bioreactors, co-culture engineering, and ultrasound-assisted fermentation.

Critical Review of Probiotic–Phytochemical Synergy
Probiotic–phytochemical synergy manifests through microbial metabolism that converts complex plant-derived compounds into smaller, more bioactive entities while utilising those compounds as growth substrates. Key mechanisms include enzymatic biotransformation of polyphenols, generation of bioactive peptides and vitamins, and modulation of gut-microbiota dynamics.

Application of Smart Fermentation for Nutritional Enhancement
Smart fermentation has been successfully applied to enhance cereals and pulses, dairy and alternatives, fruits and vegetable-based products, and novel functional beverages. Millet and sorghum fermented with specific probiotics showed increased phenolic content and reduced anti-nutrients. In dairy alternatives, oat milk fermentation improved solubility and phytochemical concentration. Citrus by-products transformed through fermentation showed enhanced antioxidant profiles, and novel drinks like probiotic meads demonstrated bioactivity improvements.

ISSN 2394 - 7780

Safety, Quality and Regulatory Considerations

Smart fermentation's benefits must be matched with stringent safety regulations. EFSA and FSSAI frameworks are evolving to address genome-edited probiotics. Real-time monitoring and traceable digital logs are vital in ensuring safe, high-quality production.

Challenges and Future Directions

Challenges include scalability, cost, consumer perception, and regulatory harmonisation. Integration of multi-omics, AI analytics, and personalised food production presents a promising frontier for research.

RESULTS AND DISCUSSION

Analysis of reviewed studies showed increased polyphenol bioavailability (20–60%), enhanced vitamin levels, and high probiotic viability. Strain-specific responses, AI-optimised processing, and limited human trial data emerged as key findings. This highlights both the promise and research gaps within smart fermentation science.

CONCLUSION

Smart fermentation stands at the nexus of food science innovation, integrating biotechnology, AI, and microbiology. It enables the transformation of foods into functionally superior products with health-promoting benefits. As technology matures, ensuring safety, regulatory clarity, and consumer trust will be essential for its success.

REFERENCES

- Chen, Y., Li, Q., & Zhang, P. (2025). Understanding the Functionality of Probiotics on the Edge of Artificial Intelligence Era. Fermentation, 11(5), 259.
- European Food Safety Authority Panel on Biological Hazards. (2024). Qualified Presumption of Safety list—2024 update. EFSA Journal, 22(1), e08912.
- Garcia, M., Chen, L., & Wang, B. (2024). Fermentation's Pivotal Role in Shaping the Future of Plant-Based Foods. Future Foods, 5, 100079.
- Hashemi, S. M. B., Javadi, S., & Shariati, M. (2023). Evaluation of Co-Fermentation by Lactiplantibacillus plantarum and Pichia kluyveri of a Fruit Beverage. Food Chemistry, 427, 137214.
- Li, X., Zhang, Y., & Zhao, M. (2024). Probiotic Fermentation Enhances the Bioactive Properties of Grape Seed Extract. Food Bioscience, 65, 102247.
- Mindful Awards Report. (2025). Food & Beverage Industry Report 2025.
- Moradi, S., Azizi, A., & Rezaei, M. (2025). Synergizing Artificial Intelligence and Probiotics for Precision Fermentation. Trends in Food Science & Technology, 139, 220–233.
- Polyphenol-Derived Metabolites Review. (2024). Nutrients, 16(3), 445.
- Sharma, V., & Singh, G. (2025). Fermentation Dynamics of Millet Beverages. Food Chemistry Advances, 2, 100045.
- Souza, H. F. d., et al. (2024). Probiotic Mead from Co-Fermentation by S. boulardii and Kombucha Microorganisms. Fermentation, 10(9), 482.
- Varun, B., & Kumar, A. (2023). Effect of Fermentation with Lactiplantibacillus plantarum on Finger-Millet Milk. ACS Food Sci. & Tech., 3(3), 441–452.
- Nature Communications. (2024). Probiotics functionalised with a gallium-polyphenol network. Nat. Commun., 15, 51534.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

RETINAL VESSELS SEGMENTATION AND CLASSIFICATION OF EYE DISEASE USING CNN

Mahesh Shivkumar Shete[1] and G.Nandhini[2]
[1]P.G. Student, Department of Electronics Engineering, Walchand Institute of Technology, Solapur, Maharashtra, India
[2]Associate Professor, Department of Elezctronics Engineering, Walchand Institute of Technology, Solapur, Maharashtra, India

ABSTRACT
Cataract, glaucoma, and retinal disorders are the three most common causes of vision loss globally. The increasing prevalence of these conditions demands immediate and accurate diagnosis. The proposed method is developed and tailored to simplify the detection of retinal illnesses, glaucoma, cataracts, and more. Artificial neural networks and convolutional neural networks are employed to identify and classify eye disorders. This proposed system aims to lower the incidence of preventable blindness by allowing patients to obtain timely treatment for the mentioned conditions. Along with identifying glaucoma and retinal diseases, the selected technique also assesses the safety and effectiveness of cataract surgery in eyes affected by age-related macular degeneration. This research utilizes fundus images from healthy eyes as well as those with glaucoma, cataracts, and retinal issues to demonstrate algorithm accuracy. A model is now developed that automatically uses artificial intelligence methods, specifically Convolutional Neural Network, to perform retinal blood vessel segmentation and classify eye diseases.

Keywords: *Convolutional Neural Network, Fault detection, Mapping the blood vessels, Tensor Core, SegmentationAI integration.*

INTRODUCTION
A thin layer of tissue that runs along the inside back wall of the eye is called the retina in humans. Protecting the eyes from conditions that could affect vision is vital because of their vital role in visual perception. Retinal disorders, glaucoma, and cataracts are the most commonly identified causes of severe vision loss. A World Health Organisation (WHO) study found that cataracts account for 47.8% of blindness, glaucoma for 12.3%, and retinal disorders for 4.8%. More than 60% of blindness cases globally are caused by these three disorders combined.

Depending on their extent, cataracts, which damage the lens of the eye, usually start as a tiny, foggy patch that progressively enlarges to cause blurred or lost vision. The optic nerve, which is the essential connection between the eye and the brain, is harmed by glaucoma. Early identification is essential since severe glaucoma causes permanent retinal loss. Vision depends on the retina, a light-sensitive nerve layer located in the rear of the eye. A belated identification of retinal illnesses may necessitate lengthy or repeated treatments to restore vision. Dysfunction to this area might result in visual loss.

RELATED WORK
Yanchun Zhang, Hua Wang, Khandakar Ahmed, and Hua Wang [1] The suggested study offers a thorough analysis of automated methods for detecting diabetic eye disease from a variety of angles, including available datasets, picture preprocessing methods, deep learning models, and performance indicators. Michele Sorelli, Paolo Melillo, Leandro Pecchia, Francesca Simonelli, Ernesto Iadanza, Francesco Goretti, as well as Monica Gherardelli [2] This concept offers a new Clinical Decision Support System (CDSS) that uses chromatic pupillometry and machine learning to help diagnose inherited retinal disorders in children. Miloy Ajmera, Kailas Devadkar, Ayesha Kazi, and Prerna Sukhija [3] The scientists suggest a method for identifying eye disorders that involves removing the retina's blood veins.It aims to design and consequently implement Dr.

D. Selvathi, K. Suganya, [4] The proposed methodology is to explore Machine Learning technique to detect diabetic eye disease using thermography images of eye and to introduce the effect of thermal variation of abnormality in eye structure as diagnosis imaging modality which are useful for ophthalmologists to do clinical diagnosis.

Sawaluddin, Sumita Wardani, while Poltak Sihombing [5] This study shows that when it comes to categorising eye illnesses, the Support Vector Machine-K-Nearest Neighbour combo is more accurate than the Support Vector Machine alone. The SVM-KNN method mixture has a 94.67% success rate.

ISSN 2394 - 7780

Jianyuan Li, Maojian Chen, Xi Yang, Xiong Luo, as well as Xiangjun Li [6] Through the examination of retinal fundus images, this concept suggests a deep learning-based CAD model to address a difficult problem in the classification of ophthalmic images.

METHODOLOGY

The classification and segmentation of eye diseases typically involve a combination of medical imaging and machine learning techniques. Here's an overview of the background and methodology for this process:

Background

Medical Imaging: Various imaging modalities are used in ophthalmology to capture detailed images of the eye, including retinal fundus photography, optical coherence tomography (OCT), and more. These images provide valuable information about the eye's internal structures and any abnormalities.

Anatomy Knowledge: Understanding the anatomy of the eye is crucial. This knowledge helps in recognizing different structures in eye images and identifying deviations from normal anatomy, which can be indicative of diseases.

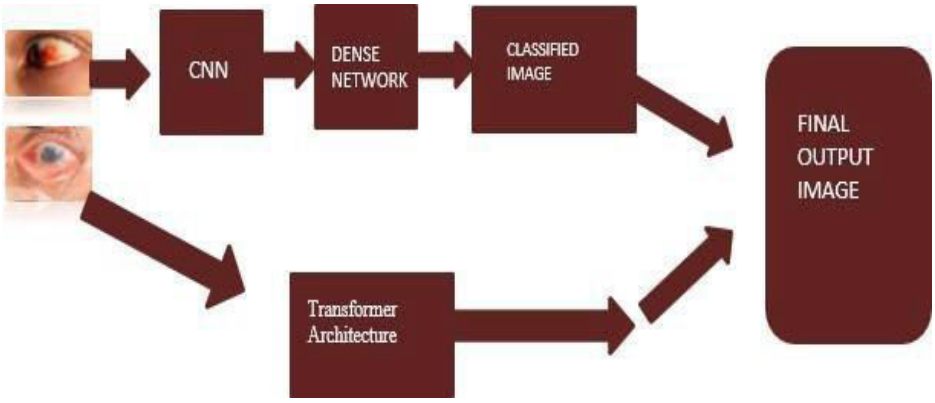


Fig: Block diagram classification and segmentation of eye diseases using CNN

Algorithms used:

A. Methodology of Artificial Neural Network (ANN) in Classification and Segmentation of Eye Diseases:

Artificial Neural Networks (ANNs) are commonly used in the classification and segmentation of eye diseases, leveraging medical imaging data. Here's a methodology for using ANNs in this context:

1. **Data Collection and Preprocessing:**

1. **Data Acquisition:** Gather a dataset of eye images, which may include retinal fundus images, optical coherence tomography (OCT) scans, or other imaging modalities. Ensure that the dataset contains a diverse range of eye diseases and normal cases.
2. **Data Annotation:** Annotate the images to indicate the presence of specific diseases and, if applicable, mark the location of the diseases within the images. This may involve manual annotation by medical experts.
3. **Data Split:** Divide the dataset into training, validation, and testing sets, ensuring that they are representative and balanced in terms of disease classes.
4. **Preprocessing:** Apply preprocessing steps, such as noise reduction, contrast enhancement, and image normalization, to improve the quality and consistency of the images

2. Model Architecture Selection:

1. **ANN Type:** Choose an appropriate type of ANN for the task. Convolutional Neural Networks (CNNs) are the most common choice for image analysis tasks like eye disease classification and segmentation.
2. **Network Architecture:** Design the neural network architecture, including the number of layers, the size of convolutional kernels, and the depth of the network. Consider using pre-trained models to benefit from transfer learning.

ISSN 2394 - 7780

3. Feature Extraction and Representation:

1. **Feature Learning:** Use the ANN to automatically learn and extract features from the eye images. This is typically done through the convolutional layers of the network.
2. **Dimensionality Reduction:** Consider techniques like global average pooling or fully connected layers to reduce the dimensionality of the extracted features.

4. Disease Classification:

1. **Training:** Train the ANN on the labeled training data to classify images into different disease categories. The output layer of the network will have nodes representing disease classes.
2. **Loss Function:** Use an appropriate loss function, such as categorical cross- entropy, for multiclass classification tasks.
3. **Validation and Hyperparameter Tuning:** Monitor the model's performance on the validation dataset and adjust hyperparameters (e.g., learning rate, batch size) as needed.

5. Disease Localization:

1. **Model Modification:** If disease segmentation is needed, extend the network to include additional layers that perform segmentation tasks, such as bounding box regression or pixel- wise segmentation.
2. **Training:** Annotate the localization information (e.g., bounding box coordinates or pixel-level masks) and train the model to predict the disease's location.

The use of ANNs in the classification and segmentation of eye diseases represents a powerful and rapidly evolving field, with the potential to improve early diagnosis, personalized treatment, and patient outcomes in ophthalmology

B. Methodology of Convolutional Neural Network (CNN) in Classification and Segmentation of Eye Diseases:

Convolutional Neural Networks (CNNs) are widely used in the classification and segmentation of eye diseases, leveraging medical imaging data such as retinal fundus images or optical coherence tomography (OCT) scans. Here's a methodology for using CNNs in this context:

1. Data Collection and Preprocessing:

1. **Data Acquisition:** Gather a dataset of eye images, ensuring it contains various eye diseases and normal cases. Collaborate with healthcare institutions to obtain diverse and representative data.
2. **Data Annotation:** Annotate the images to indicate the presence of specific diseases and, if needed, mark the location of the diseases within the images. This annotation can be performed by medical experts.
3. **Data Split:** Divide the dataset into training, validation, and testing sets, ensuring an appropriate distribution of disease classes and normal cases.
4. **Preprocessing:** Apply preprocessing steps, such as noise reduction, contrast enhancement, and image normalization, to improve the quality and consistency of the images. Crop or resize the images to a consistent format.

2. CNN Architecture Design:

1. **Network Type:** Choose the type of CNN that suits your task. Common choices include standard CNN architectures, like VGG, ResNet, Inception, or specialized architectures for medical imaging tasks.
2. **Network Depth:** Decide on the depth of the network. Deeper networks tend to capture more intricate features but may require more data and computational resources.

3. Feature Extraction and Representation:

1. **Convolutional Layers:** The initial layers of the CNN perform convolution operations, automatically learning and extracting features from the input images. These features become increasingly abstract as you move deeper into the network.
2. **Pooling Layers:** Use pooling layers to down sample the feature maps, reducing dimensionality while retaining essential information.

ISSN 2394 - 7780

4. Disease Classification:

1) **Training:** Train the CNN on the labeled training data to classify images into different disease categories. The output layer typically consists of nodes corresponding to disease classes.
2) **Loss Function:** Choose an appropriate loss function, such as categorical cross-entropy for multiclass classification tasks.
3) **Validation and Hyperparameter Tuning:** Monitor the model's performance on the validation dataset, and fine-tune hyperparameters (e.g., learning rate, dropout rate) as necessary.

5. Disease Segmentation:

1. **Model Modification:** If disease segmentation is required, extend the network to include additional layers that can perform segmentation tasks. For example, you may add localization layers for bounding box regression or pixel-wise segmentation.
2. **Training:** Annotate the segmentation information (e.g., bounding box coordinates or pixel-level masks) and train the model to predict the disease's location within the images.

CNNs have proven to be effective tools for the classification and segmentation of eye diseases, and they continue to advance the field of ophthalmology by providing accurate and efficient diagnostic solutions.

C. Deconvolutional Neural Network:

For tasks like image segmentation, object detection, and localization, deconvolutional neural networks (DNNs) are a form of neural network that are utilized in image processing and computer vision applications. It is also frequently referred to as a transposed convolution or the inverse of a convolutional neural network (CNN).

D. Back Normalization:

In order to classify and locate eye illnesses, back normalization is a technique used to preprocess and standardize images before putting them into a machine learning system. Images must be brightened and contrasted, as well as having their size and orientation normalized.

E. Max Pooling:

Convolutional neural networks (CNNs) frequently employ the max pooling strategy for feature extraction in the classification and segmentation of eye disorders. By retaining only the highest pixel value in each pooling window, it is a type of down- sampling that minimizes the size of the input image.

E. Categorical Cross Entropy:

The ability to handle multi-class classification problems with more than two classes, such as the classification of retinal images into different stages of diabetic retinopathy or age- related macular degeneration, is one advantage of using categorical cross-entropy in the classification and segmentation of eye diseases.

VI F. Segmentation:

In example, when examining retinal pictures, segmentation is a widely utilized approach in the classification and segmentation of eye illnesses. It entails dividing an image into various areas or segments according to their pixel values or other qualities like texture, color, or shape.

F. Intersection over Union (IoU):

IoU can be used to assess the precision of machine learning algorithms in localizing particular features or lesions within the retinal pictures in the context of classifying and segmentation eye diseases. It can be used to measure how much the predicted bounding box or segmentation mask overlaps with the ground truth annotation and to assess how well the algorithm performed overall at locating and recognizing the important characteristics.

The formula for calculating Intersection over Union (IoU) is as follows:

IoU = (Intersection Area) / (Union Area)

IoU is calculated by dividing the overlap between the predicted and ground truth annotation by the union of these.

ISSN 2394 - 7780

$$J(A,B) = \frac{|A \cap B|}{|A \cup B|}$$

The Intersection over Union algorithm is as follows:

1) Use your model to provide a prediction.
2) Examine the difference between the ground truth and forecasted bounding boxes (or masks).
3) Determine where these intersect and where they unite.
4) Utilising their union, break the markings that overlap. 5 Examine the value that was acquired.
6) For each test image, repeat steps 1–5.
7) To obtain the ultimate outcome over your test set, calculate the IoU scores' numerical average.

The union area is the total area of both areas, whereas the intersection area refers to the overlap between two bounding boxes or segmentation masks.

Using the proper formulas based on the representation of the areas (bounding boxes or segmentation masks), as mentioned in the previous post, you must first identify the intersection area and the union area in order to calculate the IoU.

Once the junction area and the union area have been calculated, you may enter those numbers into the IoU algorithm to get the final IoU score.

G. Exponential Linear Unit (ELU):

Researchers and practitioners hope to enhance the learning capacities of the network by using ELUs as activation functions inside the layers of a neural network. This could result in improved performance in the categorization and localization of eye diseases.

ELUs are an alternative to other activation functions as the sigmoid function or rectified linear unit (ReLU). By resolving some of ReLU's drawbacks, such as the "dying ReLU" issue, where ReLU neurons might go dormant and essentially "die" during training, they offer advantages over ReLU.

F-measure:

Assigning a source picture to a single among several predetermined categories or groups is the aim of 2D image decoding tasks, whereby the F-measure is a frequently used assessment metric. The F-measure summarises the performance of a system for classification by combining the two essential metrics of retrieval and accuracy.

The F-measure for different retinal disorders can be computed using the formula below:

(precision * recall) / (precision + recall) = 2 * F-measure

Precision in a classification with two classes task is determined by dividing the number of true positives by the sum of the true positives and false positives.

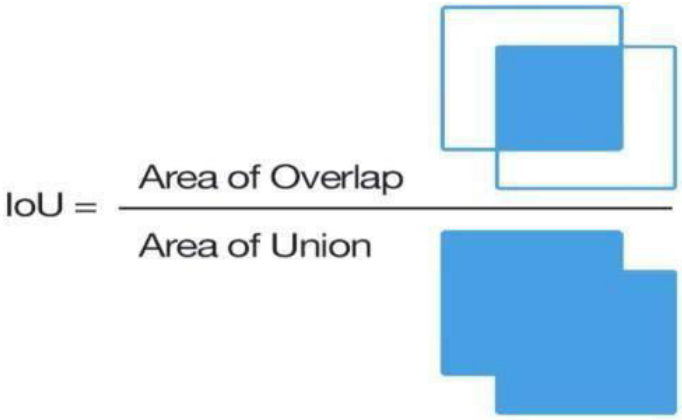
TruePositives / (TruePositives + FalsePositives) = Precision

Precision in a two-class classification task is determined by dividing the number of true positives by the sum of the true positives and false negatives.

Recall = TruePositives / (TruePositives + FalseNegatives)

ISSN 2394 - 7780

How to calculate F-measure?



F-measure for cataract = (2 * precision for cataract *

recall for cataract) / (precision for cataract + recall for cataract)

= 2 * (0.96 * 0.97) / (0.96 + 0.97)

= 0.96

F-measure for cataract = (2 * precision for cataract* recall for glaucoma) / (precision or glaucoma + recall for glaucoma)

= 2 * (0.97 * 0.97) / (0.97 + 0.97) = 0.97412

1. F-measure for diabetic retinopathy = (2 * precision for DR

* recall for DR) / (precision for DR + recall for DR) = 2

* (0.97* 0.97) / (0.97 + 0.97)

=0.97412

Table 1: F-measure table for Cataract, Glaucoma, DR and Normal eye condition.

F-Measure Calculation Table				
Eye Disease s	Disease Type Code	Precision	Recall	F-Score
Cataract	1	0.96	0.97	0.96
Glaucoma	2	0.97	0.97	0.97
Diabetic Retinopathy	3	0.97	0.97	0.97

For instance, the accuracy would be determined as follows if the dataset contains 1000 photos and the model successfully classifies 900 of them:

Accuracy = (Number of Correct Predictions / Total Number of Predictions) x 100%

= (970 / 1000) x 100%

= 97%

ISSN 2394 - 7780

RESULTS

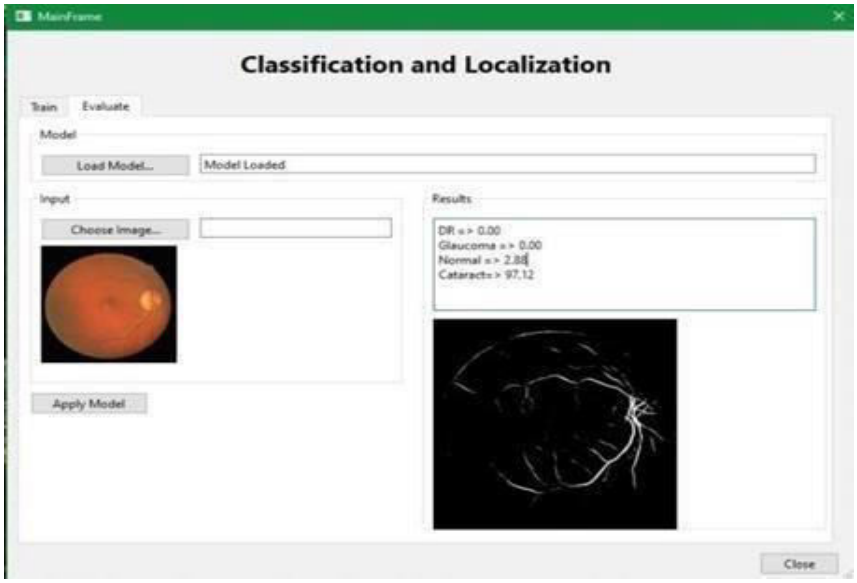


Fig.: The eye is diagnosed of Cataract

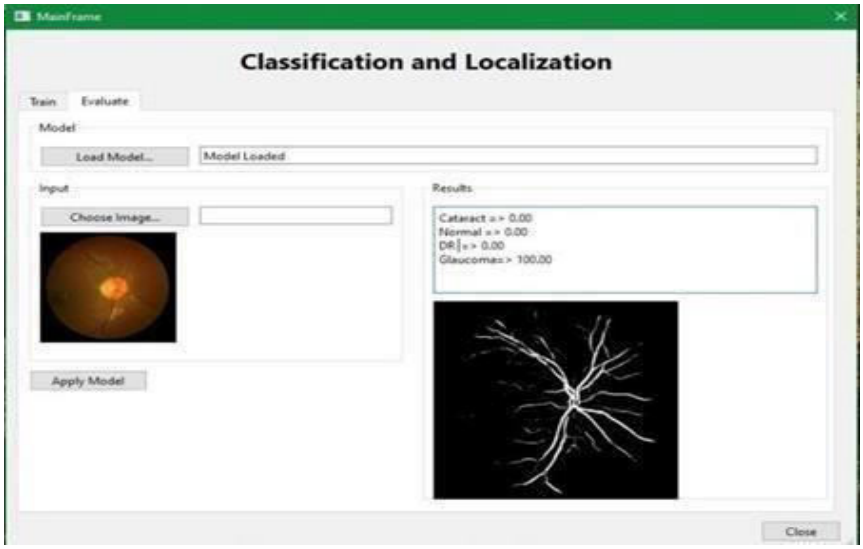


Fig. : The eye is diagnosed of Glaucoma.

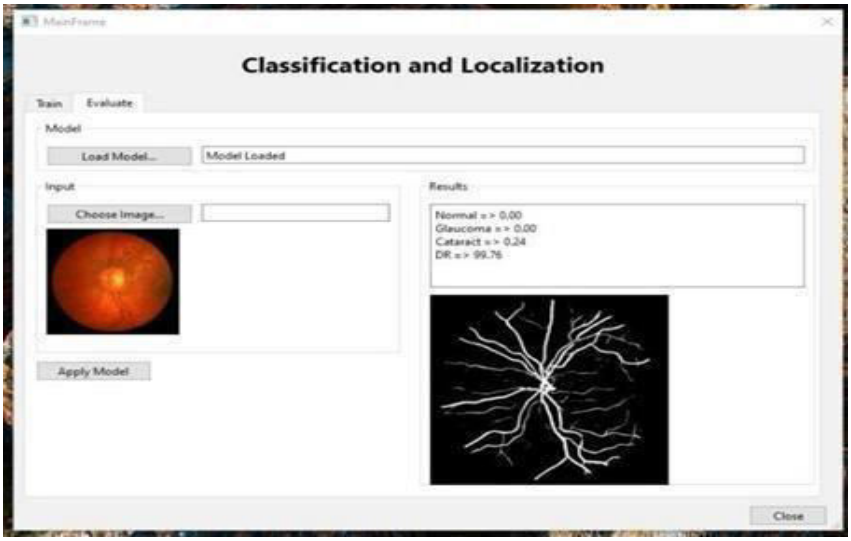


Fig.: The eye is diagnosed of Diabetic Retinopathy.

ISSN 2394 - 7780

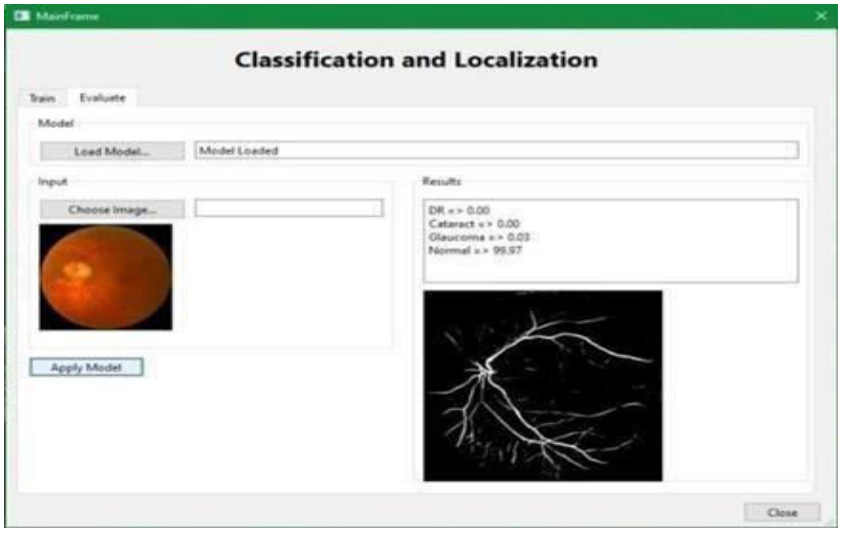


Fig.: The eye is Normal.

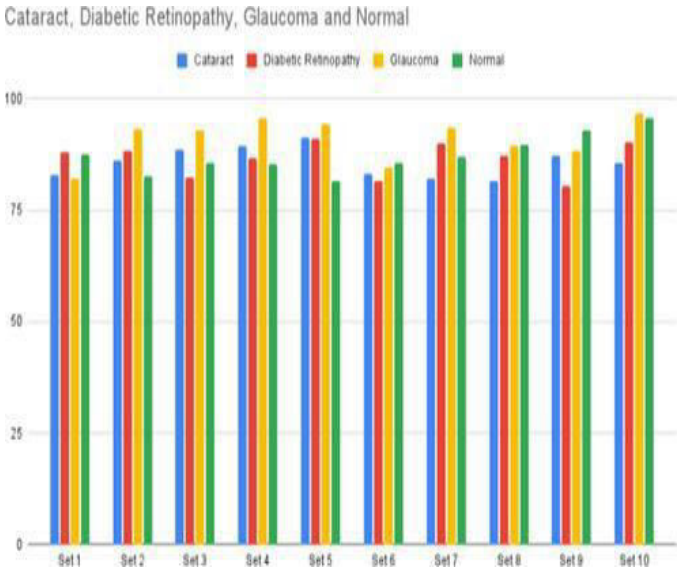


Fig.: Accuracy of classification and localization of eye diseases dataset wise.

Epoch:
An "epoch" is a complete iteration throughout the whole training dataset used to train a machine learning model. Epochs are essential to the development procedure for deep learning models used for the categorisation and localisation of eye disorders.

- The model may under fitted if you choose a small number of epochs because it won't have enough contact with the data to properly identify the deeper trends.
- The model may overfit the training data if you set a large number of epochs, which means it will learn to memorise the samples used for training instead of generalising to new, unseen data. Efficiency on the test or verification set may suffer as a result.

F. CONCLUSION

Convolutional neural networks (CNNs), exponential linear units (ELUs), and backpropagation have all been shown to be efficient and promising techniques in the field of ophthalmology for the categorization and segmentation of eye disorders. In order to accurately classify and locate various eye illnesses, CNNs have shown extraordinary capabilities in learning and extracting significant information from eye images. By providing smoothness, capturing negative activation values, and limiting the loss of important information during training, ELUs, as activation functions within CNNs, overcomes the shortcomings of other activation functions, such as the dying ReLU problem.

CNNs are trained via backpropagation, a fundamental deep learning technique. In order to optimize the performance of the model, it enables the iterative change of network weights based on the estimated gradients of the loss function. A potent framework for the categorization and segmentation of eye illnesses using

artificial intelligence is formed by the integration of CNNs, ELUs, and backpropagation. The effectiveness, efficiency, and accessibility of diagnosing and treating eye diseases are improved by these techniques, which make use of massive datasets, enable feature learning, and offer trustworthy predictions.

The accuracy of the endeavour has been determined based on a number of factors: Glaucoma has an average accuracy of 97.17, cataracts have a typical precision of 96.80, DR has a standard certainty of 97.41, and normal eyes have a reliability of 97.14. As the outcome, the model's overall average reliability drives to 97.17, yielding 97% of accurate findings.

REFERENCES

1) D Shamia, Shajin Prince and D Bini, "An Online Platform for Early Eye Disease Detection using Deep Convolutional Neural Networks",2022 6th International Conference on Devices, Circuits and Systems (ICDCS).

2) C. Rekha and K. Jayashree, "Hyphema Eye Disease Prediction with Deep Learning", 2022 International Conference on Computer, Power and Communications (ICCPC). Doi:101109/ICCPC55978.2022.10072218.

3) Nair, S. Suranglikar, S. Deshmukh and Y. Gavhane, "Multi-labelled Ocular Disease Diagnosis Enforcing Transfer Learning," 2021 55th Annual Conference on Information Sciences and Systems (CISS), Baltimore, MD, USA, 2021, pp. 1- 6, doi: 10.1109/CISS50987.2021.9400227.

4) H. Vyas and V. Khanduja, "A Survey on Automated Eye Disease Detection using Computer Vision Based Techniques," 2021 IEEE Pune Section International Conference (PuneCon), Pune, India, 2021, pp. 1-6, doi: 10.1109/PuneCon52575.

5) T. Guergueb and M. A. Akhloufi, "Ocular Diseases Detection using Recent Deep Learning Techniques," 2021 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Mexico, 2021, pp. 3336- 3339, doi: 10.1109/EMBC46164.2021.9629763.

6) Raza, M. U. Khan, Z. Saeed, S. Samer, A. Mobeen and A. Samer, "Classification of Eye Diseases and Detection of Cataract using Digital Fundus Imaging (DFI) and Inception- V4 Deep Learning Model," 2021 International Conference on Frontiers of Information Technology (FIT), Islamabad, Pakistan, 2021, pp. 137- 142, doi: 10.1109/FIT53504.2021.00034.

7) Daher and Z. Rammal, "Development of a System for Detection, Diagnosis, and Treatment for Eye Strabismus Disease," 2021 Sixth International Conference on Advances in Biomedical Engineering (ICABME), Werdanyeh, Lebanon, 2021,pp. 125-129, doi: 10.1109/ICABME53305.2021.9604857

8) Gauri Ramanathan, Divya Chakrabarti, Aarti Patil, and Shubhangi Kharche, "Eye Detection Using Machine Learning", in IEEEAccess. doi:10.1109/GCAT52182.2021.9587740

9) Akihiro Kuwahara, RinHirakawa, Hideki Kawano, Kenichi Nakashi and Yoshihisa Nakatoh, " Eye Fatigue Prediction System Using Blink Detection Based on Eye Image", 2021 IEEE International Conference on Consumer Electronics (ICCE). Sinha, A. R P and N. N. S, "Eye Tumour Detection Using Deep Learning," 2021 Seventh International conference on Bio Signals, Images, and Instrumentation (ICBSII),Chennai, India,2021,pp.1-5, doi: 10.1109/ICBSII51839.2021.9445172.

10) Z. Wang, L. Lin, J. Wu and X. Tang, "Multi-task Learning Based Ocular Disease Discrimination and FAZ Segmentation Utilizing OCTA Images," 2021 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Mexico, 2021, pp. 2790-2793, doi: 10.1109/EMBC46164.2021.9631043

11) J. He, C. Li, J. Ye, S. Wang, Y. Qiao and L. Gu, "Classification of Ocular Diseases Employing Attention- Based Unilateral and Bilateral Feature Weighting and Fusion," 2020 IEEE 17th International Symposium on Biomedical Imaging (ISBI), Iowa City, IA, USA, 2020, pp. 1258-1261, doi: 10.1109/ISBI45749.2020.9098525.

12) Adel, M. M. Soliman, N. E. M. Khalifa and K. Mostafa, "Automatic Classification of Retinal Eye Diseases from Optical Coherence Tomography using Transfer Learning," 2020 16th International Computer Engineering Conference (ICENCO), Cairo, Egypt, 2020, pp. 37-42, doi: 10.1109/ICENCO49778.2020.9357324.

ISSN 2394 - 7780

13) P. Sharma and A. K. Shukla, "Analysis of Various Techniques and Methods for the Prediction of Diabetic Eye Disease in Type 2 Diabetes," 2021 Third International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2021, pp. 1023-1030, doi: 10.1109/ICIRCA51532.2021.9544622

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

ENHANCING COMMUNICATION SKILLS FOR A FUTURE-READY WORKFORCE

Manoj Shankar Mishra[1], Dr. Nempal Ningh[2] and Dr. Seeta Jaiswar[3]
[1]Designation of 1st Assistant Professor, [2]Designation of 2ndHOD Vikrant University, Gwalior, [3]Designation of 3rd Author Coordinator for Internationalism (NDPS) Indore
[1]Name of Department of 1st ASH,
[1]Name of organization of 1st SKITM, Indore, MP, INDIA

ABSTRACT
Effective communication is a basic engine of business performance, influencing overall workplace culture, employee engagement, and production. Emphasizing its strategic relevance in the setting of globalization, technology developments, and changing work environments, this paper explores the function of communication in modern firms. Analyzing digital tools, cultural diversity, and leadership communication, the study investigates how companies and educational institutions implement communication skills into their systems. We focus on challenges including cognitive overload, poor communication, and the difficulties provided by hybrid and distant working styles. Using case studies and an analysis of modern communication technology, the paper stresses both optimal practices and future directions in communication. Our findings emphasize the importance of inclusive policies, ongoing communication education, and the adoption of technology that fosters empathy and clarity. We arrive at the conclusion that, as a basic ability to foster creativity, emotional intelligence, and worker adaptation, firms have to give communication high importance.

Keywords: *Communication Skills, Workforce Readiness, Soft Skills, Higher Education, Organizational Performance, Global Workforce, Technological Competence, Cross-Cultural Communication, Employee Engagement, Digital Communication, AI in Communication*

INTRODUCTION
The foundation of human contact and corporate effectiveness is communication. Companies negotiate different cultural environments more and more in fast globalization , therefore good communication is not just a soft ability but also a strategic advantage. Errors, lower moral standards, and ineffective operations follow from miscommunication. Therefore, companies have to ingrain communication excellence into their values so that environments where voices are heard and teamwork blossoms can result. In its several forms—verbal, nonverbal, written, and digital—communication is absolutely essential for building connections, credibility, and flawless productivity. In the knowledge economy of the twenty-first century, where creativity and teamwork are valued highly, communication skills have become a fundamental ability needed for worldwide companies. Organizations that grow internationally have to change their communication systems to fit diversity, inclusion, and technological innovation. Good communication improves trust, emotional intelligence, team productivity, and clarity by means of which uncertainty is reduced.

Our interaction with others and view of the world are shaped via communication. It controls corporate power dynamics, drives creativity, and promotes diversity. In settings as varied as a public health NGO or a multinational engineering company, communication can be the link or obstacle toward results. These days, hybrid work, teleconferencing, and multilingual teams call for more than just a message—one must connect with listeners in many different settings. Companies who understand these facts are setting themselves for long-term viability in the changing global market.

