INTERNATIONAL CONFERENCE PROCEEDINGS ON
EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH AND TECHNOLOGY

16th August 2025

Organized by

UNIVERSITY OF EDENBERG
LUSAKA, ZAMBIA

VIVEKANANDA COLLEGE
DEPARTMENT OF COMMERCE AND RESEARCH CENTRE
(Reaccredited with B+ Grade by NAAC)
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Agastheeswaram, Kanyakumari, Tamilnadu, India -629701

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Dr.Samson Davidson
Dr.E.Joseph Rubert
Dr.D.Anto Pravin Singh
Ms.Aaziya

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Multi Spectrum Rural Skill Development and Social Education

Kanyakumari,Tamilnadu,India

Editors

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PERFACE

It is with great pleasure and a deep sense of academic responsibility that we present the preface for the International Conference on Emerging Trends in Multidisciplinary Research and Technology (ICETMRT – 2025)**.** This conference marks a significant milestone in promoting dialogue and collaboration across diverse domains of knowledge, hosted collaboratively by the University of Edgenberg**,** Zambia,Africa**.,** Vivekanandha College,Agatheswaram,Kanyakumari,Tamilnadu,India and Multi Spectrum Rural Skill Development and Social Education, India initiative. In an era defined by rapid technological transformation, complex global challenges, and the convergence of academic disciplines, there is an increasing need to foster integrative thinking and cross sectoral collaboration. Multidisciplinary research is no longer a theoretical concept, it is a necessity. Whether we speak of climate change, public health, digital innovation, rural upliftment, or educational reform, real-world problems demand holistic and inclusive approaches. This conference serves as a timely platform where researchers, educators, scientists, technologists, policy-makers, and students converge to share insights, challenge conventions, and shape new directions in research and practice. The central theme of this conference. The emerging trends in multidisciplinary research and technology encourages participants to move beyond traditional boundaries of specialization and embrace a culture of innovation that spans across science, engineering, humanities, education, social sciences, and rural development. It is this spirit of openness and curiosity that defines the true essence of this event. One of the distinctive highlights of this conference is its emphasis on rural skill development and social education areas that often remain on the periphery of mainstream academic discourse. By integrating community-oriented goals with high-level academic inquiry, we aim to ensure that research serves not only the advancement of knowledge but also the upliftment of marginalized communities and the betterment of society as a whole. This inclusive vision aligns with national and global priorities of sustainable and equitable development. The papers and presentations featured in this conference proceedings reflect an impressive range of scholarly excellence and innovative thinking. Each submission has undergone rigorous peer review to ensure quality, originality, and relevance. The topics covered span multiple disciplines and represent both theoretical advances and practical applications. We express our heartfelt gratitude to the organizing committee, reviewers, and technical team whose relentless efforts and commitment made this conference a success. Our sincere thanks go to all the keynote speakers, invited guests, session chairs, and panelists for their valuable contributions. We are especially thankful to all the participants—authors, researchers, students, and institutions—whose presence and input enriched the quality and impact of this conference. It is our hope that the knowledge shared through this platform will inspire continued exploration, meaningful collaborations, and impactful outcomes. We believe that this conference is not an end, but a beginning—a spark that will ignite new research paths and long-lasting academic partnerships.

Editors

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Chancellor's Message

Dr.Gunasekar Ariyamuthu
Chancellor
University of Edgenberg
Lusaka,Zambia,Africa

It gives me immense pleasure to extend my warm greetings and best wishes to all the distinguished participants, scholars, and organizers of the International Conference on Emerging Trends in Multidisciplinary Research and Technology, jointly hosted by the University of Edgenberg, Zambia, Africa, Vivekananda College, Agathesswaram, Kanyakumari, India and the Multi Spectrum Rural Skill Development and Social Education, Kanyakumari, India initiative. In today's rapidly evolving world, the boundaries between disciplines are continually dissolving, paving the way for innovative, integrative, and impactful research. This conference is a testament to the power of collaboration and knowledge-sharing across diverse academic domains. It offers a vital platform for academicians, scientists, technologists, and community leaders to explore emerging ideas, showcase groundbreaking research, and inspire solutions to some of the world's most pressing challenges. The inclusion of rural skill development and social education as a key focus highlights the deep-rooted commitment to inclusive and sustainable progress. Empowering rural communities through skill-based education and multidisciplinary approaches ensures that the benefits of technology and research reach every corner of society. I congratulate the organizing committee for their vision and dedication in bringing together such a prestigious and impactful forum. I am confident that this conference will foster meaningful dialogue, forge new partnerships, and ignite transformative ideas for the future.

Wishing the conference grand success and all participants an enriching experience.

Warm regards,

Dr.Gunasekar Ariyamuthu,Chancellor

University of Edenberg,Zambia,Africa.

Principal's Message

Dr.P.Makesh
Principal
Vivekananda College
Agatheswaram,Kanyakumari,Tamilnadu,India

It is with great honor and enthusiasm that I welcome all participants, resource persons, and delegates to the International Conference on Emerging Trends in Multidisciplinary Research and Technology, jointly organized by the University of Edgenberg**,** Vivekananda College, and the Multi Spectrum Rural Skill Development and Social Education initiative.

This conference serves as a dynamic platform to bring together scholars, researchers, and practitioners from diverse disciplines to engage in meaningful dialogue, share innovations, and foster collaborative solutions. In an age where challenges are complex and interconnected, multidisciplinary research has become not just relevant, but essential. At Vivekananda College, we are deeply committed to academic excellence, innovation, and social responsibility. The inclusion of themes related to rural skill development and social education resonates with our institutional mission of empowering communities through education and applied research. We believe that bridging the gap between technology and society is vital for sustainable progress. I commend the efforts of all organizing institutions and extend my heartfelt appreciation to the contributors and participants whose presence and ideas will undoubtedly make this conference a grand success. May this gathering of minds lead to new insights, lasting collaborations, and meaningful impact.

Wishing everyone a fruitful and inspiring conference.

Warm regards,
Dr.P.Makesh -Principal,
Vivekananda College,India

Convener's Message

It gives me immense pleasure to welcome you all to the International Conference on Emerging Trends in Multidisciplinary Research and Technology, a collaborative endeavor by the University of Edgenberg**,** Vivekananda College, and the Multi Spectrum Rural Skill Development and Social Education initiative.

In today's interconnected world, research must transcend traditional boundaries. Multidisciplinary approaches offer holistic perspectives to address real-world challenges be it in science, technology, humanities, or community development. This conference aims to create a vibrant intellectual space where ideas converge, knowledge is shared, and innovation is inspired.

We are particularly proud of the inclusion of rural skill development and social education as part of this academic dialogue. These dimensions reflect our collective commitment to inclusive growth, social equity, and community empowerment ensuring that the fruits of research reach the grassroots.

This conference is the result of months of collaboration, planning, and dedication by a passionate team of academicians and professionals. I express my deepest gratitude to all keynote speakers, paper presenters, session chairs, and participants for contributing to the success of this event.

May this conference serve as a beacon of knowledge, opening new pathways for collaboration and impactful research.

With warm regards,
Convener
Dr.Samson Davidson, Dean, University of Edenberg, Zambia,Africa.
Dr.R.Dharmaragini, Head-Dept. of Commerce, Vivekananda,India
Dr.E.Joseph Rubert, Diretcor, MSRSDSE, India
Dr.R.Sivanesan, Vice Principal, St.Alphonsa Arts & Science College, India

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SCIENCE AND INNOVATIVE TRENDS IN SPORTS EVENTS: THE FUTURE SCOPE AND DEVELOPMENT

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Abstract

Physical recreation is becoming more and more important in our lives. It is an important and necessary factor for a healthy existence and there is no doubt that it contributes to our well-being. While gaming was once synonymous with physical leisure, it may no longer be. Quantities of hobby should be measured in wider variety, with extra precision, and with better sampling frequency. We present a brief creation to motor gaining knowledge of in game and its desires for era back-up. We gift homes and obstacles of diverse sensors used for game as time sign acquisition, way of verbal exchange, and homes and obstacles of verbal exchange channels. We shed a few mild at the evaluation of diverse components of game pastime sign and facts processing. We present timing, spatial, and computational electricity constraints of processing. Attention is given additionally to the kingdom of the art work facts processing strategies together with gadget gaining knowledge of and facts mining. In end we present a few technological tendencies and demanding situations in sports, together with Internet of Things, clever game system, and actual-time biofeedback structures and packages.

Keywords: Wearable gadgets, Sports, physiological, sensors, technological tendencies.

Introduction

In a sense, we can classify leisure physical activities into leisure games, or leisure, beginner games and expert games. Each of the three classes has a different position in society and consists of people with extraordinary goals. But one element is not unusual for all of them; desire and desire to quantify one's bodily pastime. The technology used in the game is growing very quickly; the modern era has homes and capabilities that were most easily imagined a few years ago. Internally, for example, it is easiest to analyze a gymnast's movement in a positive element through video recordings, while talented gymnasts can equip their uniforms with motion sensors that authenticate their movements. Such structures can provide a comprehensive assessment of their movement in three-dimensional space based on a kinematic version of the athlete. Similar examples can be found in various sports. Today, cheaper toys and hobby tracking devices have been introduced. Devices with armbands provide statistical parameters and selected body time substance functions. For example, they count the steps taken during the day, can detect falls, sleep quality, etc. Typically, such devices collect the movements or physiological techniques of the consumer at a low frequency and random accuracy that is reasonably adequate. for his purpose.

Trends in sports

Technology make a step into the area of training? With a wonderful solution a great quantity of opportunities open. For example, a clever eCoach that follows athlete’s movements and offers recommendation primarily based totally on all of the statistics to be had from athlete’s

non-public records and statistics to be had within-side the "recreation cloud". Perhaps the arena of training will alternate forever. Signals and facts processing in recreation comments structures degrees from tremendously simple to extra ordinarily stressful and time consuming. The processing wishes on one hand and the processing abilities however depend upon quite a number of things and situations: time of processing, region of processing, processing complexity, to be had processing electricity, to be had battery capacity, etc. Time of processing relies upon at the kind of comments. If the comments is concurrent, given for the duration of the motion, the processing ought to be done in actual time. If the comments is terminal, given after the motion is completed, then the device can manage to pay for to do the whole lot in post-processing.

Review of literature

Human-Centered Computing (HCC) places the customers on the middle of layout and improvement. HCC is an interdisciplinary subject that intersects lap top technological know-how, psychology, and cognitive technological know-how. HCC specializes in the layout and implementation of computing structures that help human beings's sports and human improvement It is the technological know-how of designing computations and computational artifacts in help of human endeavors (Jaimes, Sebe, & Gatica-Perez, 2006).

Aim of the study:

The specific aim of this scholarly qualitative study was to explore the impact of modern technology on sports performance.

Methodology:

A thorough on-line and offline search procedure was applied for the acquisition of evidence in this systematic qualitative study. An analysis of the paper was systematically done through online databases: PubMed, Google Scholar, and Google Advance Search.

Sport background of feedback systems

Motor gaining knowledge of is primarily based totally on repetition. Numerous accurate executions, on the whole numerous thousand of them, are required to accurately analyze a positive movement. According to sports activities experts, remarks is the maximum vitalidea for gaining knowledge of, besides the exercise itself. It may be concluded that motor gaining knowledge of closely relies upon at the remarks given to the learners. In this paper we are able to attention at the opportunities of erasubsidized motor gaining knowledge of enhancements. During the exercise, the natural (inherent) remarks records is supplied internally via human feel organs. Augmented remarks is suppliedvia way of means of outside source, historically via way of means of teachers and trainers, these days additionally via way of means of technical gadget and devices. Coach supported motor gaining knowledge of is depicted in Fig.2. A train or an teacher is following or tracking athlete's movements and offers the remarks approximately the performance, results, and recommendation approximately viable improvements. With this form of remarks technical gad get isn't always essential because the sensors may be train's eyes, the processing and tracking may be completed for my part via way of means of the train, the remarks to the athlete is given in any

of the conventional ways: via way of means of oral recommendation, via way of means of drawings, via way of means of displaying the appropriate action, etc.

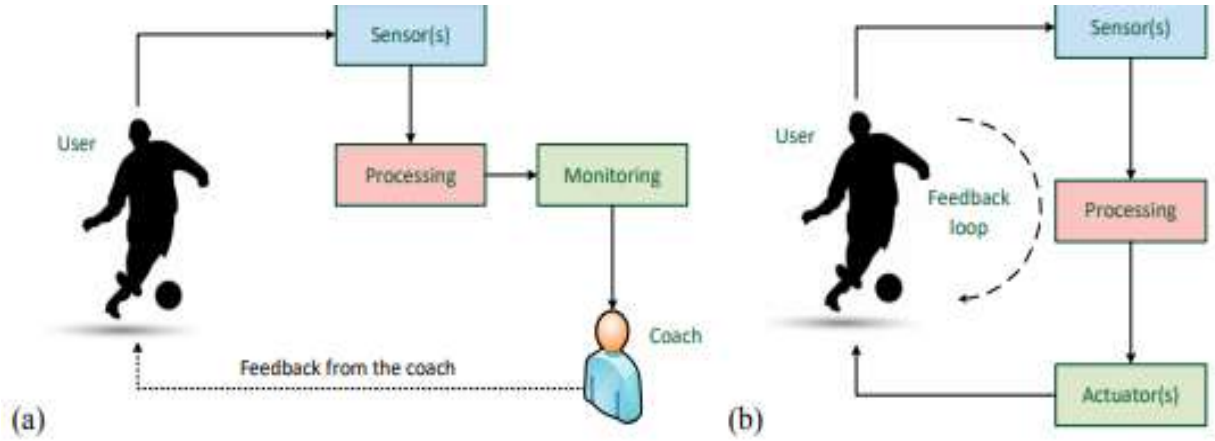

Fig-2 improved feedback during the established motor learning

Motor learning that supports traditional teaching can be improved by the introduction of a technical device that can measure, calculate and provide the locations of the movements made. Figure 2 shows the technical setup using the sensor, processing and monitoring block. An important reason for the use of technical equipment is the possibility of obtaining imperceptibly incomprehensible or miles beyond human capabilities statistics. For example, a teacher cannot see the pressure applied during a gymnast's jumps, or the teacher cannot see the exact place where the tennis ball hits the racket during a serve. With the help of a special technical device, both the pressure of the gymnast and the impact point of the tennis ball can be measured, calculated and delivered. For example, in Figure 2, the sensor could be a too-fast, too-accurate digital camera recording a tennis serve. The live video is processed and the ball score is calculated. The instructor receives a graphical representation of the service, followed by many applicable parameters on the instrument screen. The teacher can then look at the facts and possibly make a recommendation to the tennis player.

Snick-o-Meter:

The Snick-o-meter identifies whether or not a snick occurred. A snick whilst the cricket ball comes in touch with the bat is a nice noise. That is expressed within side the captured audio sound-waves. There is frequently confusion approximately whether or not the ball has made touch with the bat, or a batsman's gear. Among the prevailing techniques, Rock et al. in probed the usage of wavelets for area detection in cricket signals. Wavelet-primarily based totally functions had been extracted and an synthetic neural network (ANN) machine become educated on them. The ANN classifier become educated to inform the numerous instructions apart. The accuracy of the machine become 97.fivepercentage on uncooked trying out data. Rock et al. in supplemented their elegance machine's efficacy with the resource of the use of centering their hobby on extraction of wavelet region descriptors for the fast period of the snicks. Additionally, they made use of time region-based definitely higher order statistical functions, inclusive of skewness and kurtosis, and have beenable to gain a category price of a hundred percent on unprocessed finding out statistics.

Modern track and field events using technology:

Track and discipline varies from maximum different disciplines, as it's miles measured in meters and seconds simplest. Within tune, a fragment of a 2ndcould make all of the difference. Which is why the system which tracks tune and discipline race information must be as dependable as particular as practicable. An digital beginning pistol is any other innovation used to enhance tune occasion startups. In addition, whilst the runner begins, they 'll observe their development the usage of Radio-Frequency Identification (RFID) chips. These chips are so precious that during trendy they have got come to be popular. RFID chips can be bandaged to shoes to reveal the pace, distance and sample of a runner. Global Positioning System era has been applied for a while in aggressive game, which include in practice sporting activities in addition to in the course of play. By the usage of Electronic Performance and Tracking System (EPTS) gadgets, groups can tune the motion of gamer son the pitch and accumulate huge quantities of records approximately their overall performance. In 2006 the primary tries to affirm GPS for discipline game programs had been made. Although GPS has been licensed for aggressive sports activities sports, a few questions stay concerning the suitability of GPS for monitoring rapid high-speed runs. Consequently, GPS has been usually utilized in American football, baseball, basketball, rugby union and league and soccer. GPS performance in comparing human locomotion is tormented by unique elements as described for validity in element above. That is, pattern price, speed, project duration, and project kind every in phrases of GPS reliability. The GPS is a monitoring tool that accesses the GPS satellite tv for pc signal (or comparable satellite tv for pc networks consisting of GLONASS, GNSS, BDS or NAVIC) to triangulate its very own position.

Aerodynamics:

While without a doubt any game will be used to demonstrate this new function of high-tech tennis, fencing, swimming, golf, and cycling – is a superb example. In the twenty first century, global-elegance tennis gamers (and their coaches and trainers) could have a clean understanding of the legal guidelines of aerodynamics in an effort to absolutely draw close the game and obtain a bonus over opponents . Therefore whilst engineer broaden technological gadgets for sports activities they have got to research the real aerodynamics of the respective video games and sports activities.

Conclusion

There isn't any doubt that athletes in novice and expert recreation will usually attempt for higher results; in keeping with the Coubertin's Olympic moto: "Faster, higher, stronger!" Application of technology and era can also additionally provide vast aggressive advantage, what's in today's exceedingly aggressive and commercialized re creation really priceless! The cognizance of this paper is extended motor studying with using era. While it isn't debatable that era can outperform human senses in nearly all aspects, one query remains; can technology make a step into the area of training? With a wonderful solution a great quantity of opportunities open. For example, a clever eCoach that follows athlete's movements and offers recommendation primarily based totally on all of the statistics to be had from athlete's non-public records and statistics to be had within side the "recreation cloud". Perhaps the arena of training will alternate forever.

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PREPAREDNESS OF B.ED COLLEGE STUDENT TEACHERS RELATED TO AI IN EDUCATION

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Abstract

Artificial Intelligence (AI) is becoming increasingly integrated into educational systems worldwide, offering new opportunities for teaching and learning. As future educators, B.Ed (Bachelor of Education) student teachers must be adequately prepared to understand and utilize AI tools effectively. This study explores the preparedness of B.Ed student teachers concerning AI in education, focusing on their awareness, skills, attitudes, and the challenges they face. Using a mixed-methods approach, the research found a significant gap between interest in AI and actual competence in using AI tools. The study concludes with recommendations for curriculum reform, faculty training, and institutional support to bridge the AI preparedness gap.

Key words: Artificial Intelligence, Teacher Education, B.Ed students, Educational Technology, AI integration, Digital Pedagogy

Introduction

Artificial Intelligence (AI) has emerged as a transformative force in modern education. AI applications such as adaptive learning platforms, AI-assisted grading, predictive analytics, and intelligent tutoring systems are redefining pedagogical strategies (Holmes et al., 2021). In this evolving landscape, teachers are not only facilitators of knowledge but also key mediators in the integration of emerging technologies. B.Ed student teachers represent the future workforce of the education sector. Their ability to understand, evaluate, and implement AI tools will significantly determine how effectively AI is adopted at the classroom level. However, there is a growing concern that teacher education programs have not adequately prepared these future educators to operate in AI-supported learning environments (Zawacki-Richter et al., 2019). This study investigates the current state of AI preparedness among B.Ed student teachers and offers practical recommendations for improvement.

Background of the study

Luckin et al., (2016) Artificial Intelligence (AI) is increasingly influencing educational practices worldwide. Its applications, such as personalized learning and automated assessment, demand that future teachers develop new technological skills. He emphasized that AI will play a crucial role in reshaping education and teaching methods. However, many teacher education programs still lack comprehensive AI training. B.Ed. student teachers, as future educators, must be prepared to integrate AI tools effectively in classrooms. Without proper readiness, they may struggle to meet the needs of a technology-driven learning

environment. Understanding their level of preparedness is essential to reform teacher education curricula. This study focuses on assessing the awareness, skills, and attitudes of B.Ed. college student teachers toward AI. It aims to identify gaps and propose improvements for future training. Preparing teachers for AI integration is vital for the future of education.

Holmes, Bialik, and Fadel (2019) Artificial Intelligence (AI) is rapidly transforming the education sector through innovations like adaptive learning systems and automated feedback. Holmes, Bialik, and Fadel (2019) highlighted the growing importance of AI in creating personalized and efficient learning experiences. Despite this, many teacher education programs have not fully incorporated AI training into their curriculum. As future educators, B.Ed. student teachers must be prepared to adapt to AI-driven changes in classrooms. A lack of preparedness could limit their effectiveness in using modern teaching tools. Therefore, assessing their knowledge, attitudes, and readiness regarding AI is critical. This study seeks to understand the current level of preparedness among B.Ed. student teachers. The findings can guide curriculum reforms to better equip future teachers. Ensuring teacher readiness for AI integration is essential for advancing educational quality. Well-prepared teachers can help students thrive in a technology-rich world..

Significance of the study

This study is significant as it addresses the urgent need for future teachers to be equipped with AI-related competencies. As AI reshapes education, B.Ed. student teachers must be prepared to integrate these technologies effectively. The findings will highlight the current gaps in their knowledge, attitudes, and skills regarding AI. It will provide valuable insights for teacher education institutions to enhance their curriculum. Policymakers can also use the results to develop training programs focused on AI literacy. By improving teacher preparedness, schools can ensure better student engagement and personalized learning experiences. The study also contributes to the growing research field of AI in education. Ultimately, it aims to support the creation of a future-ready teaching workforce. Empowering teachers with AI skills is essential for fostering innovation and inclusion in education.