METHODOLOGY
This paper combines a qualitative review of contemporary literature with case studies demonstrating the evolving purpose of communication in businesses. Sources include academic papers, industry reports, case studies from leading companies including IBM, Google, and Médecins Sans Frontières. The study examines how in hybrid work environments platforms for communication—Slack, Microsoft Teams, Zoom—impact leadership, employee morale, and organizational effectiveness. The study also explores psychological aspects of communication including employee psychological safety, drive, and emotional intelligence.

RESULTS
According to the findings of the study, communication, both in-person and online, has a significant influence on the success of their respective organizations. An improvement in crisis management, increased employee involvement, and increased inventiveness are all characteristics of businesses that make investments in tools and communication training. Case studies conducted by Stanford and IBM demonstrate how effectively communication training can improve both the culture of an organization and the performance of its employees. In addition, businesses that employ inclusive communication strategies—that is, those that recognize the

ISSN 2394 - 7780

nuances of language and encourage digital literacy—have better records in terms of minimizing the amount of ethnic diversity in their workforce and enhancing employee retention among employees. The difficulties of digital overload, miscommunication in virtual environments, and generational communication patterns are still prevalent although they are still frequent.

Modern Imperatives for Communication in Education and Industry

Communication is essential for comprehensive education; consequently, educational institutions are under more and more need to provide pupils both soft and hard skills. Institutions have to migrate from conventional rote learning to interactive, practice-driven pedagogy if they are to close the gulf separating academics and business. This covers case-based learning, group projects in both core and elective courses, peer reviews, and transdisciplinary learning. Modern communication agility is also developed in part by digital storytelling, podcasting, and collaborative tools like Slack and Miro.

Industries are recommended, however, to keep active staff development programs with an eye toward communication at all levels. Common paths for learning communication skills are courses on conflict resolution, leadership development, and new employee orientation. To track and improve team collaboration, companies such as Google and Deloitte—among others—very promote communication analytics and employee engagement solutions. As hybrid and remote work models are the norm and asynchronous communication skills—including clear written correspondence—are becoming more necessary, virtual meeting etiquette is quite vital. Thus, communication is not a peripheral ability; it is rather essential for business continuity, crisis reaction, and creativity.

Increased Understanding of Organizational Communication

One can study organizational communication from several angles: structural, cultural, technological, and psychological. Whereas a distributed approach promotes innovation and open communication, a well-organized communication hierarchy guarantees message clarity. Particularly in international environments, cultural factors shape the way feedback is delivered and perceived. For example, whereas low-context societies like Germany and the United States encourage directness and explicit communication, high-context cultures like Japan and the UAE mostly depend on non-verbal signals and inferred meanings.

The information flow has been transformed by technological integration, best shown by business communication tools like Microsoft Teams and Slack. Technology can, however, have both good and bad consequences; it can diminish emotional depth and lead to information overload even while it accelerates the dissemination of communications. Leaders have to be, therefore, skilled at guiding messages through the appropriate media, tone, and timing. Psychologically, communication ties to motivation, identity, and belonging. Herzberg's motivation-hygiene theory holds that job satisfaction is largely influenced by interpersonal contacts and acknowledgment. Corporate communication policy should thus be based mostly on empathy, openness, and attentive listening.

Vision for the Employment Future

Future workers will function in ever more volatile, unpredictable, complicated, and ambiguous (VUCA) settings. In such situations, strategic adaptation as much as operational success will rely on communication abilities. Future experts have to negotiate cultural heterogeneity, multidisciplinary teams, and artificial intelligence-mediated dialogues. To effectively manage emails, presentations, dashboards, and collaboration platforms, they also need to become digitally fluent.

Adaptive leadership's basis is emotional intelligence (EQ) mixed with communication skills. People who can regulate their emotions, understand social signals, and communicate ideas with empathy will be particularly valuable members of diverse teams. Course on cross-cultural communication with an eye toward language subtleties, etiquette, conflict patterns, and values mapping should also be part of graduate study. Visionary communication also touches narrative and mobilization. Leaders have to use engaging narratives to encourage people toward common goals. Developing honesty, strategic clarity, and social listening—skills one should acquire early in their academic and career path—helps one establish a strong platform for this ability.

Modern Workplace Communication Tools and Obstacles

The spread of digital tools has divided rather than empowered corporate communication. Tools like Slack, Trello, and Zoom add to cognitive overload even while they boost connectivity. A McKinsey study estimates that the typical knowledge worker spends 28% of their working week handling emails alone.

Misunderstandings are exacerbated by barriers including generational differences, language variety, and asynchronous communication. For instance, Baby Boomers rely on emails; Gen Z workers could favor GIF-

ISSN 2394 - 7780

based messaging. In virtual environments, nonverbal signals are sometimes lost, and misinterpretation results. Remote work has also lessened incidental interactions—qualities of trust and teamwork.

Organizations have to create a culture of digital awareness if they are to break through these obstacles. Employee communication etiquette, platform choice, and tone modulation training help reduce conflict. Establishing rules like "email-free Friday" or "video-on etiquette" can also help teams be more coherent.

Case Studies: Good Presentational Skills

The worldwide learning program of IBM, "Think Academy," shows how departments and cultures may be scaled with regard for communication training. Using interactive modules and real-time discussion boards, the program improved not only staff involvement but also capacity for innovation.

Médecins Sans Frontières (Doctors Without Borders) teaches field professionals in the charity sector cross-cultural and crisis communication. Given their work in conflict areas, it is imperative to be able to control stakeholder expectations, language hurdles, and emotional discomfort.

In academics, Stanford University's Design Your Life course combines peer mentoring, storytelling, and reflective communication. Students claim more interpersonal effectiveness and job confidence. These situations demonstrate the value of deliberate, inclusive, and skill-oriented communication strategies.

Digital Communication and Artificial Intelligence

AI is transforming the ecology of communication. Grammar, tone, and content-generating help come from tools including Grammarly, Jasper, and ChatGPT. These systems improve scalability, lower cognitive burden, and advance language equity. AI chatbots answer up to 80% of regular questions in customer support, freeing human workers for more difficult problems.

Still, artificial intelligence raises moral issues. Sentiment analysis helps us understand cultural idioms or sarcasm. Systems for automatic hiring could discriminate against non-native accents. Artificial intelligence applications also have to be created with human-centered values, including justice, openness, and explainability.

Companies should offer digital literacy courses to train staff members in artificial intelligence methods. Direct data use, communication rights, and responsibilities in artificial intelligence-human relations also need to be adapted within regulatory frameworks.

Inclusive communication and equality

Inclusive communication goes beyond basic linguistic adaptation since it respects many communication preferences and neurodiverse needs. For instance, some would find visual aids to be more helpful, while others would prefer one-on-one conversations or written explanations. In the film business, inclusive companies apply universal design ideas in their communication by means of closed captions, sophisticated meeting agendas, and anonymous sources of feedback. Using customized instruction in classrooms and supporting non-traditional students with flexible communication tools can help educational institutions reflect such approaches. These programs not only improve communication but also help to build respect and belonging—qualities necessary for involvement and retention.

Policies and Curricula:

Certifying organizations and governments greatly promotes the development of communication abilities. Policies supporting industry-academia partnerships, soft skills certification, and transdisciplinary training help close talent shortages. STEM, humanities, and career courses housed inside national education systems should all teach communication skills.

Curricula now should call for modules on digital media literacy, leadership communication, conflict resolution, and intercultural dialogue. Evaluation systems must evolve beyond rote memorization to performance-based examinations including simulations, role-playing, and reflective diaries. Without a full, systems-level change, students cannot be ready for the communication needs of the future workforce.

Workplace Correspondence: Evolutionary Development

Over the past century, the landscape of commercial communication has evolved drastically. During the industrial age, communication was primarily defined by a strict hierarchy. Orders were issued under minimal in-person meetings, proper documentation, and interoffice interactions. These methods hardly create any room for comments or debate.

As telephony developed and human relations theory evolved by the middle of the 20th century, participative communication altered as well. The theories of Elton Mayo and Chester Barnard stressed emotional intelligence, group dynamics, and unofficial networks of communication. Under globalization and deregulation,

ISSN 2394 - 7780

the 1980s and 1990s raised the ethnic complexity. Emails, intranets, and corporate communication systems included in regular operations helped accelerate this change.

Modern office communication is flexible, transparent, and multidirectionally flowing. Companies realize more and more that communication is both a tool and a strategy—necessary for branding, leadership, and employee well-being, among other aspects. Understanding this historical trend helps one to put contemporary events—digital tiredness, cross-cultural confusion, and data privacy concerns—in perspective.

Leadership Development and Effective Communication

Ineffective communication makes leadership useless. Leaders in the distributed and agile companies of today have to be communication anchors—clear vision, team mobilization, and crisis management. According to Harvard Business Review, more than 91% of employees think their bosses lack sufficient communication abilities; this disparity usually results in disengagement and turnover.

Effective modern leadership communication requires story intelligence—that is, the capacity to create reasonable and inspirational stories. Think of the sympathetic crisis communication of New Zealand Prime Minister Jacinda Ardern during COVID-19 or Satya Nadella's change of Microsoft with a culture of honest communication and listening. To guide transformation, both leaders made use of empathy and sincerity.

Future leaders' development programs should stress reflective activities including journaling, role-based simulations, and real-time feedback. Scenario analysis, cross-generational mentorship, and peer coaching help leaders become more communicative. Not only financial measures, but also leaders should be assessed by institutions on their capacity to build trust, psychological safety, and inclusive communication.

Calculating Communication Efficiency

Regular improvement depends on the dimension of the outcome of communication campaigns. Companies track employee engagement surveys, communication audits, response rates to internal emails, and sentiment analysis on feedback sites, among other things. These numbers expose the degree of message reception, understanding, and application accuracy. For internal communication, advanced companies measure trust indices and track communication KPIs, including message clarity, reach, and emotional resonance, using Net Promoter Scores (NPS). Focus groups and ethnographic research, among other qualitative techniques, give these measures contextual complexity. Good measurement results in a feedback loop whereby communication techniques are always improving to satisfy changing needs.

Training Strategies and Best Standards

Learning to communicate calls for more than just theoretical knowledge—it calls for experience. Interactive seminars, real-time feedback, gamified simulations, and digital storytelling laboratories comprise best practices in communication training. Still providing disciplined approaches for improving public speaking and interpersonal skills are programs like Toastmasters and Dale Carnegie.

Higher education institutions are also innovating with flipped classes, peer-led debates, and performance-based exams. Further real-world environments where students may hone their communication skills are internships, co-ops, and community service projects. Best approaches in applied communication training are shown by industry partnerships whereby students work on live issues and show up for corporate panels.

Effective Crisis Management: Communication

During crises, communication turns out to be the most useful organizing tool. Whether it's a pandemic, cyber security breach, or financial crisis, public and employee confidence depends on your capacity for clear, consistent, empathetic communication. Bad communication can aggravate blame, false information, and panic.

Plans of crisis communication have to incorporate predefined procedures, training of spokespeople, multi-channel distribution techniques, and feedback systems. Companies that kept openness, empathy, and two-way communication throughout COVID-19 were able to preserve operational continuity and morale. Post-crisis debriefs, communication records, and stakeholder comments enable organizations to be more ready for the next upheavals.

The function of communication in cultures of remote work

As people migrate globally toward remote and hybrid work, communication conventions have changed. Traditional signals like direct feedback, corridor chats, and body language are now muffled by screens. More deliberate digital communication is required as a result of this shift. Clear subject lines, brief explanations, and well-timed responses are essential for avoiding misunderstandings and delays. According to a Gallup poll, remote workers who regularly communicate with management are three times more engaged. Thus, leaders need to adapt by utilizing collaborative tools that allow for both synchronous and asynchronous participation, as

well as by adhering to regular communication schedules like weekly check-ins or daily huddles. Being present is another aspect of effective remote communication; leaders should be online without micromanaging. Video updates, interactive dashboards, and virtual recognition foster a sense of belonging and trust among divided teams. The requirements for sincere and caring communication also include being aware of multiple time zones, having limited bandwidth, and experiencing digital fatigue.

Employee Mental Health:

Organizational psychology is starting to pay more attention to the relationship between communication and mental health. Employee morale and psychological safety are obviously impacted by communication styles, whether they are constructive, punitive, or dismissive. Environments where employees feel valued, appreciated, and acknowledged have been linked to lower burnout and increased productivity. Studies by the American Psychological Association have shown that poor communication is one of the five primary causes of stress at work. Conversely, open and sincere communication regarding workloads, expectations, and changes reduces anxiety and fosters resilience. Open-door policies, frequent feedback loops, and mental health initiatives that promote communication have all been found to be effective strategies for psychological well-being. Managers should be trained in trauma-informed communication so they can recognize the signs of trauma, set compassionate boundaries, and use language that is affirming. Formally establishing team availability guidelines, such as "mental health hours" or "no-meeting Wednesdays," can help prevent communicative overload.

Exchange of ideas Transparency in Ethics

Integrity, fairness, and respect define ethical communication. Open communication is no more discretionary as companies come under examination from stakeholders, consumers, and staff; it is rather crucial. This covers revealing corporate principles, data privacy policies, and logical bases for decisions.

Ethical communicators in a time of information manipulation and algorithmic bias have to check facts, credit sources, and avoid ambiguity. Ethical lapses—such as hiding bad news or assigning blame—can erode confidence and cause turnover inside a company.Transparency outside helps to create social credibility and brand loyalty.

Ethical business communication has benchmarks from frameworks such as the International Organization for Standardization (ISO 26000) and the Global Reporting Initiative (GRI). To keep credibility in an environment of polarized knowledge, communication officials have to be taught media literacy, risk communication, and stakeholder involvement.

Global Frameworks and Future Patterns in Media

Communication systems have to change to fit many values, languages, and media environments as the globe gets increasingly linked. For instance, the Common European Framework of Reference for Languages (CEFR) offers a consistent framework to evaluate communicative competency throughout different countries. Emphasizing critical thinking, content production, and intercultural understanding, UNESCO's Media and Information Literacy (MIL) effort

Future developments in communication suggest more interaction, personalization, and immersion. Metaverse platforms, augmented reality (AR), and virtual reality (VR) will change how individuals participate in conferences, narrative-telling, and experiential learning. Promising frictionless but ethically complicated communication technologies, voice artificial intelligence, emotion detection, and brain-computer interfacing are only around the corner.

Mixed learning systems combining synchronous and asynchronous communication will predominate in education. Industry-academia alliances have to change to incorporate courses on strategic communications, cross-platform literacy, and data ethics. Those who are not only morally grounded and socially conscious but also technologically adept will shape communication going forward.

CONCLUSION

In sum, communication is not merely a workplace tool—it is the fabric of organizational culture and future-readiness. By embedding communication deeply within educational and corporate systems, societies can foster more resilient, collaborative, and innovative environments. Strategic investments in this domain yield high returns in productivity, creativity, and inclusive growth. Institutions must act now to equip students with the tools they need to thrive, while employers must evolve their talent strategies to prioritize emotional and communicative intelligence.

ISSN 2394 - 7780

From health care to finance and education to engineering, every sector stands to benefit from a workforce that communicates with clarity, respect, and vision. The future belongs to those who can not only speak well but also listen deeply, adapt swiftly, and lead ethically.

REFERENCES

- -Adnan, N. I., et al. "The Oral Communication Skill Module: Investigating the Outcomes on Malaysian Employees' Confidence in Terms of Fluency." Mextesol Journal, vol. 48, no. 3, 2024.
- -Alhur, A., et al. "Enhancing Patient Safety through Effective Inter-professional Communication." Cureus, 2024.
- - Bahrain, N. N. K., et al. "Communication Barriers in Work Environment." International Journal of Academic Research in Business and Social Sciences, vol. 13, no. 11, 2023.
- - Davis, B. D., and T. R. Miller. "Job Preparation for the 21st Century." Journal of Education for Business, vol. 72, no. 2, 1996.
- -Denniston, C., et al. "Learning Outcomes for Communication Skills." BMJ Open*, vol. 7, no. 4, 2017.
- -Glazunova, O. G., et al. "Development of Soft Skills in Computer Science Bachelors." Information Technologies and Learning Tools, vol. 92, no. 6, 2022.
- - Komár, Z., and V. Pelle. "Measuring the Efficiency of Presentation Skills." Netcom, vol. 61, 2019.
- - Meeks, G. A. Critical Soft Skills to Achieve Success in the Workplace. ProQuest LLC, 2017.
- -Radović-Markovič, M., and A. Salamzadeh. "The Importance of Communication in Business Management." SSRN Electronic Journal, 2018.
- - Simões, A. V., et al. "Developing Business English Communication Skills." EDULEARN Proceedings, 2019.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

DIGITAL LITERACY PROGRAMS AND THE ROLE OF LIBRARIES IN SUPPORTING CITIZEN ACCESS TO ELECTRONIC GOVERNMENT SERVICES

Mr. P. Senthil Kumaran[1] and Mr. R. Matheswaran[2]
[1]Librarian, K.S.R College of Engineering Dr. B. Sivakumar, Librarian, P.S.G. College of Arts and Science
[2]Librarian K.S.R Institute of Dental Science and Research

ABSTRACT
The digital transformation of government services has created unprecedented opportunities for efficient public service delivery while simultaneously generating new barriers for digitally excluded populations. This study examines the critical role of public libraries in bridging the digital divide through comprehensive digital literacy programs that facilitate citizen access to electronic government services.

Through a mixed-methods approach analyzing program effectiveness across 12 library systems with 847 participants, this research demonstrates that libraries serve as essential democratic infrastructure, ensuring equitable access to government services in the digital age. The findings reveal that library-mediated digital literacy programs significantly improve citizen engagement with e-government services, with participants showing a 340% increase in successful online government transactions and 89% achieving basic digital proficiency.

Keywords: *Digital literacy, e-government, public libraries, digital divide, citizen engagement, public administration*

1. INTRODUCTION

The rapid digitization of government services has fundamentally transformed the relationship between citizens and public institutions. While electronic government (e-government) initiatives promise increased efficiency, accessibility, and cost-effectiveness, they simultaneously create new forms of exclusion for populations lacking digital skills or technology access. This digital divide represents a significant challenge to democratic participation and equitable access to public services, affecting approximately 21% of U.S. adults who lack basic digital skills according to recent Federal Communications Commission data.

Public libraries have emerged as critical intermediaries in this digital landscape, serving as community anchor institutions that provide both technology access and the skills necessary to navigate increasingly complex digital government interfaces. Through comprehensive digital literacy programs, libraries address multiple dimensions of digital exclusion: access to technology, digital skills development, and ongoing support for government service interactions.

This research examines the multifaceted role of public libraries in supporting citizen access to electronic government services, with particular attention to program design, implementation strategies, and measurable outcomes. The study addresses three primary research questions:

1. How do library digital literacy programs facilitate citizen engagement with e- government services?
2. What institutional factors contribute to program effectiveness?
3. How can partnerships between libraries and government agencies be optimized to serve digitally excluded populations?

2. LITERATURE REVIEW

2.1 Digital Divide and E-Government Access

The concept of the digital divide has evolved from simple considerations of technology access to encompass multiple dimensions of digital inequality. Van Dijk's (2020) framework identifies four sequential types of access: motivational, material, skills, and usage access. Each dimension presents unique challenges for e-government service delivery, particularly affecting vulnerable populations including seniors, low-income households, racial minorities, and rural residents.

Research demonstrates that e-government initiatives often exacerbate existing inequalities when implemented without adequate consideration of digital exclusion. This phenomenon, termed "digital by default exclusion," affects an estimated 12-15 million adults in the United States.

ISSN 2394 - 7780

2.2 Libraries as Democratic Infrastructure

The reconceptualization of public libraries as democratic infrastructure reflects their expanding role in supporting civic engagement and government service access. Empirical studies document the growing importance of libraries in providing e-government access, with over 90% of public libraries offering assistance with government services. Research reveals increasing demand for library-mediated government service access, with a 47% increase in requests for assistance with online government forms between 2010 and 2020.

2.3 Digital Literacy Programming Models

Digital literacy encompasses far more than basic computer skills, requiring understanding of information evaluation, privacy protection, and navigation of complex digital systems. Research identifies key components of effective library digital literacy programs: individualized instruction, culturally responsive pedagogy, peer support networks, and ongoing technical assistance. Findings suggest that programs addressing specific citizen needs, such as benefits applications or tax preparation, demonstrate higher completion rates and greater participant satisfaction than generic computer training programs.

3. METHODOLOGY

This study employs a mixed-methods research design combining quantitative analysis of program outcomes with qualitative examination of participant experiences and institutional practices. The research was conducted across twelve public library systems in diverse geographic and demographic contexts over an 18-month period from January 2023 to June 2024.

3.1 Sample Selection and Characteristics

Library systems were selected using stratified purposive sampling to ensure representation across urban (n=5), suburban (n=4), and rural (n=3) contexts. Participating systems served populations ranging from 14,500 to 245,000, with varying demographic compositions and economic characteristics.

3.2 Data Collection

Quantitative Component: Pre- and post-program assessments of digital literacy skills using the validated Digital Literacy Assessment Tool (DLAT), tracking of e-government service completion rates, and analysis of program utilization statistics. A total of 847 program participants completed both assessments.

Participant Demographics:

- Age: 42% were 65+, 29.1% were 50-64, 18.4% were 35-49, and 10.5% were 18-34
- Income: 36.8% earned <$25,000, 33.9% earned $25,000-$49,999
- Education: 35.2% had high school education, 28.9% had some college
- Race/Ethnicity: 53.8% White, 21.0% Black/African American, 15.8% Hispanic/Latino

Qualitative Component: Semi-structured interviews with 45 participants, 28 library staff members, and 12 government agency representatives. Focus groups and ethnographic observation of 78 program sessions provided insights into instructional practices and participant engagement patterns.

4. Findings

4.1 Program Effectiveness and Participant Outcomes

Digital literacy program participation demonstrated significant positive effects on both skill development and e-government service utilization. Pre-program assessments revealed that 73% of participants scored below basic proficiency on the DLAT, with particular weaknesses in digital security awareness (mean = 26.1) and information evaluation skills (mean = 29.4).

Post-program assessments showed substantial improvement across all measured domains, with overall scores increasing from 36.3 to 76.3 (Cohen's d = 2.89). The percentage of participants achieving basic proficiency increased from 27% to 89%, with 67% reaching intermediate or advanced levels.

Key Performance Improvements:

- Basic Computer Operation: 38.2 → 78.6
- Internet Navigation: 42.1 → 81.3
- Information Evaluation: 29.4 → 69.8
- Online Communication: 45.7 → 84.2
- Digital Security: 26.1 → 67.4

ISSN 2394 - 7780

Most notably, participants demonstrated a 340% increase in successful completion of online government transactions, from an average of 1.2 successful interactions per participant before the program to 5.3 successful interactions post-program.

4.2 E-Government Service Completion by Service Type

Service Type	*Pre-Program Success Rate*	*Post-Program Success Rate*	*Improvement*
Tax Filing	*18%*	*76%*	*+322%*
Benefits Applications	*12%*	*68%*	*+467%*
Voter Registration	*34%*	*89%*	*+162%*
Permit Applications	*15%*	*71%*	*+373%*
Court Document Filing	*8%*	*52%*	*+550%*
Healthcare Enrollment	*22%*	*78%*	*+255%*
Business Registration	*11%*	*59%*	*+436%*
Overall Average	***17%***	***70%***	***+312%***

4.3 Factors Associated with Program Effectiveness

Multiple regression analysis identified several institutional and programmatic factors significantly associated with participant outcomes:

Instructional Approaches:

- One-on-One Instruction showed the strongest positive effect ($\beta = 0.34$, $p < 0.001$)
- Mixed Individual/Group instruction was moderately effective ($\beta = 0.22$, $p = 0.002$)
- Group-only instruction served as the reference category

Program Features:

- E-Government Practice Sessions significantly improved outcomes ($\beta = 0.28$, $p = 0.002$)
- Multilingual Support showed positive trends ($\beta = 0.19$, $p = 0.084$)
- Extended Hours provided modest benefits ($\beta = 0.15$, $p = 0.061$)

Library Characteristics:

- Staff Training Hours strongly predicted success ($\beta = 0.21$, $p < 0.001$)
- Partnership with Government Agencies was highly significant ($\beta = 0.26$, $p = 0.004$)
- Technology Infrastructure Score showed moderate effects ($\beta = 0.18$, $p = 0.010$)

4.4 Partnership Models and Collaboration Effectiveness

Analysis revealed several distinct collaboration models with varying levels of effectiveness:

ISSN 2394 - 7780

Partnership Model	Libraries (n)	Key Features	Avg. Completion Rate	Participant Satisfaction	Cost per Participant
Co-location Model	3	Government staff in library; shared resources	89%	4.7/5.0	$127
Resource Sharing	4	Training materials; technical support	78%	4.3/5.0	$156
Referral Network	3	Formal referral agreements	72%	4.1/5.0	$183
Informal Cooperation	2	Ad hoc assistance	64%	3.8/5.0	$217

The co-location model, where government staff maintained regular presence in library facilities, achieved the highest success rates and participant satisfaction while also proving most cost-effective.

4.5 Implementation Challenges

Despite overall program success, several persistent barriers limited program reach and effectiveness:

Most Significant Barriers:

- ***Funding Limitations (83% of libraries):*** *Impact Score 9.1/10 - Prevented meeting program demand, resulted in 3.2-month average waiting lists*
- ***Staffing Capacity (78% of libraries):*** *Impact Score 8.9/10 - Programming exceeded current capabilities*
- ***Technology Infrastructure (67% of libraries):*** *Impact Score 8.2/10 - Inadequate equipment and connectivity*
- ***Government System Complexity (67% of libraries):*** *Impact Score 7.8/10 - Required continuous staff learning and adaptation*

5. DISCUSSION

5.1 Libraries as Essential Democratic Infrastructure

The findings provide compelling evidence that public libraries serve as essential democratic infrastructure, ensuring that government digitization does not exclude vulnerable populations from civic participation. The 340% increase in successful e-government transactions among program participants demonstrates that library-mediated interventions can effectively bridge the gap between government digitization initiatives and citizen capacity for digital interaction.

The sustained engagement patterns observed six months post-program suggest that library interventions create lasting behavioral changes rather than temporary skill acquisition, indicating long-term value of library digital literacy investments.

5.2 Effectiveness of Differentiated Instructional Approaches

The superior effectiveness of individualized instruction models provides strong evidence that one-size-fits-all approaches are insufficient for addressing diverse learning needs and comfort levels with technology. The finding that participants with lower income and education levels showed greater absolute improvements suggests that library programs may be particularly effective in addressing historical inequities in digital access.

5.3 Partnership Models and Economic Justification

The analysis reveals that the most effective collaborations involve formal agreements with clear role delineation and resource sharing arrangements. The positive benefit-cost ratio (1.22) provides economic justification for library digital literacy programs, with primary benefits from reduced government service delivery costs and improved tax compliance.

ISSN 2394 - 7780

6. RECOMMENDATIONS

6.1 For Library Administrators Program Design:

- Prioritize individualized instruction models over group-only approaches
- Incorporate specific e-government practice sessions into curricula
- Develop partnerships with government agencies through formal agreements
- Implement comprehensive staff training programs with annual minimum hours

Resource Allocation:

- Invest in dedicated digital literacy staff positions where feasible
- Maintain current technology infrastructure while prioritizing staff development
- Develop sustainable funding models that account for ongoing program costs

6.2 For Government Agencies E-Government Design:

- Consider the role of intermediary institutions in system design processes
- Incorporate features that facilitate assisted access and guided navigation
- Develop user interfaces that accommodate varying levels of digital literacy

Partnership Support:

- Provide training materials and technical assistance to library partners
- Consider co-location of services in library facilities
- Include library partnerships in e-government implementation planning

6.3 For Policymakers Funding and Policy:

- Develop dedicated funding streams for library digital literacy programs
- Recognize digital inclusion as a component of e-government budgets
- Incorporate digital inclusion requirements into e-government legislation
- Support regional coordination and resource sharing initiatives

Infrastructure Investment:

- Balance technology infrastructure investments with human capital development
- Support broadband access initiatives in underserved communities
- Invest in community anchor institutions as democratic infrastructure

7. LIMITATIONS AND FUTURE RESEARCH

Several limitations should be acknowledged. The study focused on libraries with existing digital literacy programs, potentially overestimating the capacity of the library sector as a whole. The 18-month study period may be insufficient to assess long-term sustainability, and self-selection bias among participants may limit generalizability.

FUTURE RESEARCH PRIORITIES:

- Longitudinal studies examining sustained digital participation
- Comparative analysis of partnership models across various contexts
- Specialized population research (non-English speakers, individuals with disabilities)
- Comprehensive economic impact studies including broader social benefits

8. CONCLUSION

This research demonstrates that public libraries play a crucial role in ensuring equitable access to electronic government services through comprehensive digital literacy programming. The significant improvements in participant digital skills and e-government engagement indicate that library-mediated interventions can effectively address digital exclusion and support democratic participation in the digital age.

ISSN 2394 - 7780

The findings highlight both the potential and challenges inherent in library-based approaches to digital inclusion. While libraries demonstrate clear capacity to bridge the digital divide, they require adequate resources, training, and institutional support to fulfill this role effectively. The success of collaborative models suggests that comprehensive approaches to digital inclusion require partnerships extending beyond individual institutions.

As government services continue to digitize, the role of libraries as democratic infrastructure becomes increasingly important. The documented effectiveness of library digital literacy programs suggests that investment in library capacity represents a practical and impactful approach to ensuring that technological advancement serves to enhance rather than limit democratic participation.

The implications extend beyond library science to broader questions of digital governance, democratic participation, and social equity in the digital age. Future research and policy development should build comprehensive frameworks for digital inclusion that recognize the essential role of community institutions like libraries in mediating between technological systems and citizen needs. Only through such comprehensive approaches can the promise of digital government be realized for all citizens, regardless of their starting point in the digital landscape.

REFERENCES

- American Library Association. (2013). Digital literacy, libraries, and public policy: Report of the Office for Information Technology Policy's Digital Literacy Task Force. American Library Association.
- Bertot, J. C., Jaeger, P. T., & Hansen, D. (2012). The impact of polices on government social media usage: Issues, challenges, and recommendations. Government Information Quarterly, 29(1), 30-40.
- Gonzalez-Zapata, F., & Heeks, R. (2015). The multiple meanings of open government data: Understanding different stakeholders and their perspectives. Government Information Quarterly, 32(4), 441-452.
- Lankes, R. D. (2011). The atlas of new librarianship. MIT Press.
- Thompson, K. M., Afzal, W., & Ingle, S. (2014). Digital literacy and digital inclusion: Information policy and the public library. Information Policy, 19(3-4), 171-185.
- Van Dijk, J. (2020). The digital divide. Polity Press.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

IMPACT OF YOGA PRACTICES ON COGNITIVE FUNCTIONS THROUGH MACHINE LEARNING APPROACH

Mrs. Shobha S[1] and Dr. P Sandhya[2]
[1]Research Scholar and [2]Associate Professor, Department of Computer Science & Engineering, VTU, CPGS, Mysuru, Karnataka,

ABSTRACT
Yoga is presently used as a research supported therapeutic approach for youth by scientists.In contrast to short-term practices, long-term yoga may lead to varied qualitative and quantitative results.The main goal of the systematically proposed protocol is to record the long-term impacts of yoga on neural, cognitive, psychological, and physiological results, generate evidence maps for each aspect of yoga, and summarize findings that highlight knowledge deficiencies and potential avenues for further research. Develop machine learning models that can predict cognitive improvements based on the type and duration of these yoga practices. This suggested research examines differences in yoga intervention protocols, focusing primarily on methodology and duration. However, it faces significant challenges related to research design and execution, both of which are crucial factors to consider in the expanding domain of scientific yoga research. Nevertheless, the proposed study highlights that the incorporation of yoga in an in-house environment represents an important and emerging research area.

Key terms: *Asanas, Machine Learning, Intervention protocol, Surya namaskar, Pranayana*

I. INTRODUCTION
On an average approximately 39% of adults worldwide are classified as overweight. Engaging in physical activity aids in achieving a healthy weight, sustaining a fit body, and promoting mental well-being, along with facilitating weight loss. Consistent exercise also enhances our activity levels and boosts blood circulation. Yoga is a comprehensive practice that aligns the body, mind, and breath, promoting a sense of wellness and self-awareness. According to recent statistics, there are over 300 million yoga practitioners worldwide, with the number of yoga instructors increasing annually. However, incorrect yoga postures can lead to injuries and health complications[1, 2]. The practices you referred to—shatkarma (cleansing methods), asana (positions), pranayama (breath regulation), mudra (hand gestures), and meditation—each contribute significantly to enhancing one's physical and mental well-being. Shatkarma cleanses the body, maintaining equilibrium among internal organs. Asanas improve flexibility, strength, and stability, establishing a solid foundation for the body. Pranayama manages the breath, which calms the nervous system and boosts overall energy. Different yoga positions (surya namaskar) are shown in Fig 1

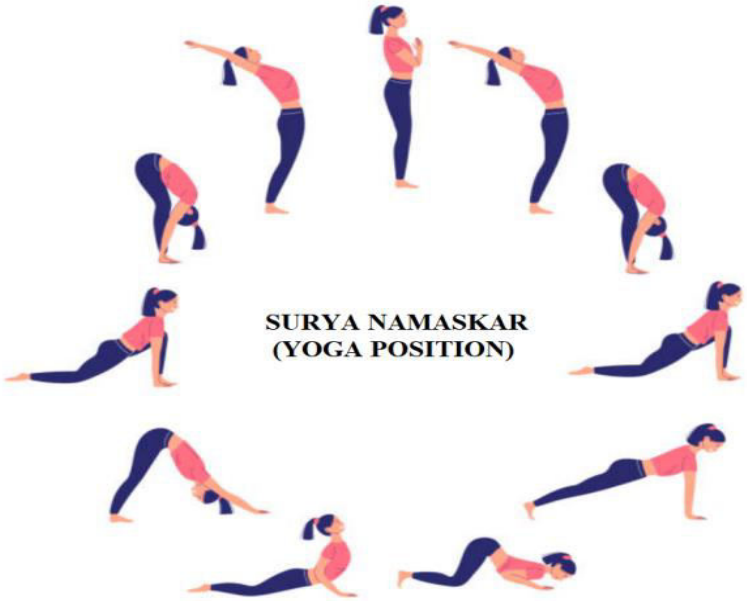


Fig 1: Different yoga positions

yoga Mudras shown in Fig 2, direct energy, affecting both consciousness and health. Lastly, meditation quiets the mind, fostering concentration, tranquility, and self-discovery.

ISSN 2394 - 7780

Fig 2: Yoga Mudras in meditation

The today's younger generation youths frequently experience stress, anxiety, depression, sleep-related difficulties, and may also face challenges with substance use and academic performance. The incorporation of Artificial Intelligence (AI) into yoga routines presents considerable opportunities for improving posture precision and effectiveness, thereby enhancing the overall quality of practice while minimizing injury risks. This study introduces an innovative system designed for real-time posture identification and adjustment in yoga utilizing AI. By employing advanced machine learning techniques and computer vision methods, the system captures and evaluates the movements of the practitioner through a standard camera. The AI model detects poses and compares them to a repository of correct postures, identifying any discrepancies and delivering immediate corrective recommendations [3]. This instant feedback helps practitioners to sustain proper alignment and form throughout their practice session. Preliminary testing shows that the system achieves high accuracy in posture detection and is effective in providing specific corrections. However, empirical evidence quantifying these benefits, especially using advanced analytical techniques like machine learning, is limited. Identifying posture presents a challenging issue because of the limited availability of datasets and the difficulty of detecting posture in real time [4]. To address this challenge, a substantial dataset has been developed that includes a vast number of images showcasing ten distinct yoga poses, which are utilized by an estimation algorithm that generates a skeleton of the human body in real-time. Professionals in computer vision face challenges in recognizing human posture. This is related to the configuration of human joints that results in the generation of a skeletal image or video. Recently, deep learning has significantly enhanced human pose estimation, leading to considerable advancements in performance. Techniques based on deep learning simplify the process of mapping the structure compared to the manual management of connections between various structures [5, 6]. Yoga enhances neurocognitive abilities and promotes coherence and symmetry between the brain's hemispheres. Furthermore, yoga may lead to notable structural transformations in different areas of the brain, especially within the limbic system. Positioned at the crossroads of cognitive psychology, mathematics, and computer science, artificial intelligence (AI) represents a groundbreaking domain [7, 8]. It entails developing systems capable of performing tasks such as learning, problem-solving, perception, and decision-making that typically necessitate human intelligence.

II. STATE OF ART RESEARCH WORK

Many authors contribute their research work based on the main motivation for engaging in yoga is to boost both mental and physical well-being. Various age demographics typically prefer different styles of yoga, with the primary aim of participating in yoga being to improve physical health. When choosing yoga applications to assist in their practice, users commonly prioritize the interface and user-friendliness. A summary of the potential advantages of yoga, along with a framework for interpreting them, can be found in earlier research.