Objectives of the study

1. To find if there is a significant difference in AI preparedness between male and female B.Ed. student teachers.
2. To find the impact of locality on the awareness and knowledge of AI among B.Ed. student teachers.
3. To find if AI preparedness differs across various departments among B.Ed. student teachers.

Hypothesis of the study

1. There is no significant difference in AI preparedness between male and female B.Ed student teachers.
2. There is no significant difference in AI preparedness between B.Ed. student teachers from urban and rural localities.
3. There is no significant difference in AI preparedness across different departments among B.Ed. student teachers.

Methods adopted in the present study

The investigator has adopted survey method to assess the preparedness of B.Ed student teachers in integrating AI in education.

Tools used in the present study

A self made tool "Preparedness of B.Ed college student teachers related to AI in education."

Population of the study

Students those who are studying in B.Ed college in regular mode in Tirunelveli district was considered as a population.

Sample of the study

Among the population, 50 were selected as the sample. Simple random sampling techniques was adopted by the investigator.

Statistical techniques used

i. 't' test
ii. 'F' test

Null hypothesis 1

There is no significant difference in AI preparedness between male and female B.Ed student teachers.

Table 1 Difference between AI preparedness of male and female B.Ed. student teachers.

Background variables	Category	N	Mean	S.D.	Calculated 't' value	Remark at 5% level
Gender	Male	25	39	9.02	0.905	NS
	Female	25	37	9.27		

(At 5% level of significance, the table value of 't' is 1.96)

From table 1,it is inferred that the calculated "t"value is lesser than the "t" value at 5%level of significance. This implies that there is no significant difference in AI preparedness between male and female B.Ed student teachers. Hence null hypothesis is accepted.

Null hypothesis 2

There is no significant difference in AI preparedness of B.Ed. student teachers from urban and rural localities.

Table 2 *Difference between AI preparedness of B.Ed. student teachers from urban and rural localities.*

Background variables	Category	N	Mean	S.D.	Calculated 't' value	Remark at 5% level
Locality	Rural	31	38.3	8.6	0.007	NS
	Urban	19	38.7	10.0		

(At 5% level of significance, the table value of 't' is 1.96)

From table 2, it is inferred that the calculated "t" value is lesser than the table "t "value at 5% level of significance. This implies that there is no significant difference in AI preparedness of B.Ed. student teachers from urban and rural localities.Hence null hypothesis is accepted.

Null hypothesis 3

There is no significant difference in AI preparedness across different departments among B.Ed. student teachers.

Table 3

Differencebetween AI preparedness across different departments among B.Ed. student teachers.

Background variables	Source of variation	Sum of squares	Degrees of freedom	Mean square variance	Calculated 'F' value	Remark at 5% level
Department.	Between Groups	679.398	6	116.233	1.495	NS
	Within Groups	3342.78	43	77.730		

(At 5% level of significance, the table value of 'F' is 2.34)

From table 3,it is inferred that the calculated "F" value is lesser than the table "F" value at 5% level of significance .This implies that the there is no significant difference in AI preparedness across different departments among B.Ed. student teachers. Hence null hypothesis is accepted.

Findings

i. There is no significant difference in AI preparedness between male and female B.Ed student teachers.

ii. There is no significant difference in AI preparedness between B.Ed. student teachers from urban and rural localities.

iii. There is no significant difference in AI preparedness across different departments among B.Ed. student teachers.

Interpretation

This findings suggests that AI preparedness among B.Ed. student teachers is broadly consistent across different groups. The absence of significant gender differences indicates that both male and female student teachers are equally ready to adopt and integrate AI technologies. Similarly, the lack of difference between urban and rural students implies that access to AI knowledge and skills is becoming widespread, regardless of geographical background. This may reflect the growing availability of online resources and digital education across locations. Additionally, the finding that no significant difference exists across departments shows that AI preparedness is not confined to specific academic disciplines. Students from all fields appear equally familiar and comfortable with AI-related

concepts. This overall pattern suggests that AI literacy efforts have reached student teachers in an inclusive manner. It highlights that the current generation of B.Ed. students is adapting well to technological advancements. The results also imply that future AI training programs can be designed uniformly, without the need for special modifications based on gender, locality, or academic specialization. The uniform preparedness may foster collaborative and innovative teaching practices. It points to a promising future where AI integration in education can proceed smoothly across diverse teacher populations. Overall, the interpretation reflects a positive and balanced landscape of AI readiness among future educators.

Conclusion

The study concludes that AI preparedness among B.Ed. student teachers is consistent across gender, locality, and departmental differences. Male and female students, as well as those from urban and rural backgrounds, show similar levels of readiness to engage with AI technologies. Likewise, student teachers from various academic departments demonstrate comparable preparedness for AI integration. These results indicate that factors such as gender, place of residence, and field of study do not create significant disparities in AI literacy among B.Ed. students. The uniformity in preparedness suggests that efforts to enhance AI skills in teacher education have been widely accessible and effective. Consequently, future training programs and AI-based educational initiatives can be designed without the need for group-specific modifications. Overall, the findings present a positive outlook for the integration of AI in education, highlighting that future educators are well-positioned to embrace and utilize AI tools in their professional practice.

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A Comprehensive Review of Artificial Intelligence and Machine Learning: Concepts, Trends and Application

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ABSTRACT

A Comprehensive Review of Artificial Intelligence and Machine Learning: Concepts, Trends, and Applications": The Data-Related AI and ML Difficulties The foundation of AI and ML is data, but it presents a number of difficulties. The accessibility of sizable, excellent datasets is a significant problem. Labeled or domain-specific data are lacking in many domains. Missing values, noise, and inconsistent data all have an impact on model accuracy. Predictions can be skewed by imbalanced datasets, where certain classes predominate. Particularly when it comes to sensitive or personal data, data privacy and security raise moral and legal issues. Annotating data is costly and time-consuming, and it frequently calls for expert opinion. Additionally, models may perform worse as a result of data drift, or changes in data over time.

1.1 INTRODUCTION

Artificial intelligence (AI) and machine learning (ML) are two of the most innovative technologies of the twenty-first century. Artificial Intelligence (AI) is the development of computer systems that can reason, solve problems, and make decisions—tasks that typically call for human intelligence. A subfield of artificial intelligence called machine learning (ML) aims to create algorithms that enable computers to learn from data and progressively improve their performance without the need for explicit programming. Many industries, including manufacturing, transportation, healthcare, finance, and education, now make extensive use of these technologies. The development and implementation of AI and ML systems have been accelerated by the ongoing expansion of big data, the rise in processing power, and developments in algorithmic models. Advances in automation, personalization, and intelligent decision-making have been made possible by trends like deep learning, natural language processing, computer vision, and reinforcement learning. Notwithstanding their achievements, there are still many obstacles to overcome, including algorithmic bias, data privacy, and ethical issues. This essay offers a thorough analysis of AI and ML, going over its fundamental ideas, current developments, and real-world uses. Along with outlining the main issues and potential paths forward, it also emphasizes how these technologies affect society. Researchers, students, and professionals who want to comprehend the changing field of AI and ML can use this study as a guide.

1.2 OBJECTIVE

This study's main goal is to present a thorough and organized overview of machine learning (ML) and artificial intelligence (AI), emphasizing its various applications, developing trends, and fundamental ideas.

- Describe the fundamental ideas of AI and ML, such as system architectures, learning styles, and algorithms.
- Examine contemporary developments like explainable AI, natural language processing, deep learning, and learning.

3) Examine practical uses of AI and ML in a range of industries, including cybersecurity, healthcare, finance, education, agriculture, and transportation.

4). List the main obstacles, including model bias, data privacy, lack of transparency, and ethical.

5) Draw attention to potential research avenues and future directions that could advance the creation and responsible application of intelligent systems.

1.3 FUNDAMENTAL OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

The science of building machines that are capable of solving problems, learning, and making decisions—tasks that require human intelligence—is known as artificial intelligence, or AI. A branch of artificial intelligence called machine learning (ML) allows systems to learn from data and get better on their own without explicit programming. ML encompasses unsupervised learning (identifying patterns in unlabeled data), supervised learning (using labeled data), and reinforcement learning (learning through rewards). These technologies create models that can forecast results or automate procedures using data and algorithms. AI and ML work together to create intelligent systems that are utilized in a wide range of fields and applications.

1.4COMPONENTS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

A number of fundamental elements form the foundation of artificial intelligence (AI), which makes it possible for machines to carry out intelligent tasks. In order to build systems that can mimic human thought and behavior, each component has a distinct function. Without explicit programming, machine learning (ML) allows systems to learn from data and get better over time. Communication between humans and computers is made possible by natural language processing (NLP), which enables machines to comprehend, interpret, and produce human language.

- Computer vision: Assists machines in deciphering and evaluating visual data from pictures or videos. Expert systems simulate a human expert's decision-making process by using pre-established rules and logic.
- Robotics: This field creates intelligent machines that can carry out physical tasks by fusing artificial intelligence (AI) with mechanical systems.

KEYCOMPONENTS

Artificial intelligence, machine learning (ML) aims to build systems that can learn from their experiences and get better over time. Important ideas include:

1. Types of Learning: Supervised Learning: Trains prediction models using labeled data. Finding patterns and connections in unlabeled data is known as unsupervised learning. Reinforcement learning uses rewards and penalties to teach the best course of action.
2. Algorithms Decision trees: It support vector machines, and neural networks are examples of common algorithms; each is made for a particular kind of data and task.

1.5 CODEALGORITHM INMACHINE LEARNING

Several algorithms are used in machine learning to evaluate data, identify trends, and generate predictions. These algorithms, which differ according to the type of learning employed, form the basis of machine learning models.

- Learning Algorithms Under Supervision: Continuous values are predicted by linear regression. For problems involving binary classification, logistic regression is utilized. Tree-based models for regression and classification include Random Forest and Decision Trees. SVMs, or support vector machines, work well in high-dimensional spaces.
- Algorithms for Unsupervised Learning: Data is grouped into clusters using K-Means clustering. PCA, or principal component analysis, lowers the dimensionality of data.
- Algorithms for Reinforcement Learning: Q-Learning: Acquires knowledge of the best course of action through rewards. Q-learning and deep learning are combined in Deep Q-Networks (DQN).

1.6 CORE ALGORITHM OF MACHINELEARNING

A variety of fundamental algorithms are used in machine learning to process data, identify trends, and reach conclusions. These algorithms differ according to the learning approach and problem type.

✓Learning Algorithms Under Supervision: Continuous outcomes are predicted by linear regression. For binary classification, logistic regression is utilized. Decision Trees: Decision-making models based on trees. An ensemble of decision trees for increased accuracy is called Random Forest. Data is classified by the Support Vector Machine (SVM) with a maximum margin.

✓Algorithms for Unsupervised Learning: Similar data points are grouped using K-Means clustering. Using data similarity as a basis, hierarchical clustering creates nested clusters. Principal Component Analysis, or PCA, lowers the dimensions of data.

✓Algorithms for Reinforcement Learning: Q-Learning: Acquires knowledge of the best course of action through reward feedback. Today, the majority of machine learning applications are powered by these fundamental algorithms.

1.6.1 FEATURE LINEAR SVM AND KERNEL SVM

Converts data into higher dimensions using kernel functions. Ideal for Data that can be divided by a straight line is said to be linearly separable. Data that is not linearly separable (complex boundaries). Intricacy easier and quicker to calculate. More intricate and computationally demanding.

Precision Excellent for basic datasets. Increased precision for high-dimensional or complex data. The Kernel Function Only a linear decision boundary is utilized. Makes use of kernels such as Sigmoid, Polynomial, and RBF. For instance. Use Case Basic features for detecting spam emails. Pattern recognition and image classification

1.6.2 LINEAR SVMVS KERNEL SVM

This comparison primarily pertains to Support Vector Machines (SVM) and other kernel-based machine learning techniques.

Linear Definition: Data is separated using a straight line (or hyper plane in higher dimensions). Use case: When it is possible to draw a straight line between classes, or when data is linearly separable. Example: If there is a noticeable difference between apples and oranges, separate them based on size and weights.

Kernel Definition: Makes input data linearly separable by transforming it into higher dimensions. Use case: When there are non-linear patterns in the data, such as complex or circular patterns. For instance, spiral or concentric circles where the data cannot be separated by a straight line. Typical Kernels: Radial Basis Function (RBF) for polynomials Transformation of the Sigmoid Model.

1.7 IMPORTANT ALGORITHMS INARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

A number of important algorithms have surfaced as fundamental tools in the rapidly changing fields of AI and ML. Depending on the type of machine learning, these algorithms can be classified as deep learning, reinforcement learning, supervised learning, unsupervised learning, or symbolic AI.

1.7.1 Supervised learning algorithms

Models are trained using labeled datasets in supervised learning. For predicting continuous numerical values, one of the most popular and straightforward algorithms is linear regression. Logistic regression is frequently used for classification tasks in order to classify data into binary outcomes and calculate probabilities. Choice Another significant supervised learning technique is the tree, which divides data into branches for decision-making. Multiple decision trees are combined in Random Forests to improve accuracy, decrease overfitting, and boost performance. Support Vector Machines (SVMs) are strong classifiers that, particularly in high-dimensional spaces, determine the ideal boundary (hyperplane) between classes. K-Nearest Neighbors (KNN), another user-friendly algorithm, categorizes new data points according to the 'k' closest examples in the training set. Based on Bayes' Theorem, Naïve Bayes assumes feature independence and works particularly well for text classification issues like spam filtering.

1.7.2 Unsupervised Learning Algorithm

Unsupervised learning seeks to reveal hidden patterns in unlabeled data. K-Means Clustering, one of the most widely used algorithms, separates data into "k" clusters according to feature similarity. Another is Hierarchical Clustering, which creates nested clusters and works well with data that has tree-like relationships. A popular method for reducing dimensionality is Principal Component Analysis (PCA). It speeds up learning and makes data useful for visualization by reducing its dimensions while maintaining its variance. Density-Based Spatial Clustering of Applications with Noise, or DBSCAN, is robust for spatial and irregular data by identifying outliers and grouping together closely packed data points.

1.7.3 Reinforcement learning algorithm

Learning through interaction and feedback is known as reinforcement learning. Q-Learning is a fundamental algorithm that teaches an agent the importance of performing particular actions in particular states in order to maximize long-term rewards. To handle high-dimensional input spaces like pictures or games, Deep Q-Networks (DQN) integrate Q-learning with deep neural networks.

Instead of estimating value functions, a different group called Policy Gradient Methods optimizes the decision policy directly. Real-time control systems and robotics both make extensive use of these.

1.8 DEEP LEARNING ALGORITHM

Deep learning models complex data using multi-layered neural networks. The Artificial Neural Network (ANN), which consists of several layers of interconnected nodes (neurons), is the fundamental structure. Convolutional Neural Networks (CNNs) are highly effective at tasks like object detection, face recognition, and image classification because they are trained on visual data. Text and speech sequence data are processed by recurrent neural networks (RNNs). They are perfect for language modeling and time-series forecasting because they retain memory across time steps. An enhanced version of RNNs that can learn long-term dependencies without experiencing vanishing gradients are called Long Short-Term Memory (LSTM) networks. The Transformer architecture, which substitutes attention mechanisms for recurrence, is among the most important innovations. Modern natural language processing models such as BERT, GPT, and T5 are built on transformers.
Autoencoders compress and reconstruct data into a lower-dimensional representation for unsupervised learning, which is helpful for anomaly detection. Two networks, a generator and a discriminator, compete to create realistic-looking synthetic data, like pictures, videos, or music, in Generative Adversarial Networks (GANs).

1.9 TRENDS IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- Generative AI:AI models with the ability to produce audio, video, images, and text. For instance, DALL·E (pictures), Sora (video), and ChatGPT (text). Utilized in marketing, entertainment, and content production.
- Explainable AI: focuses on ensuring that AI decisions are clear and intelligible to people. Crucial for sectors where trust is essential, such as healthcare and finance.
- Auto AML (automated machine learning):Automates the process of choosing, training, and tuning a model. Trend: Makes ML easy for people who don't know much about it.
- Edge AI:Executing AI models locally on gadgets (such as IOT and smartphones). Benefits include improved privacy, offline functionality, and quicker response times.
- Federated Learning:Models are trained on dispersed devices without transferring data. Used in: Settings where data is sensitive, such as healthcare and mobile apps.
- Multimodal Learning:integrates various data types, including text, images, audio, and more. For instance, GPT-4o can comprehend voice, text, and images.
- Ethical and Responsible AI:increasing emphasis on minimizing bias, maintaining equity, and abiding by rules. Includes bias detection, data privacy, and AI safety.
- Self-supervised learning:Without labeled datasets, models learn from unlabeled data. Resulting in significant advances in computer vision and natural language processing.

1.10APPLICATION IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- Medical Imaging: Use CNNs to identify diseases from MRIs and X-rays.
- Drug Discovery: AI speeds up the testing of novel medications.
- Fraud Detection: Look for odd transaction patterns.
- Credit Scoring: Use machine learning models to evaluate creditworthiness.
- Algorithmic Trading: AI decides what to invest in in real time.
- Retail and E-commerce: Recommendation engines: such as Netflix and Amazon, which make movie and product recommendations.

- Customer Sentiment Analysis: Use NLP to comprehend reviews and comments. Demand forecasting: Make pricing and inventory more efficient.
- Autonomous vehicles: Self-driving cars are powered by AI, which can recognize roads, signs, and pedestrians. Makes decisions in real time using deep learning.
- Crop Health Monitoring: AI image analysis and drones.
- Yield Prediction: Examining crop, weather, and soil data. AI-guided automated sprayers for weed detection.
- Education: Al-powered personalized learning adjusts content to each student's unique learning style. Essays and assignments are graded automatically.
- Tutors and chatbots: Respond to student questions around-the-clock.
- Cybersecurity: AI instantly detects anomalies and cyberthreats. Applications include phishing prevention and intrusion detection systems.
- Manufacturing: AI-powered predictive maintenance foresees machine failure before it occurs. Using vision systems to identify flaws on assembly lines is known as quality control.

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IMPACT OF LEADERSHIP STYLE ON EMPLOYEE COMMITMENT AND JOB PERFORMANCE – MANUFACTURING COMPANIES IN CHENNAI

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ABSTRACT

The main aim of this study to analyze the impact of Leasership Styles on Employee Commitment and Job performance. This paper explored the implications of these findings on employee motivation, commitment, engagement and job satisfaction. Empirical research has been conducted on employee's perception of the impact of employees' motivation and engagement on employees' performance. Leadership style is the manner of providing direction, motivating employees towards attainment of manufacturing sectors‘ goal. The main aim of this study to analyze the impact of Employee Commitment on Job Satisfaction and Motivation. The leadership style has been analysed in the different socio-economic and manufacturing sectors in Karnataka.

Keywords: Employee Commitment, Job Performance, Leadership and Job Satisfaction etc.,

INTRODUCTION

Leadership is one of the most important area in management that occupies the central position in our day to day life. The human group is always a leader otherwise they cannot live to achieve their purpose in the society. The success in leading this group is contingent upon the ability of the leaders to hold the power effectively and existence of an opportunistic situation. Leadership includes the source of influences that built the positions in the organizational hierarchy. The leaders are the people who have clear idea of what they want to achieve, develop best strategies and adopt the effective leading style which are goals oriented to influence the subordinates in achieving the organizational goals. The subordinate should adopt the organizational goals as their own personal goals. The leadership style of the organization will increase the subordinate performance that will lead to accomplishing the organizational goals. Every employees and managers should understand the organizational goals and understand the type of the employees they dealing with. The managers need to achieve the strategic goals, but most of the subordinates become curious about the special styles, traits, and behaviour their leaders may exhibit their job side.

SCOPE OF THE STUDY

The Scope of this study is uniquely develops both the mind-set and ability of leaders need in order to develop the people, foster teamwork, and produce the results. Rather than the random set of competencies, it takes into consideration the dependencies and the hierarchy of optimal leadership development. The study of leadership is also a time for the personal introspection and growth. The organizations intending to obtain the better performance from their employees by using the new approaches to leadership and reducing the influence of authoritative leadership and increasing the use of corporate leadership. This would help to reduce social accidents, wastage and internal conflicts in the working environment. This

research is also intended to be useful to future researchers, students and academicians to see the importance of different leadership styles on performance. This study will add to existing knowledge. The aim of this study is exploring how the various leadership styles stimulated the execution of defined duties, meeting deadlines and achieving the organizational goals.

OBJECTIVES OF THE STUDY

1. To study the demographic profile and leadership styles on employee commitment and job performance.
2. To analyze the organizational information of the manufacturing companies.
3. To determine the impact of leadership style on the employee commitment.

HYPOTHESIS OF THE STUDY

1. H0: There is no significant influence on demographic variables of employees and the leadership styles.
2. H1: There is a significant influence on demographic variables of employees and organizational information of manufacturing companies.

Review of Literature

Leavy and Mckiernan (2009) examined that the leaders are expected to make right decision apart from contributing and generating new ideas and knowledge in the organizations in order to respond the changes. The leadership styles are measured in the following sections as transactional leadership, transformational leadership and laissez-faire leadership styles. These leadership styles help to improve the skills of the employees.

Rafiq and Mahmood (2009) ascertained that positive relationship between employees‘ organizational commitment dimensions and leadership styles. Some of the other factors except the leadership styles increase the organizational performance. The employee‘s performance need to be directed towards to achieve the goal of the organization. Task oriented employee‘s skills increase the organizational productivity. Self-evaluation will improve the skills of the employees.

Nuhu (2010) it can be seen that the transactional, laissez-faire, and autocratic styles are among the most commonly used leadership styles. According to this study, the autocratic style negatively affected employee performance, while the laissez-faire style positively affected employee performance, although to a lesser extent. Thus, the result underscores the relative importance of transactional style in enhancing employees' desired performance and achieving organisations' intended goals.

RESEARCH METHODOLOGY

This research was done through surveys and interviews it includes the historical and present information. This is the strategy of research, it give best idea to the researcher to achieve their research objective. This study conducted by using analytical and descriptive methodologies. Primary as well as secondary data were used for this study. The primary data were collected through questionnaire.