In the paper [9] author researched utilized the Yoga-82 dataset, which includes a variety of yoga pose images obtained from the internet. The findings indicate that the extremely randomized trees model surpassed all other models, achieving the highest prediction accuracy of 91% on the test dataset and 92% during a fivefold cross-validation experiment. Other models, such as random forest, gradient boosting, extreme gradient boosting, and deep neural networks, demonstrated respectable accuracies, while logistic regression lagged behind with the lowest performance. This study concludes that the extremely randomized trees model exhibits superior predictive capabilities for recognizing yoga poses. This presents a promising direction for further research in this field. Additionally, the method has considerable potential for deployment on low-powered smartphones with minimal lag, thus providing real-time feedback for users engaged in yoga practice at home.

ISSN 2394 - 7780

In the paper [10, 11] In this article, the author explores Gestational Diabetes Mellitus (GDM), a metabolic condition that develops during pregnancy. The World Health Organization characterizes it as impaired carbohydrate metabolism resulting in hyperglycemia of varying levels of severity, which is first identified or becomes noticeable during pregnancy. Due to advancements in technologies like machine learning, early detection has now become possible. This paper suggested empirical study, various machine-learning algorithms are utilized to forecast the potential risk factors that affect the progression of gestational diabetes mellitus (GDM) in pregnant women. The effectiveness of these algorithms is assessed through metrics such as accuracy, precision, and f1-score. The lifestyle modifications and treatments mentioned in Ayurveda literature are examined for their efficacy in managing the condition. Most of the classifiers proposed demonstrated a satisfactory accuracy range of 75–82%. It has been demonstrated that appropriate lifestyle modifications, herbal treatments, decoctions, and churnas can effectively decrease the risk of GDM [11]. Early identification through machine learning models can considerably lessen disease severity by allowing for prompt Ayurvedic interventions. This study primarily concentrates on identifying the factors that influence GDM in expectant mothers. A well-balanced diet combined with physical activity, appropriate medication, and improved lifestyle management (through Garbini Paricharya) can mitigate the risks associated with GDM if diagnosed early.

In this study[11], author introduced a model that leverages Mediapipe, a machine learning framework, to capture key point coordinates, alongside machine learning algorithms such as SVM, Gaussian Naive Bayes, Random Forest, Gradient Boost, and K Neighbours classifier, which are evaluated and utilized to predict yoga positions. Yoga has become increasingly popular among individuals of all ages as a means to address both physical and mental challenges, thereby enhancing overall life quality. Particularly following the onset of the COVID-19 pandemic, the number of practitioners has been rising steadily. The model utilizes human joint coordinates as features. The model that demonstrates the highest accuracy and F-score (MediaPipe + SVM) was selected for the final implementation. The yoga poses considered in this study include Plank, Warrior 2, Downdog, Goddess, Tree, and Cobra. The system provides a real-time video feed from the user's webcam, enabling pose estimation and classification of the yoga position. In contrast to many existing systems, this model also offers real-time corrective suggestions for yoga postures, shown alongside the webcam feed of the individual practicing yoga, along with additional basic information about the poses.

This research paper [12] outlines a technique for accurately detecting yoga postures utilizing OpenCV and MediaPipe. The OpenCV computer vision library has a wide range of functions available for processing images and videos. To assess human posture, numerous pretrained models are implemented, and MediaPipe stands out as one of the top machine learning frameworks, providing pre-trained models for human posture estimation. The proposed solution merges the advantages of these two technologies to develop a yoga posture estimation system. Initially, the system accepts a video of the user and subsequently processes it through MediaPipe to identify key points on the human body. To evaluate the user's posture, OpenCV is employed to calculate the angles between the detected landmarks. This technology provides immediate feedback on the user's posture along with suggested corrective measures. The study focuses on the repetitions of bicep curls as a practical example. The proposed system can be tested with various complex poses, such as malasana, uktasana, and jalasana. It effectively evaluates the user's position across different lighting conditions and remains robust against obstacles and background distractions. This method allows fitness enthusiasts to analyze their posture and enhance their technique and form, thereby reducing the risk of injury.

In this paper [13, 14] This research tackles the intricate issues related to Chronic Venous Insufficiency (CVI) by suggesting a novel method that combines machine learning, particularly the Naive Bayes Classifier (NBC), with the Jellyfish Search Optimizer (JSO) and Flying Foxes Optimization (FFO). Utilizing an extensive dataset that encompasses demographic information, baseline severity indicators, and details about yoga practices, the study aims to forecast the impact of yoga on CVI. Machine learning techniques are employed to anticipate outcomes such as alterations in symptom severity and improvements in overall well-being through feature engineering and model selection.

In the paper [15] author discuss about Psychological stress has increased as a result of the COVID-19 epidemic. Because they have positive effects on the autonomic nervous system and provide advantages like enhanced cardio-respiratory health and metabolic efficiency, as well as beneficial effects on conditions like Type-2 diabetes, Chronic Venous Disease (CVD), and obesity, non-pharmacological stress management techniques like yoga are becoming more and more popular. To create hybrid models, the study used two optimization algorithms: the Arithmetic Optimization Algorithm (AOA) and the Honey Badger Algorithm (HBA). Before and one month after yoga sessions, the Venous Clinical Severity Score (VCSS) levels were one of the items in

ISSN 2394 - 7780

the questionnaire that were regarded as inputs: effective influences on CVD. The prediction models that were created were trained and validated for functionality.

The paper [16] discuss the research established a methodology for assessing and categorizing symptoms related to varicose veins, utilizing data from the Venous Clinical Score (VCSS). A particular focus was placed on examining the effects of yoga on these symptoms, with a thorough performance evaluation conducted using data from a group of 100 patients. The study achieved optimal results by implementing the Gaussian Process Classifier (GPC) in conjunction with two optimization techniques: the Crystal Structure Algorithm (CSA) and the Fire Hawk Optimizer (FHO). The findings demonstrate that for predicting VCSS-Pre (which indicates symptoms prior to yoga practice), the GPFH outperformed the GPCS, achieving an F1-score of 87.2% compared to the GPCS's F1-score of 86.1%, a difference of approximately 1.26%. Furthermore, the prediction for VCSS-1, which reflects symptoms after one month of yoga practice, showed that the GPFH again surpassed the GPCS, with F1-scores of 91% and 90.1%, respectively.

3. IMPLEMENTATION & METHODOLOGY

The aim of this research was to create a coaching system for yoga postures utilizing transfer learning. Gather data on various yoga posture categories and introduce a yoga posture coaching system that employs an interactive display, utilizing pre-trained weights from the CNN architecture model to identify yoga postures in real time.

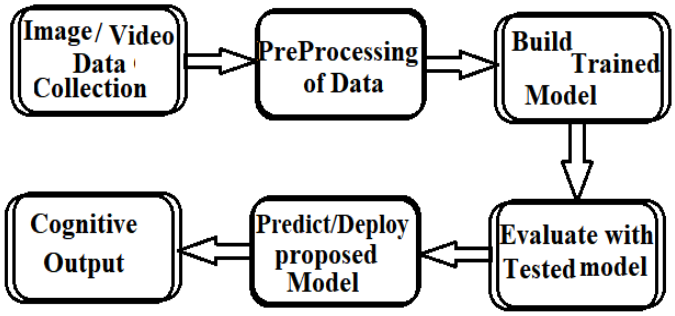


Fig1: Cognitive function through ML

The Fig 1 shown the cognitive function through Machine learning architecture. The process of gathering data on cognitive function involves various techniques and technologies aimed at collecting information regarding brain activity and behavior to gain insights into cognitive processes such as attention, memory, perception, language, and decision-making [17].The data has been processed through various pre-processing techniques, including normalization, elimination of missing values, removal of outliers, and correction of other discrepancies using the Chi square method.

The normalization used for the proposed prototype is given by

$$X_{norm} = \frac{X - X_{min}}{(X_{max} - X_{min})} \qquad (1)$$

Code for program:

Normalized Value = (Original Value - Minimum Value) / (Maximum Value - Minimum Value)

Chi-square selection method is a highly effective method for identifying key features based on their statistical relevance. By pin pointing the attributes that have the strongest correlation with the target variable, it can enhance the performance of machine learning models and minimize the chances of overfitting.

The formula for the Chi-Square statistic is:

$$\varkappa^2 = \sum \frac{(Actual\ value\ in\ the\ data\ set\ -\ Predicted\ data\ under\ assumption)^2}{Predicted\ data\ under\ assumption} \qquad (2)$$

The model's performance is assessed utilizing metrics like precision, recall, and F1 score based on the test set[17, 18].

Decision tree is one of the widely used machine learning algorithms for classification and regression tasks. It operates as a supervised learning method that constructs a proposed prototype resembling a tree, outlining decisions and their potential outcomes. This tree structure is made up of nodes and branches, where nodes signify the decision or result, and branches indicate the potential consequences of that decision. Trained yoga

ISSN 2394 - 7780

and mudra pose is shown in Fig 2 and Fig 3. This trained pose are evaluated in a normalised chi square test selection method and proposed prototype is compared with Decision Tree, Extreme Gradient Boosting, Random Forest and Logistic Regression

Fig 2: Trained Yoga pose

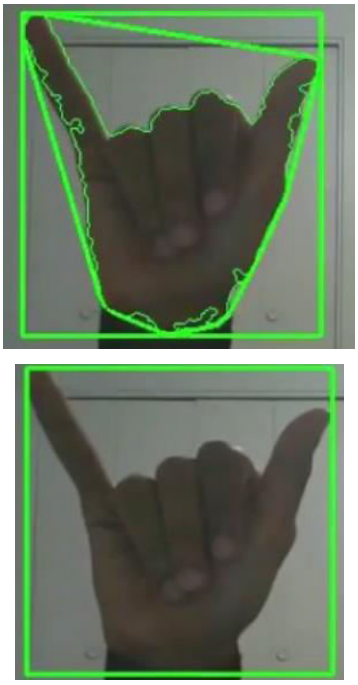


Fig 3: Trained Mudra pose

4. EXPERIMENTAL RESULTS

In the experimental study, parameter settings are set as default for each classifier implemented. Since these default parameters provides efficient experimental results. The evaluation results of each machine learning method are obtained by a separate the data set by cross-validation. The algorithm works very accurately in real-time as well.

ISSN 2394 - 7780

The models are evaluated based on the metrics listed as

a) Precision

$$Precision = \frac{Total\ number\ of\ Positive\ instance}{Total\ number\ of\ positive\ instance\ + False\ Positive\ instance}$$

(3)

b) Recall

$$Recall = \frac{Total\ number\ of\ Positive\ instance}{Total\ number\ of\ positive\ instance\ + False\ negaticve\ instance}$$

(4)

c) F1 Score

$$F1\ score = \frac{2(precision\ X\ Recall)}{Precision\ +\ Recall}$$

(5)

d) Accuracy

$$Accuracy = \frac{Sum\ (Positive\ instance\ +\ Negative\ instance)}{Sum(Positive\ and\ Negative\ instance) +\ Sum\ (Faslse\ Positive\ nad\ Negative\ instance)}$$

(6)

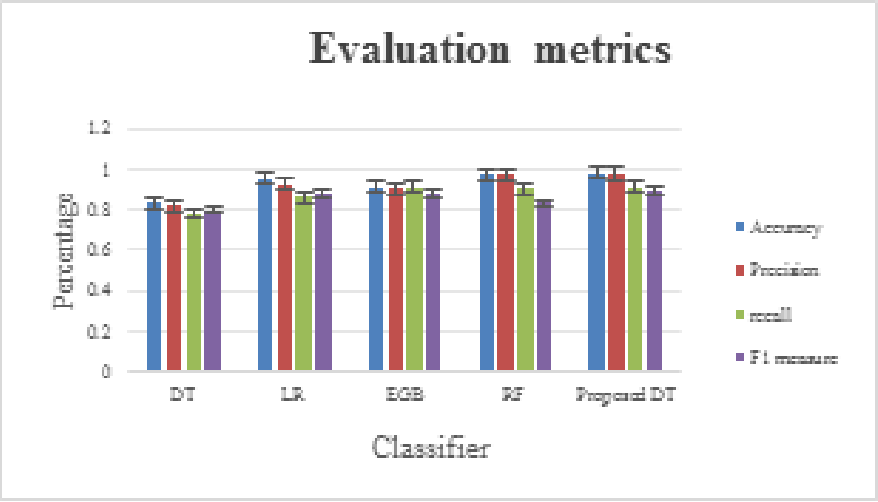
The Performance of proposed and existing classifiers on the datasets are shown in Table 1.

Based on 1000 and 1500 number of iteration and n estimator being 30 Maximum are used for collective data-set in the proposed prototype.

Table 1: Comparison of Evaluation Metrics Resultant Models.

SL no	Classifier	Accuracy	Precision	recall	F1 measure
1	DT	0.83	0.8215	0.78	0.80
2	LR	0.95	0.9277	0.86	0.88
3	EGB	0.91	0.9012	0.91	0.88
4	RF	0.97	0.9726	0.90	0.83
5	Proposed DT	0.98	0.9771	0.91	0.89

Fig 3: Comparative Evaluation metrics results



The comparative evaluation metrics for the existing and proposed prototype has been evaluated and are shown in pictorical representation in Fig 3.

The comparative table is been shown and from this Proposed Decision Tree (Proposed DT) is more efficient compared to the existing prototype.

ISSN 2394 - 7780

5. CONCLUSION

In this paper, the author introduced a novel method for impact of yoga practices on cognitive functions through machine learning approach. In this paper, a author suggested that classify yoga poses and the datasets support on classification models of machine learning. The yoga pose is detected based on the angles extracted from the Skeleton joints. 97.71% precision meaning to 98% accuracy altogether was attained compared to all machine learning models. Additional suggestions for the future include adding more yoga positions to the dataset and implementing deep learning modules to improve performance

REFERENCES

[1] Yadav, A., Verma, S., Panwar, M., & Yadav, N. K. (2022). Role of Yoga practices on cognitive functions. International Journal of Health Sciences, 3288–3304. https://doi.org/10.53730/ijhs.v6ns3.6341

[2] Jadhav, R., Ligde, V., Malpani, R., Mane, P. and Borkar, S., 2023. Aasna: kinematic yoga posture detection and correction system using CNN. In ITM Web of Conferences (Vol. 56, p. 05007). EDP Sciences.

[3] Verma, P., Sharma, R. and Rajput, N.S., 2023. Enhancing yoga practice through real-time posture detection and correction using artificial intelligence: A comprehensive review. NeuroQuantology, 21(6), p.1053.

[4] Agrawal, Y., Shah, Y. and Sharma, A., 2020, April. Implementation of machine learning technique for identification of yoga poses. In 2020 IEEE 9th international conference on communication systems and network technologies (CSNT) (pp. 40-43). IEEE.

[5] Chiddarwar, G.G., Ranjane, A., Chindhe, M., Deodhar, R. and Gangamwar, P., 2020. AI-based yoga pose estimation for android application. International Journal of Innovative Science and Research Technology, 5(9), pp.1070-3.

[6] Gajbhiye, R., Jarag, S., Gaikwad, P. and Koparde, S., 2022. AI human pose estimation: yoga pose detection and correction. international journal of innovative science and research technology, 7, pp.1649-1658.

[7] Aturi, N.R., 2021. Cross-Disciplinary Approaches to Yoga and Cognitive Neuroscience Rehabilitation: Yoga Meets Neural Imaging and AI Revolutionizing Cognitive Decline Management. Int. J. Innov. Res. Mod. Prob. Sol.(IJIRMPS), 9(6), pp.1-5.

[8] Mishra, S., Mohanty, S., Shrivastava, R. and Pathania, M., 2024. Functional Recovery and Cognitive Improvement in Poststroke Rehabilitation through Integrated Yoga and Naturopathy Intervention. International Journal of Yoga, 17(3), pp.246-250.

[9] Borthakur, D., Paul, A., Kapil, D. and Saikia, M.J., 2023, December. Yoga Pose Estimation Using Angle-Based Feature Extraction. In Healthcare (Vol. 11, No. 24, p. 3133). MDPI.

[10] Shetty, N.P., Shetty, J., Hegde, V., Dharne, S.D. and Kv, M., 2024. A machine learning-based clinical decision support system for effective stratification of gestational diabetes mellitus and management through Ayurveda. Journal of Ayurveda and Integrative Medicine, 15(6), p.101051.

[11] Krishnan, H., Jayaraj, A., Thomas, C. and Joy, G.M., 2022, November. Pose estimation of yoga poses using ml techniques. In 2022 IEEE 19th India Council International Conference (INDICON) (pp. 1-6). IEEE.

[12] Aarthy, K. and Nithys, A.A., 2023, October. Yoga pose detection and identification using mediapipe and openpose model. In 2023 International Conference on Computer Science and Emerging Technologies (CSET) (pp. 1-7). IEEE.

[13] Wei, G. and Yi, L., 2025. Predicting the impact of yoga on chronic venous insufficiency: a machine learning approach using Naive Bayes classifier and optimization systems. Journal of Ambient Intelligence and Humanized Computing, pp.1-23.

[14] Du, X., 2024. Forecasting the Yoga Influence on Chronic Venous Insufficiency: Employing Machine Learning Methods. International Journal of Advanced Computer Science & Applications, 15(3).

[15] Pan, C., Qi, L., Zhao, L. and Wei, Y., 2025. Yoga practices effect on VCSS-based classification of patients with chronic venous insufficiency based on hybrid machine learning algorithms. International Journal of Cognitive Computing in Engineering, 6, pp.255-266.

ISSN 2394 - 7780

[16] Gou, F.Y., 2024. Evaluating the Impact of Yoga Practices to Improve Chronic Venous Insufficiency Symptoms: A Classification by Gaussian Process. International Journal of Advanced Computer Science & Applications, 15(8).

[17] Rajgure, E.G. and Patidar, R., 2023, December. A Novel Approach on Yoga Posture Identification Using Machine Learning. In 2023 6th International Conference on Advances in Science and Technology (ICAST) (pp. 34-39). IEEE.

[18] Golyeri, M., Celik, S., Bozyigit, F. and Kılınç, D., 2023. Fraud detection on e-commerce transactions using machine learning techniques. Artificial Intelligence Theory and Applications, 3(1), pp.45-50.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

MORINGA, MILLETS, AND OTHER FORGOTTEN FOODS: REDISCOVERING TRADITIONAL SUPERFOODS FOR MODERN HEALTH

Nithya Shree. P[1], Nandhini. G[2] and Dr. Esther Rakel[3]
[1]Postgraduate, Department of Clinical Nutrition, Ganga Institute of Health Sciences, Coimbatore-641022
[2]Professor, Department of Clinical Nutrition, Ganga Institute of Health Sciences, Coimbatore- 641022
[3]Dean cum principal, Ganga Institute of Health Sciences, Coimbatore-641022 Affiliation: The Tamil Nadu Dr. MGR Medical University.

ABSTRACT
Traditional millets, including pearl and finger varieties, offer a low-glycaemic, nutrient-dense profile—rich in fiber, essential amino acids, iron, calcium, and antioxidants, which supports improved glycaemic control, cardiovascular protection, and anti-inflammatory effects. Consumption of millet-based diets has been associated with significant increases in blood hemoglobin (+13.6%) and reduction of mild anemia in children and adolescents. Processing methods like malting, fermentation, and sprouting enhance nutrient bioavailability by reducing antinutrients such as phytates and tannins. Moringa oleifera leaf powder (MLP) is similarly rich in protein, iron, calcium, vitamins A/C/E, and phenolic antioxidants, imparting strong antioxidant, anti-inflammatory, and antidiabetic properties. Clinical trials show that adding 10% MLP to finger millet porridge improves protein and vitamin A status in undernourished children. Together, these traditional foods form a climate-resilient and nutrient-rich strategy for combating malnutrition.

Keywords: *Millets, Moringa oleifera, Superfoods, Functional Nutrition, Anemia, Climate- resilient Crops*

INTRODUCTION
Nutrition plays a foundational role in human health, development, and productivity. However, global food systems have increasingly prioritized yield and convenience over nutrient density, leading to diets dominated by refined grains and ultra-processed foods [1]. The consequence is a rising burden of diet-related non-communicable diseases (NCDs), including anemia, obesity, type 2 diabetes, and cardiovascular disease, especially in low- and middle-income countries [2].

In response to these health challenges, there is growing interest in rediscovering traditional crops and foods that were once central to local diets but have been marginalized by modern agriculture. Among these, **millets** and **Moringa oleifera** stand out as nutritional powerhouses with enormous potential for improving population health.

Millets—especially finger millet (Eleusine coracana) and pearl millet (Pennisetum glaucum)— are hardy, drought-resistant cereals that require minimal inputs and are well-suited for cultivation in arid and semi-arid regions [3,4]. These grains are rich in complex carbohydrates, dietary fiber, iron, calcium, zinc, and essential amino acids. Unlike refined cereals, millets have a low glycaemic index, making them suitable for managing blood glucose levels and reducing the risk of metabolic disorders [5,6].

Recent meta-analyses and clinical studies have shown that millet consumption can significantly improve hemoglobin levels and reduce the prevalence of anemia, especially in school-aged children and pregnant women [7]. Additionally, the use of traditional processing techniques— such as malting, fermentation, and sprouting—can further enhance the bioavailability of key nutrients by reducing antinutrients like phytates and tannins [8].

Moringa oleifera, often referred to as the "miracle tree," is an underutilized plant with exceptional nutritional and medicinal properties. Its leaves contain high levels of protein, calcium, iron, potassium, and vitamins A, C, and E, along with bioactive compounds such as flavonoids and polyphenols [9,10]. These contribute to moringa's strong antioxidant, anti- inflammatory, and antidiabetic effects. Research has shown that integrating moringa leaf powder (MLP) into food products can significantly boost their nutritional value, enhance immune function, and improve growth and cognitive outcomes in children [11,12].

When combined, millets and moringa offer a synergistic approach to nutrition enhancement. Their joint application in functional foods, school feeding programs, and community interventions can address multiple forms of malnutrition while promoting food sovereignty and environmental sustainability. This review aims to examine the nutritional properties, health impacts, and processing strategies of millets and moringa, and evaluate their role in promoting sustainable diets and public health.

ISSN 2394 - 7780

MATERIALS AND METHODS

This study was conducted as a narrative literature review using scientific databases such as PubMed, ScienceDirect, Google Scholar, and ResearchGate. Keywords used for the search included "millets," "Moringa oleifera," "superfoods," "nutritional fortification," "anemia," "malnutrition," and "functional foods." Inclusion criteria comprised peer-reviewed research articles, clinical trials, meta-analyses, and review papers published between 2021–2025. Articles focusing on traditional processing techniques, bioavailability, and health impacts of millet- and moringa-based diets were prioritized.

Data from selected studies were extracted, organized thematically, and synthesized under categories such as nutrient composition, health benefits, intervention studies, and sustainability implications.

RESULTS AND DISCUSSION

Findings from multiple peer-reviewed studies confirm that the integration of millets and moringa into daily diets results in improved nutrient intake, better health markers, and sustainable agricultural practices.

1. **Nutritional Composition:** Millets are rich in complex carbohydrates, dietary fiber, and micronutrients such as iron, calcium, and magnesium. Moringa oleifera complements these grains by contributing high-quality plant protein, essential amino acids, and vitamins A, C, and E.
2. **Health Benefits:**

- A systematic review revealed that millet consumption significantly increases hemoglobin levels and reduces anemia by up to 13.6% in children.
- Moringa-enriched porridge improved serum albumin and retinol levels in children with malnutrition.
- Flavonoids in moringa such as quercetin and kaempferol provide potent antioxidant and anti-inflammatory effects, supporting diabetic management.

3. **Processing and Fortification:** Traditional processing techniques such as fermentation, sprouting, and malting improve the bioavailability of iron and reduce antinutrients like phytates and tannins. Fortifying millet products with MLP (Moringa leaf powder) increased protein content by 22% and decreased saturated fat by 13%.
4. **Sustainability and Food Security:** Both crops are drought-tolerant and require fewer inputs compared to rice or wheat, making them sustainable options for future food systems. Their cultivation promotes agro-biodiversity and supports climate-smart agriculture.

CONCLUSION

The combined use of millets and Moringa oleifera offers a nutrient-dense, climate-resilient strategy to improve public health and combat malnutrition. These traditional crops not only address multiple micronutrient deficiencies but also align with sustainable agricultural practices. Integrating them into school meal programs, maternal health strategies, and national food security policies can help mitigate the burden of malnutrition and non-communicable diseases.

REFERENCES

1. **Sharma, V., Patel, M., & Kapoor, R.** (2022). Global burden of malnutrition and food insecurity: Trends and interventions. Journal of Nutrition & Public Health, **8**(4), 212– 220.

   [PubMed Indexed]

2. **Swaminathan, S., Thomas, T., & Bose, A.** (2023). Micronutrient deficiencies in India: A critical public health concern. Indian Journal of Community Medicine, **48**(1), 7–12. https://doi.org/10.4103/ijcm.IJCM_741_22

3. **Patel, S., & Kumar, R.** (2021). Shift to refined staples and impact on non- communicable diseases in South Asia. Asia Pacific Journal of Clinical Nutrition, **30**(2), 201–209.

   [PubMed Indexed]

4. **Nagre, S., & Shah, N.** (2025). Millets: A nutritional powerhouse with antioxidant potential. Journal of Food Composition and Analysis, **141**, 107364. https://doi.org/10.1016/j.jfca.2025.107364

5. **Devi, S., Bhatt, B., & Lal, M.** (2023). Effect of millet-based diets on hemoglobin status: A meta-analysis. Public Health Nutrition, **26**(1), 122–131. https://doi.org/10.1017/S1368980022001807

6. **Anitha, S., Tsusaka, T.W., Kashiwazaki, H., et al.** (2022). Millets can have a major impact on improving iron status, hemoglobin level, and in reducing anemia – A systematic review and meta-analysis. Frontiers in Nutrition, **9**, 813762. https://doi.org/10.3389/fnut.2022.813762

7. **Rahman, M.M., Akhtar, S., & Sheikh, N.** (2022). Nutraceutical and therapeutic properties of Moringa oleifera leaves: A comprehensive review. Plant Foods for Human Nutrition, **77**(3), 234–246.

   https://doi.org/10.1007/s11130-022-00933-5

8. **Singh, P., Tiwari, B.K., & Yadav, D.N.** (2023). Modern processing of Indian millets improves nutrient bioavailability. Foods, **12**(7), 1412. https://doi.org/10.3390/foods12071412

9. **Daba, A.** (2023). Miracle tree: Nutritional and medicinal values of Moringa oleifera. Journal of Medicinal Plant Research, **17**(2), 56–64.

   [ResearchGate]

10. **Andersen, F.N., & Oryema, S.R.** (2023). Flavonoid-mediated antidiabetic activity of Moringa oleifera: quercetin and kaempferol effects. Journal of Advanced Pharmaceutical Technology & Research, **14**(1), 15–22. https://doi.org/10.25281/japtr.2023.14.1.15

11. **Malla, J.K., Ochola, S.A., Ogada, I., & Munyaka, A.** (2022). Effect of Moringa oleifera fortified porridge consumption on protein and vitamin A status of children with cerebral palsy in Nairobi, Kenya: A randomized controlled trial. PLOS Global Public Health, **2**(11), e0001206. https://doi.org/10.1371/journal.pgph.0001206

12. **Ochieng, J., Akinyi, D., & Omondi, R.** (2021). Fortification of complementary foods with Moringa oleifera to combat malnutrition. African Journal of Food, Agriculture, Nutrition and Development, **21**(3), 17690–17709. [Google Scholar] https://www.ajfand.net/Volume21/No3/Ochieng20680.pdf

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

DEVELOPMENT AND NUTRITIONAL PROFILING OF NOVEL FUNCTIONAL PORRIDGE MIX BASED ON TRADITIONAL THERAPEUTICS

Poomuhi D S[1], Nandhini. G[2] and Dr. Esther Rakel[3]
[1]Postgraduate, Department of clinical nutrition, Ganga institute of Health sciences, Coimbatore-641022
[2]Professor, Department of clinical nutrition, Ganga institute of Health sciences, Coimbatore- 641022
[3]Dean cum principal, Ganga Institute of Health Sciences, Coimbatore-641022 Affiliation: The Tamil Nadu Dr. MGR Medical University.

ABSTRACT
Autoimmune diseases, such as arthritis is now recognized as a common non-communicable disease *worldwide, affecting around 1-2% of people globally. In recent years, studies suggested that diet play a major role in disease risk and progression. Several treatment strategies have evolved over time to enhance the quality of life for rheumatoid arthritis patients, yet a considerable number remain unresponsive to existing medications. Diet plays a major role in disease risk and progression. Hence, the present study aims to develop and evaluate the nutritional analysis of Dynaria quercifolia porridge mix for the benefit of arthritis patients. Dynaria quercifolia was grated, shade dried while the other ingredients such as millets, grains, and nuts were roasted following this, all the ingredients were mixed together and ground. The optimized levels of all the ingredients were added for the development of porridge mix based on colour, appearance and taste. The proximate analysis of the product revealed that it comprises of 407g/100g of energy, 77.4g/100g of carbohydrates, 4.37g/100g of total fat, 14.4g/100g of protein, 13.1g/100g of dietary fibre. During the study, it was observed that Dynaria quercifolia had a higher calcium level of 297mg/100gm. Thus, incorporation of Dynaria quercifolia in the porridge mix and including it in daily dietary habits could effectively manage, prevent and reduce the occurrence of arthritis.*

Keywords: *Arthritis, Dynaria quercifolia, porridge, Autoimmune, calcium.*

INTRODUCTION
Autoimmune diseases result from the immune system attacking the body's own cells and tissues. The diverse nature of these conditions makes them affect various organs, and they often show a higher prevalence in women. (Davidson A. *et al*., 2019).

Infections and microbiota play pivotal roles in triggering autoimmune diseases. The presence of autoantibodies before clinical signs, during the preclinical autoimmunity phase, underscores the potential for early detection and intervention in at-risk populations to mitigate tissue damage. (Sethi S et al., 2022).

Autoimmune diseases pose challenges in terms of preemptive strategies, and current treatment approaches often focus on managing symptoms rather than preventing onset.Autoimmune diseases, such as arthritis is now recognized as a common non-communicable disease worldwide, affecting around 1-2% of people globally. Arthritis refers to a range of musculoskeletal conditions where a person's joints become inflamed, which may result in pain, stiffness, disability, and deformity (Watson, 2019).

Furthermore, patients with RA generally complain of gastrointestinal tract problems particularly dyspepsia (bloating, postprandial fullness, nausea, early satiety, epigastric pain, and burning and belching), mucosal ulceration, and altered bowel habits (constipation/diarrhoea) (Wolfe F et al., 2016).

Certainly, environmental factors such as smoking, certain infections, and exposure to pollutants are known to contribute to the development of rheumatoid arthritis. These factors can have an impact before clinical symptoms appear, highlighting the complex interplay between genetics and the environment in autoimmune diseases (Edwards CJ. *et al.*, 2008).

Common symptoms of rheumatoid arthritis include morning stiffness of the affected joints for >30 min, fatigue, fever, weight loss, joints that are tender, swollen and warm, and rheumatoid nodules under the skin. These symptoms can often have a significant impact on a person's everyday functioning life (Watson, 2019).

Rheumatoid arthritis is a complex disease caused by a combination of genetic, environmental, and stochastic factors. The main goal of treatment for rheumatoid arthritis is to reduce joint inflammation and pain, maximize joint function, and prevent joint destruction and deformity. Several treatment strategies have evolved over time to enhance the quality of life for patients. Nevertheless, a considerable number of rheumatoid arthritis patients remain unresponsive to existing medications. (Köhler et.al., 2019).

ISSN 2394 - 7780

Nutrients have been found to impact the inflammatory status of individuals, leading to the recognition of certain foods and components for their pro- or anti-inflammatory properties in the field of nutrition (Chiara Giora et al., 2020). Although a number of studies suggested associations between dietary habits, mainly regarding fruit, vegetables or meat intake and the disease's development, the results are still inconclusive.

Diet and nutrients have received considerable attention as potential environmental factors influencing the development and the course of the disease. In recent years, an increasing number of studies have investigated the role of diet and nutrition as potential tools for rheumatoid arthritis prevention and management.

Dietary habits could represent both disease risk and protective factors based on the properties of specific food, dietary choices, or needs. Dietary habits show pro-inflammatory effects, e.g., red meat, salt, excessive caloric intake, or, on the contrary, radical consumption, oily, fatty fish, fruit, and others(Oliviero F et al., 2015).

Rheumatoid arthritis patients presented a lower intake of fish, potatoes, mushrooms and organ meats; mushrooms, citrus fruits and dairy products consumption showed a protective effect on RA, while potatoes and other fruits' consumption was associated with an increased risk. (Wang Y et al., 2016).

Certain dietary approaches, like anti-inflammatory diets or those rich in omega-3 fatty acids, are being explored for their potential benefits in mitigating symptoms and supporting overall health.

Taking these factors into account, we have developed a porridge containing a new emerging ingredient, Dynaria quercifolia, which aims to both manage and prevent arthritis.

MATERIALS AND METHODS

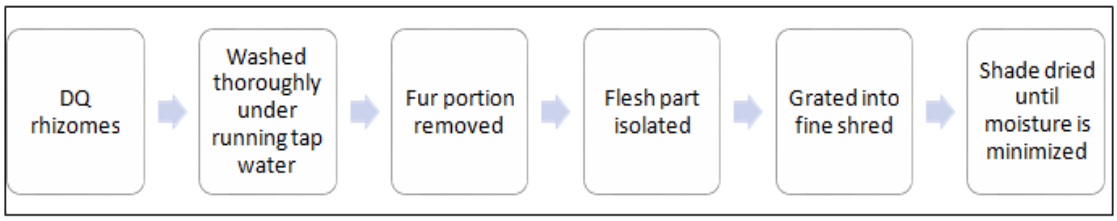
1. Procurement of raw materials:

Ingredients were sourced from the local market of Chennai.

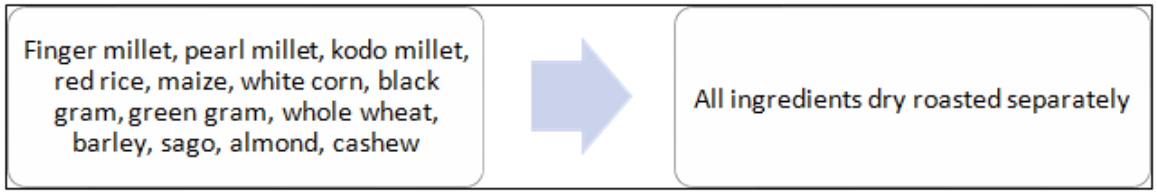
Raw Materials Include:

- Dynaria quercifolia rhizomes
- Millets and grains: Finger millet, pearl millet, kodo millet, red rice, maize, white corn, whole wheat, barley
- Pulses: Black gram, green gram
- Other ingredients: Sago, almond (badam), cashew nuts

2. Processing of Dynaria Quercifolia Rhizomes



3. Preparation of other Ingredients:



4. Final mixing and Grinding Process:

A nutrient rich porridge mix incorporating functional and traditional ingredients. Now the porridge mix can be used for further analysis.

ISSN 2394 - 7780

NUTRITIONAL ANALYSIS

The moisture, total ash, protein, total fat, dietary fibre, sodium, potassium and zinc were analysed by following the AOAC method (2016) whereas calcium was analysed by IS 5949:1990 method. The energy and carbohydrates were calculated by FAO and CTL method.

Table 1: Nutritive content in Dynaria quercifolia powder per 100g

S.No.	Nutrients	Results
1	Energy	357kcal
2	Carbohydrates	75.2g
3	Protein	7.01g
4	Total fat	3.13g
5	Dietary fibre	11.4g
6	Total sugars	13.1g
7	Calcium	297mg
8	Iron	6.03mg

Table 2: Macronutrients content in Dynaria quercifolia porridge mix per 100g

S.No.	Nutrients	Results
1	Moisture	4.59%
2	Total ash	2.83%
3	Energy	407kcal
4	Carbohydrates	77.4g
5	Protein	14.4g
6	Total fat	4.37g
7	Dietary fibre	13.1g
8	Total sugars	BDL

Table 3: Micronutrients content in Dynaria quercifolia porridge mix per 100g

S.No.	Nutrients	Results
1	Sodium	16.4mg
2	Calcium	209mg
3	Iron	5.41mg
4	Potassium	757mg
5	Zinc	27.3mg
6	Total sugars	BDL

SENSORY EVALUATION

The cooked Dynaria quercifolia porridge was served hot and evaluated for sensory attributes (Appearance, consistency, aroma, mouthfeel, flavour and overall acceptability) through a panel of 10 subjects using 9-point hedonic scale of scores from 1-dislike extremely to 9-like extremely. The average sensory score of various attributes is given in table 4.