STUDY AREA

This survey was conducted among the manufacturing companies in Karnataka. Selected manufacturing companies only used for this study. Companies taken for this study is Hitachi

Energy India Limited, Mangalore Chemicals and Fertilizers Limited (MCF), Solidex Manufacturing Company (SEMCO) and Hindustan Unilever Limited (HUL).

SAMPLE SIZE AND DESIGN

The researcher circulated 100 questionnaires among the employees in the manufacturing companies of Karnataka to know their views and awareness about the leadership styles. A pilot study was conducted by using the pre-tested questionnaire.

PRIMARY DATA

A well-framed questionnaire was used for this research to obtain responses from the manufacturing company employees in Karnataka. The questionnaire comprises three parts. The first part comprises the demographic factors of employees in manufacturing companies with optional type questions. The second part comprises the general information related with the companies like the facilities and other information of the organization. The third part consist of the assessment of leadership styles on employee commitment in manufacturing companies.

SECONDARY DATA

Secondary data has been collected from different sources such as articles, magazines, books, web source and other research reports. The purpose of secondary data were identification of study variables, references for standardized questionnaire and literature survey for identifying the research problem and research gap.

Factors of leadership styles

Factors of leadership styles	Cronbach's Alpha Reliability
Management gives careful attention to the health of employees	.936
Top management pays attention to the subordinates suggestion	.936
Companies take care of the employee's development	.936
Have career development opportunities for the employees	.936
Companies maintain a competitive pay structure and other benefits	.935
Employees receive very good salary based on their responsibilities	.934
Companies have clear and good policies related to salary, increment and other benefits	.934
Manager makes the other employees feel proud of working with him	.936
The manager act in the way that benefit the respect of others	.935
The supervisor help employees to look at the problem from the different point of view	.934
The manager help the employees to develop their strength	.934
The manager create motivating vision of the future	.936
Specify and clarify the responsibility of every one to achieve their goals	.949
The supervisor express his satisfaction when the employees achieve the expectation of their supervisor	.944
The manager pay attention on handling the mistakes and complaints	.945
The manager monitor all the activities of the subordinates	.946
The manager pay attention to the failures in order to achieve the standards	.944
The workers want to be a part of decision-making process	.945
The manager gives complete freedom to their subordinates to solve the problems on their own	.935
The manager allows their subordinates to appraise their own work	.934
Receiving supportive communication from the manager	.934
The manager stays out of the way of employees as they do their work	.936

Source: Primary Data

The above table explores the Cronbach's Alpha values for the factors of leadership styles on employee commitment and job performance (above 0.700) as suggested by Cavana et al. (2001). This leads to the conclusion that there is a higher consistency in the measurement of variables and scales are highly reliable. However, in the light of the experience gained through the pilot study, the questionnaire was modified to get appropriate and elicit responses

Findings

The value of F=100.673, P=.000 are statistically significant at 5% level of significance therefore it is concluded that there is a significant relationship between leadership style factors and the outcome of shaping the employee attitude. The compensation and benefits (β=.424, t= 6.270, P =.000), transformational leadership (β=-.026, t=-.850, P=.000), are statistically significant @5% level of significance. The researcher should explain that, the leadership style measures such as compensation and benefits and transformational leadership creates positive influence on shaping the employee attitude. The value of F=182.059, P=.000 are statistically significant at 5% level of significance hence it is identified that there is a significant relationship between leadership style factors and employee engagement and passion.

Conclusion

This study reveals that there is a positive relationship between the leadership styles, employees 'commitment and job performance. This study pays attention to the employees, thus it stimulating the employees to accomplish unprecedented results, which goes beyond the specified expectations, and the manager and leaders are able to develop their capacity. According to this study it has been identified that most of the manufacturing companies are not giving importance for leadership styles. So the manufacturing companies need to arrange training programme for their employees to improve their leadership skills. Some of the monetary and non-monetary benefits also help the employees to improve the performance.

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NARCO-TERRORISM

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ABSTRACT

Narco-terrorism, the involvement of terrorist organizations and insurgent groups in drug trafficking, has become a problem with international implications. The concept of "narcoterrorism" was introduced in 1983 by the Peruvian President Belaunde Terry to designate terrorist-like attacks against his country's drug enforcement police. Drug criminals utilized methods from political assailants to influence the politics of the country by causing terror and obstructing justice. Such organizations include FARC, ELN, AUC in Colombia, PCP-SL in Peru, Hezbollah, and the Taliban. These groups, who even killed a Catho- lic cardinal, have no political agenda. However, their terrorist acts have the same effect as politically motivated terrorists: they render political, judicial, economic and commercial institutions ineffective, and destabilize the government and the economy. The Golden Triangle comprises parts of Thailand, Laos, and Myanmar . These countries play a major role in global drug trafficking due to their extensive opium cultivation in the world. Myanmar, in particular, has become the largest producer of opium globally, overtaking Afghanistan (UN Office on Drugs and Crime). Challenges in Tackling Narco-terrorism. Regulating organised drug-smuggling syndicates and cracking down on terrorist financing is a complex task for law enforcement and intelligence agencies. In India, this challenge is further complicated by issues of corruption, lack of capacity, and poor inter-agency coordination. The Narcotic Drugs and Psychotropic Substances Act, 1985, commonly referred to as the NDPS Act, is an Act of the Parliament of India that prohibits the production/manufacturing/cultivation, possession, sale, purchase, transport, storage, and/or consumption of any narcotic drug or psychotropic substance.

Key Words: Narco-terrorism, Drug criminals, Judicial, Trafficking, terrorist financing

INTRODUCTION:

Terrorism is the calculated use of violence or the threat of violence against civilians and non-combatants to instill fear, intimidate populations, or coerce governments into specific actions or policies. It is a method of coercion used to achieve political or ideological goals, often through acts that are intended to cause widespread panic and disruption. Some terrorist groups believe that they can weaken their enemies by flooding their societies with addictive drugs. Growing pressure on state sponsors of terrorism has increased the likelihood that terrorists will become involved in the drug trade. Narco-Terrorism is defined as the 'use of organized terror to secure control over a state by another state or organize criminal networks by the insurgents or by a combination of any or all of them to achieve fixed political, economic or social objectives based on organizational and financial empowerment through drug trafficking.

Challenges of illicit drugs

Political: The Taliban uses its profits from the opium trade to buy weapons, food and technology to support their insurgency in Afghanistan. The economic losses are hefty too as they are mainly financed by hawala, Eg: Abu Sayyaf Group (ASG) in the southern Philippines and the FARC in Colombia.

Environment: "The war against illegal drugs would be completely justified on environmental grounds alone." Firstly, the poppy growers clear the land in the mountains. The poppy and coca growers, further, do not allow any other plants to grow near the poppy and coca plants, since the narcotics plants will not produce to their maximum, if other plants nearby are competing for nutrients." This affects other legal occupations such as coffee growing and banana plantations.

Social: Adverse health outcomes in illicit drug users can cause mental disorders, psychosis, road traffic accidents, violence, drug overdose, suicides and even death. WHO estimated that 0.7 percent of the global burden of disease in 2004 was due to cocaine and opioid use, with the social cost of illicit substance use nearly two percent of Gross Domestic Product in those countries that have measured it. School children who use drugs often suffer from impairment of short-term memory and other intellectual faculties thus generally impaired classroom performance.

Drugs increase the likelihood of many kinds of criminal activity. Drug-related crime occurs primarily in the form of trafficking, including violent conflicts among trafficking groups. It also results from the need of drug consumers to finance their addiction through theft and prostitution.

Narco- Terrorism in Asia: The International Narcotics Control Board (INCB) Annual Report 2023 has provided a comprehensive overview of the drug trade landscape in South Asia, shedding light on the evolving challenges posed by drug trafficking, terrorism, and the Internet.

With nearly 40% of the world's opiate users residing in South Asia, the region faces significant challenges in tackling drug abuse and trafficking. India, in particular, has emerged as a key market for opiates, with a rising number of trafficking incidents and illicit opium cultivation in its northeastern states.

The report also highlights the influx of heroin from South-West Asia, particularly Afghanistan, further complicating the drug control scenario.

A concerning trend identified in the report is the surge in online drug trafficking. Cyber-enabled drug markets, operating on the dark web and crypto-markets, are making illicit drugs more accessible than ever before. Moreover, the proliferation of illegal online pharmacies poses a significant challenge to drug control efforts.

Presenting key findings of the report at an event in New Delhi, The INCB Member, Chair of the Committee on Finance and Administration and Member of Standing Committee of Estimates, emphasized the need for evidence-based treatment for drug users, especially those from vulnerable demographics. She also highlighted the environmental impact of drug production and trafficking, including the harmful effects of spraying illicit substances on

crops. Government officials from various departments discussed the findings of the report, underscoring the nexus between drug trafficking and terrorism. Investigations indicate that proceeds from drug trafficking are increasingly being used to finance terrorism and support armed groups, fueling concerns about the rise of narco-terrorism in the region, experts highlighted.

Senior Indian Government officials from the Department of Revenue, the Directorate of Revenue Intelligence, the Narcotics Control Bureau, and the All India Institute Of Medical Science (AIIMS) participated in the report launch.

On rising incidents of narco-terrorism, the Deputy Director General of India's Narcotics Control Bureau said: "Investigations indicate that proceeds of drug trafficking are increasingly being used to fund terrorism, and to support armed groups."

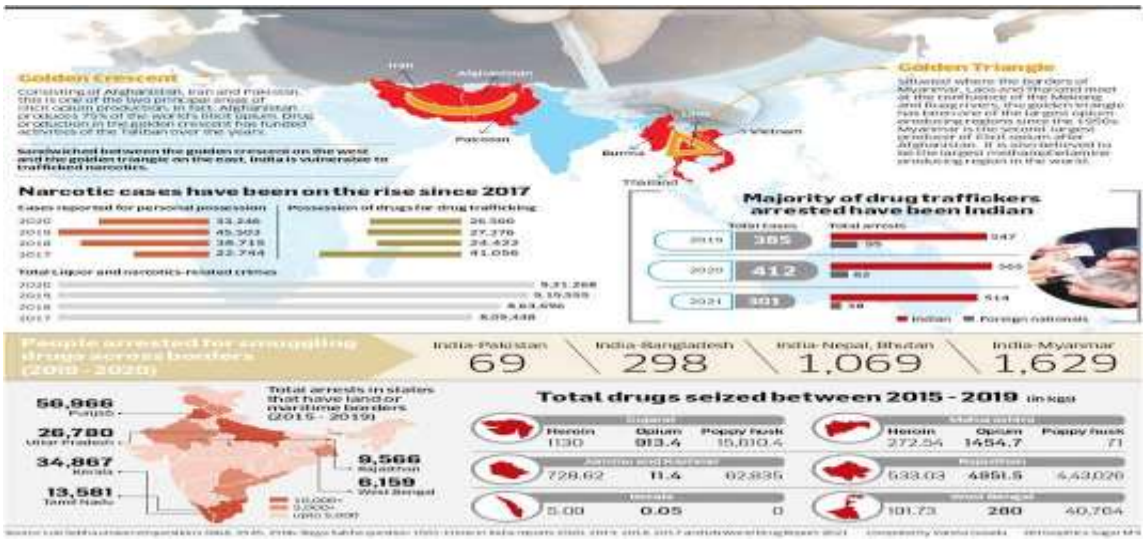
*****THE GOLDEN TRIANGLE**

Narco- Terrorism in India Production and Cultivation : Production and cultivation Illicit Cultivation For centuries, opium has been cultivated in the northeastern states of India for medical use by both people and livestock. It is also used in festivals and celebrations in these areas as well as Rajasthan. Most areas have now curtailed this practice, but it remains prevalent in remote areas, such as in the east of Arunachal Pradesh. Illicit cultivation of opium poppy still occurs in India. It has been argued that illicit cultivation of opium poppy in the north east became commercial when the tribal population came into contact with timber merchants from the plains in the late 1980s. There is very little economic activity in these districts, and agricultural practices are essentially still subsistence-based. Opium is often the only marketable commodity produced, and it has the added advantage of being collected at the farm gate by traders or wholesalers – an option not normally available for other agricultural products.

Though it is extremely difficult to estimate the extent of illicit cultivation, according to a UNODC-sponsored study in 2001 which received logistical support from the Central Bureau of Narcotics (CBN), some production of opium was reported in Arunachal Pradesh (in the

Upper Siang, Lohit, Changlang districts and Khonsa circle of Tirap district), Uttaranchal (Uttarkashi and Dheradun districts) and in Himachal Pradesh (Kulu, Mandi and Kalpa districts). Certain quantities are reportedly also produced in Jammu & Kashmir, Bihar and West Bengal (NCB 2002). Reports in 2004 cited experimental cultivation in Karnataka. Illicit cultivation areas The market dynamics of illicit opium cultivation have been studied in some depth in Arunachal Pradesh. In order to determine the extent of illicit cultivation of opium poppy, a survey was carried out with logistical support from the CBN in three districts of Arunachal Pradesh. The survey covered 86 villages out of 506 on the three districts Upper Siang, Tirap and Changlang. Out of 86 villages 52 were observed to be growing opium. The main findings of the survey are as follows: (a) the majority of the cultivators had only started opium growing in 1999; (b) the size of the plots varied between 50sq.m and 12ha.; and (c) the average yield is approximately 5-8kg/ha. On this basis, it was estimated that cultivation in Arunachal Pradesh could reach 1,000ha, and that about half of this amount was accounted for in Lohit district. CBN destroyed 248, 153 and 218 hectares of illicit poppy during 1999, 2000 and 2002 respectively in Upper Siang, Lohit, Tirap and Changlang districts of Arunachal Pradesh. It also destroyed 9 hectares of illicit opium in Kullu during 2001 in association with Himachal Pradesh police.

The extent of such cultivation is very limited in comparison with the quantity of licit opium cultivation in India. Nonetheless, in line with its obligations under the international drug control treaties, India has stepped up its efforts to destroy illicit opium . Area 66 50 1,23 n/a 2,620 Destruction of opium and cannabis crops (in acres) (1998-2003) 3000 2000 1000 0 1998 1999 2000 2001 Poppy plant Cannabis plant 2002 2003 Cannabis is also illicitly cultivated in the states of Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Kerala and Manipur. Every year, 80 to 100 tonnes of ganja (cannabis herb), both indigenous and smuggled is seized by the enforcement agencies (NCB 2002). Judged on the basis of seizures, most of the cannabis cultivation in India occurs in the north east (NCB 2004).



THE DATA OF 2015-2019 DRUGS SEIZED IN INDIA (Narco –Terrorism in India)

Drug Traffiking in India:

Heroin and Opium: In 2021, nearly 3,000 kg of heroin were seized at Mundra Port in Gujarat, one of the largest busts in India's history.

Methamphetamines: Significant seizures of methamphetamines have been reported in northeastern states like Manipur, Nagaland, and Mizoram, where these drugs are trafficked from Myanmar.

Cannabis: Cannabis remains prevalent, with major seizures reported across states like Odisha and Madhya Pradesh.

* Role of the Golden Triangle: The Golden Triangle (Myanmar, Laos, Thailand) is a major source of heroin, methamphetamines, and opium. Drugs from this region flow into India's northeastern states, which share borders with Myanmar, making them prime trafficking routes. This area is also home to insurgent groups, further complicating security.

*** Drug Trafficking as a National Security Threat**

Funding Terrorism and Insurgency: Drug cartels fund insurgent groups and terrorists in India, including militant outfits in the northeast and Kashmir. The Taliban in Afghanistan uses the opium trade to fund its activities, impacting India indirectly.

Corruption and Law Enforcement: Drug trafficking fuels corruption in law enforcement, weakening border security and enabling trafficking syndicates to operate with impunity. This compromises India's ability to protect its borders and enforce anti-trafficking laws.

Regional Instability: The northeastern states are highly vulnerable due to their proximity to Myanmar, a major drug producer. The Attari-Wagah border with Pakistan is also a critical route for opium trafficking, adding to the threat.

Social and Economic Impact: Drug abuse, especially among youth, leads to violence, crime, and a burden on the healthcare system. It also destabilizes communities and erodes the socio-economic fabric.

*** Economic and Social Consequences**

Cost to Public Health: Rising drug abuse strains India's healthcare system, with increasing numbers of drug-related health crises and rehabilitation needs.

Parallel Economies: The drug trade fosters illegal economies, fueling corruption and money laundering, which undermines legitimate businesses.

*** Strengthening Efforts to Combat Drug Trafficking**

Border Security: Improve surveillance with advanced technologies and enhanced border security measures.

Regional Cooperation: Collaborate more effectively with neighboring countries like Myanmar and Afghanistan to curb cross-border trafficking.

Anti-Corruption Measures: Strengthen internal controls to combat corruption within law enforcement agencies.

Public Awareness: Expand prevention, education, and rehabilitation programs, focusing on vulnerable communities and youth.

Government Initiatives:

- **Legal Frameworks:**

  NDPS Act (1985): Prohibits the production, sale, and trafficking of narcotic drugs and psychotropic substances, with strict penalties for violators.

  UAPA (1967): Targets terrorism and insurgent activities funded by drug trafficking, especially in sensitive regions like Jammu & Kashmir and the northeast.

  PMLA (2002): Enables action against money laundering linked to drug trafficking, allowing asset seizure and prosecution.

- **Other Measures:**

  Border Security: Strengthened border fencing, especially along India's borders with Pakistan and Myanmar, and enhanced surveillance using drones and sensors to curb drug trafficking.

  Integrated Border Management System (IBMS): Facilitates real-time data sharing between agencies for better control over illegal cross-border activities.

- **Revenue Department Initiatives:**

  Customs and DRI Enforcement: The Directorate of Revenue Intelligence (DRI) intercepts drug consignments at major ports and collaborates with international agencies to track trafficking networks.

  Financial Monitoring: The Financial Intelligence Unit (FIU-IND) monitors suspicious transactions linked to drug money laundering.

- **Awareness and Prevention Programs:**

  Narcotics Control Bureau (NCB): Runs national awareness campaigns targeting youth, emphasizing the dangers of drug abuse and encouraging the use of the National Narcotics Helpline (MANAS).

  Schools and Communities: Drug prevention programs in schools and communities focus on education, counselling, and early intervention, aiming to curb youth involvement in drug abuse.

- **International Cooperation:**
  Bilateral and Multilateral Cooperation: India works with international organizations like the UNODC and neighboring countries to share intelligence and coordinate anti-trafficking efforts, focusing on transnational drug routes.
- Cross-border Law Enforcement: Cooperation with neighbouring countries like Myanmar, Afghanistan, and Pakistan to jointly combat drug trafficking and dismantle international networks.

Reasons for the prevalence of Narco- Terrorism & Drug Trafficking:

- Economic Incentives: Drug trafficking can provide massive profits, especially when production costs in source countries are significantly lower than the wholesale prices in consumer countries.
- High Demand for Illicit Drugs: In countries with widespread drug use, such as the U.S., there is a consistent demand for illegal drugs like cocaine, heroin, and marijuana. This demand ensures a constant market for traffickers to supply.
- Poverty and Lack of Opportunity: In many regions with high levels of poverty and unemployment, individuals often turn to drug trafficking as a means of survival when legitimate work opportunities are scarce.
- Political Instability and Corruption: In countries with weak governance or political instability, drug cartels can thrive due to the corruption of law enforcement and political figures who enable illegal operations.
- Gang and Criminal Organization Influence: Drug trafficking is often controlled by gangs and criminal organizations, which use violence and intimidation to protect their interests. These groups rely on drug trade revenues to fund their activities and expand their influence.
- Addiction and Dependency: Addiction to drugs fuels trafficking, as users become involved in the trade to sustain their own habits. The cycle of addiction and trafficking is self-perpetuating, creating ongoing demand and supply.
- Geography and Accessibility: Drug-producing regions, often remote or difficult to monitor (such as jungles or mountainous terrains), make it easier for traffickers to produce and transport drugs while evading detection.

Way to reduce Narco – Terrorism and Drug trafficking:

- Strengthening Border Security: Implement advanced technologies like drones, thermal imaging, and AI to monitor borders more effectively, helping to detect and prevent drug smuggling operations before they enter countries.
- International Cooperation: Foster stronger international cooperation between countries, including intelligence sharing, joint task forces, and extradition agreements, to combat transnational drug trafficking networks.
- Enhancing Law Enforcement and Corruption Prevention: Invest in training and equipping law enforcement agencies to better combat drug trafficking. At the same time, implementing stronger anti-corruption measures within governments can prevent traffickers from bribing officials to escape legal consequences.
- Demand Reduction Programs: Focus on reducing the demand for illegal drugs through education, prevention programs, and public awareness campaigns. Address the root causes of

addiction, such as poverty and mental health issues, by providing support services to at-risk communities.

- Alternative Livelihood Programs: Provide farmers in drug-producing regions with viable alternative crops and resources to help them transition away from illegal cultivation. Support for sustainable agriculture and market development can help reduce the appeal of illegal drug production.
- Community and Social Support Systems: Create strong community-based programs aimed at providing economic opportunities, job training, and support for those affected by addiction. Community programs that focus on mental health and rehabilitation can help break the cycle of trafficking and abuse.
- Criminal Justice Reforms: Ensure that penalties for drug trafficking are severe enough to deter criminal activity but also focus on rehabilitation for offenders involved in low-level trafficking. A balanced approach that includes treatment, education, and reintegration programs can reduce recidivism.

Conclusion

Narco- Terrorism and Drug trafficking poses a serious threat to national security, public health, and social stability in India. Driven by economic incentives, high demand, poverty, political instability, and organized crime, it fuels violence, terrorism, and corruption. India's proximity to drug-producing regions like Myanmar further complicates the issue. Combating this requires a multi-pronged approach: strengthening border security with advanced technologies, enhancing international cooperation, improving law enforcement, and tackling corruption. Additionally, demand reduction, alternative livelihoods for farmers, and community support systems are essential to breaking the cycle of trafficking.