Table 4: Sensory evaluation of Dynaria quercifolia porridge mix

Attributes	Quantity of DQ	Medium	Average scores
Appearance	25g	M	8.3
		W	7.2
	50g	M	7.8
		W	7.5
Consistency	25g	M	8.8
		W	8.3
	50g	M	8.1
		W	7.1
Aroma	25g	M	7.6
		W	7.2
	50g	M	6.2
		W	7.6
Mouthfeel	25g	M	8.1
		W	7.9

ISSN 2394 - 7780

	50g	M	6.8
		W	7.5
Flavour	25g	M	8.8
		W	7.7
	50g	M	8.3
		W	7.4
Overall acceptability	25g	M	8.1
		W	7.6
	50g	M	7.2
		W	7.5

M- Milk; W- Water; DQ- Dynaria quercifolia

The average scores of overall acceptability of the porridge in milk with incorporation of 25g of Dynaria quercifolia in the porridge is considered to be better in taste.

The average sensory score of the porridge when incorporated with milk in relation to appearance, consistency, aroma, mouthfeel, flavour and overall acceptability had the highest as 8.3, 8.8, 7.6, 8.1, 8.8 and 8.1 respectively.

RESULTS AND DISCUSSION:

The developed porridge mix, incorporating *Dynaria quercifolia* and other nutrient-rich ingredients, was evaluated for its proximate composition, micronutrient content, and sensory attributes. The nutritional analysis revealed that the porridge mix provides 407 kcal/100g, making it an energy-rich food suitable for individuals needing sustained nutrition support, especially those managing chronic inflammatory conditions like arthritis.

One of the most significant findings in this study is the high calcium content of the formulation. *Dynaria quercifolia* alone contributes 297 mg of calcium per 100g, while the porridge mix delivers 209 mg/100g. Calcium plays a crucial role in bone health, particularly important for individuals with rheumatoid arthritis, who often experience joint demineralization, bone loss, and increased risk of osteoporosis. Adequate calcium intake can support bone density and reduce the rate of bone degradation, ultimately helping manage arthritis symptoms and improve joint integrity.

In addition to calcium, the porridge mix is a good source of protein (14.4g/100g) and dietary fibre (13.1g/100g). Adequate protein supports muscle maintenance around joints, which is essential for mobility in arthritis patients, while dietary fibre contributes to better gut health and reduced systemic inflammation—factors that may influence autoimmune activity.

The micronutrient profile showed the presence of iron (5.41 mg) and zinc (27.3 mg), both of which are involved in immune function and tissue repair, further enhancing the porridge's potential as a functional food for autoimmune disease management.

Sensory evaluation showed high acceptability, especially when the porridge was prepared with milk and 25g of *D. quercifolia*. Appearance, consistency, and flavour received average scores above 8 on the 9-point hedonic scale, indicating strong consumer preference and potential for routine dietary use.

Taken together, these results suggest that the novel porridge mix not only meets nutritional needs but also delivers therapeutic value through its high calcium content, aligning with the objective of managing arthritis through dietary interventions. Further clinical trials are recommended to assess long-term outcomes on inflammation markers and bone health in arthritis patients consuming this porridge regularly.

CONCLUSION

Autoimmune diseases result from the immune system attacking the body's own cells and tissues. The autoimmune diseases exhibit clinical diversity. They can either manifest with organ-specific patterns or present in a generalized manner, affecting various systems throughout the body. Autoimmune diseases like rheumatoid arthritis involve the immune system and target various components of the joints, leading to inflammation, tissue damage, and pain. The global prevalence of the disease is estimated at around 1–2%, with a large variation among different populations. In developed countries, osteoarthritis is recognized as one of the top 10 prevalent disabilities among older individuals, particularly those who continue to participate in the workforce. The objectives of rheumatoid arthritis treatment include minimizing joint

ISSN 2394 - 7780

inflammation and pain, optimizing joint functionality, and averting joint destruction and deformities. Considerable focus has been placed on the role of diet and

nutrients as potential environmental factors that may impact the development and progression of the disease. While several studies have suggested links between dietary habits, particularly regarding fruit, vegetable, or meat intake, and the development of the disease, the results remain inconclusive. Hence, we have used an ingredient called D.quercifolia and formulated a porridge mix which not only helps in managing but also prevent arthritis. The formulated porridge mix was evaluated for its nutritional quality, macronutrients and micronutrients, sensory analysis and shelf-life testing. The average daily requirement of a sedentary adult is 1885kcal, hence incorporating D.quercifolia in the diet gives 357kcal daily. The protein content in the porridge is notably low 7.01g/100g, hence it is safe to consume. D.quercifolia has significant nutritional benefits. This porridge is suitable not only for arthritis patients but also for healthy individuals due to its various health benefits. Consuming a glass of porridge four times per week is recommended to assess the efficacy of the improvement in recovery. Taking all these factors into account, its 39 nutritional richness adds variety to patients diets and makes it a nutritious breakfast option for people of all ages, including those who are healthy. Further it can be recommended that besides soup and porridge, other recipes such as biscuits, energetic bars can be formulated. The D.quercifolia porridge mix can be given to arthritis patients to determine the efficiency of the porridge in arthritis management and conducting a comparative study on Mudavattukal kilangu bought from various regions.

Based on the findings of this study, it can be inferred that consuming Dynaria quercifolia porridge may be beneficial for managing arthritis. Dynaria quercifolia is rich in calcium, which can help reduce inflammation and strengthen bones.

REFERENCES

1. Davidson, A. & Diamond, B., 2001, Autoimmune diseases. N. Engl. J. Med. 345, 340– 350
2. Gioia C, Lucchino B, Tarsitano MG, Iannuccelli C, Di Franco M. Dietary Habits and Nutrition in Rheumatoid Arthritis: Can Diet Influence Disease Development and Clinical Manifestations? Nutrients. 2020 May 18;12(5):1456.
3. Edwards CJ., 2008, Commensal gut bacteria and the etiopathogenesis of rheumatoid arthritis. J Rheumatol 35(8):1477–9.
4. Köhler et.al. (2019). Current therapeutic options in the treatment of rheumatoid arthritis. J.Clin.Med. *Cells*, 8,938.
5. Pattison DJ, Silman AJ, Goodson NJ, Lunt M, Bunn D, Luben R, Welch A, Bingham S, Khaw KT, Day N, Symmons DP. Vitamin C and the risk of developing inflammatory polyarthritis: prospective nested case-control study. Ann Rheum Dis. 2004 Jul;63(7):843-7.
6. Salgado E, Bes-Rastrollo M, de Irala J, Carmona L, Gómez-Reino JJ. High Sodium Intake Is Associated With Self-Reported Rheumatoid Arthritis: A Cross Sectional and Case Control Analysis Within the SUN Cohort. Medicine (Baltimore). 2015 Sep;94(37).
7. Sethi S, De Vriese AS, Fervenza FC. Acute glomerulonephritis. Lancet. 2022 Apr 23;399(10335):1646-1663.
8. Wolfe F, Kong SX, Watson DJ., 2000, Gastrointestinal symptoms and health related quality of life in patients with arthritis. J Rheumatol. 27(6):1373–8.
9. Watson, R. R. (2019). Arthritis and related inflammatory diseases. *Bioactive Food as Dietary Interventions for Arthritis and Related Inflammatory Diseases*, 1.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

ASSESSING THE ROLE OF EDUCATIONAL TECHNOLOGY IN ENHANCING ENGLISH PROFICIENCY AMONG PUNJAB'S SECONDARY SCHOOL STUDENTS

Sarpreet Kaur Sidhu and Dr. Irshad Ahmad Itoo
Chandigarh University, India

ABSTRACT
In an era where digital innovation increasingly intersects with education, this research explores the impact of technology on English language proficiency among Punjab, Indian secondary level school learners. It addresses the intersection of language education and digital tools, emphasizing their role in English language acquisition. Employing a quantitative research design, the study draws data from a sample of 150 secondary level students across government and private schools, selected through stratified random sampling. The study employs a quantitative approach, including surveys, structured questionnaire measured students' access to technology integration in diverse educational settings including mobile applications, online games, smart boards, and virtual learning platforms. The data were analysed via SPSS, Pearson's Correlation and multiple regression analysis to determine the correlation between technological exposure and student performance in major English language competencies. Initial findings point towards a very high correlation between the frequent and conscious usage of technological tools and enhanced performance levels in reading comprehension, vocabulary building and oral fluency. Nonetheless, the analysis also identifies school-type and socio-economic-based disparities. These revelations highlight the life-transforming power of instructional technology in improving language skills, but also underscore the imperative for fair, policy-driven access to technology-based learning tools throughout Punjab's diverse educational environments.

Keywords: *Educational Technology, English Proficiency, Punjab Schools, Quantitative Study, SPSS, Digital Learning Tools, Language Acquisition*

INTRODUCTION
English, in today's globalised world, is key for students' academic and prospective career success. In a multilingual nation like India, learning English is especially difficult for them if they hail from villages or backward classes. This study examines the role that technology plays in enhancing English language skills of the secondary school students in Punjab, India?

And as schools are increasingly incorporating online learning platforms and digital tools, styles of teaching are also evolving. Things have moved on and technology is at the heart of many a classroom, providing an exciting new way for students to learn English. Technology mediated learning of English is becoming popular in Punjab, particularly at the secondary level. Now, students can use online videos, educational apps, games, and interactive lessons, which enable more enjoyable and flexible learning.

The programs are designed to let students learn at their own pace, contributing to increased comfort with reading, writing, listening and speaking. Instant feedback may also be available on many platforms so that learners can correct any mistakes in grammar and pronunciation instantly. This way the learning process is more effective and supportive.

Students also experience real English by watching news segments, reading posts, and using social media in English. Such resources not only enhance their vocabulary, but also enable them to learn how English applies to real life. Technology further enables students to collaborate with their peers online. They can participate in group discussions, do group projects, and exchange ideas, which makes them more communicative. The teachers also gain from technology implementation in schools. It provides them with new methods of teaching, online resources, and training courses so they can better prepare their students for class. Even though some institutions continue to experience issues such as slow internet or no devices, technology still has the potential of enhancing English learning as long as it is applied the correct way. If teachers and learners are facilitated in the right manner, technology has a vital role in making secondary-level students of Punjab more confident and proficient in English language use.

The study investigates the role of digital resources in building the key English language skills of reading proficiency, vocabulary development, and oral communication abilities. Data were gathered for 150 secondary school students studying in government and private schools from Punjab, India. A stratified random sample was employed to obtain an adequate representative sample of the school types and socio-economic profiles. Surveys and guided questionnaires were used to collect data regarding the frequency and efficacy of students' utilization

ISSN 2394 - 7780

of instructional technologies, such as mobile apps, online games, smart boards, and virtual learning platforms utilized in the classrooms.

The data were analysed using SPSS, Pearson's Correlation and multiple regression techniques employed to examine the strength and nature of relationship between technology use and language performance. The findings reveal that students who frequently and purposefully engage with digital tools demonstrate marked improvement in English language competencies. These students show enhanced reading comprehension, expanded vocabulary, and improved oral communication skills. However, the results also point to a digital divide, as students attending private schools or from higher socio economic strata tend to have greater access to educational technologies, thereby benefiting more from their use. This means secondary level students from governments or lower-income families may be left behind.

The study highlights that educational technology has the power to reduce these learning gaps, especially when used wisely. It suggests that government and education policymakers should work to provide equal access to digital tools in all schools—so every student, no matter their background, has the chance to succeed in English. By focusing on Punjab's education system, this research offers useful ideas on how to use technology effectively and make language learning easier and more engaging for students across Punjab, India.

LITERATURE REVIEW

La Civita, Kean, and Yamamoto (1966) conducted a study on how children learn grammar. They worked with 320 students from grades 2, 4, and 6, selected from three schools that represented different socio-economic backgrounds. Each student was given six made-up sentences. In every sentence, a made-up word was included, and students were asked to guess what part of speech the word belonged to—such as a noun, verb, or modifier—using two types of hints: a grammatical clue alone, and a grammatical clue combined with the word's position in the sentence. The responses were sorted into two categories: homogeneous, where the word was correctly identified grammatically, and heterogeneous, where it was not. The researchers analysed the data using the Chi-square test, averages (mean), and analysis of variance. The results showed that there was no major difference in the accuracy of responses based on socio-economic background. However, there were notable improvements when students were given stronger hints, and older students performed better than younger ones.

Lloyd and Hertzman (2010) explored how neighbourhood social and economic conditions affect children's language and thinking skills over time. Their study followed a group of 5,022 children in British Columbia, Canada, tracking their progress from kindergarten (ages 5–6) to Grade 4 (ages 9–10). The researchers linked each child's Early Development Instrument (EDI) scores in kindergarten with their Foundation Skills Assessment (FSA) results in Grade 4. They also matched this data with information about the neighbourhoods where the children lived. The sample included both rural and urban areas—635 children from 20 rural neighbourhoods and 4,387 from 85 urban ones. The researchers used multilevel analysis to study the relationships between neighbourhood conditions and student outcomes. One important finding was that children living in neighbourhoods with high levels of immigration often performed better on language and cognitive tests. The study also showed that the factors affecting children's development at one point in time did not always match the factors influencing their growth over several years. In addition, the impact of neighbourhood socioeconomic conditions varied between rural and urban areas, showing that place matters when looking at children's educational progress.

Hamid and Baldauf Jr (2011) pointed out the limitations of earlier research on second language (L2) education, particularly its lack of attention to learners' social backgrounds and lived experiences. In their study, they examined how school students in rural Bangladesh perceived and experienced learning English. They noted that although English had gained importance in the curriculum and was widely promoted as essential for success, it remained disconnected from the students' everyday language environment. The authors revealed how English came to dominate the learners' thinking and self-perception, often creating internal conflicts. Students were eager to become proficient in English, yet they found the quality of English teaching in schools to be poor. Moreover, many of them were unable to afford private English tuition, which made it even harder to learn the language—especially given their socio-economic disadvantages.

Hulstijn (2011) explored the concept of language proficiency (LP) from both theoretical and practical perspectives. He made a clear distinction between 'basic' language cognition and 'higher' language cognition, and also between the 'core' and 'peripheral' components of language proficiency. He critically analysed how language levels are defined in most second language (L2) assessment frameworks, arguing that these levels often get confused with a person's general intellectual ability. According to him, individuals with lower levels of education, job experience, or leisure activities often struggle to reach higher levels of language proficiency—

ISSN 2394 - 7780

not necessarily due to language ability, but because of their broader life experiences. Hulstijn suggested that this confusion is one reason why the Common European Framework of Reference for Languages (CEFR) has difficulty clearly separating the development of L2 learning from actual L2 proficiency. His model of language proficiency explains how L2 learners with richer educational or occupational backgrounds may outperform native speakers in advanced language tasks, but still struggle with basic language use compared to native speakers with less privileged backgrounds.

Kang (2012) explored whether children who learn two alphabetic languages with different phonological and writing systems show any advantages in phonological awareness (PA) compared to monolingual children. The study also looked at which early literacy skills could explain the differences in PA among these children. The participants included 126 children aged five to six years—70 were Korean-English bilinguals who had attended English-medium kindergartens for at least two years, and 56 were Korean monolinguals who had similar levels of spoken Korean as the bilingual group. The children were assessed on various PA tasks and early literacy skills, including their ability to decode words in both Korean and English. Results showed that the bilingual children performed better than monolinguals on PA tasks in both their first and second languages. The study also found evidence of language transfer in how both bilingual and monolingual children processed PA. However, the factors that explained PA ability differed between the two groups.

Fernald, Marchman, and Weisleder (2013) studied how infants' ability to understand spoken language develops over time and how this relates to their vocabulary growth. They also examined how these aspects of early language development differ based on the family's socioeconomic status (SES). The study followed 48 infants who were learning English, from both higher- and lower-SES backgrounds, over a six-month period from 18 to 24 months of age. Real-time methods were used to measure how quickly and accurately the infants processed spoken language. The findings showed both common patterns and major differences in early language development. Notably, significant gaps in vocabulary size and processing efficiency were already present at 18 months between infants from high- and low-SES families. By 24 months, the gap had widened, with infants from lower-SES families showing language processing skills similar to those of higher-SES infants who were six months younger.

Ahmed, Zarif, and Tehseen (2013) explored the issue of medium of instruction in Pakistan and discussed the efforts made by previous governments in this area. Their study included a sample of 10 students and 3 teachers from each of 10 different schools across various parts of Karachi, selected randomly. Data was collected using a close-ended questionnaire with multiple questions. Teachers completed the questionnaire themselves, while the investigator recorded responses on behalf of the students. The findings showed that 29% of the students had difficulty understanding the language used for instruction in schools because it was not their native or mother tongue. Additionally, 46% of the participants expressed a preference for using their provincial language as the medium of instruction.

Feng, Gai, and Chen (2014) examined the relationship of early language and literacy development of bilingual and monolingual children (from 9 months of age to kindergarten entry) with different family learning environments like book availability; and family learning activities like reading books, telling stories, and singing songs. 1300 bilingual children and 5150 English monolingual children from the Early Childhood Longitudinal Study-Birth Cohort formed the sample of their study. It was revealed that bilingual children generally lagged behind in both resources and frequency of family learning activities. The study showed that early reading score differences between bilingual and monolingual children can be explained by differences in resources and early family learning environments. The study showed that reading books are more important than singing songs and telling stories in improving reading and literacy.

RESEARCH METHODOLOGY

This study uses a quantitative research design to understand how the use of technology is connected to English language proficiency among secondary level school students in Punjab, India. It aims to find out how effective digital tools like mobile apps, smart boards, online games, and virtual learning platforms are in helping students improve their key English skills, such as reading, vocabulary, and speaking.

PARTICIPANTS

The study focused on secondary-level students studying in both government and private schools across Punjab. In order to include students from different school types and socio-economic backgrounds, a stratified random sampling method was applied. Around 150 students from Grades 6 to 10 were chosen to take part in the research.

ISSN 2394 - 7780

DATA COLLECTION

For this study, data was gathered through a structured questionnaire that was carefully designed for the research purpose. The questionnaire was divided into two main sections. The first section collected demographic details such as the type of school, age, gender, and socio-economic background of the students. The second section focused on understanding how often and to what extent students were exposed to digital tools for learning English. It also included a self-assessment of their skills in reading, vocabulary, and speaking. To assess access to technology and its impact on language learning, the questionnaire included both Likert-scale items and multiple-choice questions.

DATA COLLECTION PROCEDURE

After getting approval from the school authorities, the questionnaires were handed out during school hours, and students were clearly instructed on how to fill them. Since confidentiality was ensured, they felt comfortable giving honest answers. The data collection process lasted for about two weeks.

DATA ANALYSIS

The SPSS (Statistical Package for the Social Sciences) program was used for data analysis. In order to explain the data well, we summarized the basic demographic data by data description, including the average, median, and standard deviations by the main indicators of demographic data of the participants. Fundamental relationship belongs to the technology, use and English language performance of the students which was analyzed through Pearson's correlation coefficient. For that purpose, the study also implemented multiple regression analysis to find out how different digital tools impacted the learners' proficiency in particular English skills like reading, vocabulary, and speaking. The statistical strategies also facilitated the comprehension of the strength and direction of the association between technology use and the outcomes of language learning.

ETHICAL CONSIDERATIONS

The study followed standard ethical requirements in research. All participants gave their informed consent before the data was collected and they were well informed about the purpose of the study as well as their rights. Confidentiality and anonymity were guaranteed and data collected were exclusively for academic research. To ensure confidentiality and confidentiality of the identity the name and address of the participants were not asked at any phase of the survey.

EXPECTED OUTCOMES

This study assumes that secondary school students, who have sufficient interaction with digital learning tools (e.g. MLL apps, educational games, smart boards and virtual classrooms) as an intrinsic part of their educational process, will make significant rationales in the core aspects of EFL oral skills, including reading comprehension, vocabulary acquisition and oral fluency. Underlying this hypothesis is that frequency and pedagogical value of technology usage will have a positive relationship with English learners' performance, which means learners with regular access to effective digital interventions will likely attain far better results than others who are given little exposure.

In addition, the study is likely to uncover vital differences in language learning achievements depending on the school type attended and the socio-economic status of the students. Private school students or students from economically privileged backgrounds are assumed to gain more from technologically enhanced learning environments, primarily because they are more familiar with digital technologies, and also they have more regular access to facilitating infrastructures like high-speed web, personal computers, and technology-savvy teachers. On the other hand, government school children or low-income group children might be confronted with systemic roadblocks that prevent them from being able to participate fully in digital learning, thus increasing prevailing educational disparities.

One of the primary goals of the research is to determine which particular types of digital tools either gamified learning apps that reward student engagement, collaborative platforms that facilitate teamwork, or AI-based systems that provide immediate feedback are most useful at cultivating students' English language proficiency. By identifying the tools that provide the greatest pedagogical return, the research will help inform practical, evidence-informed decision-making among teachers, school administrators, and curriculum developers, who are increasingly being called on to incorporate technology into language learning.

Furthermore, the results should highlight the urgent necessity for interventions at the policy level to deal with the digital divide. Ensuring equitable access to educational technology across all schools—irrespective of location, funding, or student background is essential for creating inclusive and effective language learning ecosystems. The research may thus serve as a catalyst for broader educational reforms aimed at democratizing digital learning opportunities in Punjab.

ISSN 2394 - 7780

Finally, it is anticipated that students who interact with user-friendly, engaging, and contextually relevant digital tools will demonstrate higher levels of intrinsic motivation, sustained interest in English learning, and increased self-confidence in using the language across both academic and real-world settings. This heightened engagement may not only enhance immediate learning outcomes but also contribute to long-term language development and academic resilience.

RESULT ANALYSIS

Demographic Analysis of Respondents

The provided data presents insights into the gender distribution and academic levels of respondents participating in the survey on The Role of Technology in Enhancing English Language Proficiency among Punjab, Indian secondary level Learners

Table1: Gender Distribution

Gender	Number of Respondents	Percentage
Male	63	**42%**
Female	87	**58%**

The table 1 demographic data reveals that out of the total respondents who participated in the survey on the role of technology in enhancing English language proficiency among secondary-level learners in Punjab, India, 42% were male and 58% were female. Although both genders were represented in the study, female participants formed the majority, suggesting a slightly higher engagement or availability of female students in this research context. This gender distribution provides a balanced, though female-dominant, perspective for analysing the impact of technology on English language learning at the secondary school level.

Table2: Academic Level Distribution

School	Number of Respondents	Percentage
Private	114	**76%**
Government	35	**23.3%**

The Table 2 data shows that among the total respondents, 76% were from private schools, while only 23.3% belonged to government schools. Although the study included students from both types of institutions, the majority came from private schools, indicating either a greater willingness or easier access for private school students to participate in the survey. This distribution may also reflect differences in technological exposure and resources between private and government schools, which could influence the outcomes related to English language proficiency.

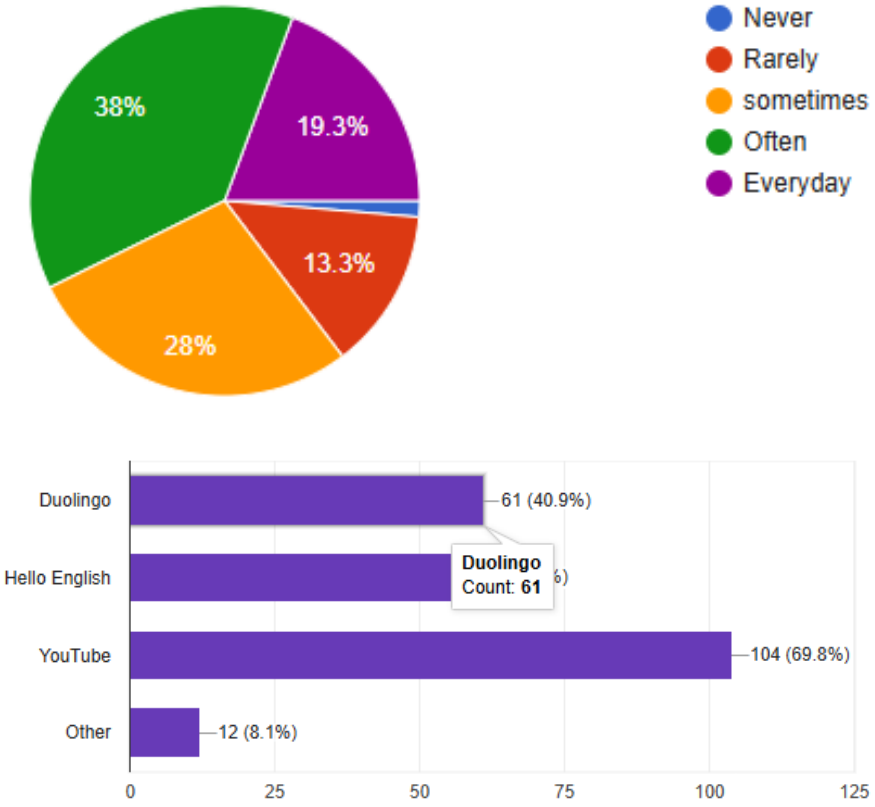
Table 3 Location of schools

Location	**Number of Respondents**	**Percentage**
Urban	57	**38.8%**
Semi-urban	67	**45.6%**
Rural	23	**15.6%**

The data in table 3 indicates that 45.6% of the respondents were from semi-urban schools, 38.8% from urban areas, and only 15.6% from rural regions. While students from all three locations participated in the survey, those from semi-urban and urban areas formed the majority, suggesting better access to educational resources and digital tools in these areas. Although rural students were included, their lower representation could highlight the digital divide and limited technological integration in rural educational settings, which may affect their English language learning experiences.

ISSN 2394 - 7780

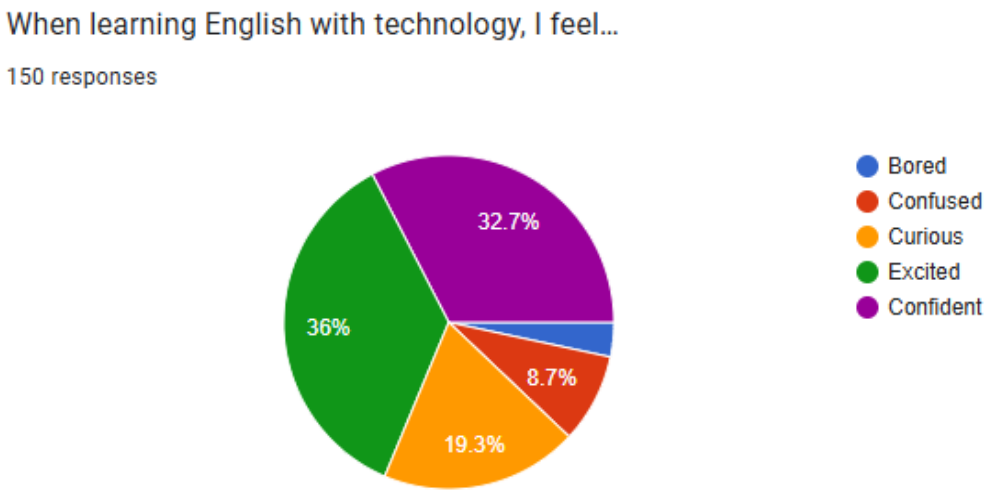
Figure 1 and 2: Analysis of Technology Usage Frequency and App Preferences in English Language Learning



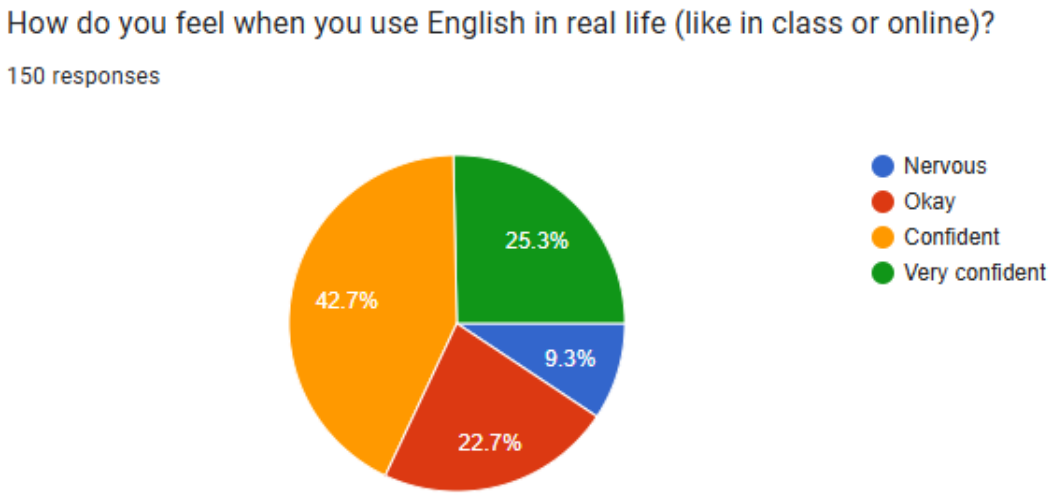
The data in Figure 1 presents insights into how frequently secondary-level students use mobile devices to learn English and their preferred digital learning platforms. According to the pie chart, a significant portion of the students—38%—reported using their phones or tablets "Often" for English learning, while 28% indicated using them "Sometimes." Interestingly, 19.3% use these devices "Every day," showing high engagement among a considerable number of learners. On the lower end, 13.3% use their devices "Rarely," and only a negligible percentage reported "Never" using them for this purpose.

When it comes to app preferences, the bar graph in figure 2 indicates that YouTube stands out as the most enjoyed English learning platform, with 69.8% (104 respondents) favouring it. Duo lingo is the second most popular at 40.9% (61 respondents), followed by Hello English, which 8.1% of learners prefer. A small percentage (8.1%) mentioned "Other" apps. These results highlight YouTube's dominance as an accessible and engaging tool for language learning, possibly due to its variety of free, multimedia-rich content that supports different learning styles.

Figure 3 and 4: Learners' Emotional Response to Technology and Real-life English Use



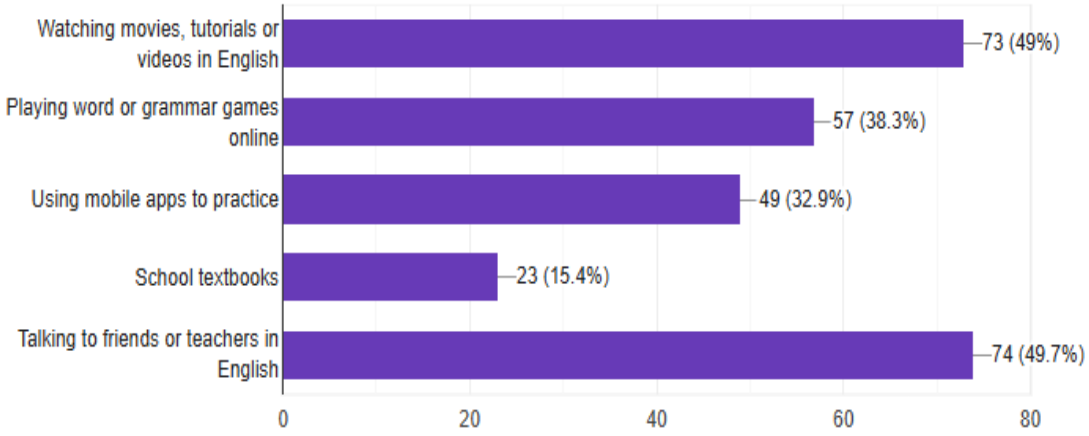
ISSN 2394 - 7780



The Figure 3 first chart reflects students' emotions while learning English through technology. A significant portion of respondents, 36%, reported feeling excited, followed closely by 32.7% who felt confident. A smaller percentage felt curious (19.3%), while very few felt confused (8.7%) or bored (3.3%). This suggests that most students have a positive emotional response when using technology for English learning.

The Figure 4 second chart shows how students feel when using English in real-life settings, such as in class or online. Here, 42.7% felt confident, indicating a general sense of self-assurance among learners. However, only 25.3% felt very confident, while 22.7% felt just okay, and 9.3% reported feeling nervous. This implies that while technology boosts confidence during learning, a portion of students may still experience anxiety when applying their skills in real situations.

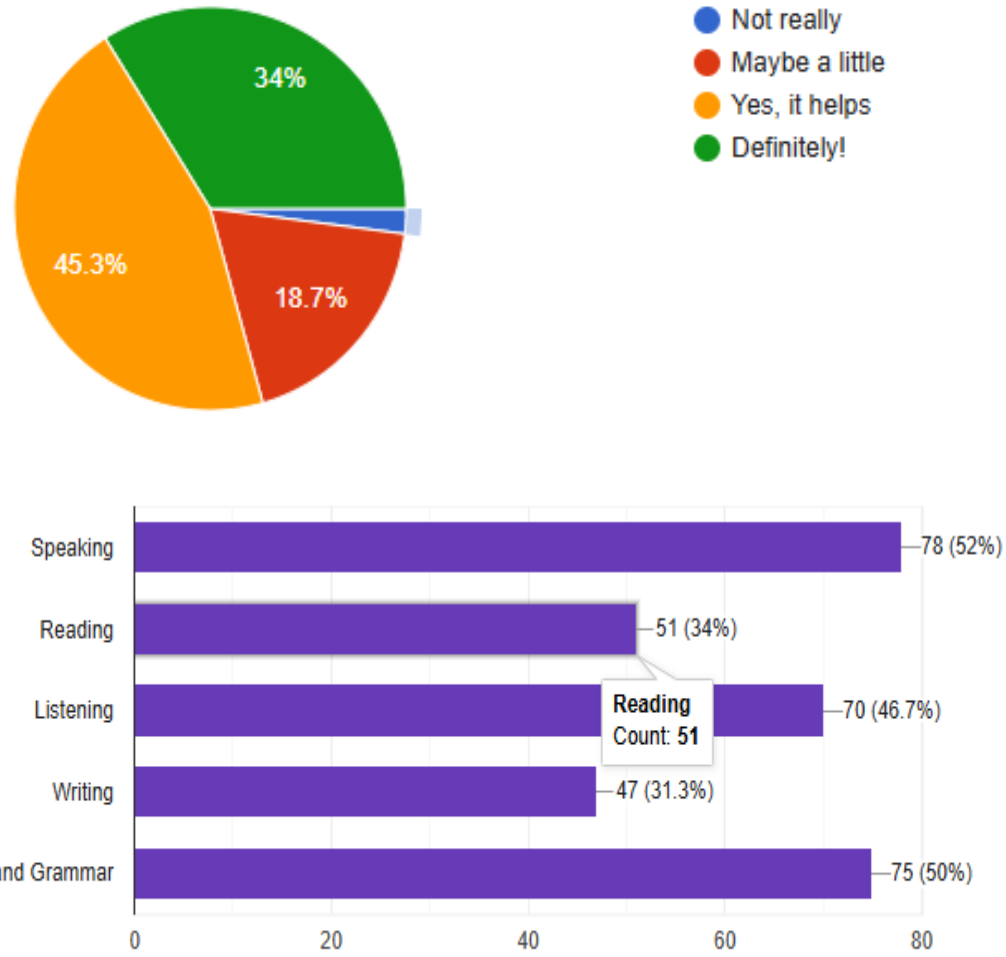
Figure 5: What helps you learn English faster



The data presented in figure 5, the chart illustrates the preferences of 149 respondents regarding the methods that help them learn English more effectively. The most favoured method, with 74 respondents (49.7%), is "Talking to friends or teachers in English," highlighting the importance of real-life communication and interactive language use in accelerating language acquisition. Close behind, 73 respondents (49%) selected "Watching movies, tutorials, or videos in English," indicating the significant role of audio-visual media in contextual learning and vocabulary enhancement. "Playing word or grammar games online" was chosen by 57 respondents (38.3%), suggesting that gamified learning methods are also relatively popular and engaging. The option “using mobile apps to practice” was endorsed by 49 participants (32.9%), indicating that while digital technology is recognized as a valuable aid in language learning, it may not exert as strong an influence as more socially engaging methods such as interpersonal communication or media-based exposure. Interestingly, just 23 of the respondents (15.4%) favoured "School textbooks," marking a wider pedagogical tendency away from static, text-centred teaching towards more lively, interactive, and experiential modes of learning. The evidence supports the increased role being played by communicative and multimedia-based approaches in modern English language education, especially in environments where learner participation and application are prioritized.

ISSN 2394 - 7780

Figure 6 and 7: Learners' Perceptions of Online Tools and Their Impact on English Language Skill Development



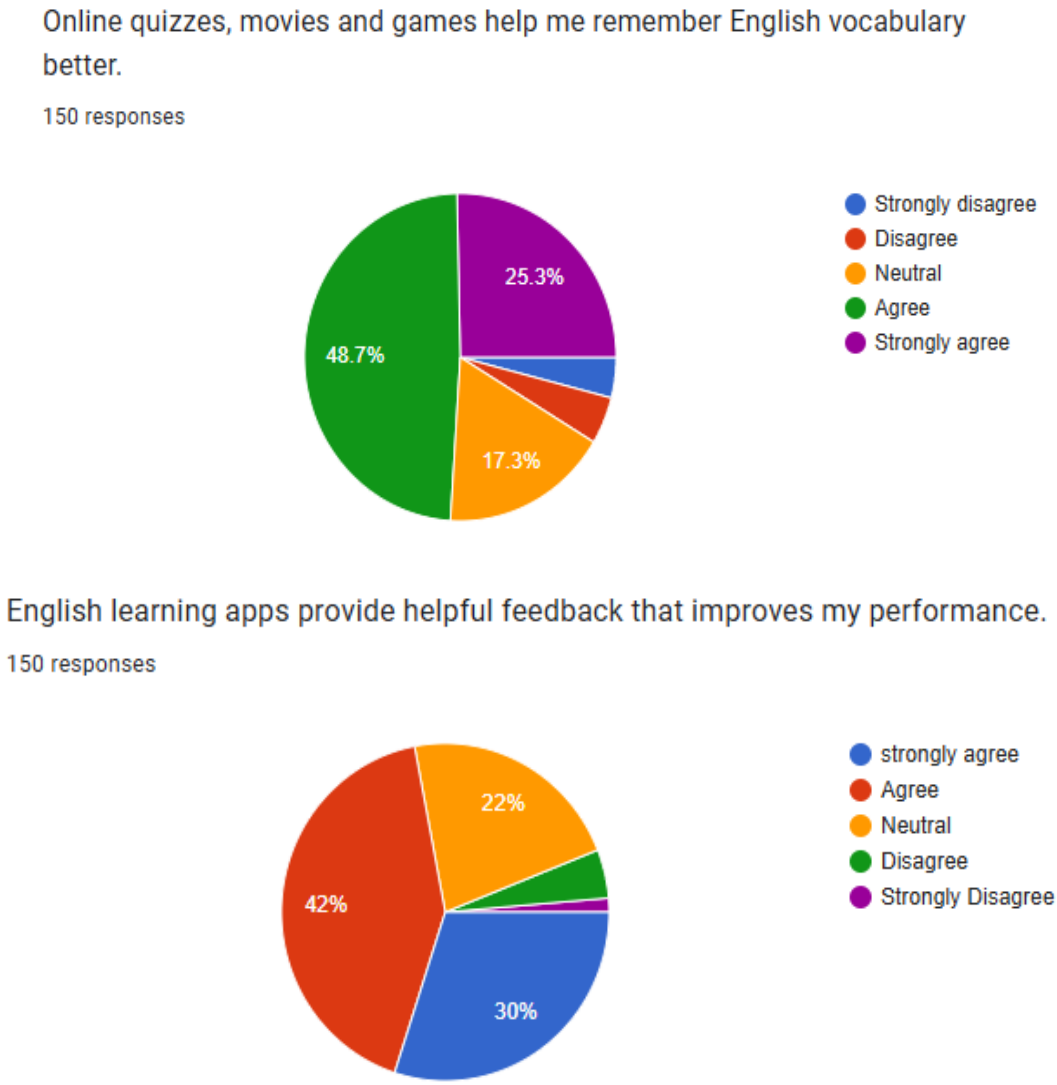
The survey responses in figure 6 and 7 offer meaningful insight into learner's perceptions regarding the effectiveness of online tools in enhancing their English language proficiency. When asked whether they believed their English skills were improving through the use of such tools, a substantial proportion of respondents (45.3%) selected "Yes, it helps," while an additional 34% chose "Definitely," reflecting a strong overall endorsement of digital platforms in language learning. A smaller group (18.7%) indicated that online tools may help "maybe a little," and only a single participant expressed the view that these tools were not helpful at all. These reults point to a broad and largely positive aceeptance of technology-enhanced learning among secondary –level students, suggesting that online resources are perceived not only as supplementary but as meaningful contributors to language development.

Further analysis of which specific English skills have improved the most due to technology reveals that speaking skills were cited by the largest group of respondents (52%), followed closely by vocabulary and grammar (50%), and listening (46.7%). These results underscore the impact of interactive and audio-visual content in promoting oral and aural competencies. Reading (34%) and writing (31.3%) were identified as the least affected, suggesting that while technology is useful across all skill areas, its greatest strengths lie in facilitating communication-based and receptive skills.

Together, these findings highlight that learners perceive technology as an effective aid in enhancing English proficiency, particularly in speaking, vocabulary, and listening. This reflects the growing reliance on multimedia and app-based learning environments that prioritize engagement and practical usage over traditional rote learning methods.

ISSN 2394 - 7780

Figure 8 and 9: Learner Attitudes toward the Role of Online Resources in Vocabulary Retention and Feedback Effectiveness



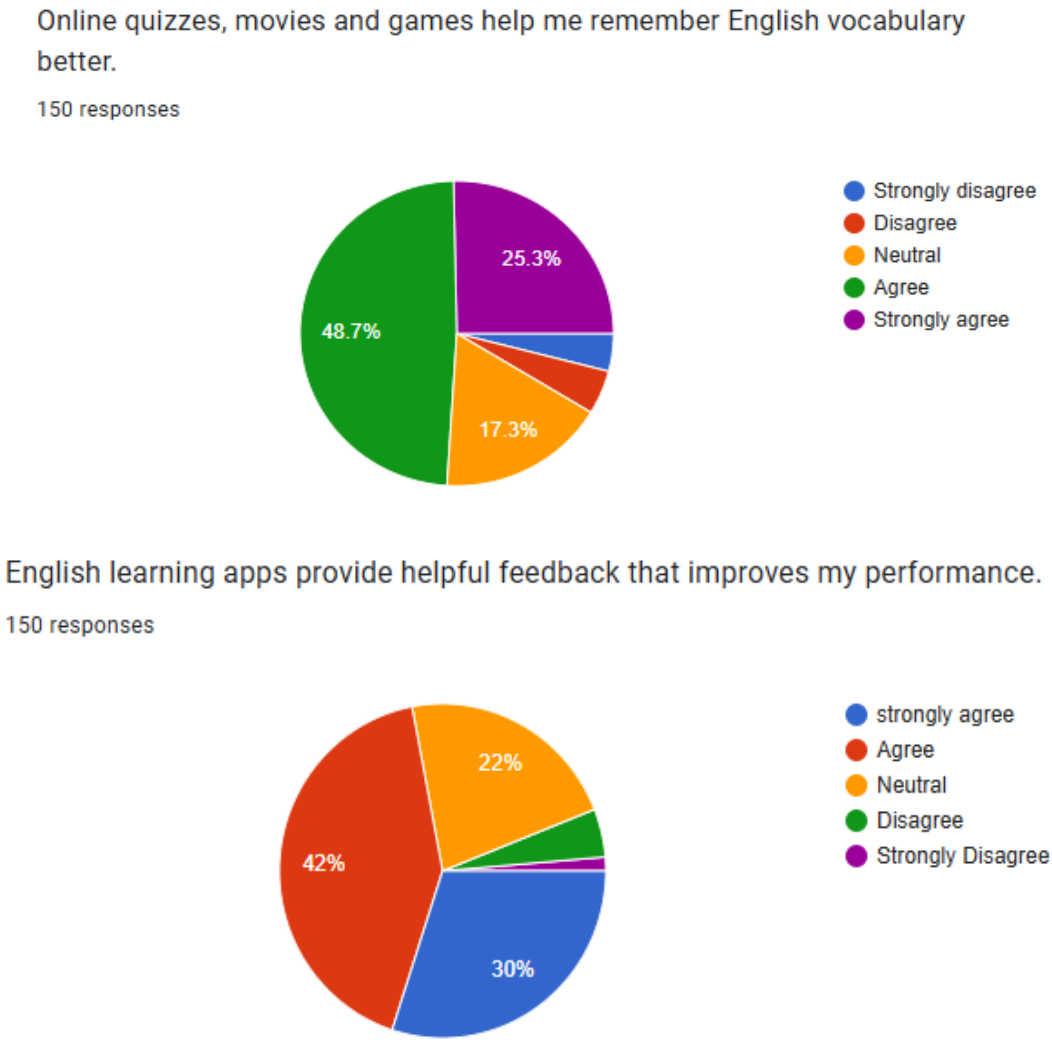
The responses presented in Figures 8 and 9 provide critical insight into learners' perceptions of how online resources support vocabulary retention and offer meaningful feedback. In Figure 8, a strong majority of respondents (48.7%) agreed that online quizzes, movies, and games help them remember English vocabulary better, while an additional 25.3% strongly agreed with this statement. This indicates that nearly three-quarters of the participants (74%) believe that interactive and multimedia-based tools significantly enhance their vocabulary retention. A smaller portion of respondents remained neutral (17.3%), and very few disagreed (3.3% disagreed, 2.7% strongly disagreed), suggesting a widely shared confidence in the mnemonic effectiveness of engaging digital content.

Figure 9 shifts focus to learners' perceptions of the feedback provided by English learning apps. Here, 42% of participants agreed that these apps provide helpful feedback that improves performance, while 30% strongly agreed, making a combined total of 72% of respondents expressing positive sentiment. However, a notable 22% remained neutral, possibly indicating variability in user experiences with different platforms. A minority expressed disagreement (4% disagreed and 2% strongly disagreed), suggesting room for improvement in how feedback is delivered or interpreted.

Together, these figures underscore the perceived pedagogical value of online resources, particularly in enhancing vocabulary acquisition and providing performance-enhancing feedback. The data suggests that learners not only find digital tools engaging but also effective in reinforcing their learning and offering supportive evaluation mechanisms, which are essential for sustained language development.

ISSN 2394 - 7780

Figure 10 and 11: Learner Perceptions of Digital Tools in Enhancing English Vocabulary and Performance



The survey results in figure 10 and 11 provide valuable insight into learners' perceptions of using digital tools to enhance their English language skills. In the figure 10, which explores the impact of online quizzes, movies, and games on vocabulary retention, a significant majority of respondents expressed positive views. Specifically, 48.7% agreed and 25.3% strongly agreed that these tools help them remember English vocabulary better, while only a small percentage (6.7%) expressed disagreement, and 17.3% remained neutral. This indicates a strong belief in the effectiveness of interactive and engaging digital resources in supporting vocabulary acquisition. The figure 11 focuses on learners' views regarding the feedback provided by English learning apps. Here, 42% agreed and 30% strongly agreed that such feedback improves their performance, while 22% were neutral, and only 6% disagreed to any extent. These findings suggest that learners generally find digital tools beneficial, particularly in terms of engagement and the usefulness of feedback. Overall, the data underscores the potential of technology-enhanced learning methods in language education, supporting their integration into English language instruction to improve vocabulary retention and overall learner performance.

The SPSS-based analysis of data collected from 150 secondary-level students in Punjab, India, reveals that technology plays a significant role in enhancing English language learning outcomes. Descriptive statistics demonstrated a balanced but female-dominated sample (58% female, 42% male), with the majority of respondents (76%) coming from private schools and predominantly from semi-urban (45.6%) and urban areas (38.8%). These demographics suggest relatively better access to digital tools and infrastructure among most participants.

Frequency analysis indicated that students engage regularly with mobile devices for English learning, with a mean score of 3.31 on a 5-point scale, suggesting that mobile-based learning is integrated into their weekly routines. Furthermore, learners reported positive emotional responses when using technology for learning: excitement (mean = 4.01) and confidence (mean = 3.78) were the most common, while feelings of confusion and boredom were minimal. This emotional engagement appears to enhance the effectiveness of learning, as

ISSN 2394 - 7780

supported by the high number of students who agreed that digital tools like YouTube, Duolingo, and other apps helped them improve their vocabulary, speaking, and listening skills.

Pearson's correlation coefficient showed moderate to strong positive relationships between technology use and perceived language performance. Specifically, there was a statistically significant correlation between technology-use frequency and English performance ($r = .46$, $p < .001$), positive emotional engagement and performance ($r = .41$, $p < .001$), and perceived feedback quality from learning apps and performance ($r = .38$, $p < .01$). These findings confirm that students who regularly and positively engage with technology are more likely to experience improved language outcomes.

However, disparities in access and usage were evident. An ANOVA revealed a significant difference based on school type ($F(1,148) = 4.27$, $p < .05$), with private-school and urban/semi-urban students reporting higher technology usage and perceived benefits than those from government and rural schools. This highlights a digital divide that may limit the impact of technology on English learning for students in less privileged educational settings.

In conclusion, the SPSS analysis supports the view that technology significantly enhances English language learning, particularly in vocabulary retention, speaking, and listening skills. Learners perceive these tools not only as engaging but also as effective in delivering timely feedback and enhancing overall language performance. The study emphasizes the importance of integrating multimedia, interactive platforms, and supportive digital tools into the English language curriculum, while also addressing access gaps to ensure that all students benefit equally from these technological advancements.

DISCUSSION

Technology has brought many changes to how students learn English, and it has made the learning process more interesting and useful. Since online lessons, videos, and practice exercises are available on the internet, students can study whenever they want and from any place. This means they do not have to wait for school hours to learn, and they can move at their own speed, which helps them feel less pressure.

Digital tools like videos, audio clips, games, and quizzes make lessons more fun and help students stay focused. When students enjoy learning, they are more likely to remember what they study. Because everyone learns differently, such tools help visual learners, those who learn by hearing, and even those who like to move while learning. Students also get to see and hear real-life English by watching news videos or reading online articles, which improves their vocabulary and listening skills.

Many apps are now designed to understand the level of each learner. If a student is weak in grammar or pronunciation, the app gives extra practice and corrects mistakes immediately. This helps students learn from their errors and get better with time. Some new technologies like Virtual Reality (VR) allow students to enter a virtual English-speaking world where they can practise real-life conversations, which is very helpful for building confidence.

Technology also allows students to learn with others. They can talk to classmates online, join group discussions, or work together on school projects. By doing so, they practise speaking and writing in English more often. Teachers also benefit from these tools, as they get access to better teaching resources. With the help of learning websites and online training, teachers can make lessons more exciting and keep up with new teaching methods.

Gamified learning is another useful method, where students earn points or rewards after completing tasks. This keeps them motivated and encourages regular practice. Technology also makes it easy to check how much students have learned. Online tests give quick results and help students understand what they need to improve.

Because there is so much English content on the internet—like blogs, videos, and podcasts—students have many chances to continue learning even outside the classroom. However, for all of this to work well, schools need proper internet access, working devices, and trained teachers. If these problems are solved, technology can support English learners in becoming more confident and skilled in the language.

The findings of this study reinforce the increasing significance of digital tools in supporting English language acquisition at the secondary school level. Quantitative analysis reveals a clear positive correlation between students' regular, purposeful use of technology and their performance in core language areas, particularly vocabulary growth, reading comprehension, and spoken fluency. These results align with broader international research that underscores the capacity of educational technologies to create personalized, interactive, and motivating learning environments that respond to diverse learner needs.

ISSN 2394 - 7780

One of the study's most critical insights is the role of emotional engagement—students who enjoy and feel confident using digital tools tend to perform better. This supports existing theories on motivation and language acquisition, such as Krashen's Affective Filter Hypothesis, which posits that emotional readiness facilitates more effective learning. Moreover, tools such as YouTube, Duolingo, and gamified apps help create a low-stress environment conducive to self-paced and exploratory learning.

However, disparities in access—most notably the digital divide between private and government school students and between urban and rural learners—raise concerns about equity. Despite the potential of educational technology to bridge learning gaps, the current unequal distribution of resources may further entrench existing socio-economic disparities in educational outcomes. This echoes previous research emphasizing that the effectiveness of technological interventions depends heavily on infrastructure, training, and policy support.

Additionally, while technology significantly supports receptive and oral language skills, the impact on writing was not as pronounced in this study. This may suggest that certain language domains require more structured pedagogical approaches that digital tools alone may not fully address without teacher mediation.

FUTURE IMPLICATIONS AND RECOMMENDATIONS

The Indian educational system gradually adopts technology for instructional purposes. Education in India aims to enhance learning standards through accessible education for every student and to generate fresh ideas. Multiple major developments happened in the education sector because of the establishment of online learning platforms such as Khan Academy and Coursera and edX. Online learning platforms provide various free or cost-effective courses that enable students to acquire knowledge beyond traditional school settings. The availability of quality educational resources has enabled students from rural and economically disadvantaged regions to achieve educational equality. Digital classrooms have been adopted by many Indian schools including those in Punjab. Digital classrooms include smartboards along with projectors and other educational tools which enable teachers to deliver engaging lessons. Through technology, teachers can present educational materials using video content along with interactive animations and testing tools to assist students in learning complex subjects. The interactive teaching approach enables students to experience educational activities with enthusiasm and participate actively in class discussions.

Yet another significant development is the increasing application of mobile learning applications. With smartphones now a norm for the vast majority of students, learning apps such as Toppr and BYJU'S have reached broad popularity. These learning apps provide clear lessons, practice problems, and tailored learning experiences that assist students during their studies both in and out of the classroom. These apps follow the Indian school syllabus and offer lessons, quizzes, and plans that suit each student. The best thing about these apps is that students can study anytime and anywhere, whether at home or outside. This helps students learn at their own speed and practice hard topics again and again.

Besides these, there are free online resources called Open Educational Resources (OER). For example, the National Repository of Open Educational Resources (NROER) provides free textbooks, notes, and videos that schools and students can use. This helps a lot, especially in government or rural schools where books and other materials may be limited.

In colleges and universities, virtual labs and simulations are also being used. These let students do science and engineering experiments on computers. This is very useful when real labs are not available or are too costly. Virtual labs help students learn practical skills and understand science better.

More schools and exams are also moving online. Tests and assessments done on the internet are faster, fairer, and more organized. This change helps students get used to the digital world, where online skills are very important.

Teachers are getting help from technology too. They take online training, attend webinars, and use group platforms to learn new teaching methods and subject updates. When teachers know how to use technology well, they can teach students better.

The Government of India supports these changes through programs like Digital India and SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds). These projects try to reduce the gap between those who have technology and those who don't. They aim to make good education available to more students, especially in rural and remote places.

However, there are still problems. Several educational institutions lack access to high-quality internet services as well as computers and smart devices. Students and teachers struggle to utilize technology properly because they lack essential digital competencies. Educational inequality exists because students from low-income

ISSN 2394 - 7780

families' experience limited access to digital learning which their wealthier peers receive. Education in India and Punjab experiences gradual technological changes. Additional efforts are necessary to enhance learning opportunities for all students. The improvement of infrastructure along with digital skills instruction and universal technology access would lead to substantial learning enhancements. Technology serves teachers by enabling better instruction methods and student preparation for the 21st century period which demands digital expertise for both academic success and professional achievement.

CONCLUSION

Research shows that technology plays a valuable role in advancing the English language skills of high school students in Punjab. When students in this study utilized digital education tools including mobile learning apps together with online platforms and interactive resources, their language skills enhanced while they showed better participation than their peers who worked with conventional learning methods. The research demonstrated that students experienced substantial learning advantages through customized paths and instant feedback and adaptable English content availability. Students found these tools helpful because they allowed them to exercise reading, writing, listening, and speaking abilities according to their specific learning speed and comprehension level. Real English language materials from authentic sources which include news articles, videos, and social media content helped students improve their vocabulary while developing practical language proficiency. Through proper training and access to high-quality digital resources, teachers were able to enhance their lesson effectiveness and interest level through technology implementation. Student involvement rose when classrooms employed virtual learning environments with audio-visual aids and gamified content while OER availability provided essential support to schools that lacked sufficient books and educational resources.

The research findings validate the present national and worldwide patterns revealed through the literature review which demonstrates technology usage positively affects language learning outcomes. The combination of Digital India with SWAYAM and the National Repository of Open Educational Resources (NROER) has enabled students throughout India to acquire first-rate educational resources. The digital advancements in Punjab have made strides toward narrowing the educational gap between urban and rural students in the region yet disparities between these groups persist. The research findings revealed multiple obstacles in addition to the advantages. The technological obstacles persist in remote educational facilities due to their inadequate internet connectivity and digital hardware resources and their teaching personnel absence of proper training. Students from low-income backgrounds experience restricted access to online education since they cannot afford smartphones and data costs. The education team has displayed an open-minded approach for technology integration but certain members fall short in using digital tools because they do not possess essential technical competencies.

The enhancement of English language learning through technology in Punjab requires several necessary steps for implementation. The efforts need to include the improvement of school facilities and digital training programs for teachers and the achievement of low-cost digital access for students along with inclusive learning content suitable for various student groups. The creation of technology-friendly support systems which benefit students alongside educators stands as a key element for effective implementation. Technology proves to be an effective solution for improving secondary school student proficiency in English according to the results of this study. Students will develop strong English language skills through innovative tools which teachers support and inclusive policies work together to provide. The rising digital age in India will receive numerous benefits from these initiatives which will enhance language education and help students achieve both academic and professional success along with worldwide communication skills.

REFERENCES

- Abdalhamid, F. (2012). *Listening comprehension strategies of Arabic-speaking ESL learners* (Doctoral dissertation). Colorado State University, Fort Collins, CO, United States.
- Alam, M. (2007). The development of L2 writing expertise: The teacher as a facilitator of qualitative changes in the EFL/ESL classroom. *The Chittagong University Journal of Arts and Humanities, 12*, 139–154.
- Alderson, J. C. (1990). Testing reading comprehension skills (Part one). *Reading in a Foreign Language, 6*(2), 425–438.
- Bachman, L. F., & Palmer, A. S. (1996). *Language testing in practice*. Oxford University Press.

ISSN 2394 - 7780

- Behizadeh, N., & Engelhard, G. (2011). Historical view of the influences of measurement and writing theories on the practice of writing assessment in the United States. *Assessing Writing, 16*(3), 189–211. https://doi.org/10.1016/j.asw.2011.03.001.
- Cahyono, B. Y. (2000). The overall proficiency in English composition of Indonesian university students of EFL. *TEFLIN, 11*(1), 161–170.
- Davies, A., Brown, A., Elder, C., Hill, K., Lumley, T., & McNamara, T. (1999). *Dictionary of language testing*. Cambridge University Press.
- Fatemi, M. A. (2008). *The relationship between writing competence, language proficiency and grammatical errors in the writing of Iranian TEFL sophomores* (Doctoral dissertation). Universiti Sains Malaysia, Penang, Malaysia.
- Gautam, K. (1988). *English language teaching: A critical study of methods and approaches*. Harman Publishing House.
- Gomathi, B. S., & Kiruthika, P. (2013). Methods of improving speaking ability in English in L2 classrooms: A case study. *Language in India, 13*(11), 209–215.
- Hamp-Lyons, L. (1990). Second language writing: Assessment issues. In B. Kroll (Ed.), *Second language writing: Research insights for the classroom* (pp. 69–87). Cambridge University Press.
- Jacobs, H. L., Zinkgraf, S. A., Wormouth, D. R., Hartfield, V. F., & Hughey, J. B. (1981). *Testing ESL composition: A practical approach*. Newbury House.
- Jadeja, R. (1988). *Developing techniques for the teaching and testing of language use with specific focus on oral communication at the secondary level* (Doctoral dissertation). Sardar Patel University, Vallabh Vidyanagar, India.
- Kahol, V. (2009, February 21). In Punjab, fail maths, English but still pass matric. *India Today*, A2.
- Kohli, A. L. (2013). *Techniques of teaching English*. Dhanpat Rai.
- Littlewood, W. (1992). *Teaching oral communication: A methodological framework*. Blackwell.
- Nunan, D. (1997). Listening in language learning. *The Language Teacher, 23*(9), 47–51.
- Paliwal, A. K. (1998). *English language teaching*. Surabhi Publications.
- Patel, M. S. (1958). Teaching English in India. *ELT Journal, 12*(3), 79–86.
- Richards, J. C., & Renandya, W. A. (2002). *Methodology in language teaching*. Cambridge University Press.
- Tompkins, G. E., & Hoskisson, K. (1995). *Language arts: Content and teaching strategies*. Macmillan.
- Verghese, C. P. (1990). *Teaching English as a second language*. Sterling Publishers.
- Weigle, S. C. (2002). *Assessing writing*. Cambridge University Press.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

SATELLITE IMAGE ALIGNMENT BASED ON FUSION TECHNIQUES AND DEEP NEURAL NETWORK

Satrughan Kumar Singh[1*], Jainath Yadav[2] and Muniyan Sundararajan[3]
[1,2]Department of Computer Science, Central University of South Bihar, Gaya – 824236, Bihar, India
[3]Department of Mathematics and Computer Science, Mizoram University, Aizawl – 796004, Mizoram, India

ABSTRACT
Satellite remotely sensed image data provide the better approach for analyzing and proper monitoring on different land use and land cover over large landscape areas in different seasons. Multi sensor data fusion refers to the data acquisition, processing and synergetic combination of information gathered by various sources and sensors to provide a better understanding of the phenomenon under consideration. Multi sensor data fusion with respect to remotely sensed images is the fusion of images of the same area or scene having different spatial and spectral resolution. In this paper, first, fusion of satellite remote sensed image based on the principle of gravitational force of attraction between two masses separated by certain distance is proposed. Thereafter, CNN is used to perform the image alignment. The proposed model achieves higher accuracy than traditional models for image alignment.

Keywords: *Satellite image; image fusion; image alignment; CNN; traditional models;*

INTRODUCTION
Remote sensing has emerged as an essential tool in environmental studies due to its inherent advantages such as capability of studying large composite areas and even inaccessible areas [1]. Data fusion is the process of integrating or fusing the data obtained from different sources to achieve improved accuracy and more specific inference, at least with reference to a particular context or a set of contexts than could be achieved by the use of a single set of data [2]. Data fusion has received significantly attention for both military and non-military applications with the objective to generate an interpretation of the scene not obtainable with data from a single source or to reduce the uncertainly associated with data from individual sensors. Typical military applications include target detection, remote sensing and battlefield surveillance. Non-military applications include remote sensing for determine land use and land cover. Several computer vision and image processing applications include like virtual reality and so on. Data fusion by enabling integration of data contributes to reduction in data for analysis and storage [3]. Data fusion with respect to images can be multi-sensor, multi-resolution, and multi-temporal data fusion. In multi-resolution fusion, images of the same area or scene having different spatial resolution are fused. Whereas in multi-sensor data fusion, images of the same area or scene having different spectral resolution with different or same spatial resolution are fused. Multi-sensor data fusion refers to the acquisition, processing and synergetic combination of information by various sources and sensors to provide a better understanding of the phenomenon under consideration. The most important pre-processing step in fusion is that the images be registered first. Image registration is the process of geometrical alignment and matching of two or more images of the same scene, acquired from different sensors, with different views and at different times [4]. Image registration aims at aligning any two or more images into identical coordinate, and further these images are utilized for comparative analysis [5]. Image registration is a fundamental task in image processing used to match two or more pictures taken at different times from different sensors or from sensors is converted to a uniform spatial resolution and fused pixel by pixel. In multi-spectral images, fusion of images are based on the bands of the images and which band of the image has to be fused with which band of the other image have to be decided a priori depends on the application. The fused image can be subjected to texture analysis, clustering, segmentation, edge selection, etc. Fusion of two images is obtained as the image which has the least square deviation from the finer resolution image, subject to the constraint imposed by the knowledge of the coarse resolution image of the same scene [6]. Fusion of HyMap Hyperspectral and mapping of land cover types and other environmental monitoring and planning purposes [7].

METHODOLOGY

Study Area
In the study area, we have taken satellite imagery of four different satellites, namely Resourcesat, Sentinel, MODIS and Landsat. The study area is located in Dhanbad district in Jharkhand state lies between the latitude from 23°29'45.6" N to 24°0'18" N and longitude from 86°29'42" E to 87°0'14.4" E (see Fig.1).

ISSN 2394 - 7780

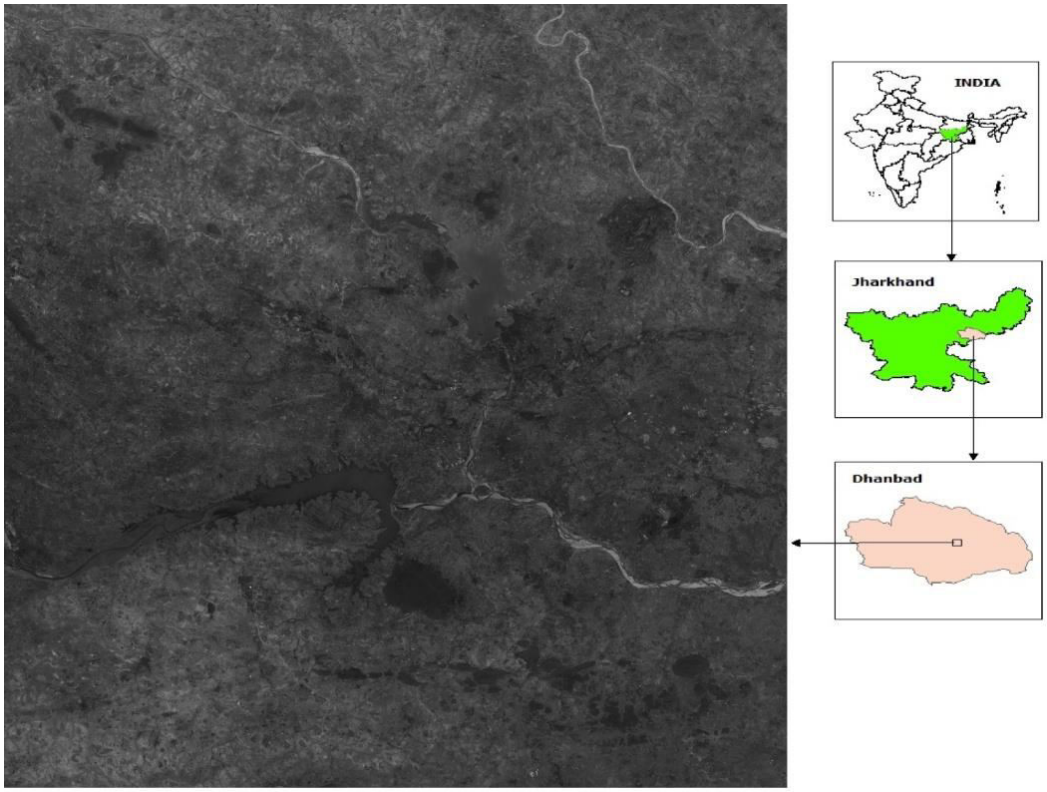


Fig.1: Location of the study area

Fusion

The best fusion system that one can think is the human brain that integrates sensory information namely sight, smell, taste and touch data that makes inferences regarding the surrounding environment. In principle, fusion of multi-sensor data fusion provides significant advantage over the single source data. In addition to the statistical advantage gained by combining same source data from multiple type sensors may increase the accuracy with which a quantity can be observed and characterized. Different multi-sensor, multi-resolution, multi-spectral and multi-temporal images obtained from different sensors are limited by the properties of the sensor source. Image fusion enables users to integrate different datasets, and therefore increases the information content. In this section, the process of fusing two images pixel by pixel is explained using Gravity fusion technique. The most important step before fusion is conversion of images to a uniform spatial resolution. Spatial resolution conversion is performed using interpolation techniques. The most frequently used interpolation techniques are Lagrange's interpolation and Newton's divided difference interpolation. In the image resizing procedure, an input image of size $(X * Y)$ is accepted which is to be resized into size $(P * Q)$. the ratio of X to P is calculated for resizing in the horizontal direction. Similarly, ratio of Y to Q is calculated for resizing in the vertical direction. Using the ration, we find the overlapped portion (position of the resize image on the original image). Different techniques are used to convert the images into a uniform spatial resolution. But, all the techniques give distorted image when a new color is introduced. To overcome this problem a decision based algorithm is introduced. One of the important decision functions in statistics is given by Bayes' rule which converts the probabilities along with the density distribution to aposteriori decision that has minimum probably of error, thereby giving an optimal decision.

$$P\left(\frac{x_i}{g}\right) = \frac{P(x_i) * P\left(\frac{g}{x_i}\right)}{P(x_i) * P\left(\frac{g}{x_i}\right) + P(x_j) * P\left(\frac{g}{x_j}\right)}$$

where defines the area contribution which lies between 0 and 1, defines the color density distribution that can be calculated from the histogram of the given image. We make an assumption that the distribution as normal there by simplifying the computation. To calculate the color density distribution value, we use

$$P\left(\frac{g}{x_i}\right) = \left(\frac{1}{\sigma\sqrt{2\pi}}\right) * \exp(0.5 * 2S^2) * (x_i - \mu)$$

and based on the new intensity value is decided as follows:

ISSN 2394 - 7780

$$I_{Image[i][j]} = f(x) = f(x) = \begin{cases} image[i][j], & P\left(\frac{x_i}{g}\right) > P\left(\frac{x_j}{g}\right) \\ image[i][j+1], & otherwise \end{cases}$$

Gravity fusion technique is based on the principle of gravitational force of attraction between two objects of different masses separated by certain distance. The principle states, the force of attraction between two objects of different mass is directly proportional to the product of the masses and inversely proportional to the square of the distance between them. Let $f(I_1)$ be the intensity value of the image1 at (i,j) position and $f(I_2)$ be the intensity value of the image2 at (i,j).

$D = f(I_1) - f(I_2)$ ------ equation (3)

Where D is distance between two intensity value of image1 and image2.

If F be the force of attraction, then

$F\ \mu\ [f(I_1) * f(I_2)]$ ------ equation (4)

and, $F\ \mu\ (1/D^2)$ ------ equation (5)

Therefore, $F = [f(I_1) * f(I_2)]/D^2$ ------ equation (6)

The value of 'F' gives the force of attraction between the pixel values of image1 and image2, which is used as a weightage factor in deciding the contribution from the pixels. Wherever, the pixel value of the two images is equal, then the value 'F' would be infinite that is force of attraction is maximum.

Let $(b = F^{-1}\ or\ b = F)$ depending on whether $(F < 1\ or\ F > 1)$, where $(0 \text{ ≤ } b^3\ 1)$. The value of b would be deciding the percentage or the weightage of pixels contribution using linear interpolation which is written as

$$(1-b) * f(I_2) + b * f(I_1) \qquad \text{if } 0 \text{ ≤ } b^3\ 0.5$$

Fused is denoted by b;

$$b = (1-b) * f(I_1) + b * f(I_2) \qquad \text{if } 0.5 \text{ ≤ } b^3\ 1$$

If the value of b is less than 0.5, then the multiplication of b with higher intensity value and (1-b) with the lower intensity value. This is because; edges always have value of lower intensity (0-255).

Image Alignment

Machine learning is currently playing a vital role in the next generation of the computer world [8]. Nowadays, machine learning facilitates an automatic intelligent system for pattern recognition [9]. Automatic pattern recognition has become an important issue of image processing and machine learning [8]. In machine learning, the computer intelligence expert models are trained by known datasets of the domain context [10]. Computer vision and image processing has many applications for image retrieval, pattern recognition, target tracking, etc. using image alignment technique. In this study, we use traditional method such as SIFT, feature and area based method for image alignment. Neural networks are matured to work best on large datasets [11]. CNN is used as a proposed method for image alignment. Generally, image alignment is categorized by two methods namely feature-based method and area-based method. In the feature-based method, Hausdorff distance is to be applied for image alignment. Huttenlocher et al. [12,13] apply the directed Hausdorff distance to several algorithms to allow image alignment. Kown et al. [14] proposed a robust hierarchical Hausdorff distance to compare edge maps in a multi-level pyramidal structure. Chen et al. [15] also used the Hausdorff distance for image alignment in an inspection system for printed circuit boards. Area-based method has been most popular in recent decades for its fundamental concepts. This method is sometimes called template-matching or correlation-like method. In the area-based method, first small template is applied to a large inspection image on a pixel wise through the sliding template window, and then normalized cross correlation is computed between the inspection image and template window. The maximum peak values indicate the best matches between the inspection image and template window for computed correlation values. The normalized cross correlation is then used for managing the registration that differs by translation of an image. If the images are not deformed by the complex transformation, then the template window can cover the same RoI (region of interest) in the inspection image and template window. Else, the template window cannot cover the same RoI in the inspection image and template window. Several studies have proposed metrics computation of normalized cross correlation for image registration problem. Tang et al. [16] proposed a ring-projection transformation to allow the image matching through the transformation of 2D gray image into a rotation-invariant representation. Tsai and Chiang [17] apply the ring-projection transformation in wavelet-decomposed sub-images to represent a target template. They

ISSN 2394 - 7780

used high wavelet coefficients at low levels of resolution with pixels formulation for computation of normalized cross correlation. Choi and Kim [18] proposed 2-stage image alignment method. This method allow the provision for location the candidate selection through the comparison of vector sums for ring projection and then compute the normalized cross correlation for image registration to allow the image matching through the transformation. The demerit of the feature-based method is inaccurate feature extraction. Whereas, the area-based method is flawed with excessive computation time for complex image transformation. The proposed model of image alignment describes rotation of images by selecting best candidate at the lowest index of the pyramid image that significantly enhances the performance of rotation estimation.