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Review of recent scientific research on LGBTQ+ issues in India: Taking into account the recent PhD theses in Shodhganga

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Introduction

LGBTQ is an acronym that is often made fun of by people who do not understand the community or people who like to hate other people. L stands for Lesbian. This is a noun that refers to a woman who loves other women. G stands for gay, which technically means anyone who loves someone of the same gender, and that includes lesbians. But generally, the word gay is used to refer to a man loving another man. The B stands for bisexual, which means someone is attracted to two genders, one of which could be their own gender but does not necessarily have to be. T stands for transgender, which means someone's gender identity does not match their sex assigned at birth. For example, a girl who was born with male body parts or a boy who was born with female body parts. Q stands for Queer or Questioning. Queer is a term used to describe someone in the LGBTQ community, but with a lot fewer syllables, and it helps people better understand our whole community. I stand for Intersex, which means a person is born with a combination of male and female biological traits. And finally, A stands for asexual or aromantic, and it means a person is not sexually or romantically attracted to any gender, but they can still have relationships and friendships.

We present a systematic review of recent theses related to LGBTQ+ issues that were published in Shodhganga from 2020 to June 2025. Shodhganga is a digital repository of PhD theses of India. We examine the objectives of the study, the methodological approaches, and the themes of research of these Theses. Based on the review, we point out the following trends: (1)Comparative study analyzing the social, political and legal reality of LGBTQ+, (2)Issues pertainingto social assimilation and the resultant impact including suicide(3)Take of contemporary Indian writers on LGBTQ+ (4) Examination of digital representation of LGBTQ+ and reaction of society, (5)Understanding the impact of decriminalization of section 377 of Indian Penal Code and way forward,(6) Profiling the current demands of LGBTQ+ in India and comparing it with global trends.

Research Question

- What is the recent scientific research on LGBTQ+ issues in India, taking into account the recent PhD theses in Shodhganga?

Research Objective

- To review recent scientific research on LGBTQ+ issues in India, taking into account the recent PhD theses in Shodhganga.

Research Methodology

Our research is primarily based on secondary data. We did a systematic review of recent theses related to LGBTQ+ issues that were published in Shodhganga from 2020 to June 2025.

Shodhganga is a digital repository of PhD theses of India. We reviewed the PhD theses that were completed and submitted by scholars of India.

Limitations of the Study

There are only 10 theses that were submitted by scholars and published in Shodhganga from 2020 to June 2025. Due to time constraints, we chose a particular period.

Homosexuality and the Supreme Court of India

The term 'homosexuality' cannot be defined in a single context. It may be interpreted differently at different times. It is sometimes referred to as "sexual aberration," "abnormalities," or "moral insanity." Historically, India enacted laws that discriminated against persons based on sexual orientation. Until 2018, homosexuals were penalised or in trouble under laws prohibiting particular sexual practices. However, the Supreme Court's judgment on September 6, 2018, was a significant milestone that shifted people's attitudes towards homosexuality, granted fundamental human rights to every human being, regardless of gender, sexual conduct, or orientation. The Supreme Court declared that consensual adult gay intercourse is no crime, stating that sexual orientation is a natural process that people cannot control.

Homosexuality in India and Russia

There is a taboo and a culture of silence on homosexuality in India and Russia; because of it, there is minimal research in this regard. Homosexuality is socially unacceptable in both countries (Borah, 2025). In both countries, the fundamental rights of the LGBTQ+ communities are violated, and there is a requirement to bring inclusivity(Borah, 2025).

LGBTQ+ and Inclusivity

Marketing has evolved from a product-centric approach to a customer-centric one, with the rise of digital technologies. In the current scenario, marketing is a multifaceted process, focuses on creating, communicating, and delivering value to diverse customers, requiring marketers to adapt to their needs and expand their reach. Increasing diversity in global marketplaces demands that marketers provide various needs of consumers and help to promote the social justice that they demand. Consumption plays a significant role in shaping the identities of consumers and social structures, and marketers are shifting their attention towards inclusivity, acknowledging the importance of serving minority and vulnerable consumer segments that were previously ignored or discriminated against in the marketplace. Thus, inclusivity is the foundation upon which the concept of inclusive marketing is built. Inclusive marketing is a human-centered approach driven by collective norms that value diversity and encourage development for all. The goal of inclusive marketing is to connect diverse consumers by accepting and valuing their unique characteristics and experiences(Sarkar, 2022). It includes different strategies like diverse representation, inclusive service and product design, and reasonable market practices. Inclusive marketing includes identity formation, maintenance, and affirmation for stigmatized consumers, encouraging social inclusion. It can have some positive effects on customers and brands, at the same time, it bears some risks as well, such as offending, disinterest, or exclusion of certain groups. Non-inclusive practices also occurred in the marketplace, like exclusion or

discriminatory representation, which highlights the need for effective inclusive marketing policies(Tuli, 2025).

This inclusivity is focused on common customer experiences and a sense of identity, while designing and implementing the challenges to gratify different groups with different needs and values. Moreover, inclusive marketing is driven by the need for social change and justice, providing diverse customer segments, and it has an impact on both societal and financial benefits. Consumers demand brands that give importance to social responsibility over profits or revenues, and adopt diverse marketing tactics that help to grow markets and upgrade the reputation of the brand. Successful inclusive marketing campaigns like Fenty Beauty, Absolute Vodka, Coca-Cola, Vicks, etc., can raise brand equity and cultivate a strong connection with diverse consumers, while shortcomings can lead to negative sentiment and a lack of alignment with the company. Therefore, marketers need to understand, adopt, and utilize inclusive marketing practices to stay relevant and build a strong connection with their target groups(Tuli, 2025).

Though literature is found in this domain, still, there is still a need for its development that primarily focuses on customer or brand values. However, there is a change in the role of inclusive marketing that promotes social justice and inclusion for marginalized communities. Due to the increasing focus on inclusive marketing, reputed marketing outlets and industry leaders emphasized their attention on this domain and investing in the same, though marketers of the present-day world must choose between traditional marketing practices and embracing inclusivity. Among the diversified and cultural identities of consumers across the globalized marketplace, the LGBTQ+ community is one of them and is evolving as a potential market segment with inherent purchasing power. But, LGBTQ+ marketing faces various challenges, such as relying on stereotypes, inadequate communication, or being perceived as inauthentic. Thus, a reliable and inclusive marketing strategy is necessary to ensure the authenticity and promote diverse identities like LGBTQ+. It is seen that the current research in the LGBTQ+ domain highlights market viability, targeted advertising, and consumers' behavioral patterns, but more effort is needed to guarantee a reliable representation and support of the community(Tuli, 2025).

LGBTQ+ and Literature

Numerous authors of India have worked on the community and strongly and openly stood for them, which gave them their identity. Their literature helped to eradicate prejudice against the community. Indian transgender people are humiliated and marginalized; therefore, Laxmi Narayan Tripathi is from the same community, came forward as a writer for their rescue(Kumari, 2023). Even Hindi literature openly discusses the community(Ojha, 2024).

LGBTQ+ and Suicide Risk

It was found that as the community fails to express their feelings and emotions, they are most likely to be suicidal and self-harming. Even if they disclose their identity, they often get bullied and face molestation. Therefore, the acceptance from the family and friends is the need of the hour(Padhi, 2022).

LGBTQ+ and Print media

The print media, like newspapers, widely covered the LGBTQ+ news after the Supreme Court verdict, but the coverage did not sustain after the next consecutive year. For the inclusivity of the community, the media coverage is a need of the hour(Hamdani, 2024).

LGBTQ+ and Workplace

For the inclusion of the community into the workplace place the employees need to be sensitized and educated on LGBTQ+. Having inclusive policies and diversity will make the workplace safer for the community(Jha, 2022). Considering the negative stereotype, they fear coming out and declaring their identity.

LGBTQ+ after decriminalization in India

There is a lack of awareness among people on the difference between Sex and Gender. People often think that sexuality is a choice; they are not aware that it is natural. The young people are more aware of Section 377 of the Indian Penal Code and its decriminalization compared to the old generation(Damini, 2024).

Queer and intimacy

Generally, there is a lack of study on queer relationships and intimacies compared to heterosexual intimacies. It is strongly recommended that people enlighten themselves and acquire extra knowledge about queer lives and intimacies(Chakravarty, 2022).

Conclusion

This positive trend of research by young scholars of India has played an important role in increasing awareness and positivity in society. The LGBTQ community is one of many diverse groups that require understanding and acceptance. Despite existing research, there is still much to be explored. While awareness has increased, taboos surrounding LGBTQ issues persist, hindering societal acceptance. Research has been conducted from various perspectives, but more is needed to educate younger generations that homosexuality is neither shameful nor a crime. Open discussions from an early age can help normalize these conversations, enabling individuals to comfortably disclose their sexuality to their parents and fostering greater societal acceptance. By promoting education and awareness, we can work towards creating a more inclusive and accepting environment for all individuals, regardless of their sexual orientation or gender identity. This can be achieved by encouraging honest conversations, promoting diverse representation, and establishing safe spaces for individuals to explore and express themselves without fear of judgment.

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"An Evaluation on The Effectiveness of Work-Life Balance Policies in Increasing Employee Productivity and Satisfaction with Special Emphasis to Hotels Based in Kochi."

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Abstract

Work-life balance (WLB) policies are organizational methods and procedures that assist employees balance their professional commitments with their personal and family lives. These policies seek to foster a supportive work environment that recognizes employees' need for flexibility and time away from work, thereby improving their well-being and job satisfaction. This study assesses the impact of work-life balance policies in increasing employee productivity and satisfaction in various hospitality units located in Kochi, Kerala. Given the hotel industry's rigorous work schedules and high-stress environment, the implementation of work-life balance policies is increasingly acknowledged as a strategic instrument for improving employee well-being and operational efficiency. This study adopts a mixed-methods approach, including quantitative surveys and qualitative interviews with employees and human resource managers from various hotels in and around Kochi. The research seeks to highlight excellent practices and provide practical assistance for enhancing work-life balance policy in the hotel industry.

Keywords
WLB, Employee, Productivity, Flexibility, Kochi.

Introduction

In today's quickly changing workplace, striking a harmonious work-life balance has become increasingly important for firms looking to boost employee productivity and satisfaction. This is especially true in the hotel industry, where personnel are frequently confronted with rigorous schedules and high-pressure circumstances. Work-life balance policies are more than a trend; they are a strategic imperative for developing a motivated and engaged workforce. This evaluation focuses on the efficacy of work-life balance policies in hotels in Kochi, a bustling city recognized for its strong tourism and hospitality industries. This study attempts to provide a complete understanding of how these rules effect employee productivity and happiness in order to improve overall workplace dynamics. Kochi, with its peculiar blend of cultural tradition and modern commercial processes, provides an interesting framework for this examination. Hotels in this region, like many others, are increasingly realizing the value of employee well-being as an essential component of operational success. This study aims to

shed light on best practices and areas for improvement in the hospitality industry by conducting a thorough examination of existing policies and their consequences, ultimately contributing to a more productive and enjoyable work environment.

Review of Literature

Kumaraswamy M., Ashwini S. (2015) in paper titled "Challenges in WLB of Married working Women" studied that it is important for employees to maintain a healthy balance between work and their private lives. Generally those employees who have better work- life balance contribute more towards the success of the organization. The organization can render better service to the customers by having productive and efficient employees. Family sphere changes that have impacted the work life balance of individuals in today's context include nuclear families, single parent households, and dual earning parents, parents working at different locations and increasing household work.

Shalini and Bhawna (2012) reported in their study, "Quality of work life balance" is being used by the organizations as a strategic tool to attract and retain the employees and more importantly to help them to maintain work life balance with equal attention on performance and commitment at work.

Holly S. and Mohnen A. (2012) in the paper titled "Impact of working hours on work-life balance" connected working hours and satisfaction with desirable work-life balance. This balance is specific to each person and relates to satisfaction with a job and all other parts in life, especially family life and free time. Therefore, a good work- life balance results in high satisfaction. Their results show diverse perceptions and influences of job conditions on employees.

Santosh R S., Jain R.(2015) in their paper titled "Study of the Effect of Emotional Intelligence of Working Fathers in India on Managing Their work-Life Balance" explained that Emotional Intelligence of Working Fathers enable them to remain both a committed employee and a fully engaged parent. The role of fathers is of importance as their direct involvement with their children's upbringing increases. The role of the father is changing. Fathers say that they want to spend more time with their children, and attitudes towards childcare and work are shifting.

Objectives

The study is undertaken

- To determine which components of work-life balance policies are most effective at increasing productivity and satisfaction.
- To investigate any factors or conditions that may improve or impede the effectiveness of Work Life Balance (WLB) policies
- To analyze employee satisfaction with work-life balance in hotels located in Kochi through questionnaire method.
- To examine how work-life balance policies affect employee productivity in Kochi-based hotels.

Employee satisfaction

It's finally the output of the employee that matters the most for an organisation. A productive employee is always an asset for the company. Hotel staff members who are content with WLB are more likely to provide outstanding service, which enhances customer experiences and promotes repeat business. In addition to lowering attrition rates and saving money on hiring and training expenses, high levels of satisfaction also promote a stable and seasoned staff. Providing excellent guest experiences and attaining operational success in hotels depend heavily on the contentment of hotel staff. Hotels may boost staff morale, raise the caliber of their services, and succeed in the long run by addressing the critical factors that affect satisfaction. Below given are the main elements that either enhance or decrease employee satisfaction.

Key elements that enhance employee satisfaction.

- Competitive pay that takes into account industry norms and the cost of living of the employees.
- Extensive benefit packages that include performance bonuses, retirement plans, and health insurance.
- Extra benefits like lunch allowances, lodging discounts, and subsidies for transportation.
- Permissions to attend workshops, certificate programs, and professional development programs.
- Possibilities for senior staff mentorship and advice.
- Supervisors who are amiable, encouraging, and receptive to employee related problems.
- Consistent recognition and compensation for efforts and accomplishments
- Options for flexible shift scheduling and time off to meet individual needs.
- Reasonable work schedules with no overtime restrictions.
- Generous policies for personal, sick and vacation time.
- Comfortable and secure work environments with the right tools and infrastructure.
- Employees should have regular opportunities to offer and receive feedback.

Key elements that decrease employee satisfaction.

- Salaries/wages that are below industry norms or do not keep up with the cost of living.
- Absence of full benefits, including retirement plans or health insurance.
- Irregular work schedules and last-minute schedule modifications.
- Excessive overtime and extended work hours without proper pay or vacation leave.
- Absence of routes for promotion or career advancement.
- Managers and supervisors who are unsupportive or inaccessible.
- A shortfall of teamwork, office politics, and poor interpersonal interactions.
- Lack of honoring workers for their contributions.
- Regular modifications to job descriptions, duties, or organizational charts.
- Uncomfortable working conditions or inadequate amenities
- Lack of employee feedback procedure.
- Antiquated tools and resources required to complete jobs efficiently.

Beneficial Effects of Appropriate Work-Life Policies

Employee motivation and engagement are generally higher when they have a healthy work-life balance. Increasing levels of involvement frequently result in increased productivity. Good work-life balance laws reduce stress and burnout, which enhances concentration and productivity. Workers who believe their employer supports their work-life balance tend to be happier in their roles. Increased productivity can result from happier employees who are more inclined to put in more effort and do better at work. Good work-life balance regulations improve mental and physical well-being and reduce absenteeism. Employees can work when they are most productive (remote work or flexible hours), which may boost productivity and efficiency.

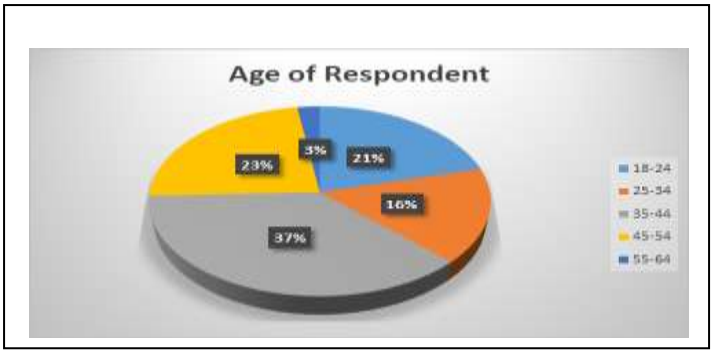
Obstacles & Difficulties

Hotels frequently run around the clock, meaning employees must work on holidays and during busy times. It can be difficult to strike a balance between these operational requirements and flexible scheduling, especially in jobs like front desk and housekeeping that call for constant coverage. Additional resources, such as systems for flexible scheduling or technology for remote work, may be needed to implement work-life balance regulations. Particularly smaller hotels may find it difficult to manage the expenses and schedule associated with these upgrades. Clear communication and thorough training are necessary to guarantee that managers and employees alike comprehend and follow work-life balance regulations. Inadequate comprehension or ignorance may result in inefficient execution. Employee expectations and hotel operating reality might not be aligned, especially if staff members demand more flexibility than the company can feasibly offer. It can be difficult to make sure that work-life balance policies abide by local labor laws and regulations, particularly in areas where there are particular rules about working hours, rest intervals, and leave benefits. Work-life balance policies may need to be continuously adjusted to ensure continual compliance and efficacy due to changing regulations and legal requirements.

Examining employee satisfaction with work-life balance in hotels located in Kochi through questionnaire method

1.1 Age of respondents.

Age of Respondent	
Parameter	**No. of Respondents**
18-24	09
25-34	07
35-44	16
45-54	10
55-64	01



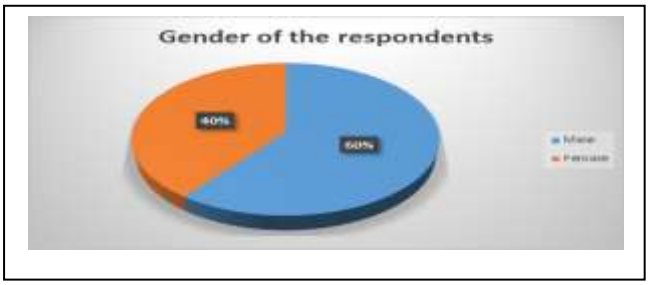
Tab.1.1 The above table and pie chart reveals the age group of the respondents.

Findings related to the age of Respondents

The majority of respondents fall within the 35-44 age group (16 respondents). The 45-54 age group is the second-largest (10 respondents) of all. Very few respondents are aged 18-24 (9 respondents), 25-34 (7 respondents) and 55-64 (1 respondent).

1.2 Gender of the respondents.

Gender of the respondents	
Parameter	**No. of Respondents**
Male	26
Female	17



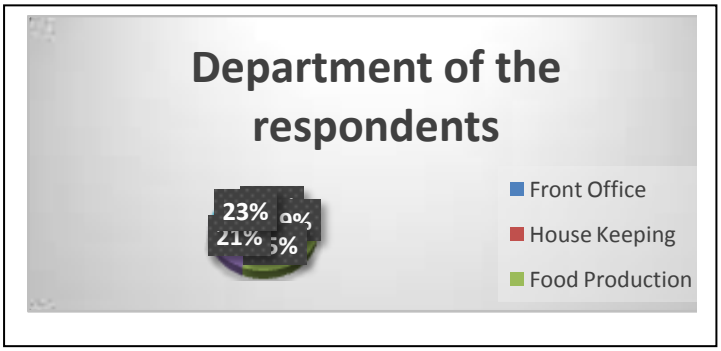
Tab.1.2 The above table and pie chart reveals the gender of the respondents.

Findings related to the gender of respondents

There are more male respondents (26) than female respondents (17).

1.3 Department of the respondents.

Department of the respondents	
Parameter	**No. of Respondents**
Front Office	5
House Keeping	8
Food Production	11
F&B Service	9
Others	10



Tab.1.3 The above table and pie chart shows the departments of the respondents

Findings related to the departments of the respondents.

Out of 43 respondents, majority (10 respondents) are working in various (non-core) departments of the hotel, 11 respondents are working in Food Production department, 9 respondents are working in F&B Service department, 8 in Housekeeping and 5 respondents is in Front Office department.

1.4 Awareness among the respondents about hotel's work-life balance policies.

Awareness about hotel's work-life balance policies.	
Parameter	**No of Respondents**
Yes	40
No	03

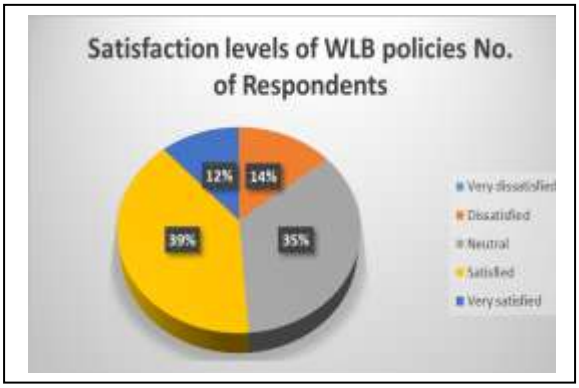
Tab.1.4 The above table and pie chart reveals the awareness among the respondents about hotel's work-life balance policies.

Findings related to the awareness among the respondents about hotel's work-life balance policies.

The majority (40 respondents) are aware of the hotel's WLB policies, with only 3 being unaware.

1.5 Satisfaction level of the respondents in terms of hotel's work-life balance policies.

Satisfaction levels of WLB policies	
Parameter	**No. of Respondents**
Very dissatisfied	0
Dissatisfied	06
Neutral	15
Satisfied	17
Very satisfied	5



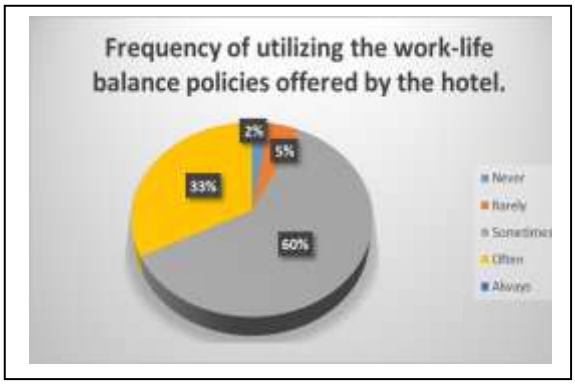
Tab.1.5 The above table and pie chart reveals the satisfaction level of the respondents in terms of hotel's work-life balance policies.