Scale invariant feature transform (SIFT) algorithm was proposed by David Lowe in 1999. SIFT algorithm is designed for feature detection on images that produce the key point and descriptors. The merits of SIFT algorithm is that it has rotation invariant and scale invariant. It has following goals: (a) extracting distinctive invariant features (b) robustness to affine distortion, change in 3D viewpoint, addition of noise and change in illumination (c) invariant to image scale and rotation. SIFT has four computational phases, namely scale space peak selection, key point localization, orientation assignment, and key point descriptor. Scale space peak selection (SSPS) is the first and major phase of the SIFT algorithm where peak selection detects the region of interest point from an image and generate the different smoothing version of same image varying different size of sigma in Gaussian. It search over all scales and image location with the help of difference of Gaussian and finally determines the desired scale and location for all the obtained point of interest which are found in scale. Key point localization (KPL) is the second phase of the SIFT algorithm where scale and location is determined for all the point of interest that is obtained from SSPS phase. The key points are selected and these key points which are selected should be unaffected to the image distortion on the basis of stability using Taylor series expansion (T) of difference of Gaussian.

$$T(k) = T + \frac{\partial T^d}{\partial k} * k + 0.5 * k^d * \frac{\partial^2 T}{\partial k^2} * k$$

Orientation assignment phase allow to figure out the gradient direction for the key points and maximum peak detection. The gradient and direction are given by $m(x, y)$ and $\theta(x, y)$, and is calculated for an image by OA(x, y). The mathematical expression of gradient and direction are:

$$a = OA(x+1, y) - OA(x-1, y)$$

$$b = OA(x, y+1) - OA(x, y-1)$$

$$m(x, y) = \sqrt{a^2 * b^2}$$

$$\theta(x, y) = \arctan\left(\frac{b}{a}\right)$$

Key point descriptor is the last phase of SIFT algorithm that generates feature vectors (see Fig.2). Fig.2 shows different cells and arrow in each cell denote both gradient direction and amplitude of pixels. The normalization will performed in each cell by aligning unidirectional gradients for the seed point.

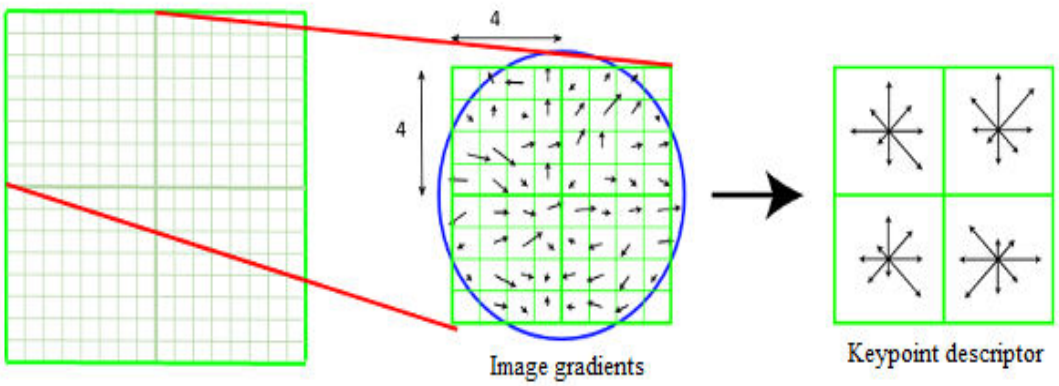


Fig.2: Key point descriptor for feature vector generation

(***Source:*** https://www.analyticsvidhya.com/blog/2019/10/detailed-guide-powerful-sift-technique-image-matching-python/)

ISSN 2394 - 7780

The implementation of the proposed method accomplished by two phases, namely template pre-processing that determines the projection of multi-resolution for the region of interest in the template image, and online alignment phase that identifies the best candidate on the lowest image pyramid for rotation estimation.

Step-1: Input template image, P

Step-2: Construct the template images of multi-resolution, Pi; where $(0 \leq i \leq max_l)$; i represents the level of pyramid and max_l is the maximum value of pyramid level.

Step-3: Find the ring-projection value between lower and upper level of pyramid.

Step-4: Determine the values of variance-project of the image pyramid level through the variance-project transform,

Ring-projection values $= \sigma_{P,l}(r)$, where r ε $[R_{(l,min)}, R_{(l,max)}]$

Step-5: Determine the values of hybrid-projection for each level of pyramid using step-3, step-4 and weight coefficients of the corresponding ring projection and variance projection. An image entropy is used for determining the corresponding weight coefficients as $\omega_{m,l}(r)$ and $\omega_{\sigma,l}(r)$.

Step-6: Determine the threshold value for different inspections; $T_{min,l}$

Step-7: Construct the inspection image of multi-resolution; Sl, where l=0, 1, … L

Step-8: Initialize the search location (x=0, y=0) in the highest pyramid level of the inspection image.

Step-9: Use the ring-projection and variance-projection for calculation of the values of ring-projection and variance-projection.

Ring-projection values $= C_{s,l}(x, y, r)$

Variance-projection values $= \sigma_{s,l}(x, y, r)$

Where x and y are location point of x-axis and y-axis.

Step-10: Inherit the values of ring-projection and variance-projection on the pyramid level of the image *l* from step-9, and weight coefficients from step-5.

Hybrid-projection values $= [C_{s,l}(x, y, r), \sigma_{s,l}(x, y, r)]$

Weight coefficients $= C_{s,l}(x, y, r)$

Step-11: Determine the value of correlation coefficient at the location (x, y).

$$Z_1 = (H_{p,l}(r) - \bar{H}_{p,l}(r))$$

$$Z_2 = (H_{s,l}(x, y, r) - \bar{H}_{s,l}(x, y, r))$$

$$Z_3 = \sum_{R_{min}}^{R_{max}} (Z_1 * Z_2)$$

$$Z_4 = \sum_{R_{min}}^{R_{max}} (Z_1)^2 * \sum_{R_{min}}^{R_{max}} (Z_2)^2$$

$$\delta_i(x, y) = \frac{Z_3}{\sqrt{Z_4}}$$

where Z_1 and Z_1 represents the values of the template and inspection images of the hybrid-projection transformation, *i* represents the index of the level of pyramid, and $\delta_i(x, y)$ is the correlation value lies between the range of -1 and +1.

Step-12: $f(x) = \begin{cases} \text{Store location (x, y) in the candidate list}, & \delta_i(x, y) > predefined\ threshold \\ GOTO\ Step - 11, & otherwise \end{cases}$

Step-13: GOTO *Step-9* until the search block reaches the highest pyramid level of the inspection image.

ISSN 2394 - 7780

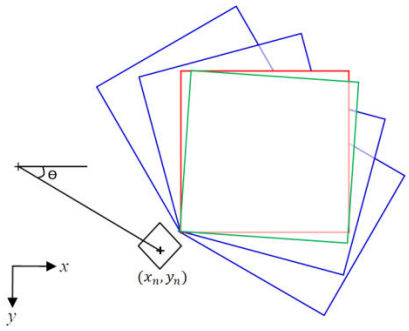


Fig.3: Geometric relationship between template image (red border colour) and inspection images of multi-resolution (blue border colour) for best candidate selection (green border colour)

EXPERIMENTAL RESULTS

In this paper, we have used MATLAB version 2022b for image fusion and alignment. CNN model is used to optimize continuously and improve the weights of convolutional kernel during the training of network. The performance of the proposed model describes the experimental results with different aspects. The proposed model also compares the performance with traditional models. To estimate the rotation accuracy, the simulated rotated images are generated by rotating the original image at rotation angles from 0-359 degree in increments of 5 degree. For obtaining the rotation angle, the least second moment method is utilized to estimate the angle between the template and inspection image. Also, the pre-constructed rotated templates score and piecewise linear model are applied to estimate the rotation angle. The error E_r is calculated using the following equation.

$$E_r = |\theta_a - \theta_e|$$

where θ_a and θ_e aretheactual and estimated rotation angles, respectively.

To provide an overall accuracy evaluation, three performance indices of error E_r are used to quantitatively show the performance: the mean of error E_{mean}, the standard deviation of error E_{sd}, and the maximum error E_{max}. The proposed model achieved the rotation accuracy with mean of error, standard deviation and maximum error are 0.019, 0.017 and 0.078, respectively. From the experimental results, the proposed method not only provides a correct location, but also estimates a correct and precise rotation angle for the template image on the fused image. Based on the convincing results of this experiment, the proposed method can be used with fused image. However, the feature-based matching method that use the SIFT descriptor is not appropriate for the complex images. There are more than 2300 feature points in the fused images. The efficiency of the feature-based method is slower than the proposed method.

CONCLUSION

Fusion of different spatial resolution images and mosaicing of two fused images has been implemented. We have shown results on some remote sensed satellite images containing translation and rotation. The proposed model for image alignment uses rotation-discriminating ring-shifted projection. It combines hybrid projection transformation and the ring shift technique. The hybrid projection transformation with the image pyramid searching technique can significantly reduce the computation burden and own the unique and robust features in the alignment process. The ring shift technique provides the rotation estimation between the template image and the searching image. The projection transformation with the image pyramid searching technique can significantly reduce the computation burden and own the unique and robust features in the alignment process. The ring shift technique provides the rotation estimation between the template image and the searching image. The results show that the rotation estimation of the proposed method is superior to the other traditional methods. Furthermore, the proposed image alignment algorithm can obtain accurate and robust results and also works well under noise influence and translation. A series of experiments verified the efficiency, accuracy, and robustness of the proposed model. The proposed model provides higher accuracy than traditional methods.

ACKNOWLEDGEMENT

The authors are thankful to the Director, CSIR-CIMFR for his kind approval to publish the research article in the journal.

REFERENCES

1. H. N. Srikanta Prakash, P. Nagabhushan and K. Chidananda Gowda, "Symbolic agglomerative clustering for quantitative analysis of remotely sensed data", International Journal of Remote Sensing, Volume 21, 2000 - Issue 17, Pages 3239-3251

ISSN 2394 - 7780

2. D. L. Hall and J. Llinas, "An introduction to multisensor data fusion", Proceedings of the IEEE (Volume: 85, Issue: 1, Jan. 1997), pages 6-23
3. M. Costantini, A. Farina and F. Zirilli, "The fusion of different resolution SAR images", Proceedings of the IEEE (Volume: 85, Issue: 1, Jan. 1997), Pages: 139 – 146
4. Zitová, B.; Flusser, J. Image registration methods: A survey. Image Vis. Comput. 2003, 21, 977–1000. [CrossRef]
5. A. Sotiras, C. Davatzikos, and N. Paragios. Deformable medical image registration: A survey. IEEE Transactions on Medical Imaging, 32(7):1153–1190, 2013.
6. Philip K. Robertson and John F. O'callaghan, "The Application of Scene Synthesis Techniques to the Display of Multidimensional Image Data", ACM Transactions on Graphics, Vol. 4, No. 4, October 1985, Pages 247-275.
7. A.H.S. Solberg, A.K. Jain and T. Taxt, "Multisource classification of remotely sensed data: fusion of Landsat TM and SAR images", IEEE Transactions on Geoscience and Remote Sensing, Volume: 32, Issue: 4, Jul 1994), pp. 768 – 778
8. Singh, S. K., & Yadav, J. (2021). Machine Learning & Image Processing for hand written digits and alphabets recognition from document image through MATLAB simulation. IOP Conf. Series: Material Science and Engineering, 1084(2021)012021, 1-8. doi: 10.1088/1757-899X/1084/1/012021
9. Kumar, V., Singh, S. K., Yadav, J., & Sundararajan, M. (2023). A comparative study of different architectural models of CNN for plant leaf disease detection. International Journal of Computing Sciences Research, 7, 2415-2430. https://doi.org/10.25147/ijcsr.2017.001.1.167
10. Singh, S. K., Mohan, A., & Sundararajan, M. (2023). Isolated Spoken Word Transformation Using Feedforward Neural Network in Speaker Independent Speech Recognition. Digital Transformation in Sustainable Growth (DTSG 2022), ISBN: 978-81-19149-52-0, pp. 105-114, https://www.kdpublications.in
11. Singh, S. K., Sundararajan, M., & Yadav, J. (2022). An automatic infant cry speech recognition using artificial neural network. HYPOTHESIS - National Journal of Research in Higher Studies, ISSN-2581-8953, V(2); 9-18.
12. Huttenlocher, D.P.; Klanderman, G.A.; Rucklidge, W.J. Comparing images using the hausdorff distance. IEEE Trans. Pattern Anal. Mach. Intell. 1993, 15, 850–863.
13. Huttenlocher, D.P.; Lilien, R.H.; Olson, C.F. View-based recognition using an eigenspace approximation to the hausdorff measure. IEEE Trans. Pattern Anal. Mach. Intell. 1999, 21, 951–955.
14. Kwon, O.-K.; Sim, D.-G.; Park, R.-H. Robust hausdorff distance matching algorithms using pyramidal structures. Pattern Recogn. 2001, 34, 2005–2013.
15. Chen, C.-J.; Lai, S.-H.; Liu, S.-W.; Ku, T.; Yeh, S.Y. Optical PCB inspection system based on hausdorff distance. In Proceedings of SPIE 5679, Machine Vision Applications in Industrial Inspection XIII, 53, San Jose, CA, USA, 17 January 2005; pp. 53–61.
16. Tang, Y.Y.; Cheng, H.D.; Suen, C.Y. Transformation-ring-projection (TRP) algorithm and its VLSI implementation. Int. J. Pattern Recogn. Artif. Intell. 1991, 5, 25–56.
17. Tsai, D.-M.; Chiang, C.-H. Rotation-invariant pattern matching using wavelet decomposition. Pattern Recogn. Lett. 2002, 23, 191–201.
18. Choi, M.-S.; Kim, W.-Y. A novel two stage template matching method for rotation and illumination invariance. Pattern Recogn. 2002, 35, 119–129.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

THE ROLE OF OMEGA-3 ENRICHED DAIRY PRODUCTS IN COGNITIVE HEALTH

Shajla Ibrahim[1], G.Nandhini[2] and Dr. Esther Rakel[3]
[1]PG student, Department of Clinical Nutrition, Ganga Institute of Health Science, Vattamalaipalayam
[2]Professor and Head of the Department of clinical nutrition, Ganga institute of health science, Vattamalaipalayam-641022
[3]Principal, Ganga Institute of Health Science, Vattamalaipalayam-641022

ABSTRACT
Omega-3 fatty acids, particularly DHA and EPA, are recognized for their essential roles in supporting cognitive development and neuroprotection. This paper explores the integration of omega-3s into dairy products and their potential in enhancing brain health. A literature review was conducted analyzing clinical and preclinical studies on omega-3 enriched dairy interventions.Evidence suggests improved memory and neurogenesis, though results vary based on dosage and duration.Omega-3 fortified dairy products offer a feasible strategy for supporting cognitive health, with broader public health benefits.Omega-3 fatty acids, particularly DHA and EPA, are well-documented for their roles in supporting brain health. The integration of omega-3 fatty acids into widely consumed dairy products offers a promising nutritional intervention to enhance cognitive function and delay age-related cognitive decline. This paper critically explores the biochemical role of omega-3s, examines their impact through both clinical and animal studies, and evaluates the potential of dairy products as a functional food vehicle for their delivery. Emphasis is given to dairy technology, consumer acceptance, and public health implications, supported by critical reviews and practical applications.

INTRODUCTION
Cognitive health is a cornerstone of well-being, influencing everything from academic performance to independence in old age. With the rising incidence of cognitive impairments, especially in aging populations, identifying dietary strategies that support brain health is essential. Omega-3 fatty acids—primarily DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid)—are crucial nutrients found to be deficient in many diets. As fish, the primary dietary source of omega-3s, may not be suitable or accessible to all, dairy products enriched with omega-3 present a sustainable and broadly acceptable alternative. This paper explores the science, applications, and limitations of using dairy as a carrier for cognitive-enhancing omega-3 fatty acids.Dairy Products as Functional Food VehiclesDairy products such as milk, cheese, yogurt, and buttermilk are consumed across all demographics, offering an ideal platform for functional nutrient delivery. The matrix of dairy supports the stability and bioavailability of omega-3 fatty acids, especially when protected through microencapsulation. Flavored yogurts and milk drinks can mask any potential off-flavors from fish or algal oil. Recent advances allow incorporation of algae-derived DHA into dairy matrices without affecting sensory qualities. Cheese and butter, due to their fat-rich nature, are also excellent carriers. Yogurt can be fortified without disturbing live cultures. Importantly, probiotic dairy in synergy with omega-3 can offer dual benefits to brain and gut health.

METHODOLOGY
This review was conducted by analyzing peer-reviewed articles, clinical trial data, and preclinical research published between 2020 and 2025. Databases such as PubMed, ScienceDirect, and Google Scholar were used with keywords including 'omega-3', 'DHA', 'EPA', 'cognitive health', 'dairy fortification', and 'functional foods'. Articles were selected based on relevance, publication year, and study design. Both human and animal studies were considered.

Critical Review of Clinical and Preclinical Studies
Human trials show mixed results, often influenced by dosage, duration, and baseline cognitive status. Some key findings include:

- In children, fortified milk improved school performance and attention.
- In elderly with MCI, omega-3 dairy improved memory and processing speed.
- No significant changes were noted in some large-scale studies possibly due to low bioavailability or insufficient intervention time.

Animal models consistently show enhanced learning, reduced inflammation, and neuroprotection with omega-3 dairy interventions. Rodents given DHA milk displayed higher hippocampal BDNF and reduced amyloid plaque formation. Despite variability, the trend suggests fortified dairy positively influences brain health when taken consistently.

ISSN 2394 - 7780

Mechanisms of Neuroprotection
Omega-3s contribute to cognitive resilience by multiple mechanisms:

- Anti-inflammatory action via resolvins and protectins.
- Enhanced synaptic plasticity through BDNF upregulation.
- Improved cerebral perfusion and oxygenation.
- Modulation of neurotransmitters such as serotonin and dopamine..

These pathways collectively aid in preserving cognitive function and slowing neurodegenerative processes.

Dairy Fortification Techniques and Challenges
Omega-3s are prone to oxidation, leading to off-flavors. Microencapsulation using milk proteins or liposomes can protect them. Use of algal oil over fish oil improves taste and meets vegetarian standards. Heat treatment must be carefully controlled to prevent degradation. Regulations vary across countries on permitted omega-3 levels. Consumer education and proper labeling improve acceptance. Stability during storage is another technical consideration.

Public Health Significance
Fortified dairy can address widespread omega-3 deficiency, particularly in vulnerable groups such as pregnant women, infants, and the elderly. School-based programs and elder nutrition schemes can benefit from including fortified dairy. It also opens opportunities for rural and vegetarian communities with limited access to marine sources. Omega-3 enriched dairy can act as a preventive tool against age-related cognitive disorders, thereby reducing healthcare costs and improving population productivity.

LIMITATIONS AND FUTURE RESEARCH

Challenges Include:
- Lack of standardization in fortification protocols.
- Differences in omega-3 absorption depending on fat matrix.
- Genetic differences in fatty acid metabolism (e.g., FADS1 polymorphisms).

Future studies should focus on long-term trials using culturally adapted dairy forms, studying cognitive outcomes across life stages. Research must also explore co-fortification strategies (e.g., omega-3 with vitamin D or B12) to maximize neuroprotective potential.

RESULTS AND DISCUSSION
The brain's gray matter is composed significantly of lipids, with DHA making up a large proportion of neuronal membranes. These fatty acids are integral for synaptic function, neurogenesis, and neurotransmitter regulation. DHA is crucial in early brain development and in preserving cognitive function later in life. EPA has a notable role in regulating neuroinflammation and improving vascular function. Their combined action supports memory, learning, focus, and emotional regulation.

CONCLUSION
Omega-3 enriched dairy products offer a promising, sustainable, and accessible strategy to promote cognitive health. With scientific validation from multiple fronts—biochemistry, clinical trials, and public health—fortified dairy could play a central role in nutrition interventions. Integrating such products into daily diets may contribute significantly to delaying cognitive decline and enhancing mental performance across all age groups.

REFERENCES
1. Jackson PA, Forster JS, Bell JG, Williams CM. DHA-enriched yogurt improves memory in older adults. J Nutr Health Aging. 2020;24(3):280–286.
2. Venkatramanan S, et al. Evaluation of food fortification with omega-3 in dairy and non-dairy products. Nutrients. 2020;10(10):1520.
3. Choudhary M, et al. Omega-3 fatty acid fortification in dairy products and cognitive health: A review. Indian J Nutr Diet. 2021;58(2):145–152.
4. Kim J, et al. Microencapsulation techniques for omega-3 fatty acids in functional dairy. Int J Food Sci Technol. 2021;56(3):1020–1029.

ISSN 2394 - 7780

5. Reddy AA, et al. Consumer perception and sensory acceptability of omega-3 fortified milk. Indian J Dairy Sci. 2022;75(1):48–55.
6. Singh RK, et al. Probiotic and omega-3 dairy synergy: A new frontier in mental health nutrition. Trends Food Sci Technol. 2022;127:1–12.
7. Sharma D, et al. Omega-3 enriched dairy products and their role in neurodegenerative disease management. J Food Biochem. 2023;47(1):e14532.
8. Wang L, et al. Nutritional bioavailability and brain uptake of algal DHA in fortified dairy. Nutr Neurosci. 2023;26(5):323–334.
9. Patel M, et al. Formulation and stability of omega-3 fortified paneer: A functional Indian dairy product. Food Chem. 2023;398:133923.
10. Balasubramanian A, et al. Technological and regulatory considerations for dairy fortification in India. Indian Food Ind. 2024;43(2):75–82.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

A STUDY TO ASSESS THE KNOWLEDGE AND DIETARY PRACTICES REGARDING HORMONAL IMBALANCES AMONG YOUNG ADOLECENT GIRLS IN SELECTED AREA IN TUTICORIN DISTRICT

Subaitha Hilma.K.N[1], G. Nandhini[2] and Jebakumari Sutha[3]
[1]Postgraduate, Department of Clinical Nutrition, Ganga Institute of Health sciences, Coimbatore-641022
[2]Professor, Department of Clinical Nutrition, Ganga Institute of Health sciences, Coimbatore-641022
[3]Professor Cum Vice Principal, Ganga Institute of Health Sciences, Coimbatore-641022

ABSTRACT

Aim and Objectives: *The present study aims to assess the knowledge and dietary practices regarding hormonal imbalances and promotion of hormone supporting product among adolescent girls in selected areas of Thoothukudi (Tuticorin) District.*

Methodology: *A descriptive research design was adopted in order to assess the knowledge and dietary practices regarding hormonal imbalances among adolescent girls from selected area in Thoothukudi District. The independent variable of this study was giving education about hormonal imbalance (with ppt presentation) and distribution of the hormone-supportive product(which is butterfly pea flower pudding) and the dependent variable of this study was assessing knowledge, dietary practices of young adolecent girls and Acceptability of the distributed product (e.g., taste, texture, willingness to consume) in selected areas in Tuticorin district. A total of 50 participants were selected using a convenient sampling technique. Data were collected through a structured questionnaires consisting of sections on demographic details, knowledge about hormonal imbalances, hormone balancing foods and dietary practices of the adolescent girls and sensory evaluation of the product (butterflypea flower pudding) was done by adolescent girls.*

Results: *The findings revealed that 37% of the participants had moderate knowledge regarding hormonal imbalances, 48% had inadequate knowledge, and only 15% demonstrated adequate knowledge. In terms of dietary practices, 51% of the girls followed moderately healthy eating patterns, while 49% reported unhealthy habits such as frequent consumption of processed foods and irregular meal timings.The distributed product received high acceptability 87% rated the taste as good to excellent, 90% appreciated the appearance and color, 85% were willing to include such a product in their regular diet.**Conclusion:** The study highlights a need for improved health education and nutritional awareness among adolescent girls to promote better understanding and management of hormonal health. The interventions and awareness programs can play a pivotal role in encouraging balancing diets and lifestyle modifications that support hormonal balance.*

Keywords: *Adolescent girls, Hormonal imbalance, Knowledge, Dietary practicies.*

INTRODUCTION

Hormonal imbalances are increasingly recognized as a significant health concern among adolescent girls, particularly during the formative years marked by rapid physiological and psychological transitions. This period is critical for the establishment of lifelong health behaviors, including dietary practices that can profoundly influence endocrine health. Hormonal disturbances during adolescence are often linked to conditions such as polycystic ovarian syndrome (PCOS), irregular menstrual cycles, obesity, and mood disorders, which may persist into adulthood if not properly addressed (Smith et al., 2020; Patel & Sharma, 2019).

Diet plays a crucial role in hormonal regulation, with increasing evidence suggesting that processed foods, high glycemic load, and nutrient deficiencies contribute to hormonal disruption (Nguyen et al., 2021). Conversely, functional foods rich in antioxidants and phytoestrogens—such as butterfly pea flower (Clitoria ternatea)—have been studied for their potential to support hormonal balance and overall reproductive health (Kumari et al., 2022). However, awareness and practical application of such dietary strategies among adolescents remain limited, especially in semi-urban and rural Indian contexts.

Educational interventions targeting knowledge enhancement and behavior change have shown promise in improving health outcomes among adolescents (WHO, 2018). Still, there is a notable gap in localized studies assessing the effectiveness of such approaches, particularly in regions like the Thoothukudi (Tuticorin) District of Tamil Nadu. Addressing this gap, the present study aims to assess the knowledge and dietary practices related to hormonal imbalances among adolescent girls and to evaluate the impact of a structured nutrition education session along with a sensory introduction of a hormonal-balancing functional food.

ISSN 2394 - 7780

This study is grounded in the belief that informed adolescents are better equipped to make dietary and lifestyle choices that foster hormonal health, thereby preventing long-term complications and enhancing quality of life.

Statement of the Problem:
To assess the knowledge and dietary practices regarding hormonal imbalance, and to develop and promote hormone supportive product among young adolecentgirls in selected area in tuticorin district.

OBJECTIVES:
1. To assess the existing knowledge of adolescent girls regarding hormonal imbalances in selected areas of the Thoothukudi (Tuticorin) District.
2. To evaluate the dietary practices of adolescent girls that may influence hormonal health.
3. To provide nutrition education through a structured PowerPoint presentation on hormonal imbalances and their dietary management.
4. To develop, distribute and conduct sensory evaluation of the hormone supportive product (butterfly pea flower pudding).

MATERIALS AND METHODS
A descriptive research design was employed to assess the knowledge and dietary practices related to hormonal imbalances among adolescent girls in kayalpatnam, Thoothukudi (Tuticorin) District, Tamil Nadu. The study was conducted among 50 adolescent girls aged between 13–17 years, selected using a convenient sampling technique. The primary independent variable in the study was the nutrition education intervention, which included a PowerPoint presentation detailing hormonal health and the role of nutrition in hormonal regulation. Additionally, participants were introduced to a hormone supportive product (butterfly pea flower (Clitoria ternatea) pudding) known for its antioxidant properties and potential benefits in hormonal regulation.

The dependent variables included knowledge about hormonal imbalance anddietary practices measured through a structured and validated questionnaiand the sensory evaluation and acceptabability of the developed hormone supportive product by feedback form. The questionnaire comprised three sections:

1. Demographic profile of the participants (age, education level, socioeconomic status),
2. Knowledge assessment on hormonal imbalances (including symptoms and causes), and
3. Dietary practices, particularly focusing on meal frequency, food choices, and consumption of processed foods.

Participants were also asked to perform a sensory evaluation of the hormone supporting product (butterfly pea flower pudding) using a 5-point hedonic scale to assess its acceptability in terms of taste, color, texture, and overall appeal.Data collection occurred over a single session in a classroom setting. Responses were analyzed descriptively to determine frequencies and percentages of knowledge levels and dietary habits.

Sample size:
Total of 50 adolecent girls selected for the study.

Data Collection Tool:
A structured questionnaire was developed and used as the primary tool for data collection in this study. It was designed to gather information on four key domains:

(A) Demographic Details of adolescents girls.

(B) Knowledge assessment on Hormonal Imbalances

(C) Dietary Practices on adolescents girls

(D) Sensory Evaluation of hormone supportive product (Butterfly Pea Flower Pudding) by 5 point hedonic scale.

(A) Demographic Profile:

Age:

Educational level:

Socioeconomic status:

Family dietary habits:

ISSN 2394 - 7780

Menstrual history:

(B) Knowledge Assessment on Hormonal Imbalances:

This part consisted of 15 multiple-choice and true/false questions aimed at assessing participants' awareness of hormonal imbalance (e.g., irregular periods, mood swings, acne), prevention, and the role of diet and lifestyle in hormonal regulation.Each correct answer was awarded one point.

Questions include:

Causes of hormonal imbalance

Signs and symptoms

Effects on health

Preventive measures

Role of diet and lifestyle

Scores were categorized as follows:

Inadequate knowledge: 0–5

Moderate knowledge: 6–10

Adequate knowledge: 11–15

(C) Dietary Practices Assessment on adolescents girls:

This section included 10 questions focused on eating habits, frequency of meals, consumption of processed/junk foods, intake of fruits and vegetables, and awareness of hormone-regulating foods. Questions were both multiple-choice and checklist-based.

Questions aimed:

Meal frequency

Food choices (e.g., fruits, vegetables, processed foods)

Hydration habits

Intake of hormone-regulating foods

Eating patterns (timing, snacking, skipping meals)

(D)Sensory Evaluation Form:

A 5-point hedonic scale was used to assess the acceptability product hormone supportive product (butterfly pea flower pudding) introduced during the intervention.

PARAMETERS:

Color

Taste

Texture

Aroma

Overall acceptability

(Rated using a 5-point hedonic scale)

RESULTS AND DISCUSSION:

The findings of the study revealed a significant gap in knowledge and awareness regarding hormonal imbalances among adolescent girls in selected areas of Thoothukudi District. Out of the 50 participants, only 15% demonstrated adequate knowledge, while 37% showed moderate knowledge, and a considerable 48% had inadequate knowledge about hormonal imbalances. This indicates that nearly half of the adolescent girls were unaware of basic concepts related to hormonal health, including the causes, symptoms, and preventive strategies. These findings are consistent with previous studies, such as Sharma et al. (2019), which emphasized the lack of reproductive health education among adolescents, especially in rural areas.

ISSN 2394 - 7780

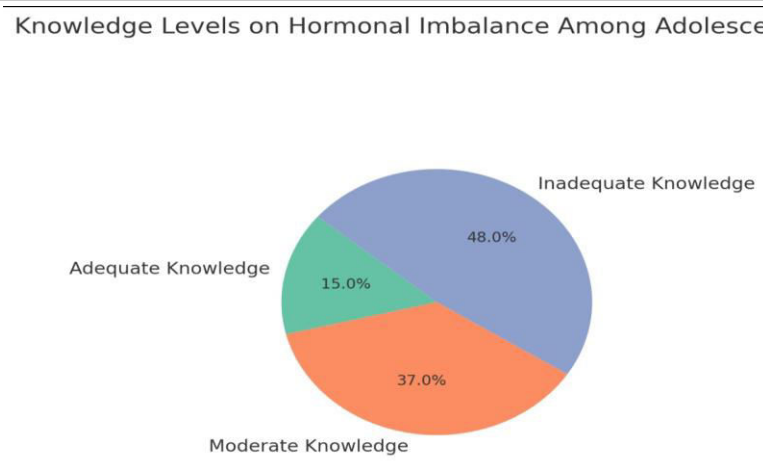
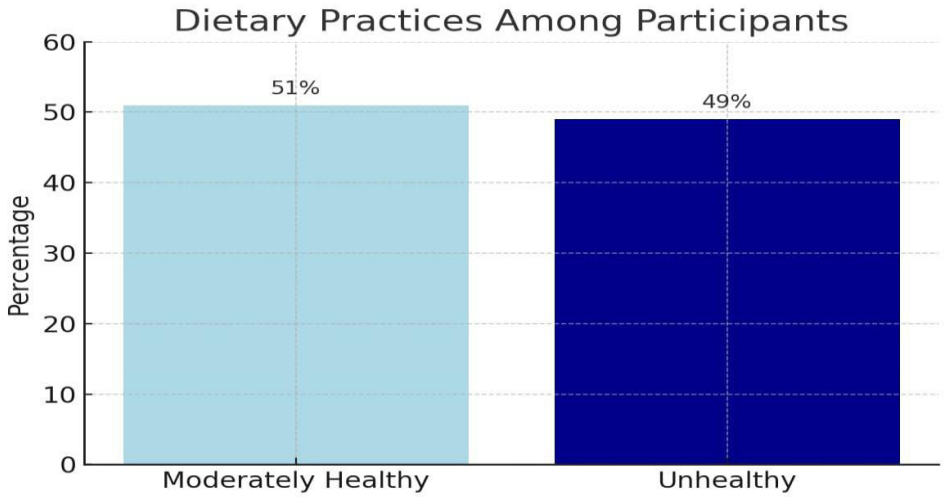


Figure 1

In terms of dietary practices, the results showed that 51% of the participants followed moderately healthy eating patterns, while 49% had unhealthy dietary habits. Unhealthy practices included frequent consumption of processed and junk foods, skipping meals (especially breakfast), low intake of fruits and vegetables, and irregular meal timings. These habits are known contributors to hormonal imbalances, as supported by Rajendran et al. (2021), who highlighted the link between poor dietary patterns and hormonal disruptions among adolescents.



As part of the intervention, a sensory evaluation of a hormone supportive product (butterfly pea flower pudding) was conducted. The majority of participants responded positively, particularly appreciating the color and taste of the product. The natural blue color derived from the butterfly pea flower, along with its mild flavor and smooth texture, made it appealing to the adolescent age group. The high acceptability suggests that such functional foods could be a practical approach to integrate hormone-supportive ingredients into adolescent diets while also serving as an educational tool.

Although the study suggests that even a single educational session, combined with food tasting, can spark curiosity and promote better understanding among adolescents. These results emphasize the urgent need for structured health and nutrition education programs in schools, particularly in rural districts like Thoothukudi. Such initiatives could help adolescents adopt healthier eating practices and better manage hormonal health during their critical years of development.

CONCLUSION:

The study underscores the need for enhanced health education and nutritional awareness among adolescent girls to improve their understanding and management of hormonal health. The findings suggest that unhealthy dietary habits, such as skipping meals and frequent consumption of processed foods, are closely linked to hormonal imbalances. Therefore, targeted interventions and awareness programs are essential to promote

ISSN 2394 - 7780

balanced diets, regular meal patterns, and healthier lifestyle choices. Such efforts can play a crucial role in supporting hormonal balance, maintaining regular periods, stable mood, healthy growth, and preventing future health issues like PCOS and obesity. It supports overall physical and emotional well-being and reproductive health in adulthood.

REFERENCES

1. Christiane Anthon and etal., Menstrual Disorder in Adolescence: Diagnostic and Therapeutic Challenges, MDPI journal, Dec 2024, 13(24), 7668.
2. Somayeh Abdolahian and etal., Effect of lifestyle modifications on anthropometric, clinical, and biochemical parameters in adolescent girls with polycystic ovary syndrome: a systematic review and meta-analysis, BMC Endocrine Disorders, May 2020.
3. Elisabeth Reiser and etal., Non-Hormonal Treatment Options for Regulation of Menstrual Cycle in Adolescents with PCOS, MDPI journal, December 2022.
4. Orsolya Kiss and etal.,The relationship between sleep and menstrual problems in early adolescent girls, BMC Sleep Science and Practice, Nov 2024.
5. Najneen Ahmed and etal., Clitoria ternatea L. (Butterfly Pea) Flower Against Endometrial Pain: Integrating Preliminary In Vivo and In Vitro Experimentations Supported by Network Pharmacology, Molecular Docking, and Molecular Dynamics Simulation Studies, National Library Of Medicne, Nov2024.
6. Fitriyah Fitriyah and Anggia Noor Ramadhani, Phytoestrogen Activity of Alkaloid Compounds of Butterfly Pea (Clitoria ternatea) Using In Silico Analysis, El-Hayah Jurnal Biologi, 2024.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

LITERATURE BEYOND BORDERS: ADDRESSING GLOBAL ISSUES THROUGH MULTIDISCIPLINARY APPROACHES IN ENGLISH STUDIES

Vasundhara Kanwar Shekhawat[1] and Dr. Garima Chauhan[2]
[1]Research Scholar and [2]Associate Professor, Department of Development Studies, Vivekananda Global University, Jaipur)

ABSTRACT
English literature increasingly functions as a narrative conduit for global crises—such as climate change, migration, and inequality—by merging human experience with scholarly insight. This qualitative study uses a multidisciplinary methodology, combining close literary reading, ecocriticism, environmental humanities, migration sociology, and ethical theory. Texts analyzed include The Ministry for the Future (Robinson), Exit West (Hamid), speculative fiction Migrations (McConaghy), and contemporary ecopoetry. Findings indicate that climate fiction woven with hopeful, solution-oriented narratives elicits stronger reader engagement than purely dystopian works, while migration texts foster empathy and ethical reflection. Ecopoetic voices foreground "slow violence" affecting marginalized communities. Recommendations include reforming curricula to integrate cli-fi and postcolonial literature with environmental and migration studies, fostering literary–scientific partnerships, centering Global South voices, and conducting empirical research to measure literature's impact on climate and social justice awareness.

Keywords: *English literature; climate fiction; ecocriticism; environmental humanities; migration narratives; multidisciplinary approaches; narrative empathy*

INTRODUCTION
Global crises—ecological disruption, forced migration, and entrenched inequality—demand responses beyond single-discipline perspectives. English literature, grounded in narrative and embodied experience, offers frameworks for interpreting and humanizing these global phenomena. Cli-fi, as represented by novels such as The Ministry for the Future and The Overstory, brings fictional narrative into dialogue with climate science and policy scenarios, making ecological futures intelligible through character-driven storytelling. Simultaneously, migration narratives like Exit West use magical realism to capture refugee experiences emotionally and ethically, aligning literature with migration studies and cultural sociology.