Findings related to the satisfaction level of the respondents in terms of hotel's work-life balance policies.

While 17 respondents are satisfied, and 5 are very satisfied, 6 respondents express dissatisfaction. A significant portion remains neutral (15 respondents).

1.6 Frequency of utilizing the work-life balance policies offered by the hotel.

Frequency of utilizing the work-life balance policies offered by the hotel.	
Parameter	**No. of Respondents**
Never	1
Rarely	2
Sometimes	26
Often	14
Always	0



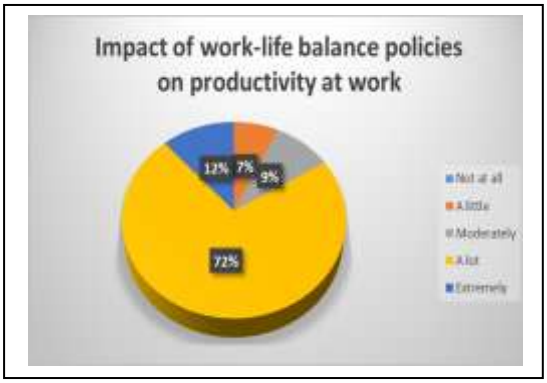
Tab.1.6 The above table and pie chart reveals the frequency of utilizing the work-life balance policies offered by the hotel.

Findings related to the frequency of utilizing the work-life balance policies offered by the hotel.

Most respondents use the policies "sometimes" (26 respondents), followed by "often" (14 respondents). Very few never (1 respondent) or rarely (2 respondents) use the policies.

1.7 Impact of work-life balance policies on productivity at work

Impact of work-life balance policies on productivity at work	
Parameter	**No. of Respondents**
Not at all	0
A little	3
Moderately	4
A lot	31
Extremely	5



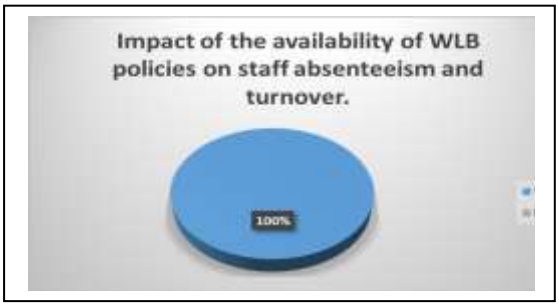
Tab.1.7 The above table and pie chart reveals the impact of work-life balance policies on productivity at work

Findings

A large majority (31 respondents) feel that the WLB policies significantly impact their productivity, with 5 respondents stating an extreme positive impact. Only 3 respondents believe the impact is minimal.

1.8 Impact of the availability of WLB policies on staff absenteeism and turnover.

Impact of the availability of WLB policies on staff absenteeism and turnover.	
Parameter	**No. of Respondents**
Yes	43
No	0



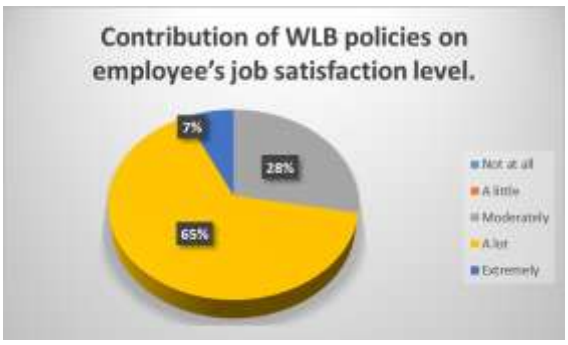
Tab.1.8 The above table depicts the impact of the availability of WLB policies on staff absenteeism and turnover.

Findings

All respondents agree that the availability of WLB policies positively affects staff absenteeism and turnover.

1.9 Contribution of WLB policies on employee's job satisfaction level.

Contribution of WLB policies on employee's job satisfaction level.	
Parameter	**No. of Respondents**
Not at all	0
A little	0
Moderately	12
A lot	28
Extremely	3



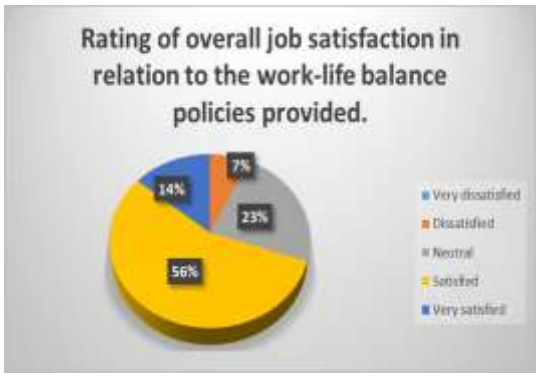
Tab.1.9 The above table shows the contribution of WLB policies on employee's job satisfaction level.

Findings

Work life balance policies contribute significantly to job satisfaction, with 28 respondents agreeing that they help "a lot" and 3 feeling they contribute "extremely."

1.10 Rating of overall job satisfaction in relation to the work-life balance policies provided.

Rating of overall job satisfaction in relation to the work-life balance policies provided.	
Parameter	**No. of Respondents**
Very dissatisfied	0
Dissatisfied	3
Neutral	10
Satisfied	24
Very satisfied	6



Tab.1.10 The above table shows the rating of overall job satisfaction in relation to the work-life balance policies provided.

Major findings through the questionnaire method

- **High awareness and utilisation**-The hotel effectively conveyed WLB policies to its staff, as evidenced by 40 out of 43 respondents being aware of them. However, the three respondents who are ignorant highlight a potential communication gap that must be addressed to ensure full awareness.
- **Positive impact on productivity-** With 31 respondents believing that WLB policies have a "significant" beneficial influence on productivity and 5 respondents suggesting an "extreme" impact, it is apparent that these policies play an important role in improving employee performance. Work-life balance and productivity are linked because of reduced stress and improved mental well-being, which leads to increased job efficiency.
- **Reduction in absenteeism and staff turn over-** All 43 respondents agreed that Work Life Balance policies lower absenteeism and turnover. This is most likely because employees who feel supported in balancing their personal and professional life are more likely to stay committed and involved with the company, resulting in lower turnover rates and fewer days of absence.
- **Level of job satisfaction among the staff working in Kochi-** The high link between Work Life Balance policies and job happiness, with 24 respondents pleased and 6 very satisfied, suggests that these policies effectively address employee demands. Job satisfaction is closely related to employees' ability to combine work and personal commitments, which the regulations appear to promote effectively.
- **Areas for improvement-** Although the majority of respondents are satisfied, the existence of 6 unsatisfied and 15 neutral respondents indicates that present policies may not entirely meet the demands of all employees. This could be due to a lack of flexibility or comprehensiveness

in the policies, emphasizing the need for ongoing feedback and improvement.

Suggestions

- **Provide targeted training and awareness programs**-Implement targeted awareness activities to ensure all employees are aware of work life balance policies and how can they benefit from them.
- **Consider neutral and dissatisfied employees-** Engage with neutral and disgruntled employees to learn their concerns and adapt policies accordingly.
- **Ongoing evaluation**-Regularly monitor the success of Work Life Balance policies through surveys and feedback to ensure they fulfill employee demands and positively impact productivity and work satisfaction.
- **Encourage more frequent implementation of WLB policies**-Improve communication and accessibility to WLB policies to increase employee use.
- **Innovative work-life balance ideas**-The innovative WLB policy ideas used in other cities' hotel sectors could be replicated in various hotels in Kochi.

Conclusion

Finally, the study of work-life balance policies at Kochi hotels provides valuable insights regarding their impact on employee productivity and satisfaction. This study emphasizes the need of implementing appropriate work-life balance techniques to improve individual and organizational performance. The research collected shows that well-structured work-life balance policies, such as flexible scheduling, wellness initiatives, and supported leave alternatives, improve employee productivity and job satisfaction. Employees who benefit from such policies exhibit higher levels of engagement, lower absenteeism, and improved overall performance. The success of these regulations varies amongst hotels, depending on factors like as company culture, policy execution, and employee expectations. While some hotels located in Kochi have successfully implemented these measures to increase morale and productivity, others have hurdles that prevent them from completely realizing the benefits.

Work-life balance policies should be evaluated and refined on an ongoing basis. Hotels should solicit employee feedback on a regular basis, assess the impact of policies that have been enacted, and make changes to address any new requirements or issues.

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Industry 4.0: India's Repercussions of Technology

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Abstract

Global production and manufacturing ecosystems have undergone radical upheaval since the introduction of Industry 4.0. Industrial practices in India are being redefined by the incorporation of cutting-edge technology like Robotics automation, Artificial Intelligence (AI), Big data analytics, the Internet of Things (IoT), Cloud Computing, andCyber-Physical System. The technological impact of Industry 4.0 in India is examined in this paper, with an emphasis on the prospects, difficulties, sectoral changes, and policy ramifications. India's readiness to use these technologies to establish itself as a major force in the world's industrial landscape is also examined.

Keywords: Artificial Intelligence, Internet of Things, Cloud Computing, Big data analytics, Cyber-Physical System, Government Policy, Employees skills.

INTRODUCTION

With the integration of digital, physical, and biological technology, Industry 4.0—also known as the Fourth Industrial Revolution—marks a new era in the industrial sector. For a country that is developing quickly, like India, this revolution provides an opportunity to modernise its economy, increase productivity, and become more competitive internationally. An expanding manufacturing base and a robust IT industry make India ideally positioned to embrace and reap the benefits of Industry 4.0 technologies. However, it is hard for Indian workers to adjust to modern technology. Therefore, this research paper examines the technological impact of Industry 4.0 in India, focussing on the opportunities, challenges, sectoral shifts, employee skills, and legal implications.

Industry 4.0 Technologies in the Indian Context:

Internet of Things (IoT):

India's use of IoT is speeding up, especially in the areas of urban infrastructure, manufacturing, and agriculture. Predictive maintenance, quality assurance, and real-time monitoring are made possible by smart sensors, particularly in industries like textiles and automobiles.

Artificial Intelligence and Machine Learning (AI & ML):

Industry 4.0 relies heavily on AI and ML to facilitate automation, data analysis, and intelligent decision-making in a wide range of industrial operations. By increasing overall operational performance, enabling predictive maintenance, and optimising manufacturing, they boost productivity, lower expenses, and stimulate innovation. AI and ML make intelligent automation, demand forecasting, and customer behaviour analysis possible, they are transforming Indian industries. Chatbots powered by AI, manufacturing process optimisation, and intelligent supply chains are now typical.

Automation and Robots:

Investments in robots are rising even though India's level of automation is lower than that of wealthy countries. In electronic manufacturing facilities and automobile assembly lines, collaborative robots, or cobots, are being implemented.

Big Data and Analytics:

Big data is being utilised by Indian businesses for client personalisation, operational efficiency, and decision-making. Particularly, data analytics is changing industries including healthcare, logistics, and retail.

The Cloud Computing:

Cloud services give small and medium businesses (SMEs) in India the scalability and affordability they need to access Industry 4.0 technology. Digital activities from the public and private sectors are driving the adoption of cloud computing.

Cyber-Physical Systems (CPS):

While it is still in its infancy, CPS integration is beginning to take shape in high-tech manufacturing centres like Pune and Bengaluru. These systems are the foundation of smart factories [5 & 6].

II. LITERATURE SURVEY

Globally, Industry 4.0—which focusses on integrating smart technologies into industrial processes—has become a crucial research subject. In the Indian context, its implications, adoption, and difficulties have been the subject of numerous studies. In 2016, Schwab presented the idea of the Fourth Industrial Revolution, emphasising the revolutionary potential of digital technologies like big data, robots, artificial intelligence, and the Internet of Things. Since then, academics have looked into how these technologies might be used to boost competitiveness and productivity across a range of industries[1].

The readiness of Indian industries for Industry 4.0 was examined by Kumar et al. (2019), who also identified the main obstacles to adoption, such as a shortage of qualified labour and limited infrastructure. Their results highlight the necessity of industry-academia cooperation and policy actions to close these gaps [2].

The usage of IoT and automation in Indian industrial companies was the main topic of Raj et al. (2020). They discovered that early adopters include the steel and automotive industries, which are motivated by the need to improve quality and reduce costs. Small and medium-sized businesses (SMEs), however, lag because of the large initial expenditure and complexity of technology [3].

The use of artificial intelligence in smart manufacturing was investigated by Singh and Gupta (2021). Their analysis focusses on successful Indian case studies, such as Mahindra & Mahindra's automated assembly line systems and Tata Steel's predictive maintenance systems. Data security is becoming increasingly important as industrial systems become more interconnected, according to the report. A number of studies also address the policy environment in India [4]. The success of programs like Digital India, Skill India, and Make in India—all of which serve as the cornerstone for the development of Industry 4.0 technologies—was assessed by Bhattacharya (2019). Better coordination between policy design and implementation on the ground is recommended by the study [8].

The Confederation of Indian Industry (CII) and the World Economic Forum (WEF) have released recent findings showing that while knowledge of Industry 4.0 is increasing, only top companies are adopting it widely. They emphasise the necessity of cluster-based development strategies, strong infrastructure, and reasonably priced technology access in order to assist SMEs [9 & 10].

III. RESEARCH AND DISCUSSION

Effects on Sectors in India:

- **Production:** Industry 4.0 objectives are in line with the Indian government's "Make in India" campaign. Key industries like steel, pharmaceuticals, and automobiles are benefiting from real-time monitoring, process automation, and quality assurance made possible by smart manufacturing technologies.
- **Agricultural:** With the use of AI and IoT sensors, precision farming is increasing crop yields, cutting input costs, and assisting farmers in making data-driven decisions. Autonomous drones and automated watering systems are becoming more popular.
- **Healthcare:** Rural communities now have easier access to and lower costs for healthcare because to wearable technology, telemedicine, and AI-based diagnostics. COVID-19 greatly sped up this industry's use of digital technology.
- **Infrastructure in Cities:** Urban planning, trash management, traffic systems, and public safety are all being improved in Indian cities like Hyderabad, Pune, and Surat by smart city projects powered by IoT, big data, and artificial intelligence [5].

Hurdles of Industry 4.0's in India:

- **Deficiencies in Infrastructure:**
  Unreliable power supplies and inadequate digital infrastructure in rural areas prevent Industry 4.0 technologies from being widely adopted.
- **Lack of Skilled Labour:**
  India faces a significant gap in skilled labor capable of operating and maintaining advanced technological systems. The necessity for reskilling and upskilling is critical.
- **High Start-Up Cost:**
  Industry 4.0 technology adoption is expensive, particularly for SMEs. One of the biggest obstacles is still getting access to funding and technical assistance.
- **Concerns about Cybersecurity:**
  The increased connectivity of Indian industry has also increased their susceptibility to cyberattacks. Strong cybersecurity frameworks must be built.

Government Projects and Assistance with Policies:

In order to encourage Industry 4.0, the Indian government has started a number of projects, including:

- Internet penetration and digital literacy are being promoted by Digital India.
- The need for a workforce prepared for the future is being met by Skill India.
- NITI Aayog is leading the national strategy on AI to improve AI use and research.
- One initiative to support the digital transformation of manufacturing is SAMARTH Udyog Bharat 4.0.

These regulations are meant to foster an environment that is conducive to the nationwide adoption of Industry 4.0 [9 & 10].

ANALYIS OF INDUSTRY 4.0 IMPLEMENTATION IN INDIA

Steel Company:

Significant cost reductions and improved operational efficiency resulted from Tata Steel's use of AI and machine learning algorithms for predictive maintenance and energy optimisation.

Car Production Company:

In their car production facilities, the company implemented smart manufacturing techniques, such as robotics and the Internet of Things, which increased efficiency and decreased faults.

State Government:

Hyderabad included AI-powered surveillance and IoT-enabled infrastructure as part of its smart city initiative to improve traffic control and public safety [9& 11].

CONCLUSION

India's industrial development is at a turning point. An exceptional chance to surpass conventional development phases and become a worldwide industrial leader is presented by Industry 4.0. In this paper, concludes that while there are obstacles, especially in the areas of infrastructure and skills of employees, a solid basis is provided by continued government supports and technical advancement. India can leverage Industry 4.0 for social development and sustainability in addition to economic growth with the help of inclusive policies, cross-sectoral cooperation, and strategic investments.

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ENTREPRENEURSHIP IN DEVELOPMENT OF RURAL SECTOR IN INDIA

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INTRODUCTION

"India lives in villages and its true spirit lives in rural areas"- Mahatma Gandhi.

The economy of India is mostly based on agriculture. It is about three-fourth of India's population are living in rural areas out of which 75% of the labour force is still depend for their livelihood from agriculture and its allied activities. The farming activity is itself a very good example of entrepreneurship because it consists of labour, land, finance, technology, process, risk, marketing, and inputs etc. Today rural entrepreneurship has emerged as a dynamic concept and it solve the problems of poverty, unemployment and backwardness of Indian economy. Compared to earlier days development of rural areas have been linked to entrepreneurship. It is the synonym of rural industrialization are viewed as an effective means of accelerating the process of rural development. Government of India has been continuously assigning increasing importance and support for the promotion and growth of rural entrepreneurship.

NEED FOR RURAL ENTREPRENEURSHIP

The reasons for the rural entrepreneurship are discussed as under:

As the rural industries are labour-intensive, they tend to have a high possibility of generating employment, which acts as a corrective measure to a number of problems causing due to unemployment stemming in the rural areas.

Rural industries have a comparatively high potential of generating income, which reduces the disparities amidst income earned by people living in urban and rural areas.

Rural entrepreneurship stimulates the dissemination of economic activities in the village areas, which ultimately results in balanced regional development.

It does not just protect but also promotes the art, culture and creativity, i.e. the varied heritage of that particular region.

When industries are set up in rural areas, it advances economic development which reduces migration of the villagers to urban areas.

Curtails unequal growth in urban areas, decreases the development of slums, environment pollution etc.

OBJECTIVES OF STUDY

To know the opportunities from rural entrepreneurship.

To study the problems and challenges faced in rural entrepreneurship in India.

To suggest some remedial to solve the problems faced by rural entrepreneurs.

METHODOLOGY

This study is based on secondary data; it is a comprehensive review of several reports, research articles, policy papers, and comparative analysis of statistical data from government

websites. The data is collected in related topic mainly from published and unpublished works on the related topic**.**

GROWTH OF RURAL ENTREPRENEURSHIP

Establishing businesses is important for a country's progress as it augments economic and employment growth. State and central governments are continuously launching new and attractive schemes to encourage their citizens to come up with innovative business ideas. Setting up an enterprise depends on one's capacity, which differs from person to person. If the enterprise must come up in a rural environment, the dynamics are more complex compared to the urban context. Rural enterprises are business entities, which by the means of effective use of local resources, promote revenue generation and act as agents of social change at the grassroots level. These entities not only play a pivotal role in the holistic development of the rural economy but also contribute to the economic growth of our nation. The establishment of a large number of profitable enterprises in a region can bring in government investment, attract private participation, generate local employment, bring partnerships and secure funding apart from channelising idle savings into business entities. According to the Government of India, "Any industry located in a rural area, village or town with a population of 20,000 or below and an investment of INR three crores in plant and machinery is classified as a village industry." It is a revised definition of the previous one provided by Khadi & Village Industries Commission. As of March 31, 2022, India has more than 63 million MSMEs, out of which about 94 per cent are micro-enterprises. According to official data released on April 30, 2022, the country's 6.33 crore MSMEs employ about 12 crore workers. According to World Bank Data 2019, about 65 per cent of the Indian population, most of them (about 58 per cent, as per 2018-19 PLFS data) earn their livelihood from agriculture and allied sectors. Rural enterprises are the best way to use local resources, which leads to prosperity and economic growth. It, in turn, spurs avenues for employment, which has a direct impact on the levels of migration. Therefore, to ensure the development of a viable business model to better support aspiring rural entrepreneurs, it is fundamental to ensure that manpower, money, material, machinery and understanding of the market is complete.

TYPES OF RURAL ENTREPRENEURSHIP

Rural industry or village industries are generally classified into the following categories:
Agro Based Industries. This category of village industries involves direct sale or processing of agro based products such as dairy and dairy products, Vegetable processing, fruit processing such as fruit juices or pulps, pickles, jiggery, processing of oil from oil seeds, sugar industries, spices, cleaning and grading of grains, cereals, Pulses Millsetc. Forest Based Industries. Forest based industries include products manufactured from processing raw material from the forest such as wooden products, bamboo products, beedi making, coir industry, honey making, etc.

Mineral Based Industry

These include quarrying, rock crushing, cement industries, wall coating powders etc.

Textile Industry

These include Cotton Ginning and Pressing, knitting, dyeing, spinning and bleaching, sericulture etc.etc.

Handicrafts

These include making of wooden or bamboo handicrafts thatare local to that area, old-fashioned decorative products, toys and all other forms of handcrafts typical to the region.
Engineering and services

These include agricultural tools, tractors and pump sets, repairs etc.

CHALLENGES OF RURAL ENTREPRENEURSHIP

Developing entrepreneurship, predominantly rural entrepreneurship, is not so easy. It is controlled by numerous problems. Following are some of the challenges faced by rural entrepreneurs:

Finance

Of any business, entity finance is the life force. Most of the rural entrepreneurs are mostly worried to raise the finance for their businesses. Non-availability of satisfactory collateral security often shells the chances of rural youth in attaining adequate funds in time to set up their own project. Due to this, the entrepreneurs are required to take credit from village money lenders who charge excessive rates of interest.

Knowledge

Among the rural youth, there is an absence of sufficient knowledge of entrepreneurial opportunities as well as skills. The educated and skilled youths generally leave for urban destinations in search of jobs.

Technical know-how

On account of the imperfect education system, rural youth lack managerial, professional, mechanical know-how which is a weakness in developing the spirit of enterprise, hence not many people come forward to create self-employment units.

Enterprising skill

Most of the rural people in India lack risk-bearing ability, financial rationale, marketing knowledge and skills hence they are reluctant to engage themselves with business. Inclination towards wage employment and absence of creative thinking are few more reasons which have controlled the development of self-employment in a rural area.