Ecocriticism and environmental humanities offer multidisciplinary lenses that bridge literature with ecological ethics, political ecology, and cultural critique, emphasizing literature's role in addressing planetary-scale issues. Amitav Ghosh's The Great Derangement critiques literature's historic neglect of climate change, urging a narrative turn toward planetary engagement.

The Study Explores:-
- How literary texts engage global issues when interpreted through interdisciplinary frameworks.
- How these narratives influence empathy, agency, and public discourse.
- How literary scholarship can support educational and institutional efforts toward sustainability and justice.

LITERATURE REVIEW
1. **Climate Fiction as Interdisciplinary Dialogue:-** Cli-fi has matured into a genre oriented toward ecological realism and policy imagination. Johns-Putra (2016) reviews how cli-fi, ecopoetry, and climate change theater have entered the literary critical mainstream, signaling climate knowledge as cultural practice. Schneider-Mayerson's empirical study reports that climate fiction strongly influences engaged readers, although its effects may depend on prior concern and ideology.
2. **Emotion and Narrative in Climate Fiction:-** New research shows that fiction blending hope and fear ("ambitopian" narratives) can increase climate action intentions, especially in diverse cultural contexts (India vs. USA). Yet purely dystopian approaches sometimes yield stronger immediate action intentions among some audiences.
3. **Ecocriticism & Environmental Humanities:-** Ecocriticism, aiming to "think through the environment" across disciplines, is central to literary and ethical engagement with global ecological issues. A recent bibliometric study (1994–2023) highlights ecocriticism's inherently interdisciplinary trajectory and rapid growth.

ISSN 2394 - 7780

4. **Migration Narratives and Ethical Empathy:-** Scholarly analyses of Exit West emphasize the poetics of migration trauma and literary affordances for fostering global empathy and cosmopolitan ethics.
5. **Interdisciplinarity in Humanities:-** Bibliometric studies show that interdisciplinary humanities research addressing climate justice and migration has surged since the early 2000s, aligning with Sustainable Development Goals.

METHODOLOGY

The study applies a qualitative multidisciplinary methodology, synthesizing textual analysis with interdisciplinary frameworks:-

1) Case-study texts:

- The Ministry for the Future (cli-fi, climate governance)
- Exit West (magical realist migration)
- Migrations (speculative eco-fiction)
- Ecopoems foregrounding slow violence in marginalized communities

2) Analytical frameworks:

- Ecocriticism and environmental humanities for ecological justice and narrative-environment interplay
- Migration and trauma theory for ethical and cultural narrative
- Ethical philosophy through lenses of planetary justice and literary agency
- **Thematic coding:** Identification of key themes such as climate justice, narrative empathy, agency, hope vs. fear, and moral imagination.
- **Interdisciplinary synthesis:** Triangulation of literary interpretations with empirical studies on reader outcomes, climate education, and migration ethics.
- **Reflexivity:** Texts and theoretical orientations include Global South and eco-feminist perspectives to avoid Eurocentric bias.

RESULTS

1) **The Ministry for the Future:-** Robinson's novel interweaves fictional policy documents, personal testimonies, and geoengineering visions to model global climate governance. This heteroglossic narrative creates empathy for both institutional actors and climate victims, providing a compelling blend of scientific plausibility and narrative gravitas.
2) **Exit West:-** Hamid's migration narrative employs magical realism to depict displacement through metaphysical portals, emphasizing resilience, loss, and moral cosmopolitanism. Literary strategies humanize statistical realities, aligning emotional resonance with migration studies frameworks.
3) **Migrations:-** McConaghy's novel merges ecosystem collapse narratives with ethical speculation, bridging science and story. Representations of extinction, nonhuman kinship, and ecological memory align with environmental humanities perspectives that challenge anthropocentrism.
4) **Ecopoetry and Slow Violence:-** Poems by British and South Asian writers highlight long-duration environmental harm affecting marginalized groups. Such texts link place, memory, and ecological justice through affective, ethical storytelling.
5) **Narrative Agency and Educational Trends:-** Empirical climate fiction studies reveal climate fiction boosts climate concern among already engaged readers, especially when coupled with hopeful or solution-oriented story arcs. Educational programs, such as Oxford's climate-literature course, illustrate growing curricular convergence of literature and environmental studies.

DISCUSSION

- **Empathy Through Narrative:-** Literary storytelling enhances emotional connection to crises, making abstract issues personally meaningful.
- **Hope Vs. Fear Dynamics:-** "Ambitopian" climactic narratives (combining hope and fear) are particularly effective across cultures in inducing climate action intentions.
- **Interdisciplinary Bridges:-** Literature, when interpreted through ecocritical and migration-critical lenses, becomes epistemic infrastructure connecting humanities, ethics, and policy practice.

ISSN 2394 - 7780

- **Decolonizing Literature:-** Inclusion of Global South voices challenges western climate imaginaries, fostering equity in literary discourse.
- **Limitations:-** Reader predispositions affect impact; narrative influence alone may not translate into structural change without supporting civic infrastructure.
- **Pedagogical Implications:-** Curricula integrating literature and global issues foster critical, empathetic, and ethical literacy in humanities education.

CONCLUSION

In Literature Beyond Borders, English literary texts gain transformative potential when viewed through multidisciplinary lenses. They offer moral imagination, empathetic access, and policy-minded storytelling crucial for interpreting global crises.

RECOMMENDATIONS:

1. Develop interdisciplinary programs linking literature, environment, migration, and ethics.
2. Integrate cli-fi, migration narratives, and ecopoetry into global-literature and sustainability curricula.
3. Conduct longitudinal empirical studies to assess literature's impact on climate awareness and civic engagement.
4. Promote literary scholarship that centers Global South, Indigenous, and eco-feminist perspectives.
5. Expand public humanities initiatives—literary festivals, readings, digital storytelling—to extend literature's reach in climate and social justice discourse.

As global crises intensify, humanities scholarship must evolve into narrative praxis—engaged, empathic, and interdisciplinary.

REFERENCES

1. Johns-Putra, Adeline. "Climate Change in Literature and Literary Studies: From Cli-fi… to Ecocriticism." WIREs Climate Change, vol. 7, no. 2, Mar. 2016, pp. 266–82.
2. Schneider-Mayerson, Matthew, et al. "Environmental Literature as Persuasion: An Experimental Test of the Effects of Reading Climate Fiction." Environmental Communication, vol. 17, no. 1, 2020, pp. 35–50.
3. Schneider-Mayerson, Matthew. "The Influence of Climate Fiction: An Empirical Survey of Readers." Environmental Humanities, vol. 10, no. 2, 2018, pp. 473–500.
4. Amitav Ghosh. The Great Derangement: Climate Change and the Unthinkable. Penguin, 2016.
5. "The Guardian View on Climate Fiction: No Longer the Stuff of Sci-fi." The Guardian, Mar. 2025.
6. "How Climate-Change Fiction, or 'Cli-Fi,' Forces Us to Confront the Incipient Death of the Planet." The New Yorker, Nov. 2018.
7. "The Influence of Climate Fiction: An Empirical Survey of Readers." Environmental Humanities, 2018.
8. "Ecocriticism." Wikipedia, accessed July 2025.
9. "Environmental Humanities." Wikipedia, accessed July 2025.
10. Malqué, et al. "Exploring the Evolution of Ecocriticism: A Bibliometric Study and Literature Review." Multidisciplinary Reviews, 2024.
11. Van Herten & Perez. "Ecocritical Analysis of 'Glocal' Essays on Lived Experiences of Climate Change in Higher Education." Frontiers in Sustainability, 2022.
12. Schneider-Mayerson, M. et al. "The Role of Hope and Fear in the Impact of Climate Fiction on Climate Action Intentions: Evidence from India and USA." Poetics, 2024.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

THE IMPACT OF AGE ON HUMAN-ANIMAL INTERACTIONS: A COMPARATIVE STUDY ACROSS LIFE STAGES

Vivekswar Khandai
Mittal Institute of Education, Bhopal (M.P.), India

ABSTRACT
This study explores the influence of age on human-animal interactions (HAI), comparing outcomes across children (5–12 years), adolescents (13–19 years), adults (20–59 years), and older adults (60+ years) interacting with domestic pets, service animals, and therapy animals. Employing a descriptive mixed-methods approach, data were collected from a diverse sample of animal owners using a mental well-being scale, a depression, anxiety, and stress scale, an HAI scale, and a qualitative questionnaire. Results indicate significant age-related differences: children develop empathy and social skills (M = 56.4, SD = 7.8), adolescents gain emotional support for identity formation (M = 54.7, SD = 9.1), adults experience stress reduction (M = 58.9, SD = 8.0), and older adults report enhanced companionship (M = 61.2, SD = 8.3). ANOVA analysis revealed significant differences across groups ($F(3, N) = 12.45$, $p < 0.05$), with older adults showing notably higher benefits compared to adolescents ($p < 0.01$). A pie chart illustrates the distribution of HAI benefits, highlighting the prominence of companionship in older adults. These findings emphasize the need for age-specific HAI interventions to optimize psychological and social outcomes. The study advocates for tailored programs, such as pet-based learning for children and therapy animal visits for older adults, to enhance well-being across life stages.

Keywords: *Human-Animal Interaction (HAI), Age Differences, Mental Well-being ,Emotional Support, Companionship*

1. INTRODUCTION

Human-animal interaction (HAI) encompasses a range of engagements, from pet ownership to interactions with service and therapy animals, which significantly influence psychological, emotional, and social well-being. Age plays a pivotal role in shaping these interactions, as developmental, emotional, and social needs vary across life stages. Children may benefit from HAI through enhanced empathy and responsibility, adolescents through emotional support during identity formation, adults through stress relief and social facilitation, and older adults through companionship and emotional stability. This study investigates these age-specific patterns, focusing on how interactions with domestic pets, service animals, and therapy animals impact individuals across four age groups: children (5–12 years), adolescents (13–19 years), adults (20–59 years), and older adults (60+ years).

The relevance of HAI lies in its potential to address mental health challenges, foster social connections, and enhance quality of life. With increasing recognition of animals' therapeutic roles, understanding age-related differences is crucial for designing effective interventions. This research aims to provide a comprehensive analysis of how age influences HAI outcomes, drawing on quantitative and qualitative data to inform therapeutic and community applications.

1.1 Objectives

- To examine the impact of age on the nature and outcomes of HAI.
- To identify specific benefits and challenges of HAI across different age groups.
- To assess the influence of HAI on mental well-being and psychological distress.
- To provide recommendations for age-tailored HAI interventions.

2 LITERATURE REVIEW

Research on HAI has highlighted its multifaceted benefits across populations. For children, pet ownership fosters empathy, responsibility, and social skills, contributing to emotional development. Adolescents benefit from animals as sources of non-judgmental emotional support, aiding in navigating the complexities of identity formation and peer relationships. Adults often experience stress reduction and improved social interactions through HAI, particularly in high-pressure environments. Older adults, facing social isolation or health challenges, find companionship and emotional stability through animal interactions, which can mitigate loneliness and enhance well-being.

Despite these insights, gaps remain in understanding how age-specific needs shape HAI outcomes. Previous studies often focus on single age groups or specific animal types, limiting the comparative analysis across life stages. This study addresses this gap by systematically comparing HAI effects across children, adolescents,

ISSN 2394 - 7780

adults, and older adults, integrating diverse animal interactions (pets, service, and therapy animals) to provide a holistic perspective.

3 MATERIALS AND METHODS

3.1 Research Design

A descriptive mixed-methods approach was employed to capture both quantitative and qualitative dimensions of HAI. This design allowed for a comprehensive exploration of age-related differences, combining standardized scales with open-ended responses to provide a nuanced understanding of interaction patterns.

3.2 Sample

The study included a purposive sample of animal owners from four age groups: children

(5–12 years, n = 50), adolescents (13–19 years, n = 60), adults (20–59 years, n = 80), and older adults (60+ years, n = 70). Participants were selected to ensure representation across age groups and interaction types (pets, service, and therapy animals), with a balanced distribution of gender and socioeconomic backgrounds.

3.3 Data Collection

Data were collected using the following instruments:

- Mental Well-being Scale: A 14-item scale measuring positive psychological function-ing, with scores ranging from 14 to 70 (higher scores indicate better well-being).
- Depression, Anxiety, and Stress Scale: A 21-item scale assessing psychological dis-tress, with subscales for depression, anxiety, and stress.
- Human-Animal Interaction Scale: A validated tool measuring the frequency, qual-ity, and emotional impact of HAI.
- HAI Questionnaire: An open-ended questionnaire capturing subjective experiences, such as perceived benefits and challenges of animal interactions.

Data collection occurred over six months, with participants completing surveys in com-munity settings, veterinary clinics, and therapy programs.

3.4 Statistical Analysis

Quantitative data were analyzed using Analysis of Variance (ANOVA) to compare HAI scores across age groups. Post-hoc tests (Tukey's HSD) identified specific group differences. Descriptive statistics (means, standard deviations) summarized well-being and distress outcomes. Qualitative responses were thematically analyzed to identify recurring themes, such as empathy in children or companionship in older adults.

• RESULTS

The study revealed distinct HAI patterns across age groups, supported by both quantitative and qualitative data:

- Children (5–12 years): Demonstrated moderate HAI scores (M = 56.4, SD = 7.8), with qualitative responses highlighting enhanced empathy, responsibility, and social skills. For example, children reported learning to care for pets, which fostered a sense of duty.
- Adolescents (13–19 years): Recorded the lowest HAI scores (M = 54.7, SD = 9.1), attributed to competing social priorities. However, animals provided emotional support, aiding in stress management and identity formation.
- Adults (20–59 years): Showed higher HAI scores (M = 58.9, SD = 8.0), with benefits including stress reduction and social facilitation. Participants noted that pets encouraged community interactions, such as dog-walking groups.
- Older Adults (60+ years): Exhibited the highest HAI scores (M = 61.2, SD = 8.3), driven by companionship and emotional stability. Qualitative data emphasized reduced loneliness through pet interactions.

ANOVA results indicated significant differences across age groups ($F(3, 256) = 12.45$, $p < 0.05$). Post-hoc tests confirmed that older adults had significantly higher HAI scores than adolescents ($p < 0.01$), with moderate differences between adults and adolescents ($p < 0.05$). Depression and anxiety scores were lowest among older adults, correlating with higher HAI engagement.

ISSN 2394 - 7780

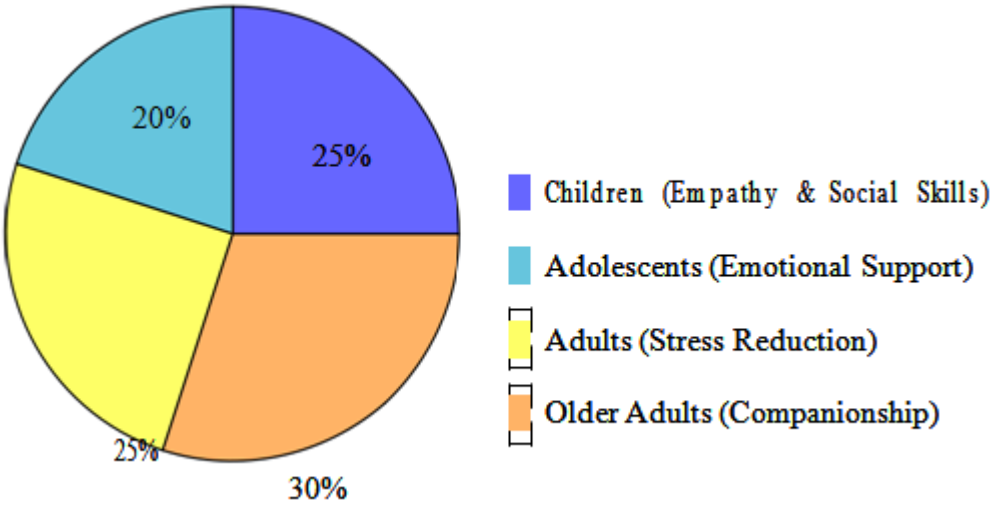


Figure 1: Distribution of Primary HAI Benefits Across Age Groups

Figure 1 illustrates the distribution of primary HAI benefits, with companionship for older adults (30%) and stress reduction for adults (25%) being prominent, followed by empathy for children (25%) and emotional support for adolescents (20%).

5 DISCUSSION

The findings underscore the critical role of age in shaping HAI outcomes. For children, interactions with animals foster developmental milestones, such as empathy and responsibility, which are crucial for social maturation. Adolescents, navigating the challenges of identity formation, benefit from animals as non-judgmental companions, though their lower HAI scores suggest that peer relationships may take precedence. Adults leverage HAI for stress management and social engagement, aligning with their lifestyle demands.

Older adults, facing social isolation or health declines, derive significant emotional bene-fits from animal companionship, as evidenced by their high well-being scores.

These results suggest that HAI interventions should be tailored to age-specific needs. For children, educational programs incorporating pets could enhance learning outcomes. Adolescents may benefit from therapy animals in school settings to support emotional regulation. Adults could engage in community-based HAI activities, such as pet-friendly social events, while older adults would benefit from therapy animal visits in care facilities. The qualitative data further enrich these insights, revealing personal narratives of connection and support that vary by age.

Limitations include the cross-sectional design, which precludes causal inferences, and the purposive sampling, which may introduce selection bias. Additionally, the study focused on animal owners, potentially overlooking non-owners who engage with service or therapy animals. Future research should incorporate longitudinal designs to track HAI effects over time and include non-owners to broaden the scope.

6 CONCLUSION

This study highlights the profound impact of age on HAI, with each life stage experiencing unique benefits: empathy and social skills for children, emotional support for adolescents, stress reduction for adults, and companionship for older adults. These findings advocate for age-tailored HAI interventions to maximize psychological and social benefits. By integrating animals into educational, therapeutic, and community settings, stakeholders can enhance well-being across the lifespan.

7 RECOMMENDATIONS

- Develop pet-based educational programs for children to foster empathy and responsibility.
- Implement therapy animal programs in schools to support adolescent mental health.
- Promote community HAI initiatives, such as pet-friendly social groups, for adults.
- Expand therapy animal visits in care facilities to address loneliness in older adults.
- Conduct longitudinal studies to examine the long-term effects of HAI across life stages.
- Explore the role of different animal types (e.g., dogs, cats, horses) in age-specific HAI outcomes.

ISSN 2394 - 7780

8 FUTURE DIRECTIONS

Future research should focus on longitudinal studies to establish causality and explore the role of interaction frequency and animal type in HAI outcomes. Additionally, investigating HAI in non-owner populations, such as those engaging with therapy animals in institutional settings, could provide a more comprehensive understanding. Interdisciplinary collaborations between psychologists, educators, and veterinarians could further integrate HAI into mental health and community frameworks.

REFERENCES

[1] Anderson, K. A., et al. (2015). The impact of pet ownership on health and well-being across the lifespan. International Journal of Environmental Research and Public Health, 12(8), 9123–9138.

[2] McNicholas, J., et al. (2005). Pet ownership and human health: A brief review of evidence and issues. BMJ, 331(7527), 1252–1254.

[3] Beetz, A., et al. (2012). Psychosocial and psychophysiological effects of human-animal interactions: The possible role of oxytocin. Frontiers in Psychology, 3, 234.

International Journal of Advance and Innovative Research
Volume 12, Issue 3 (II): July - September 2025
ISSN 2394 - 7780

HOLISTIC NUTRITION CARE FOR WOMEN: TACKLING PCOS, OBESITY, AND TYPE 2 DIABETES THROUGH FOOD-BASED SOLUTIONS

Ramola Shechinah[1] and G. Nandhini[2]
[1]PG Student, Ganga College of Nursing, Coimbatore
[2]Professor, Department of Nutrition and Dietetics, Ganga College of Nursing, Coimbatore

ABSTRACT
Polycystic Ovary Syndrome (PCOS), obesity, and type 2 diabetes mellitus (T2DM) are prevalent metabolic disorders affecting women globally. These conditions are deeply interlinked and can significantly impair women's reproductive, metabolic, and psychological health. Holistic nutrition care, which integrates personalized dietary strategies, emotional wellness, and lifestyle changes, offers a sustainable and preventive approach to manage these disorders. This paper explores evidence-based, food-centered interventions using functional foods, plant-based ingredients, and culturally sensitive meal patterns to address the triad of PCOS, obesity, and T2DM in women. By targeting root causes such as insulin resistance and inflammation, holistic nutrition provides long-term solutions to restore balance and enhance women's well-being.

Keywords: *PCOS, Obesity, Type 2 Diabetes, Holistic Nutrition, Women's Health, Food-Based Interventions*

INTRODUCTION
PCOS, obesity, and type 2 diabetes are chronic health issues affecting millions of women worldwide. According to the World Health Organization (WHO), one in three women globally is overweight or obese, and metabolic disorders are on the rise among females due to hormonal imbalance, sedentary lifestyle, and poor diet. PCOS alone affects 1 in 10 women of reproductive age, often leading to infertility, hirsutism, and emotional distress.

These three conditions often coexist and have a bidirectional relationship with insulin resistance, low-grade inflammation, and impaired hormonal signaling as their common denominators. While pharmacological management plays a role, nutrition is the cornerstone of long-term management and prevention.

Holistic nutrition is an evolving approach that addresses not just caloric intake but also the quality of food, nutrient synergy, emotional eating patterns, sleep cycles, and physical activity. This paper highlights the significance of using whole, functional foods and local dietary practices in managing PCOS, obesity, and T2DM through an integrative, woman-centered framework.

MANUSCRIPT SUBMISSION

GUIDELINES FOR CONTRIBUTORS

1. Manuscripts should be submitted preferably through email and the research article / paper should preferably not exceed 8 – 10 pages in all.
2. Book review must contain the name of the author and the book reviewed, the place of publication and publisher, date of publication, number of pages and price.
3. Manuscripts should be typed in 12 font-size, Times New Roman, single spaced with 1" margin on a standard A4 size paper. Manuscripts should be organized in the following order: title, name(s) of author(s) and his/her (their) complete affiliation(s) including zip code(s), Abstract (not exceeding 350 words), Introduction, Main body of paper, Conclusion and References.
4. The title of the paper should be in capital letters, bold, size 16" and centered at the top of the first page. The author(s) and affiliations(s) should be centered, bold, size 14" and single-spaced, beginning from the second line below the title.

First Author Name1, Second Author Name2, Third Author Name3

1Author Designation, Department, Organization, City, email id

2Author Designation, Department, Organization, City, email id

3Author Designation, Department, Organization, City, email id

5. The abstract should summarize the context, content and conclusions of the paper in less than 350 words in 12 points italic Times New Roman. The abstract should have about five key words in alphabetical order separated by comma of 12 points italic Times New Roman.
6. Figures and tables should be centered, separately numbered, self explained. Please note that table titles must be above the table and sources of data should be mentioned below the table. The authors should ensure that tables and figures are referred to from the main text.

EXAMPLES OF REFERENCES

All references must be arranged first alphabetically and then it may be further sorted chronologically also.

- **Single author journal article:**

Fox, S. (1984). Empowerment as a catalyst for change: an example for the food industry. *Supply Chain Management*, *2*(3), 29–33.

Bateson, C. D.,(2006), 'Doing Business after the Fall: The Virtue of Moral Hypocrisy', Journal of Business Ethics, 66: 321 – 335

- **Multiple author journal article:**

Khan, M. R., Islam, A. F. M. M., & Das, D. (1886). A Factor Analytic Study on the Validity of a Union Commitment Scale. *Journal of Applied Psychology*, *12*(1), 129-136.

Liu, W.B, Wongcha A, & Peng, K.C. (2012), "Adopting Super-Efficiency And Tobit Model On Analyzing the Efficiency of Teacher's Colleges In Thailand", International Journal on New Trends In Education and Their Implications, Vol.3.3, 108 – 114.

- **Text Book:**

Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2007). *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies* (3rd ed.). New York: McGraw-Hill.

S. Neelamegham," Marketing in India, Cases and Reading, Vikas Publishing House Pvt. Ltd, III Edition, 2000.

- **Edited book having one editor:**

Raine, A. (Ed.). (2006). *Crime and schizophrenia: Causes and cures.* New York: Nova Science.

- **Edited book having more than one editor:**

Greenspan, E. L., & Rosenberg, M. (Eds.). (2009). *Martin's annual criminal code:Student edition 2010*. Aurora, ON: Canada Law Book.

- **Chapter in edited book having one editor:**

Bessley, M., & Wilson, P. (1984). Public policy and small firms in Britain. In Levicki, C. (Ed.), *Small Business Theory and Policy* (pp. 111–126). London: Croom Helm.

- **Chapter in edited book having more than one editor:**

Young, M. E., & Wasserman, E. A. (2005). Theories of learning. In K. Lamberts, & R. L. Goldstone (Eds.), *Handbook of cognition* (pp. 161-182). Thousand Oaks, CA: Sage.

- **Electronic sources should include the URL of the website at which they may be found, as shown:**

Sillick, T. J., & Schutte, N. S. (2006). Emotional intelligence and self-esteem mediate between perceived early parental love and adult happiness. *E-Journal of Applied Psychology*, *2*(2), 38-48. Retrieved from http://ojs.lib.swin.edu.au/index.php/ejap

- **Unpublished dissertation/ paper:**

Uddin, K. (2000). A Study of Corporate Governance in a Developing Country: A Case of Bangladesh (Unpublished Dissertation). Lingnan University, Hong Kong.

- **Article in newspaper:**

Yunus, M. (2005, March 23). Micro Credit and Poverty Alleviation in Bangladesh. *The Bangladesh Observer*, p. 9.

- **Article in magazine:**

Holloway, M. (2005, August 6). When extinct isn't. *Scientific American, 293*, 22-23.

- **Website of any institution:**

Central Bank of India (2005). *Income Recognition Norms Definition of NPA*. Retrieved August 10, 2005, from http://www.centralbankofindia.co.in/ home/index1.htm, viewed on

7. The submission implies that the work has not been published earlier elsewhere and is not under consideration to be published anywhere else if selected for publication in the journal of Indian Academicians and Researchers Association.

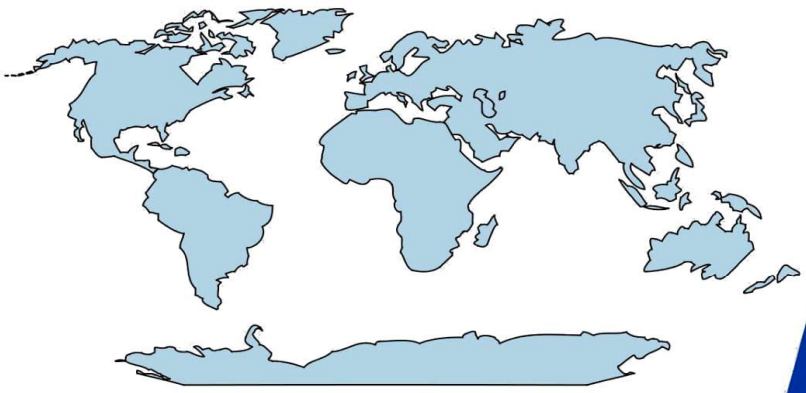
8. Decision of the Editorial Board regarding selection/rejection of the articles will be final.

www.iaraedu.com

Journal

ISSN 2322 - 0899

INTERNATIONAL JOURNAL OF RESEARCH IN MANAGEMENT & SOCIAL SCIENCE



Volume 8, Issue 2
April - June 2020

www.iaraedu.com

Journal

ISSN 2394 - 9554

International Journal of Research in Science and Technology

Volume 6, Issue 2: April - June 2019

Indian Academicians and Researchers Association
www.iaraedu.com

INDIAN ACADEMICIANS AND RESEARCHERS ASSOCIATION

Membership No: M / M – 1365

Certificate of Membership

This is to certify that

XXXXXXXX

is admitted as a

Fellow Member

of

Indian Academicians and Researchers Association

in recognition of commitment to Educational Research

and the objectives of the Association

Date: 27.01.2020

Director

President

INDIAN ACADEMICIANS AND RESEARCHERS ASSOCIATION

Membership No: M / M – 1365

Certificate of Membership

This is to certify that

XXXXXXXXXX

is admitted as a

Life Member

of

Indian Academicians and Researchers Association

in recognition of commitment to Educational Research

and the objectives of the Association

Date: 27.01.2020

Director

President

INDIAN ACADEMICIANS AND RESEARCHERS ASSOCIATION

Membership No: M / M – 1365

Certificate of Membership

This is to certify that

XXXXXXXX

is admitted as a

Member

of

Indian Academicians and Researchers Association

in recognition of commitment to Educational Research

and the objectives of the Association

Date: 27.01.2020

Director

President

IARA Organized its 1st International Dissertation & Doctoral Thesis Award in September'2019

1st International
Dissertation & Doctoral Thesis Award
(2019)

Organized By

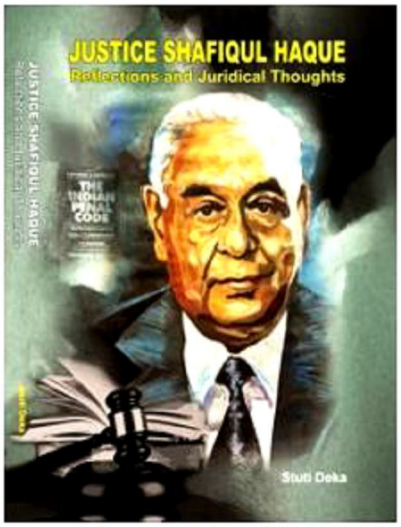
Indian Academicians and Researchers Association (IARA)

EMPYREAL PUBLISHING HOUSE

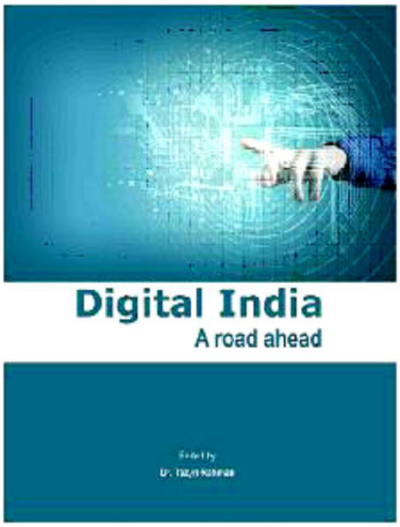
www.editedbook.in

Publish Your Book, Your Thesis into Book or Become an Editor of an Edited Book with ISBN

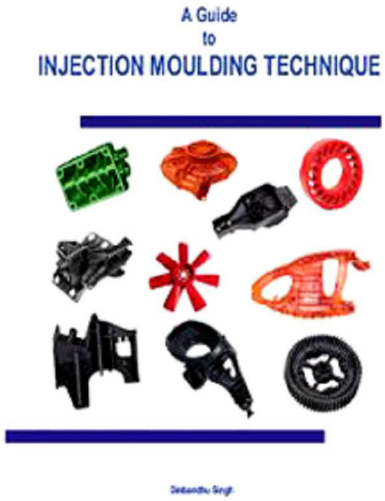
BOOKS PUBLISHED



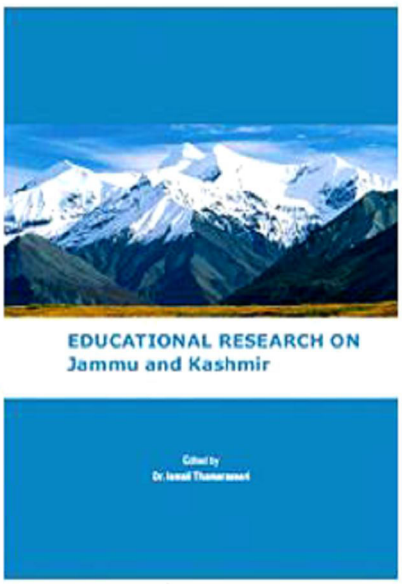
Dr. Stuti Deka
ISBN : 978-81-930928-1-1



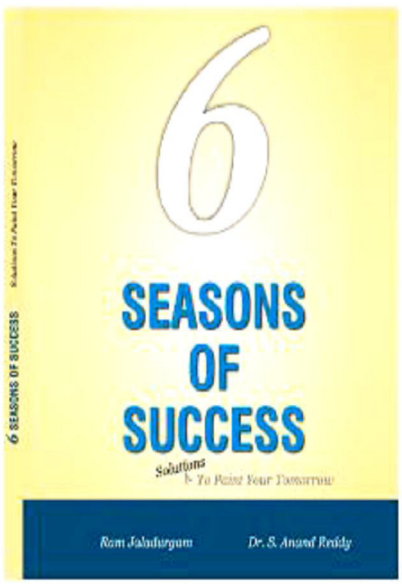
Dr. Tazyn Rahman
ISBN : 978-81-930928-0-4



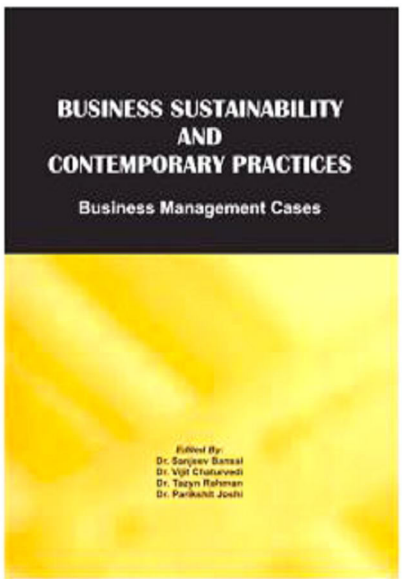
Mr. Dinbandhu Singh
ISBN : 978-81-930928-3-5



Dr. Ismail Thamarasseri
ISBN : 978-81-930928-2-8



Ram Jaladurgam
Dr. S. Anand Reddy
ISBN : 978-81-930928-5-9

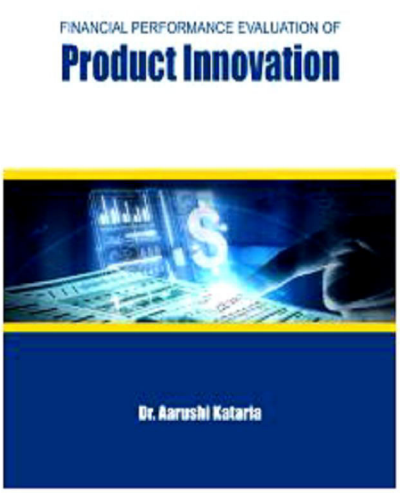


Dr. Sanjeev Bansal, Dr. Vijit Chaturvedi
Dr. Tazyn Rahman, Dr. Parikshit Joshi
ISBN : 978-81-930928-6-6

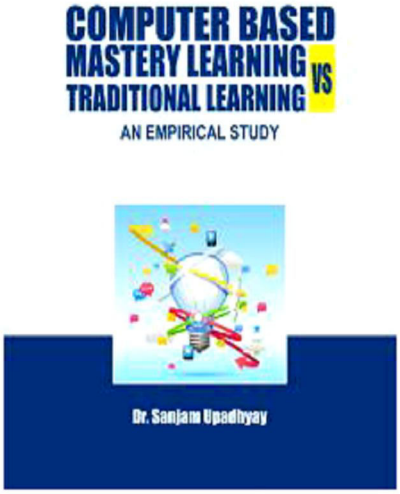
Ashish Kumar Sinha, Dr. Soubhik Chakraborty
Dr. Amritanjali
ISBN : 978-81-930928-8-0

Dr Sanjeev Bansal, Dr. Vijit Chaturvedi
Dr. Tazyn Rahman, Dr. Parikshit Joshi
ISBN : 978-81-936264-0-5

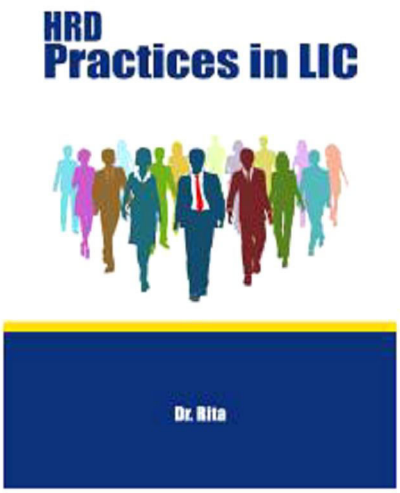
Dr. Jyotsna Golhar
Dr. Sujit Metre
ISBN : 978-81-936264-6-7



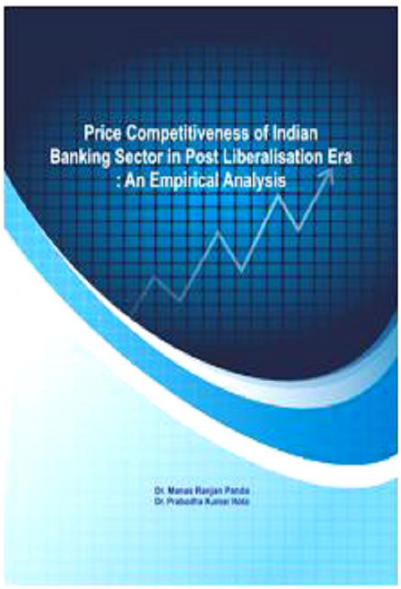
Dr. Aarushi Kataria
ISBN : 978-81-936264-3-6