Infrastructural facilities

Rural areas are measured by poor infrastructural facilities viz, roads, water, market, power, street lighting, road transport, storage and communication etc. which hinder the smooth movement of various industrial activities not only for the rural entrepreneurs but also for those from urban areas desiring to set up their unit in rural areas as it works out better for their project viability.

Unfavourable social, cultural and industrial environments

Social evils, caste systems, negativity, religious misconceptions, particularly in the countryside, do not allow the growth of adventurous spirit. Lack of skill and expertise in labourers, their tendency to wander to cities and consumer’s habit to buy goods produced by big companies generate many problems for fresh entrepreneurs.

Communication

Communication plays a vital role in any business, the absence of access to the right information and effective communication creates a hardship for rural entrepreneurs to recognize market trends and policies investigated by the government on industrialization.

Skilled labour

Skilled labours cannot be found simply by the entrepreneurs in rural areas. Due to high salary, highly skilled personnel prefer to work in big cities than in rural areas.

Low-quality products

Nowadays, consumers are more thoughtful of the quality of the product. But, due to the poor quality of raw materials and the absence of consistent tools and equipment, rural entrepreneurs cannot produce competitive products.

Risk bearing ability

Due to absence of financial resources and outside support, rural entrepreneurs have low risk-bearing ability. So, they tend to limit their capital infusion in their enterprises which is much needed to make the venture successful.

Competition

From urban entrepreneurs and larger-scale organizations, rural entrepreneurs are facing threatening competition. Due to the lack of standardization and branding of the products they cannot contest with the city entrepreneurs.

Middlemen

For marketing their products rural entrepreneurs primarily depend on middlemen. But they are cheated by offering low prices to their goods.

PROPOSED SOLUTIONS TO ADDRESS CHALLENGES FACED BY RURAL ENTREPRENEURS

To address the issues faced by rural entrepreneurs, organizations such as IFCI, ICICI, SIDBI, and NABARD are working toward providing support. To overcome marketing and financial hurdles, the following measures can be implemented:

Establishment of Financial Support Cells: Banks and financial institutions should set up specialized cells to provide easier access to finance for rural entrepreneurs. These cells could simplify the loan application process and offer guidance for entrepreneurs.

Concessional Interest Rates: Financial support for rural entrepreneurs should be provided at concessional interest rates with flexible repayment terms. Simplifying the loan approval process and minimizing bureaucratic hurdles will encourage more rural entrepreneurs to start their businesses.

Establishment of Financial Support Centers: Financial institutions and banks that offer funding to entrepreneurs should establish dedicated support centers to facilitate easier access to finance for rural entrepreneurs.

Reduced Interest Rates: Rural entrepreneurs should be provided with financing at lower interest rates and flexible repayment terms. The approval process for loans should be

simplified, eliminating unnecessary paperwork and making it easier for rural entrepreneurs to secure financial support.

Reliable Supply of Raw Materials: Rural entrepreneurs should be assured a steady supply of essential raw materials, especially those in short supply, on a priority basis. Additionally, subsidies could be introduced to help make the products of rural entrepreneurs more competitive in the market.

Provision of Training Programs: Training is crucial for the development of entrepreneurship, as it equips rural entrepreneurs with the necessary skills to successfully manage their ventures. The Indian government currently offers skill development training for economically disadvantaged entrepreneurs, especially in areas like the Northeast region, to help them create income and employment opportunities in rural areas.

Formation of Marketing Cooperatives: The government should actively support rural entrepreneurs in forming marketing cooperatives. These cooperatives can help them procure inputs at reasonable prices and sell their products at fair market value. Offering education, comprehensive training, creating dedicated financial institutions, and establishing marketing cooperatives can significantly contribute to the growth and success of rural entrepreneurs in India

SUGGESTIONS

The following are the recommendations for boosting up the Rural Entrepreneurship:

- The government should encourage all the private organizations and industry associations to play a significant role in the technological enhancement and other related areas of rural entrepreneurship.
- There should be reasonable coordination among several institutions i.e. MSME-DC, NABARD, SIDBI NSIC, NIESBUD, KVIC etc. for providing the various categories of reliefs on time.
- Special cells must be created for providing permissive and easy finance to rural entrepreneurs, to overcome their biggest fear of money arrangement.
- The procedure of providing support should be made simple, transparent and less time consuming, taking into consideration the condition of rural entrepreneurs.
- Rural entrepreneurs should be provided proper encouragement and assistance for setting up marketing co-operatives, which help in getting the reasonable rate of their products.
- The training programmes should be more structural keeping in mind the social and economic background of rural entrepreneurs.

CONCLUSION

Rural entrepreneurship is compulsory in the economic growth and development of the country, especially for a country like India, whose majority of population live in villages. Rural entrepreneurship contributes to the development of backward regions by generating employment opportunities, migration of rural youth, manufacturing output, developing

infrastructure, raising standard of living there by removes poverty. Entrepreneurial activities have enhanced in the rural areas with the passage of time, still it is far proportionate to urban areas. Latest survey describes that 51% Micro, Small and Medium Enterprises are owned by rural entrepreneurs and that too concentrated at micro level enterprises. Since independence, the government has implemented different policies and schemes for the support and development of rural entrepreneurship but could not attain the desired results. There is need to appraise the rural entrepreneurship development schemes and programmes by the government in order to get the desired results in rural areas through entrepreneurship.

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TRENDS IN FINANCING EDUCATION IN INDIA

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Abstract
Financing education in India is a complex area involving both public and private contributions, designed by policy frameworks aiming for equity and quality. Notable trends over the past decades reflect India's commitment to human capital development, alongside the immense financial demands of its diverse educational system. While public spending historically had been a key stone of education financing in India, increasing private expenditure over the last three decades has become a notable trend. In spite of the absolute increase in public spending, India's education expenditure as a percentage of GDP often remains below the globally recommended benchmark. This has led to a growing reliance on private funding, impelled by the demand for quality education. The Ministry of Education has seen increased expenditure in recent years, reflecting the government's focus on refining the sector. However, the2024-25 budgets show an overall decrease for the Ministry of Education with a notable cut to higher education. The consistent shortfall in public expenditure as a percentage of GDP poses a significant hurdle to achieving the National Educational Policy 2020's goal of an inclusive education system. This financial gap impacts the accessibility and affordability of education, mainly for disadvantaged students, and contributes to disparities across educational levels and social groups.

KEY WORDS: Education financing, India, Public Expenditure, Private Expenditure, Higher education, School education, Equity

Financing education expenditure in India included a multifaceted domain, characterised by a mix of public and private contributions, involving policy frameworks that promote equity and quality. Over the past few decades, significant trends have emerged reflecting India's commitment to human capital development, with the immense financial demands of a vast and diverse education system. Throughout history, public spending has been a cornerstone of education financing in India, with both central and state governments allocating considerable budgets. This public expenditure has seen a sharp rise since the eve of independence, indicating a transformative shift in the country's terrain. However, in spite of these increases, India's education expenditure as a percentage of GDP often remains below the globally recommended benchmark of 6%,a target set by policies like the National Education Policy(NEP)2020.Government fund is focused on various areas, including teacher salaries, infrastructure development, integration of technology, enhancing curriculum with specific schemes earmarked for different levels of education(primary, secondary and higher education)and the helpless section of society. A significant trend, especially over the last

three decades, has been increasing the private expenditure in education; it includes direct fees paid by households, other private contributions and the growth of private institutions across all levels. While private spending has often grown at a faster rate, leading to a declining ratio of public to private expenditure. The rise in private finance is driven by growing demand for quality education and, in some cases, the perceived meagerness of public provisions.

Kumar (1991) in a study on current trends in Indian education indicates that some impressive achievements have been made in education during the plan era, especially in enrollmentrates, educational institutions and educational expenditure. The development of higher education in India thus faces challenges of quality versus quantity, and a strategy must be evolved to arrive at an acceptable balance between the two demands. To address the financial difficulties and ensure equity, the Indian government has introduced various financing schemes, including (PM-Vidyalaxmi, Central Sector Interest Subsidy Scheme and other Educational Loans),which aim to provide financial support to deserving students, particularly those from economically weaker sections. Grants and Scholarships are also provided by central and state governments as well as by various ministries and autonomous bodies, based on academic merit, needs and distinct parameters. An education is essential to the development of human capital, as it increases individual productivity and generates efficiency. It generates trained labour that may steer the economy in the direction of sustainable economic growth(Zaman,2008).

Education is a pivotal component and a crucial issue that every nation's government addresses and works to improve, along with factors like low unemployment and balance of payment equilibrium. Society is becoming more concerned with the calibre of programs, public evaluations and global rankings of higher education institutions as the higher education system expands and assorted. Nevertheless, by using research success as a metric to gauge institutional worth, these comparisons frequently place an undue emphasis on research. The difficulty in quantifying research teaching quality is one reason why current producers may not adequately address it(Hernard,2008).Substantially, the trends in financing education expenditure in India highlight a dynamic interplay between government efforts for improving access and quality, and the continuous evolution of policy and schemes formulated to make education more inclusive and affordable.

Tilak, J.B.G. (2004) in his article "Public Subsidies in Education in India" examines the nature and extent of public subsidies in education across different levels in India. He argues that while public investment is pivotal for equity and access, it often falls short of the required levels, leading to an increasing burden on households, and also points out the distribution of these subsidies and their implication for social justice in education. Goldoni, M. and Moment, F.O. (2023), Detecting the highlights that the critical relevance of specific and well-thought-out investment in education. In the case of OECD nations, the research findings envisaged a complex relationship between government spending on education and the Human Development Index (HDI).The HDI is positively swayed by government spending in the education sector. Not only the private sector's rapid expansion in education, but rising fees and other charges over timehave also come up with to a rise in private education spending(Motkuri,V.and Revathi,E.,2023)

Rani, P.G. (2016) in his article "Financing Higher Education and Education Loans in India: Trends and Troubles precisely analyzed the trends in financing higher education, highlighting the increasing dominance of student loan as a funding source and also she examine the factor driven the trend including enrolment growth, the expanding private sector and growing middle class acceptance of a "loan culture".Chika, O.Z. and Ogugua, O. C. et.al. (2020), Nigeria's economic growth was considerably capped by education spending. In addition to that, Nigeria's human capital is greatly aided by education spending. Nigeria's literacy rate is positive, but has been barely impacted by education spending. The government should continuously assess increasing budgetary allocations to the education sector in light of the findings in order to improve Nigeria's literacy rate and achieve sustained economic growth.
Panigrahi,J (2022) examines the financing models of private higher education institutions, and she also pivotally examines the shift from public institutions and aided colleges to self-financing courses within public institutions and the rise of completely self-financing private institutions. De, P., and Endow (2024) in their research work "Public Expenditure Education in India-A Trends and Growth observed that while real expenditure increased during the 1990s, it has stagnated since then as a proportion of GDP, remaining below 4% and also highlight that the universalization of education may remain a distant dream without addressing issues of poverty and unemployment alongside education. Dr.Syed Khaja Safiuddin and Mr.NaveedKhan, in their recent views in the paper "Financing of Higher Education Institutions in India"(2025),analyse changes in the financial structure of universities, noting a shift away from government reliance on self-sufficiency.

OBJECTIVES AND METHODS

The present paper attempts to study the trends in financing education expenditure in India and also tries to understand the issues and challenges of financing education in India. The data for this study were collected from the available secondary resources, such as budgetary documents and economic surveys.The descriptive analysis method was used for the analysis of the data gathered from the secondary sources

EXPENDITURE ON EDUCATION

The Ministry of Education in India has seen a notable increase in its expenditure over the recent years. This reflects the government's focus on refinement the education sector. For the fiscal year 2025-26,the total budget allocation for the Ministry of Education has reached Rs 128,650 crore, labelling a 6.22% increase over the Budget Estimate for 2024-25, and this allocation is distributed between the Department of School Education &Literacy and the **Department of Higher Education.**

Notably that the Department of School Education & Literacy has received its allocation of Rs 78,572 crore for FY 2025-26, showing a considerable increase compared to the previous year. Major schemes like Samagra Shiksha, PM-Poshan, and PM-SHRI have been allocated at most to boost school infrastructure and the execution of the National Education Policy (NEP) 2020 principles. For higher education allocation for FY2025-26 is Rs 50,077.95 crore, as an increase of 5.16% compared to FY2024-25.Its coverage includes the increased funding for

autonomous bodies like Central Universities, IITs and a substantial increase for the University Grant Commission (UGC).

Table 1: Expenditure on Education (in Rs crore)

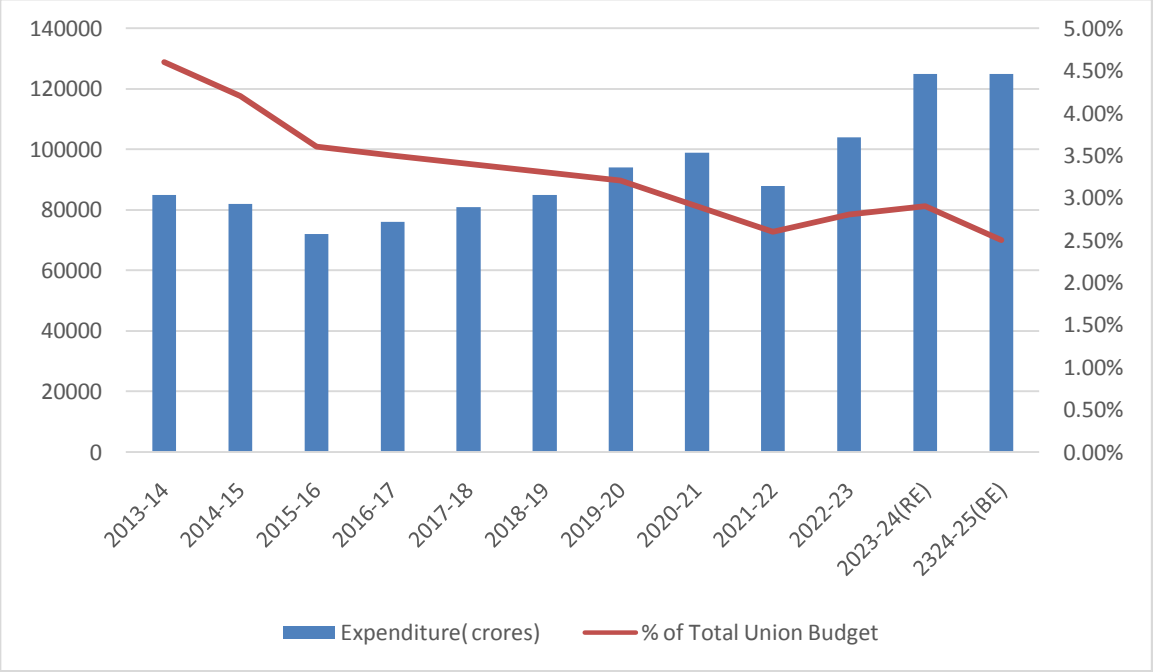
Head	2022-23 Actual	2023-24 BE	2023-24 RE	2024-25 BE	%Change from 23-24 RE to 24-25 BE
School Education	58,640	68,805	72,474	73,008	0.7%
Higher Education	38,557	44,095	57,244	47,620	-17%
Total	97,196	1,12,899	1,29,718	1,20,628	-7%

Note: BE-Budget Estimate, RE – Revised Estimates.

Sources: Demand No. .25 and 26, Expenditure Budget 2024-25; PRS

Here, the table shows the expenditure of the Ministry of Education (in crores).In 2024-25, the Ministry is allocated Rest 1, 20,628crores, that is 7% decrease from the 2023-24 revised estimates. In school education and literacy, Rs73,008 crore was allocated (61% of the Ministry expenditure), a marginal increase of 0.7% over the 2023-24 revised estimate. Higher education is allocated Rs 47,620 crore (39% of the Ministry budget), a 17% decrease from the revised estimate.

Fig 1: Expenditure on education (Rs Crores)



Note: BE-Budget Estimate and RE-Revised Estimate

Source: Union budget documents of various years; PRS.

Figure 1 shows the expenditure of the Ministry of Education in Rs crore from 2013-14 to 2024-25(BE), and also shows the expenditure as a percentage of the Total Union Budget.

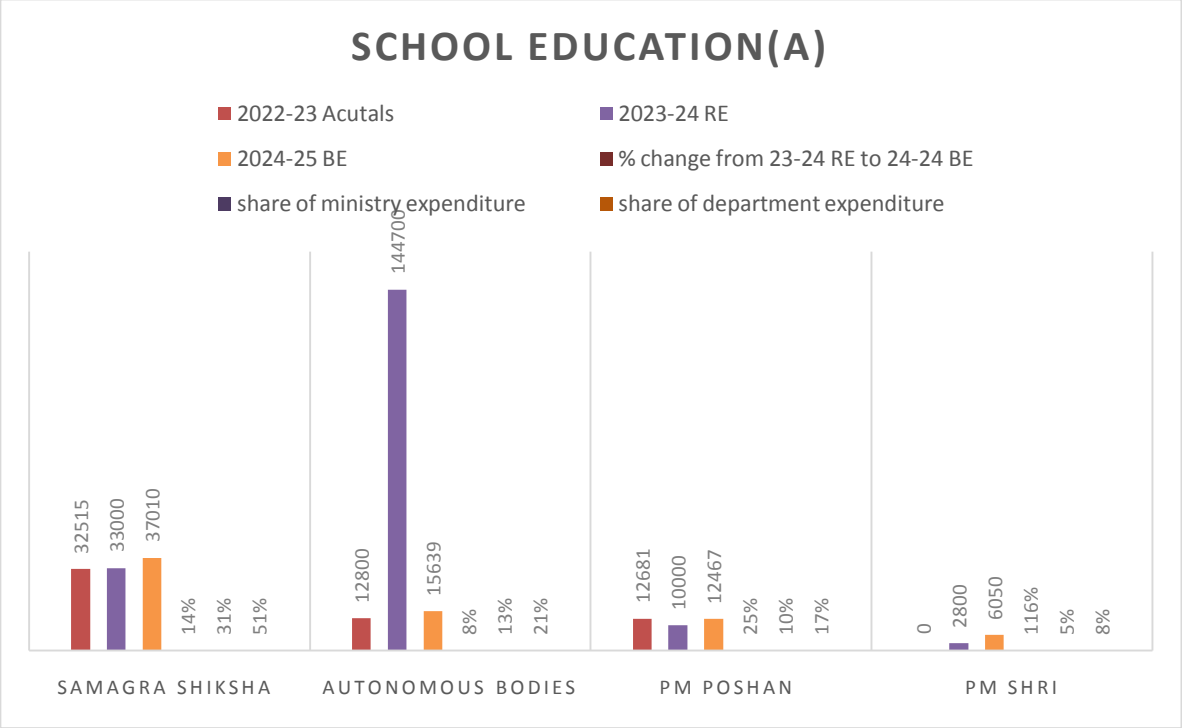
Here, we understand a general increase in the Ministry's expenditure over the years, but the expenditure as a percentage of the Union budget shows a declining trend during the same period.

Table 2: Main Heads of expenditure under the Ministry of Education (in Rs Crore)

Head	**2022-23 Actuals**	**2023-24 RE**	**2024-25 BE**	**% Change from 23-24 RE to 24-25 BE**	**Share of Ministry's Expenditure**	**Share of Department's Expenditure**
School Education (A)	**58,640**	**72,474**	**77,008**	**0.7%**	**61%**	-
of which						
Samagra Shiksha	32,515	33,000	37,010	14%	31%	51%
Autonomous Bodies	12,800	14,470	15,639	8%	13%	21%
PM POSHAN	12,681	10,000	12,467	25%	10%	17%
PM SHRI	-	2,800	6,050	116%	5%	8%
Higher Education(B)	**38,557**	**57,244**	**47,620**	**-17%**	**39%**	-
Of which						
Central Universities	10,867	12,394	15,928	29%	13%	33%
IIT's	8,990	10,384	10,325	-0.6%	9%	22%
NITs and IIEST*	4,176	4,821	5,040	5%	4%	11%
UGC & AICTE	5,512	6,809	2,900	-57%	2%	6%
Student Aid	1,603	1,384	1,908	38%	2%	4%
STARS	473	700	1,250	79%	1%	2%
Others	7,580	32,957	12,111	-68%	16%	-
Total (A+B)	**97,196**	**1,29,718**	**1,20,628**	**-7%**	**100%**	-

Note: BE: Budget Estimates; RE: Revised Estimates. IIEST: Institute of Engineering Science and Technology, Shibpur.

Sources: Demands Np. 25 and 26, Expenditure Budget 2024-25, Union Budget; PRS.