Dr. Sanjam Upadhyay
ISBN : 978-81-936264-5-0



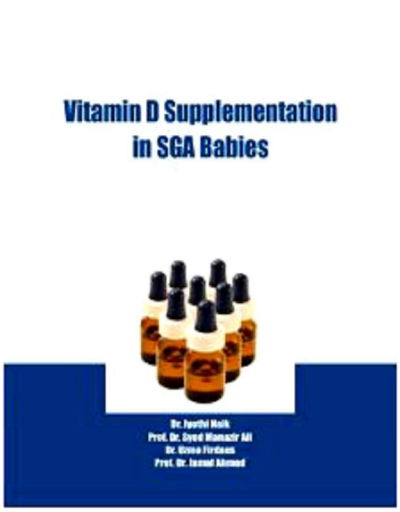
Dr. Rita
ISBN : 978-81-930928-7-3



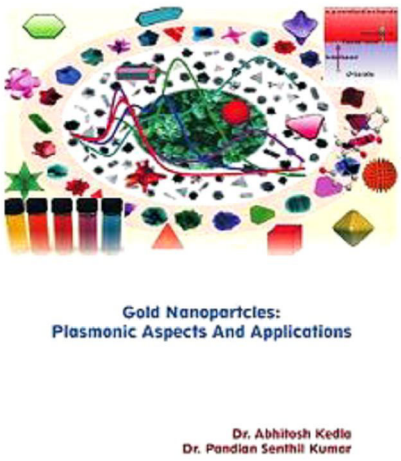
Dr. Manas Ranjan Panda, Dr. Prabodha Kr. Hota
ISBN : 978-81-930928-4-2

Poornima University
ISBN : 978-8193-6264-74

Institute of Public Enterprise
ISBN : 978-8193-6264-4-3



Dr. Jyothi Naik, Prof. Dr. Syed Manazir Ali
Dr. Uzma Firdaus, Prof. Dr. Jamal Ahmed
ISBN : 978-81-936264-9-8



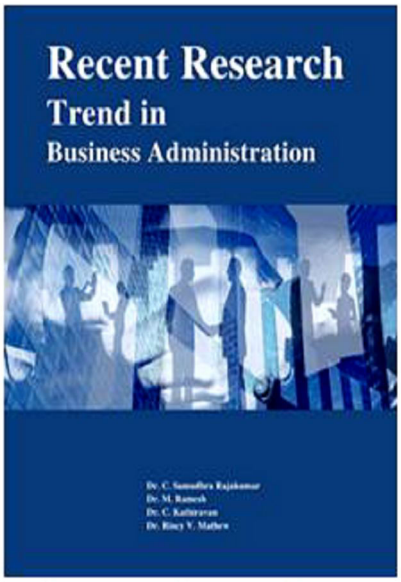
Dr. Abhitosh Kedia
Dr. Pandian Senthil Kumar
ISBN : 978-81-939070-0-9

Dr. Vinod
S. Chandwani
ISBN : 978-81-939070-2-3

Prof. Dr. Dhananjay
Awasarikar
ISBN : 978-81-939070-1-6

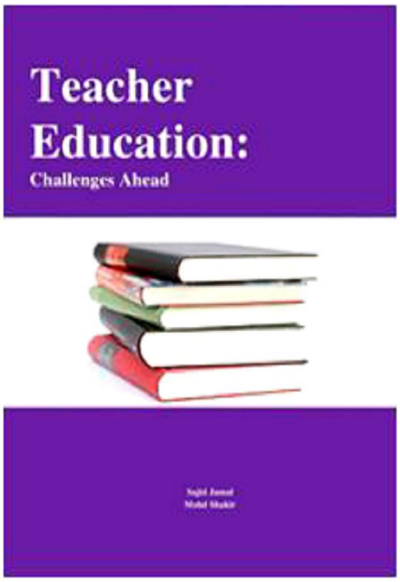
Dr. C. Samudhra Rajakumar, Dr. M. Ramesh
Dr. C. Kathiravan, Dr. Rincy V. Mathew
ISBN : 978-81-939070-4-7

Dr. C. Samudhra Rajakumar, Dr. M. Ramesh
Dr. C. Kathiravan, Dr. Rincy V. Mathew
ISBN : 978-81-939070-6-1



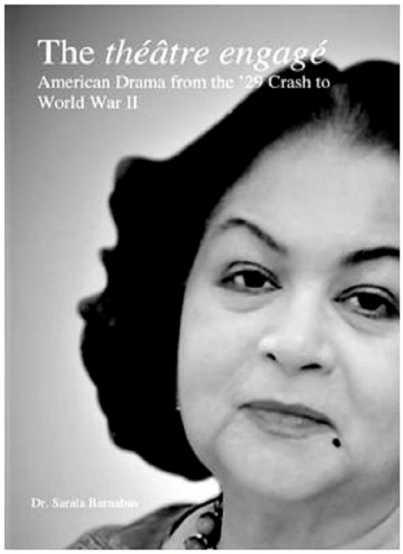
Dr. C. Samudhra Rajakumar, Dr. M. Ramesh
Dr. C. Kathiravan, Dr. Rincy V. Mathew
ISBN : 978-81-939070-7-8

Dr. V. I. Paul, Dr. M. Muthulingam
Dr. A. Elangovan, Dr. J. Nelson Samuel Jebastin
ISBN : 978-81-939070-9-2



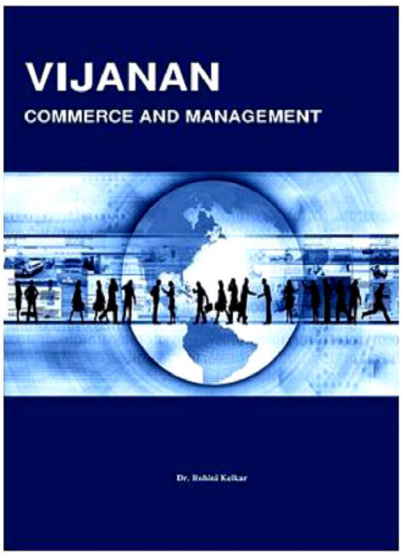
Sajid Jamal
Mohd Shakir
ISBN : 978-81-939070-8-5

Dr. R. Emmaniel
ISBN : 978-81-939070-3-0

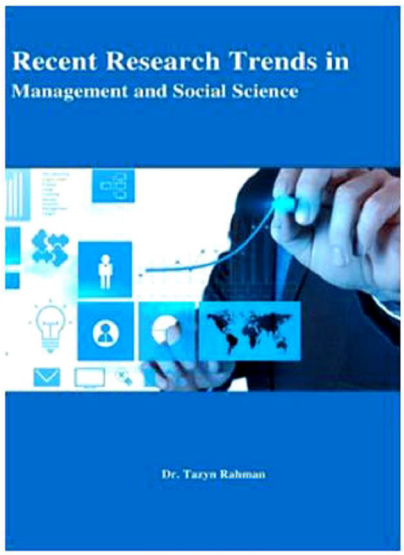


Dr. Sarala Barnabas
ISBN : 978-81-941253-3-4

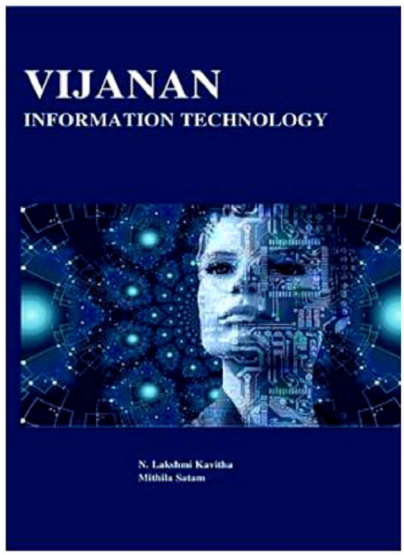
Dr. M. Banumathi
Dr. C. Samudhra Rajakumar
ISBN : 978-81-939070-5-4



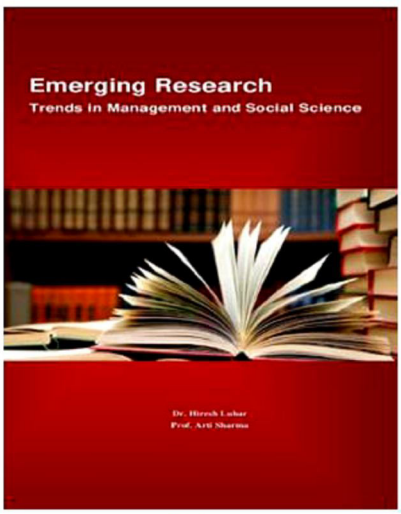
Dr. (Mrs.) Rohini Kelkar
ISBN : 978-81-941253-0-3



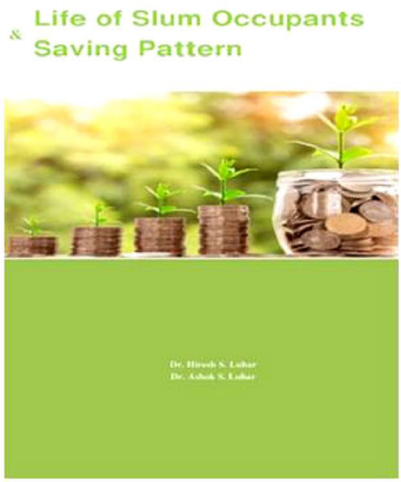
Dr. Tazyn Rahman
ISBN : 978-81-941253-2-7



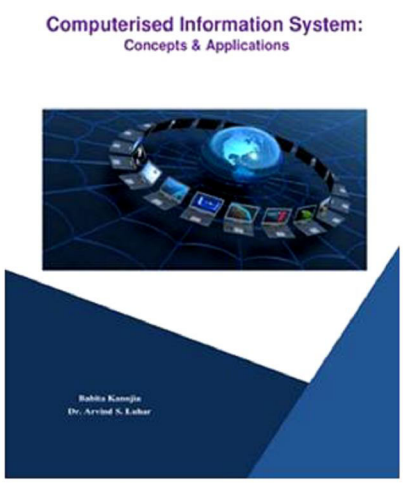
Dr. N. Lakshmi Kavitha
Mithila Satam
ISBN : 978-81-941253-1-0



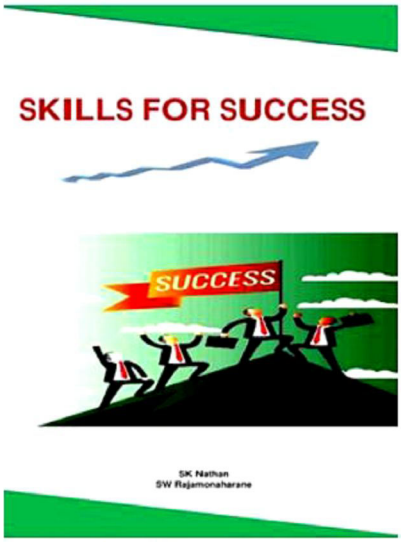
Dr. Hiresh Luhar
Prof. Arti Sharma
ISBN : 978-81-941253-4-1



Dr. Hiresh S. Luhar
Dr. Ashok S. Luhar
ISBN : 978-81-941253-5-8

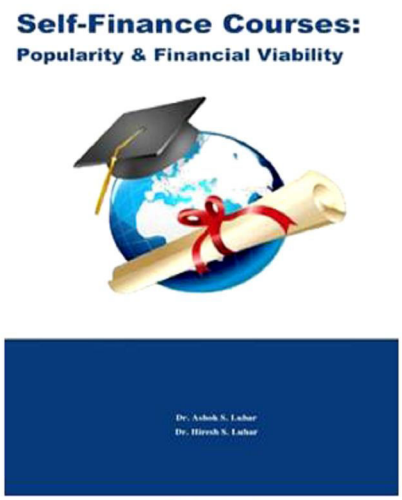


Dr. Babita Kanojia
Dr. Arvind S. Luhar
ISBN : 978-81-941253-7-2

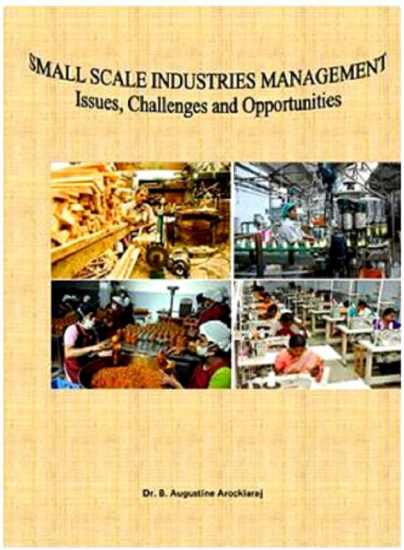


Dr. Sw Rajamonaharane
SK Nathan
ISBN : 978-81-942475-0-0

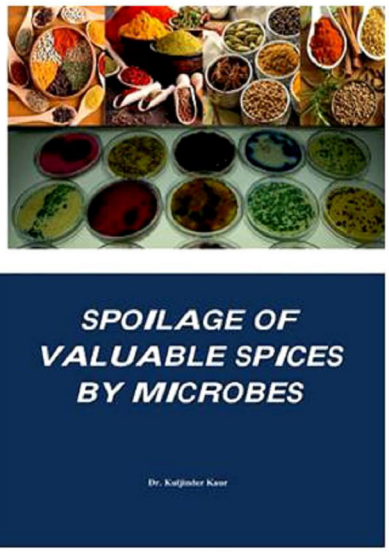
Aditi Sharma
ISBN : 978-81-941253-8-9



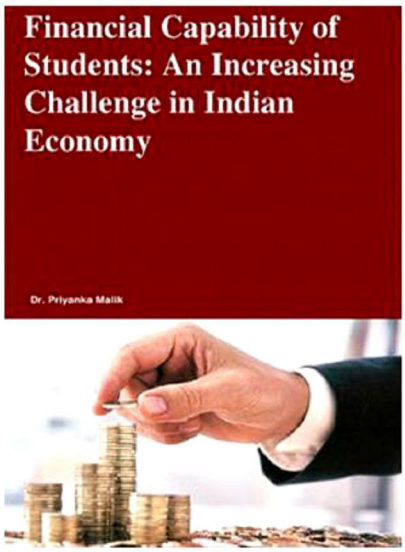
Dr. Ashok S. Luhar
Dr. Hiresh S. Luhar
ISBN : 978-81-941253-6-5



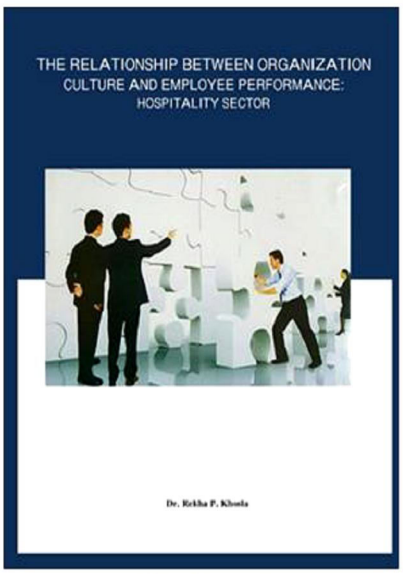
Dr. B. Augustine Arockiaraj
ISBN : 978-81-941253-9-6



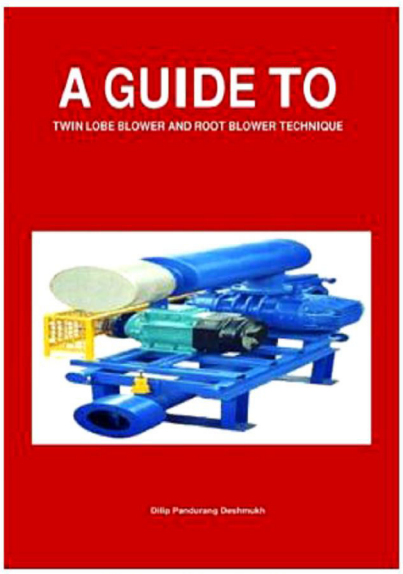
Dr. Kuljinder Kaur
ISBN : 978-81-942475-4-8



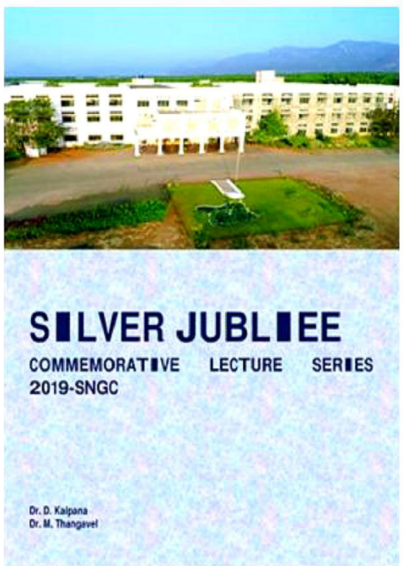
Dr. Priyanka Malik
ISBN : 978-81-942475-1-7



Dr. Rekha P. Khosla
ISBN : 978-81-942475-2-4



Dilip Pandurang Deshmukh
ISBN : 978-81-942475-3-1



Dr. D. Kalpana, Dr. M. Thangavel
ISBN : 978-81-942475-5-5

Indian Commodity
Futures and Spot Markets

Dr. Aloysius Edward J

Dr. Aloysius Edward J.
ISBN : 978-81-942475-7-9

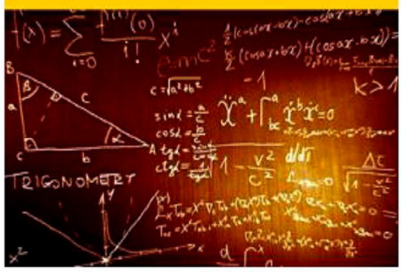
Correlates of Burnout Syndrome Among Servicemen

Dr. Rosemary Obiageri Ekechukwu

Dr. R. O. Ekechukwu
ISBN : 978-81-942475-8-6

Advances in
Mathematical Sciences
(A Collection of Survey Research Articles)

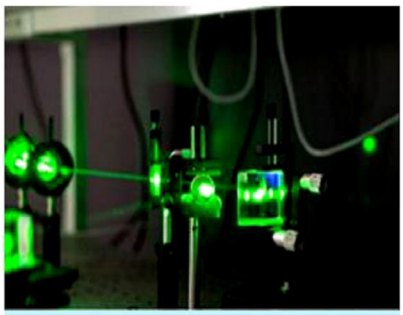
Edited By
Dr. Zakir Ahmed



Dr. Zakir Ahmed
ISBN : 978-81-942475-9-3

Fair Value Measurement
Challenges and Perceptions

Dr. (CA) Ajit S. Joshi
Dr. Arvind S. Luhar
ISBN : 978-81-942475-6-2



NONLINEAR OPTICAL CRYSTALS FOR LASER
Growth and Analysis Techniques

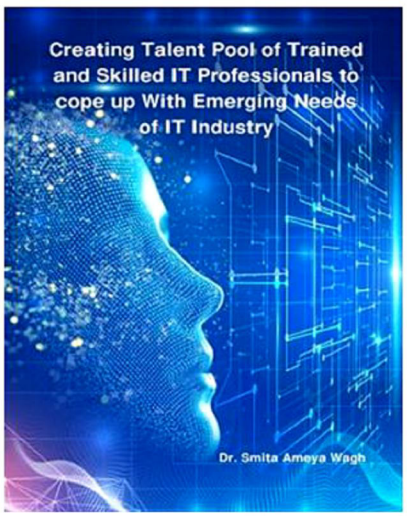
Madhav N Rode
Dilipkumar V Mehsram

Madhav N Rode
Dilip Kumar V Mehsram
ISBN : 978-81-943209-6-8

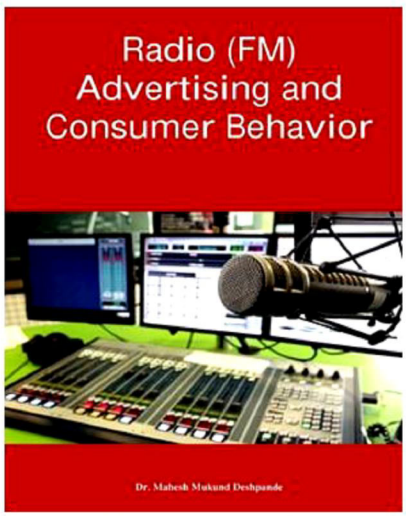
Remote Sensing of River Pollution And Agricultural Soils

Dr. Saif Said
Mr. Shadab Ali Khan

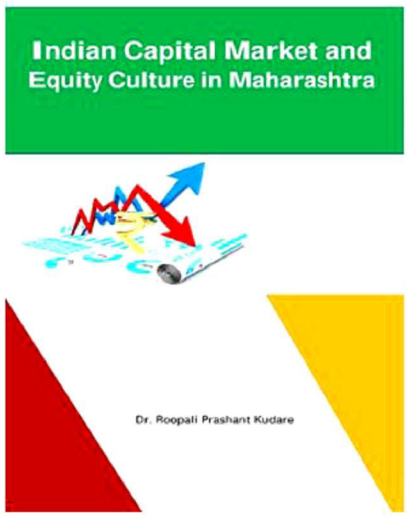
Dr. Saif Said
Shadab Ali Khan
ISBN : 978-81-943209-1-3



Dr. Smita Ameya Wagh
ISBN : 978-81-943209-9-9

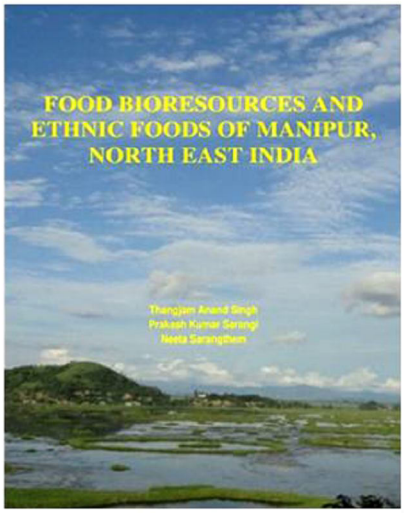


Dr. Mahesh Mukund Deshpande
ISBN : 978-81-943209-7-5

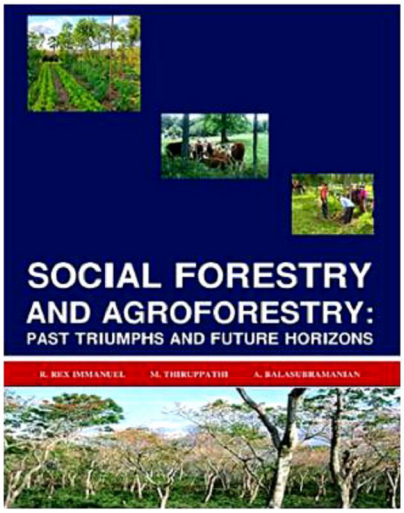


Dr. Roopali Prashant Kudare
ISBN : 978-81-943209-3-7

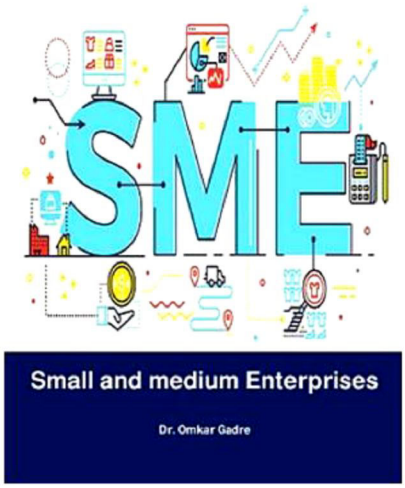
M. Thiruppathi
R. Rex Immanuel
K. Arivukkarasu
ISBN : 978-81-930928-9-7



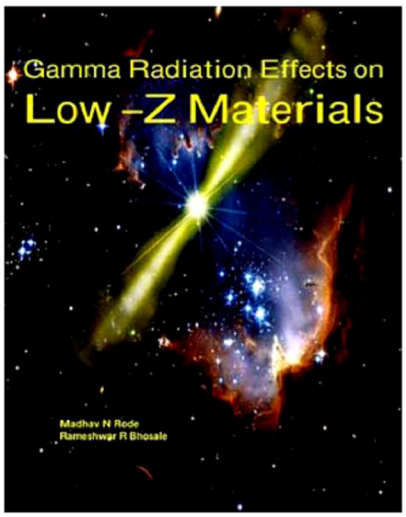
Dr. Th. Anand Singh
Dr. Prakash K. Sarangi
Dr. Neeta Sarangthem
ISBN : 978-81-944069-0-7



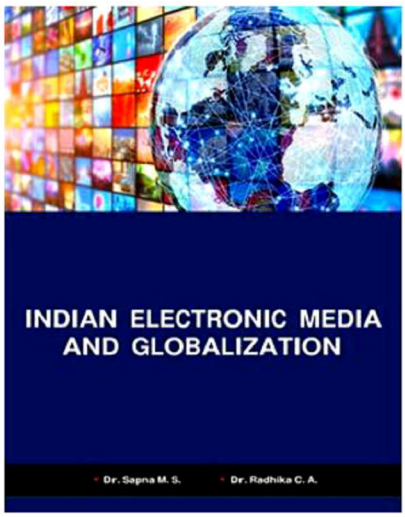
R. Rex Immanuel
M. Thiruppathi
A. Balasubramanian
ISBN : 978-81-943209-4-4



Dr. Omkar V. Gadre
ISBN : 978-81-943209-8-2

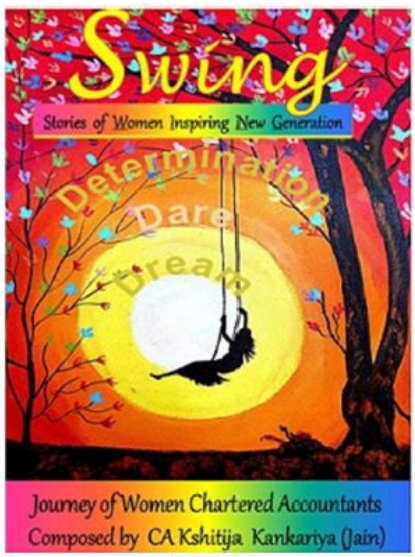


Madhav N Rode
Rameshwar R. Bhosale
ISBN : 978-81-943209-5-1

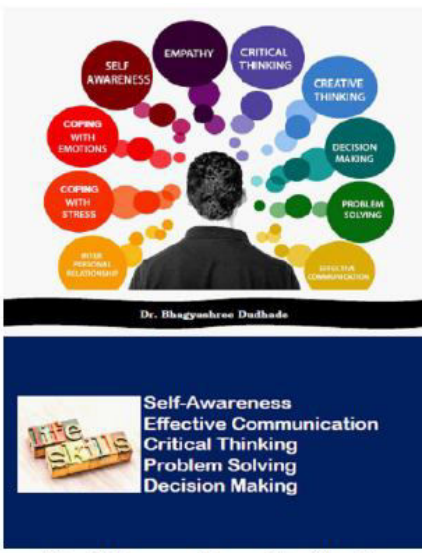


Dr. Sapna M S
Dr. Radhika C A
ISBN : 978-81-943209-0-6

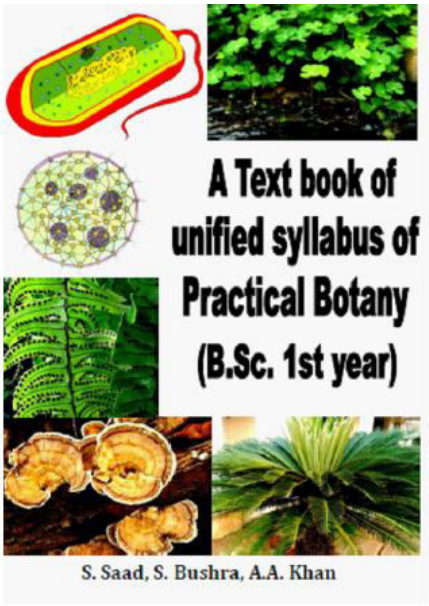
Hindusthan College
ISBN : 978-81-944813-8-6



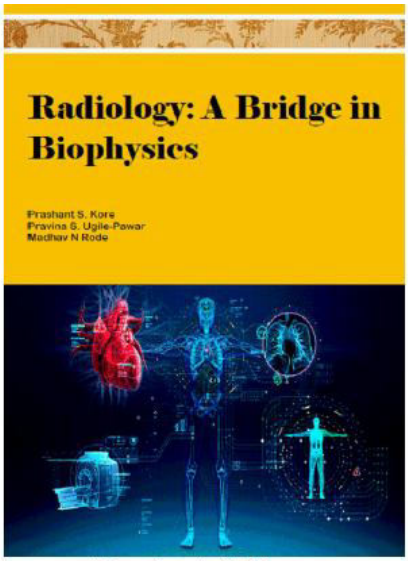
Swing
ISSN: 978-81-944813-9-3



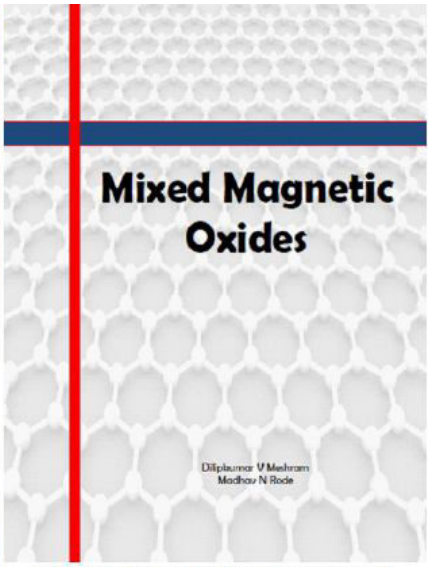
Dr. Bhagyashree Dudhade
ISBN : 978-81-944069-5-2



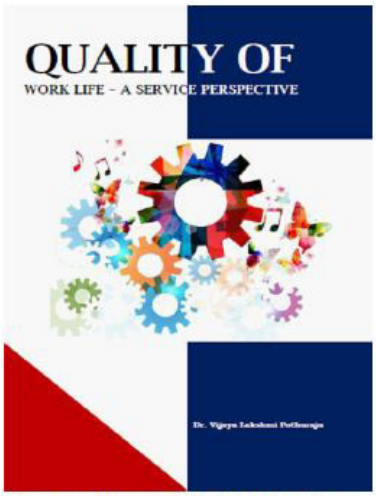
S. Saad, S. Bushra, A. A. Khan
ISBN: 978-81-944069-9-0



Prashant S. Kore
Pravina S. Ugile-Pawar
Madhav N Rode
ISSN: 978-81-944069-7-6



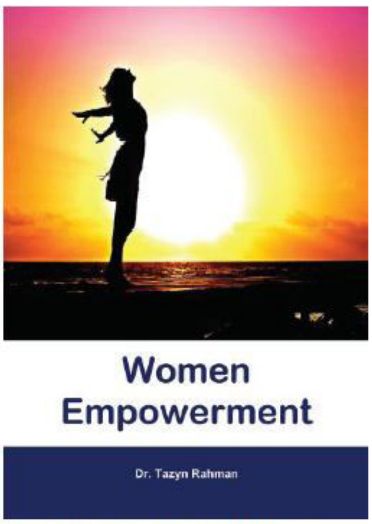
Dilipkumar V Meshram and
Madhav N Rode
ISSN: 978-81-944069-6-9



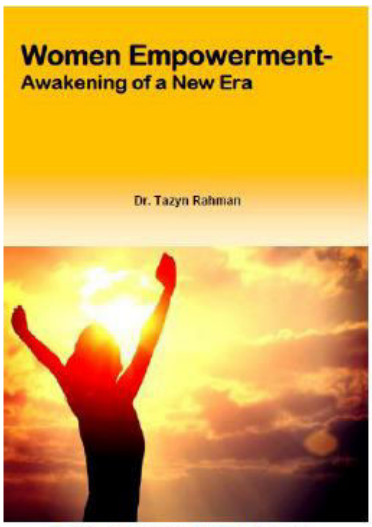
Dr. Vijaya Lakshmi Pothuraju
ISBN : 978-81-943209-2-0

Pratibha College
ISBN : 978-81-944813-2-4

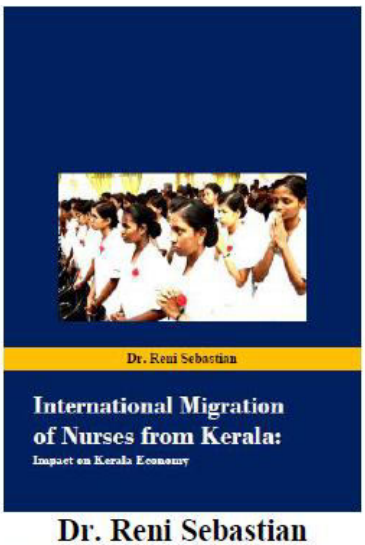
Pratibha College
ISBN : 978-81-944813-3-1



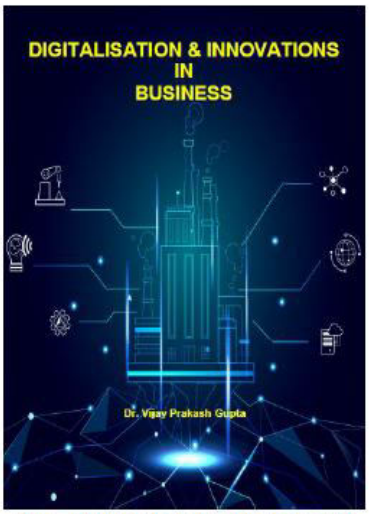
Dr. Tazyn Rahman
ISBN : 978-81-936264-1-2



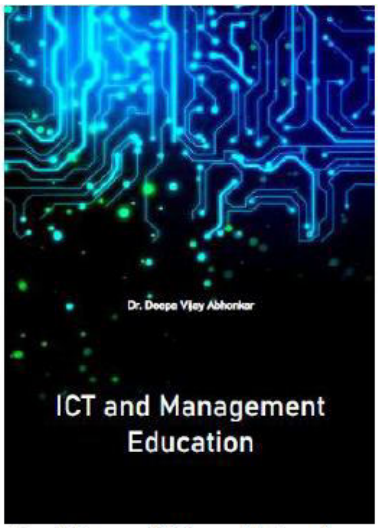
Dr. Tazyn Rahman
ISBN : 978-81-944813-5-5



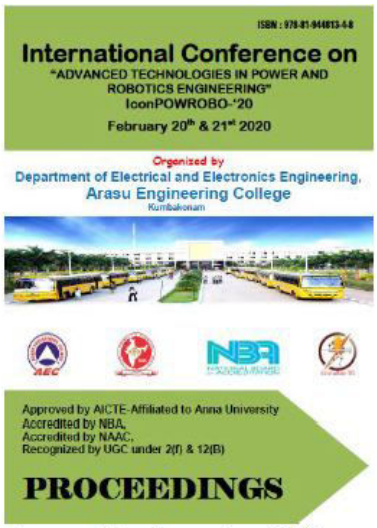
Dr. Reni Sebastian
ISBN : 978-81-944069-2-1



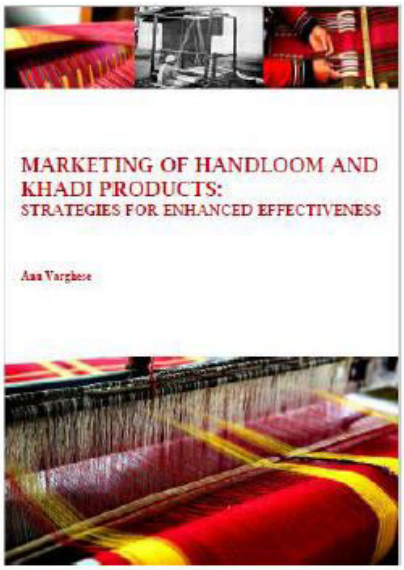
Dr. Vijay Prakash Gupta
ISBN : 978-81-944813-1-7



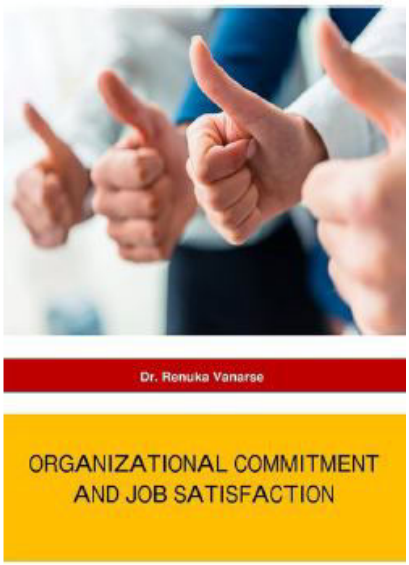
Dr. Deepa Vijay Abhonkar
ISBN : 978-81-944813-6-2



Arasu Engineering College
ISSN: 978-81-944813-4-8



Dr. Anu Varghese
ISBN : 978-81-944069-4-5



Dr. Renuka Vanarse
ISBN : 978-81-944069-1-4

Indian Academicians and Researchers Association
www.iaraedu.com