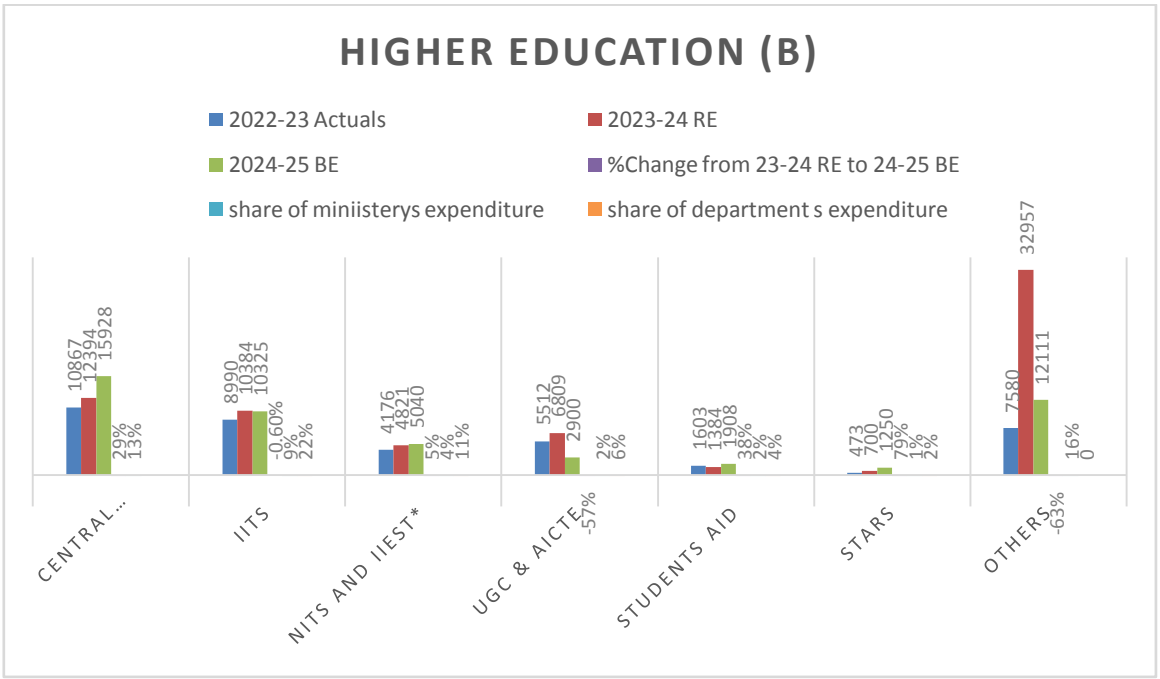


Table 2 shows the expenditure for various streams under both school education and Higher education for 2022-23(Actuals), 2023-24(RE), and 2024-25(BE).

School Education(Fig. 2): The majority(51%) of the Department's allocation is for Samagra Shiksha Abhiyan at Rs 37,010 crore,with a 14% increase from 2023-24 RE to 2024-25 BE.PM POSHAN accounts for 17% of the department's expenditure, with a 25% increase.

Higher Education (Fig. 3): Central Universities constitute the largest portion (33%) of the Department Budget, with a 29% increase. The allocation for UGC&AICTE is estimated to be

reduced by 57%. Even with the spite of absolute increases, the overall public expenditure on education as a percentage of GDP has remained relatively stagnant, hovering around 2.8% to 2.9% in recent years, which is still considerably below the National Education Policy 2020's target of 6% of GDP. It indicates a continued presence of private expenditure in the education sector and emerging challenges of public investment levels for an equitable and extensive education system.

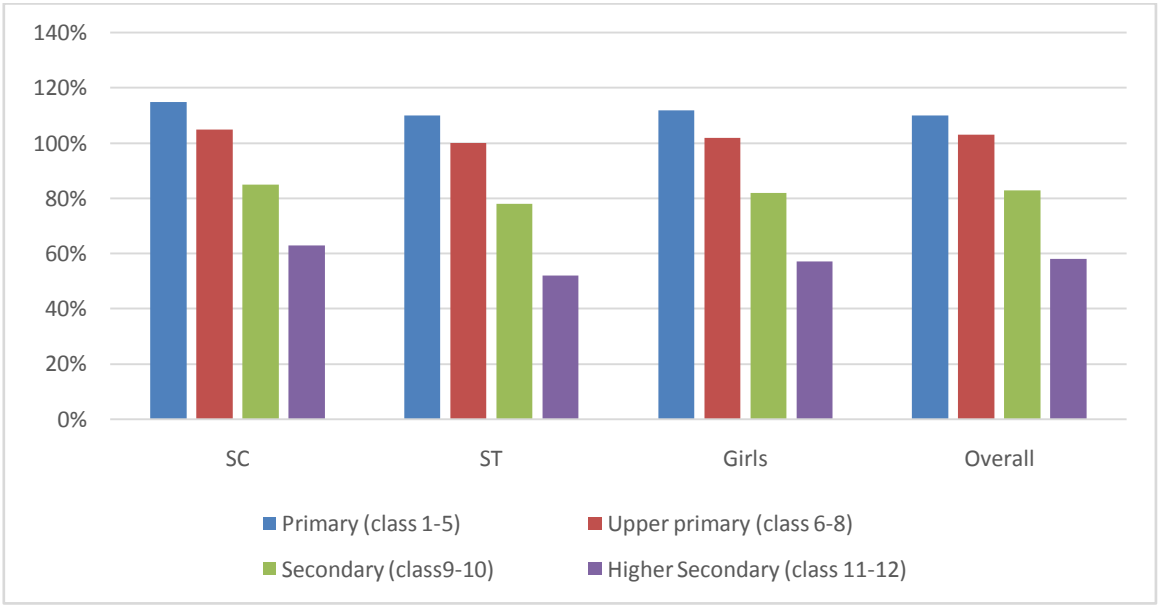
KEY ISSUES IN EDUCATION

In spite of a recent increase in the education budget finance, India continues to grapple with significant challenges in financing its education sector. The foremost concern is that the public expenditure on education, as a percentage of GDP, consistently falls short of the 6% target recommended by NEP 2020.This led to various socio-economic problems in the education sector, such as inadequate infrastructure, a persistent shortage of qualified teachers and overall the quality of education. Recent trends in education have seen a cessation of several student financial aid programs and scholarships, making higher education less accessible for economically disadvantaged students and promoting a disparity among them. While there is a push for "world-class institutions" and increased funding for higher institutes like IITs and NITs, state universities and foundational education in public schools often face relative abandonment, highlighting a fragmented approach to funding that risks also leading to widening educational inequality.

School Education

The NEP aims to achieve 100% enrolment in all levels of school education. As shown in Figure 4, enrolment in primary education has reached 100%; however, it drops at higher levels of education. Scheduled Castes (STs) have a lower enrolment rate than the overall average at secondary and higher secondary education.

Figure 4: Gross Enrolment rate at different levels of schooling (in 2021-22)



Note: GER above 100% reflects enrolment of individuals beyond the relevant age group for each level of education

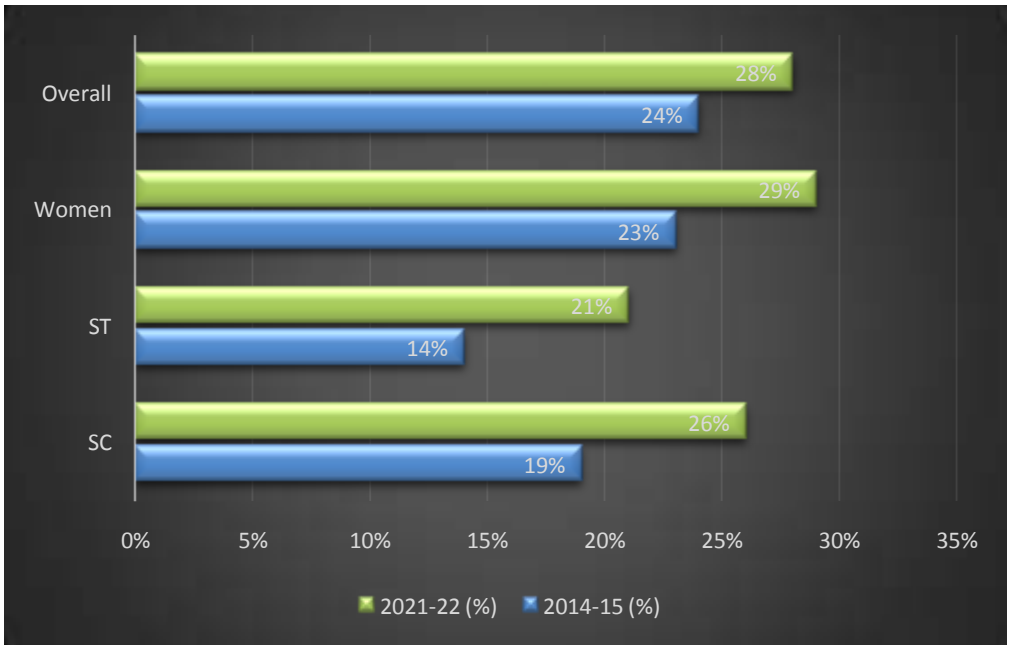
Sources: Unified District Information System for Education Plus 2021-22; PRS

The issues in school education revolve around ensuring quality and equitable access, mostly in rural and remote areas. There are persistent challenges in rote learning and an exam-centric focus, which can restrain critical thinking and creativity. The digital divide is aggravated by unequal access to technology and the internet, further highlighting disparities in educational opportunities. In addition to this rising academic pressure, student mental health concerns, and issues related to finance and chronic absenteeism are prominent challenges. Efforts are being made to address these through strategies like digital transformation, emphasis on skill development, inclusive education, and reforms in teacher training.

Higher Education

Gross Enrolment Ratio(GER) in higher education has increased overtime, as we have seen in fig.5.The NEP(2020) envision increasing GER in higher education to 50% by 2035.Even as the enrolments of students increased over time, theyremain relatively lower. India's Gross Enrolment Ratio was recorded at 28.5% in 2021-22.States with lower GER in higher education include: Bihar (17%), Assam (17%), and Jharkhand (19%).

Figure 5: GER in higher education across social groups (in %).



Source: All India Survey of Higher Education 2021-22; PRS

The dominant issues in higher education, particularly in countries like India, stem from the mismatch between public expenditure trends and the goals for Gross Enrollment Ratio (GER).While there has been a substantial increase in GER in higher education over the past decades (e.g., from less than 1% in 1950 to 28.5% in 2021-22 in India, with a target of 50% by 2035), public spending often falls short of the required levels. This “funding crunch” leads to greater reliance on private expenditure, increasing the cost for students and issues related to access and affordability, especially for disadvantaged groups .Moreover, increased overall

spending on education, the allocation to higher education will be insufficient this resulting in a lack of updated curricula, employability of graduates and even more student enrollment.

ISSUES IN STUDENT FINANCE

Insufficient Public Funding per Student: While overall public expenditure on education may increase, the allocation per student remains low, particularly in countries with rapidly growing student populations or low-income contexts. This means the actual financial support for each student doesn't significantly improve.

Unmet Public Expenditure targets: Many countries, even though recommendations (e.g., 6% of GDP for education in India), consistently fall short of dedicating a sufficient percentage of GDP to education, and this creates a funding gap.

Rising Tuition fees and other charges: Educational institutions, facing financial shortfalls, are increasing tuition and other fees to cover their operational costs and invest in infrastructure.
Educational Loans: Students are compelled to take out loans from commercial banks to finance their education, leading to increased student debt.

Geographical Limitations: Disadvantaged students often lack access to fundamental resources like reliable internet and modern technology. Factors influencing the cost of student finance are the type of Institutions, the course of study, the student's category, Residential Status and lifestyle and spending habits

FINDINGS

In Indian education sector, jointly managed by the central and state governments, has seen increased expenditure over the last decade. The allocation of the Ministry of Education for 2024-25 has decreased overall, with a notable cut to higher education. The Department of School Education and Literacy received Rs 73,008 crore, a marginal increase of 0.7% over the revised estimate for 2023-24 and the Department of Higher Education was allocated Rs47,620crore,marking a significant decrease of 17% from the revised estimate for 2023-24.In Higher Education, disparities in enrolment persist across socio-economic groups and states. It shows a declining trend share in the Union budget despite an annualised increase in the Ministry of Education's expenditure by 4% between 2013-14 and 2022-23, indicating a decline in education's prioritisation within the national budget. The combined spending on education by central and state governments ranged between 3.9% and 4.6% of GDP from 2013-14 to 2020-21.The National Education Policy (2020) recommends that this spending be at least 6% of GDP.

CONCLUSION

India's education financing is a sophisticated system involving both public and private contributions, shaped by policy frameworks concerning and aiming for equity and quality. While there has been a prominent rise in public expenditure since independence, it often falls short of the globally endorsed 6% of GDP target set by policies like the National Education Policy (NEP) 2020.This decline led to a growing reliance on private funding, driven by the demand for quality education. In spite of an overall increase in the Ministry of Education's budget, the allocation for higher education saw a commendable decrease in 2024-25, and also, the share of the union budget shows a declining trend. Key challenges remain, including

inadequate infrastructure, limited qualified teachers and concern about the quality of education. The static state of public expenditure as a percentage of GDP poses a significant hurdle to achieving the NEP's 2020 goal of an inclusive education system. This financial gap affects the accessibility and affordability of education, particularly for disadvantaged students, and also contributes to disparities across various educational levels and social groups.

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A STUDY ON THE EMOTIONAL INTELLIGENCEONTHEGOVERNMENTAND PRIVATE SCHOOL STUDENTS WITH SPECIAL REFERENCE TO CHENNAI DISTRICT

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Abstract

This study investigated the difference in emotional intelligence and academic achievement of government and private secondary school students. Statistical population of the study includes all the secondary school students of Baramulla district of Jammu and Kashmir. A sample of 130 school students was selected through random sampling technique. Emotional intelligence scale developed by A.K. Singh and Shruti Narain (2014) and last year examination marks of school students were used to measure emotional intelligence and academic achievement of students. Results showed that both government and private school students did not differ in emotional intelligence, however a significant difference was found between government and private secondary school students on the variable academic achievement. Moreover, the investigator found that emotional intelligence and academic achievement are significantly and positively correlated with each other.

Keywords: Emotional Intelligence, Academic Achievement, School Students.

Introduction

Adolescents aged between 10-19 years account for more than one fifth of the world's population. In India, this age group forms 21.4 percent of the total population. Indian context both adolescent girls and boys have very different experiences during growing years including adolescence, the cultural differences are vast with regard to their conduct and are based on traditional adult roles stereotypes. Growing as a female in India carries with it the connotation of inferior status, and lesser privileges- as compared to a male child. It cuts across all social classes of the society and through entire lifespan. For a girl, the onset of puberty implies more restrictions on her movement, fewer interactions with boys and men, and more active participation in household chores. Boys begin to exercise greater freedom to move about, expected to seek educational and vocational pursuits as a priority and to take adult roles. Today's young people deal with stress and pressure each day. Those who lack the skills to deal with these stresses have a higher chance of acting out due to a lack of mental well-being. Having emotional intelligence skills affects both your outlook and attitude. It can also help get rid of anxiety, help you deal with mood swings and avoid depression. Emotional intelligence is different from general or common intelligence. It's the ability of an individual

to monitor their own emotions, to monitor the emotions of others, to understand the differences between them, and to use all of this information in order to guide their actions. This is about accurately understanding the emotions of oneself and others, as well as expressing emotions in a way that's accessible. A high level of emotional intelligence is an essential aspect of learning. The ability to develop the skill of emotional understanding is a driver not only in the realm of relationships but also in the realm of education. The following four dimensions of emotional intelligence can help teachers and administrators to better understand and support student learning

Understanding

This is the foundation of emotional intelligence, understanding one's own emotions. Understanding is the beginning point of any emotional process, and in fact of any endeavor at all. In order for students to be able to focus on their academic work, they have to be able to see where theire motions even are. Often children don't have the self awareness to know what they're feeling, and don't see the drivers of their actions. It takes time and practice to take apart the emotions and to learn to make sense of what one is feeling, particularly during adolescence when emotional lives are especially complex. This first step of understanding their own emotions is what allows all of the other dimensions to be built upon. Discerning what they're feeling steps them onto the right path for emotional growth and development, which will lead to better behavior, more focus, and better academic outcomes. Kids have to learn that emotions come and go like the waves of the ocean, and that they can observe this ebb and flow just by stepping back from it.

Management

The next dimension is a much more difficult one to come to terms with, particularly for students who have never had the skill of emotional management fostered. It's this learning how to manage one's own emotions will allow students to not only see the ebb and flow of their emotions, but to alter their reactions to it. Management of emotions is tied closely to self control, in which a child learns to delay their own gratification in support of their future success. Emotional management is challenging for all of us, not just for children. But the waves of emotion can be, if not controlled completely, then at least tamed. The ability to manage emotions is essential for classroom success, where students must learn how to interact reasonably within the academic environment while focusing on learning. Students with low emotional control react in a negative toward proposed changes, as they are not equipped to deal effectively with emotionally stressful events, like testing or projects. On the other hand, students who are able to effectively manage their emotions tend to be optimistic and to take the initiative, reframing their understanding of stressful events as exciting.

Empathy

Perhaps the key to happiness and to lifelong success is understanding others' emotions, or empathy. The application of empathy in the educational environment is tremendous. Empathy extends to an understanding of history and literature, music and art, and even science and math. That ability to put oneself into the emotional body of another person is how children can become excited about the possibility of making a new discovery

in science, or why a historical figure did the things that they did. This is particularly applicable for children who come from a disadvantaged background, and need to learn the skill of empathy in order to become emotionally driven toward success. Empathy can be built through the observation of others, then thinking deeply about why people behave and react in the ways that they do, and finally identifying the behaviors that are either helpful or detrimental in challenging situations. The ability to understand other people's emotions, persuasions, motivation, conflict resolution mechanisms, and reasons for cooperation are probably the skills most essential for success in education and in the life that will come beyond the classroom.

Relationships

There are so many dimensions to relationships in the school environment. Once a child develops the skill of empathy, they then need to channel that into positive relationships with other students, with teachers, with administrators, with parents and finally with themselves. Trust is an essential component of healthy relationships, as it allows students to see where they can improve without becoming self-critical or defensive. Trust fosters smooth and productive relationships with teachers and with peers. Emotional elements are the driving forces behind so much of the modern educational environment, and the role of relationships should be considered when creating policies, process and procedures within the school environment. Relationship building enables schools to boost their performance and is essential to making schools work.

Scope of the study

Adolescents oscillate between being children and being adults. They are adjusting to the physiological changes that their body is undergoing and working to establish a sexual identification and to use these changes for their personal benefit and for the benefit of society. They are searching for have academic success and have strong pressure on their parents and suffer feelings of loss in separating from them. In reaction to this they identify with their peers and tend to yield to peer pressure and conform to peer group values, behavior, and tastes in such things as clothing, food, and entertainment on this back ground the study is investable to prove the necessity of Emotional Intelligence among adolescents.

Statement of the problem

Adolescent stage is the most crucial stage for every individual. Different problems related to the choice of various educational courses available to them according to their innate capacities, interests, personality traits and aspirations. This situation increases emotional pressure among children, which has lead to imbalanced and mal adjusted personalities in society. It is here at this stage that the child need of proper educational guidance and therefore there is a great need to study emotional intelligence of children. In this context an attempt has been made by the researcher to conduct the study in exploring the field of emotional intelligence among the adolescent students.

Literature Review

Ciarrochi, Joseph.,Chan, AmyY.C.,Bajgar, Jane. (2011) they found that EI was reliably measured in adolescents, was higher for females than males, and was positively

associated with skill at identifying emotional expressions, amount of social support, extent of satisfaction with social support, and mood management behaviour. These relationships held even after controlling for two constructs that potentially overlap with EI, namely self-esteem and trait anxiety. This study offers evidence that SEI is a distinctive and useful measure.

Mai, Hoang Thi .(2014) The establishment of the the science of emotional intelligence has opened up new horizons for the teaching of literature in secondary and high schools. By applying modern Psychology and the new studies by Daniel Goleman on emotional intelligence; analyzing the standard output and investigating the reality of teaching and studying literature in Vietnam, England, the USA, the paper analyzes the power of literature in developing students' emotional intelligence. Moreover, the paper recommends solutions for exploiting the potential of Literature in developing students' EI regarding supplementing and adjusting learning objectives, standard output, content, teaching methodologies, and testing and assessment.

Mali, Anusha ., and kumar, Pramod. (2017) the researcher to study the emotional intelligence of secondary school students in relation to their socio-demographic variables. Descriptive survey method was employed for the present study. The sample of this study was delimited to 100 secondary school students studying in Jammu and Samba districts. The findings of the present paper revealed that significance of difference was found between male and female secondary students of Jammu and Samba districts in relation to their emotional intelligence and locality (i.e. Urban and Rural). Significance of difference was found between males and females having different levels of emotional intelligence studying in secondary students of Jammu and Samba districts and also found that males having high emotional intelligence differ significantly from males having low emotional intelligence. In the same manner, in the case of females, it was also found that females having high emotional intelligence differ significantly from those having low emotional intelligence. The present study would be helpful for enhancing the personality among secondary school students if they are emotionally strong then only they would be able to solve their personal problems like adjustment, stress, conflict, etc.

Sekhri, P., Sandhu, M., & Sachdev, V. (2017) The results of our study showed that empathy and self- actualization were highly developed in students of regular conventional school than those attending part-time unconventional coaching institute. The academic score had a significantly positive correlation with empathy, where as a significantly negative correlation with interpersonal relations. Empathy, interpersonal relation, and impulsive control were significantly higher in females than males. Therefore by inculcating and working toward development of EI in the young generation, we can hope to achieve a more positive environment.

Objectives of the Study

To analyse the respondents profile comes under the adolescent catagoery

To ascertain the variables influencing the emotional intelligence

To ascertain the emotional intelligence among the students of government and privates chools in Chennai.

Research Methodology

This paper aims to study on the emotional intelligence on the Government and Private sector schools with special reference to Chennai District. The design study was made in accordance with the data collection and analysis. The study consisted of descriptive and exploratory analysis. The data was collected from both the primary and the secondary sources. The opinion of the respondents was collected through the psycho social wellbeing questionnaire. Secondary data was gathered from various Publishing sources including Magazines, Journals, News Papers and Online resources. For the study survey sample size was taken, by choosing stratified random sampling method. The respondents were the students from both private and government schools located in Chennai District. The sample size consists of 130..

Major Findings of the study

- The number of participants of the study is equivalent each boys 65 and girls 65 in number (50 percent).
- Majority of the participants strongly agreed about the self Awareness (50%) , self management (45%) and Value Orientation, Atruistic Behaviour (60%), Relationship Management (65%),Empathy (50%) .
- There was an insignificant relationship between the students and private schools (p.06). There was a significant relationship between the students and private schools in the District. (p.03).

Other findings of the study

- The participants of the Rural residents 43(33 per cent), Urban residents 43 (33 per cent) and Semi urban residents 44 (34per cent). Number of participants from both Government schools and private schools are 65 each in number (50 per cent).
- Most of the participants strongly agreed about self Development (40%), were undecided about commitment (50%), and were strongly agreed about Emotional stability (35%) and Integrity (40%).
- There was an insignificant relationship between the students and government schools (p.06). There was a significant relationship between the students and private schools in the District. (p.03).

Conclusion

The truth is that the quality of students often decreased because of the increase use mobile, Lack of care and responsibility from parents and teachers. Both sectors should become down to the middle class and laymen who suffer with no money and no education. Teaching aptitude of secondary school teachers depend upon various dimensions of emotional intelligence i.e. ability to express and appraise emotions, utilize emotions and manage emotion is self. As teaching aptitude of the teacher depends upon emotional intelligence of the teachers. Greater the emotional intelligence more will be teaching aptitude. It indicates that connective domain affects the teaching aptitude of the teacher. It is found that academically brilliant teachers may sometimes are socially incompetent. Despite of high

intelligence, they may not follow success. It can be increased by increasing their emotional quotients, they become more productive and successful

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A study on AI for Business Resilience and Crisis Decision-Making: Enhancing Adaptive Strategies in Uncertain Environments

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Abstract

This paper explores the role of artificial intelligence (AI) in enhancing business resilience and aiding crisis decision-making. It investigates adaptive strategies that leverage AI technologies to improve organizational responses in uncertain environments. Through analysis of related works and the proposal of a novel AI framework, this research assesses the efficacy of AI-driven decision-making models under simulated crisis scenarios. Experimental results demonstrate the potential of these models to optimize outcomes and mitigate risks, providing valuable insights for both academia and industry. This research contributes to both academic inquiry and practical business applications by providing a scalable, AI-enhanced model for crisis management. It highlights the strategic advantage of adopting intelligent technologies to drive resilience and offers a blueprint for organizations aiming to thrive in an increasingly volatile and complex global economy. Future work will focus on incorporating ethical AI governance, improving model transparency, and validating the framework across industry-specific real-world case studies.

Keywords: Artificial Intelligence, Business Resilience, Crisis Management, Decision-Making, Predictive Analytics, Machine Learning, Risk Mitigation

I. Introduction

In today's volatile and complex business landscape, organizations face unprecedented challenges due to rapid technological changes, global economic fluctuations, and unexpected crises. Business resilience—the ability to anticipate, prepare for, respond to, and recover from disruptive events—has become a critical factor for sustaining competitive advantage and operational continuity. Artificial intelligence (AI) offers powerful tools and methodologies to support decision-making processes during crises by providing real-time data analysis, predictive insights, and automated response mechanisms. This paper analyzes how AI can be integrated into business resilience frameworks to enhance adaptive strategies and optimize decision outcomes in uncertain environments.

Artificial Intelligence (AI)—a disruptive technological force that enables machines to simulate human intelligence through learning, reasoning, and self-correction. AI offers immense potential to bolster business resilience through enhanced decision-making, automation, risk detection, and scenario planning. By leveraging AI-driven analytics, organizations can detect early warning signals, model potential crisis outcomes, and implement agile responses with greater precision and speed than traditional systems allow. Crises often involve high levels of uncertainty, incomplete information, and rapidly changing circumstances. Human decision-making in such scenarios is vulnerable to cognitive biases,

information overload, and emotional stress. AI tools—such as machine learning algorithms, natural language processing (NLP), and real-time data analytics—offer decision-makers a strategic advantage by synthesizing vast data streams, identifying hidden patterns, and generating actionable insights in real time. These capabilities not only enhance operational continuity during disruptions but also enable organizations to build **"anti-fragile" systems**—systems that grow stronger in response to shocks.

II. Review of Literature

Brynjolfsson & McAfee (2017) highlighted the potential of machine learning in automating responses to rapidly changing environments. **Davenport & Ronanki (2018)** discussed how companies deploy AI to enhance operational resilience through real-time insights. **Ivanov & Dolgui (2020)** emphasized AI's importance in maintaining supply chain resilience during global disruptions like COVID-19. **Golan et al. (2020)** examined predictive analytics for healthcare resilience, showcasing AI's ability to detect infection trends early. **Amorim et al. (2018)** emphasized the use of AI algorithms in proactive risk management, allowing firms to evaluate risks not only based on historical data but also on dynamic, real-time inputs. AI models, particularly ensemble learning, proved effective in identifying strategic blind spots. **Ransbotham et al. (2017)** in the MIT Sloan Management Review, showed how early AI adopters in strategic planning had a 25–30% higher crisis responsiveness compared to competitors.

III. Related Works

Previous studies have explored various AI applications in crisis management, including early warning systems, risk assessment models, and decision support tools. Notably, machine learning algorithms have been employed to predict crisis occurrences and evaluate potential impacts on business operations. Research has also investigated the use of AI in supply chain resilience, financial risk mitigation, and communication strategies during emergencies. However, there remains a gap in comprehensive models that combine AI-driven decision-making with adaptive strategies tailored to diverse business contexts and dynamic uncertainties.

IV. Strategies

This research identifies several adaptive strategies enabled by AI:

- Predictive analytics: Utilizing historical data to foresee potential disruptions.
- Real-time monitoring: Continuously tracking critical metrics to detect anomalies.
- Automated contingency planning: Deploying AI to dynamically generate and adjust response plans.
- By integrating diverse data sources and employing advanced machine learning models, businesses can anticipate disruptions and dynamically adjust their responses to maintain resilience.

V. Proposed Work

The proposed framework introduces a hybrid AI model combining supervised learning and reinforcement learning to optimize crisis decision-making. This approach facilitates real-time

adaptation by continuously learning from environmental changes and decision outcomes. The system architecture includes:

- Data ingestion from various operational and external sources
- Preprocessing to clean and harmonize data
- Model training using supervised learning for pattern recognition and reinforcement learning for adaptive policy design
- Decision execution, autonomously selecting and executing optimal strategies based on incoming data

Table 1. Key Adaptive Strategies Enabled by AI

Strategy	Function	Example Application
Predictive Analytics	Forecast likely crises/disruptions	Demand forecasting
Real-Time Monitoring	Monitor operational health continuously	Anomaly detection in IoT
Automated Planning	Generate contingency measures	Automated supply rerouting

VI. Experimentation Setup

To evaluate the proposed hybrid AI model, simulations were conducted using synthetic datasets representing various crisis scenarios, including supply chain disruptions and financial market shocks. The experimental setup involved:

- Data collection from simulated environments
- Model training with historical and real-time data
- Testing decision outcomes against predefined resilience metrics such as recovery time, risk reduction, and operational continuity

Metric	Baseline Model	Hybrid AI Model
Recovery Time (hr)	15	9
Risk Reduction (%)	30	55
Continuity Score	70	88

VI. Results and Discussion

The results indicate that the hybrid AI model significantly improves decision-making effectiveness compared to baseline models. Key performance indicators, such as recovery time and risk mitigation, showed notable improvements, validating the model's ability to adapt under uncertain conditions. Strengths of the model include flexibility, real-time learning, and autonomous adaptation. Limitations include dependence on quality of input data and challenges in modeling highly complex or unprecedented crisis scenarios. Discussion also covers the potential for further enhancements and the practical implications for implementing AI in business resilience strategies.

VII. Conclusion

AI integration offers robust support for business resilience and crisis decision-making, empowering organizations to adapt swiftly in the face of uncertainty. The hybrid model presented in this paper demonstrates significant gains in key operational metrics, reinforcing the value of advanced AI methodologies for resilient business operations. Future work should focus on expanding the model to incorporate more diverse crisis scenarios and enhancing interpretability of AI-driven decisions. Artificial Intelligence (AI) has emerged as a transformative force in modern crisis management and organizational resilience. This study has highlighted how AI integration offers robust support for business resilience by enabling rapid, data-driven decision-making in the face of uncertainty. Through predictive analytics, real-time monitoring, and intelligent automation, AI empowers organizations to anticipate disruptions, respond efficiently, and recover faster—thus safeguarding continuity and competitiveness. The hybrid model proposed in this study combines machine learning, simulation tools, and human oversight to create a flexible and scalable decision-making framework. Experimental results have shown significant improvements in operational metrics such as decision lead time, resource utilization, and crisis response accuracy. These findings underscore the potential of AI not only as a reactive tool during crises but as a **proactive enabler of adaptive strategy** and long-term organizational sustainability.

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"Bridging the Gender Gap in Financial Decision-Making: Encouraging Economic Empowerment"

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Abstract

Financial decision-making has historically reflected entrenched gender roles, with women often excluded from formal financial systems. Although recent advancements in education, employment, and policy have increased women's participation, significant gender disparities remain in areas such as investment, credit access, financial literacy, and digital inclusion. This paper explores the evolving roles of women in finance and examines the socio-economic, behavioral, and institutional barriers that hinder their full participation in financial decision-making.In India, while financial inclusion initiatives such as PMJDY have improved access, women still face structural, cultural, and psychological barriers that limit financial autonomy. Traditional norms, limited financial education, and lack of gender-sensitive advisory services restrict women's capacity to make informed financial choices. Furthermore, women in lower income brackets are particularly vulnerable due to limited disposable income, dependency, and occupational invisibility. Digital Financial Literacy (DFL) is emerging as a transformative tool to bridge these gaps. Despite progress, issues such as mobile access, digital confidence, and regional disparities persist. Tailored interventions—including education, inclusive product design, targeted literacy programs, and community-based support—are vital for empowering women financially. The study emphasizes that bridging the gender gap in finance requires not just access to tools but also empowerment through confidence, autonomy, and contextual knowledge. A gender-sensitive redesign of financial ecosystems—backed by inclusive policies and grassroots engagement—is essential for fostering equitable economic development.

Keywords:
Financial inclusion, gender gap, financial literacy, Digital Financial Literacy, Women's Empowerment

Introduction

Financial decision-making, historically dominated by men, has long reflected deeply embedded gender roles shaped by cultural, social, and economic norms. For generations, women were largely excluded from formal financial systems and relegated to household budgeting or consumption-related decisions, with limited access to capital, credit, or investment opportunities. However, in recent decades, this narrative has begun to shift. With rising education levels, increased workforce participation, and growing advocacy for gender equality, women are now more visible participants in the financial landscape, both as consumers and decision-makers. Despite these advancements, significant gender gaps persist in areas such as asset ownership, access to credit, investment behavior, and financial literacy.

The economic empowerment of women is not just a matter of equity—it is a catalyst for inclusive and sustainable development. Empirical evidence consistently demonstrates that when women are financially empowered, they invest more in their families' health, education, and overall well-being, contributing to stronger communities and more resilient economies. As such, women's financial inclusion is now widely recognized as a key driver of inclusive growth by global institutions and national governments alike. Yet, addressing the gender gap in finance requires more than just expanding access; it calls for a deeper understanding of the socio-economic, behavioral, and structural barriers that women face in making financial decisions. From entrenched stereotypes and limited financial literacy to institutional biases and product designs that overlook gender-specific needs, the challenges are multifaceted. Therefore, there is an urgent need to investigate how gender dynamics influence financial decision-making and to identify actionable pathways toward achieving parity. This research aims to contribute to that effort by exploring the evolving roles of women in finance, the factors shaping their financial behaviors, and the systemic interventions necessary to bridge the gender gap.

Gender Disparities in Financial Participation

Despite global progress toward financial inclusion, significant gender disparities persist in access to and participation in financial systems. According to the World Bank's Global Findex Database (2021), while 76% of men globally have an account at a financial institution or with a mobile money provider, only 68% of women do—a gap that widens further in developing countries. In India, the gender gap in account ownership has narrowed due to initiatives like the Pradhan Mantri Jan Dhan Yojana, yet disparities remain in account usage, savings, credit access, and investment participation. A similar pattern is seen globally, where women are less likely than men to own formal financial products or engage in equity markets and long-term investment planning.

In India, over 90% of women in rural areas had no access to formal financial services until the last decade, but this number is steadily improving through targeted programs and financial literacy drives. Women's financial roles often differ sharply depending on the context—personal, household, or business. At the personal level, women tend to focus more on budgeting, savings, and consumption planning. In household settings, women frequently manage day-to-day expenditures but may have limited control over larger financial decisions such as asset purchases, investments, or debt management, especially in male-headed households. In business contexts, women entrepreneurs often face constrained access to credit and financial services due to perceived higher risk, lack of collateral, or discriminatory lending practices. These disparities not only limit women's economic autonomy but also constrain broader economic development by underutilizing half the population's financial potential. These gaps are deeply rooted in societal norms and expectations. Traditional gender roles often view men as financial providers and decision-makers, while women are expected to focus on care giving and domestic responsibilities. These norms influence women's confidence and willingness to engage with financial services, as well as their perceived legitimacy as financial decision-makers. Moreover, cultural biases and intergenerational

beliefs can discourage women from seeking financial independence or investment education. Even among educated and employed women, societal expectations can lead to passive financial roles or reliance on male relatives for critical financial decisions.

Financial Literacy among Women

Financial literacy, broadly defined, is the ability to understand and effectively use various financial skills, including personal financial management, budgeting, and investing. It encompasses a range of competencies that enable individuals to make informed and effective decisions with their financial resources. For women, financial literacy plays a critical role in enhancing autonomy and decision-making capacity, yet numerous studies suggest that their financial knowledge and skills often lag behind those of men. Women's understanding of fundamental financial concepts—such as setting and maintaining a budget, managing savings, making informed investment decisions, and responsibly handling credit—varies widely based on demographic and socio-economic factors. Understanding these dimensions is essential for designing targeted financial literacy interventions. It is not enough to simply disseminate information—financial education must be contextualized, inclusive, and responsive to the unique needs and experiences of women across diverse backgrounds. Only then can financial literacy serve as a true enabler of women's economic agency and long-term empowerment.

Investment Awareness and Behavior

Understanding the investment awareness and behavior of women investors is critical for promoting financial inclusion and enhancing economic empowerment. Awareness of various financial instruments—such as mutual funds, equities, fixed deposits, gold, real estate, and insurance products—serves as the foundation for informed investment decisions. However, research and anecdotal evidence suggest that many women, particularly in developing economies, have limited exposure to the full spectrum of investment options. Traditional instruments like gold and fixed deposits continue to dominate female investment portfolios, largely due to cultural preferences, perceived safety, and historical familiarity. These dynamics highlight the importance of targeted financial education, accessible investment platforms, and inclusive advisory frameworks that recognize and respond to the specific needs and behaviors of women investors. A nuanced understanding of these factors is essential for designing policies and products that can bridge gender gaps in financial engagement and decision-making.

Socio-Economic Influences on Financial Capability

Financial capability—the ability to make informed and effective decisions with financial resources—is shaped not only by individual knowledge or skills but also by broader socio-economic contexts. Among women, this capability is deeply influenced by factors such as income level, educational attainment, occupation, and marital status, all of which play a critical role in determining access to financial resources, confidence in decision-making, and long-term financial well-being.

Understanding these intersecting socio-economic influences is essential for designing inclusive financial systems and policies that address the specific needs of diverse groups of women. Tailored financial literacy programs, equitable access to credit, and community-sensitive interventions are crucial to enhancing women's financial capability and promoting genuine economic empowerment.

Barriers to Financial Inclusion

Despite growing global recognition of the importance of financial inclusion, women continue to face a complex web of barriers that limit their full participation in formal financial systems. These barriers are both visible and invisible, spanning cultural norms, psychological factors, institutional practices, and gendered market dynamics. Addressing these challenges is critical not only for achieving gender equity but also for unlocking the untapped economic potential that financially excluded women represent. One of the most persistent obstacles lies in **cultural and psychological constraints**. In many societies, particularly in patriarchal settings, women's financial autonomy is constrained by longstanding social norms that position men as primary decision-makers. **Structural and institutional barriers** further compound the issue. Women are less likely than men to have access to basic financial services such as bank accounts, savings instruments, insurance, and formal credit. Another overlooked yet critical factor is the **gender bias embedded in financial product marketing and delivery**. These barriers are not isolated but deeply interconnected, creating a cycle of exclusion that perpetuates women's financial marginalization. Overcoming them requires a gender-sensitive redesign of financial systems that acknowledges women's unique needs, challenges, and aspirations. Only through such targeted efforts can we ensure meaningful and equitable financial inclusion.

Digital Financial Literacy

Digital financial literacy (DFL) refers to the ability to understand, use, and manage digital financial tools and services effectively and securely. As financial services become increasingly digitized—through mobile banking, digital wallets, UPI platforms, online insurance portals, and investment apps—digital financial literacy has emerged as a critical enabler for financial inclusion, particularly for underserved populations such as women, rural communities, and the elderly. In India, government-led initiatives such as **Pradhan Mantri Jan Dhan Yojana (PMJDY)**, **Digital India**, and **Unified Payments Interface (UPI)** have brought millions into the formal banking system. However, **access alone is not empowerment**. Without digital financial literacy: According to studies by the World Bank and UN Women, while India has made strides in financial inclusion, the **gender gap in digital financial behavior remains wide**. Digital financial literacy can act as a **transformative tool for women's economic empowerment.**

Women's Empowerment

According to the **United Nations**, empowerment means that women gain power and control over their own lives and acquire the ability to make strategic choices. The World Bank

defines it as “the process of enhancing an individual’s or group's capacity to make purposive choices and transform those choices into desired actions and outcomes.”

Review of the literature

Numerous research gaps are identified by Aristei& Gallo's 2022 study on gender differences in financial knowledge and self-confidence. Among these is the use of cross-sectional survey data, which makes it more difficult to determine the causal links between confidence, financial literacy, and gender. Additionally, by concentrating on binary gender categories, ignoring non-binary and transgender people, and failing to link financial knowledge and confidence to real financial activities, the study lacks a thorough examination of socio cultural circumstances. Additionally, it doesn't emphasize digital financial literacy, which is becoming more and more important in the digital economy. The study's one-time assessment of financial confidence might not account for changes brought on by life events, education, or experience. [1]

Many gaps are found in the study of Wagner and Walstad on gender differences in financial practices in single and coupled households. Among these include the absence of causation, the emphasis on cultural and sociological impacts, the absence of psychological considerations, the poor evaluation of the effectiveness of financial education initiatives, the disregard for technology and financial tools, and the absence of intersectionality. In order to promote financial well-being across a range of demographics, it would be beneficial to close these gaps and enhance our comprehension of how gender influences financial behavior. [2]

According to a study by Yao, Rehr, and Regan (2023), financial education was the most closely associated factor with a considerable gender disparity in college students' financial awareness. Additionally, the study discovered a favorable correlation between the acquisition of financial information and practical financial habits, especially for female students. However, neither the gender knowledge gap nor students' financial knowledge scores were substantially correlated with family financial socialization. The study found several areas that needed more investigation, such as the impact of digital financial instruments, intersectionality, subjective financial knowledge, cultural and socioeconomic factors, and longitudinal analysis. [3]

The study by Tiwari and Dubey (2024) provides valuable insights into gender disparities in financial literacy, investment behaviors, and decision-making authority within urban Indian households. In order to better understand gender dynamics in financial decision-making and inform policies promoting financial inclusion and gender equality in India, the study suggests expanding geographic coverage, incorporating qualitative methods, looking at digital financial tools, adopting an intersectional framework, conducting longitudinal studies, and assessing policy outcomes. [4]

The 2023 study by Ade Maharini Adiandari investigates the differences in financial literacy between genders and how they affect economic empowerment. In addition to highlighting the impact of cultural norms and societal expectations on financial actions, the study finds a 12% gender disparity that favors one gender. [5]

Preston, Qiu, and Wright's (2024) study investigates how culture affects the gender disparity in financial literacy in China. According to the study, the main cause of the gender gap in the country is the ways in which men and women learn about finance. The study also reveals that Shanghai women are 13% more financially literate than Chongqing women. Gaps in the research have been noted, though, including a narrow focus on cultural analysis, a lack of behavioral and psychological aspects, a lack of a longitudinal viewpoint, and a failure to generalize across various populations. [6]

Berlinger et al.'s study on financial literacy among finance students identifies a behavioral gender gap, but several research gaps remain. These include failing to investigate psychological factors, failing to take into account cultural and societal influences, failing to conduct longitudinal analysis, failing to use intervention-based approaches, failing to recognize the importance of confidence and self-efficacy, and having a narrow focus on a variety of demographics. Future research should examine psychological factors, cultural and societal norms, longitudinal studies, implement and assess targeted financial education programs, evaluate the role of confidence and self-efficacy in financial decision-making across genders, examine psychological factors, and broaden the demographic scope to include a diverse range of participants. [7]

The 2020 study by Robson and Peetz looks at how gender differs in financial knowledge, attitudes, and behaviors while taking psychological and socioeconomic characteristics into account. The use of cross-sectional data, cultural and contextual generalizability, the efficacy of financial literacy interventions, the treatment of gender as a binary category, and the disregard for digital financial behavior—particularly in light of the pandemic—are some of the gaps. [8]

Prasad, Kiran, and Sharma's (2021) study examines the factors of financial literacy, socioeconomic determinants, and behavioral traits that influence the investment decisions of Indian retail investors, with a focus on gender disparities. [9]

The study by Rekha and Isaac George (2022) examines the impact of working women's socioeconomic circumstances on their digital financial literacy in Kerala's higher education sector. [10]

Rajan et al.'s study on financial literacy among rural women in Punjab, India, identifies a number of research gaps. The study's limited geographic reach limits its generalizability. Additionally, it pinpoints areas of ignorance about complex financial concepts like compound interest and credit card usage. Additionally, the study shows a weak correlation between financial literacy and investing habits, suggesting that cultural norms and access to financial institutions may influence investment behavior. [11]

The 2025 study by Mehta VaniJoghee et al. provides useful details regarding the financial practices of Indian working women. However, a number of research gaps remain, including a lack of a longitudinal perspective, a failure to examine psychological and behavioral aspects,

a failure to analyze the impact of financial literacy, homogeneity in geography and culture, and a lack of attention to digital financial platforms. By analyzing financial literacy programs, administering psychological tests, comparing various regions, examining how people use digital platforms, and carrying out longitudinal studies, future research could close these gaps. As a result, specific initiatives to improve working women's financial empowerment will be better informed and their investment practices will be better understood. [12]

Several research gaps have been found by Dewi's 2022 study on the socioeconomic and demographic aspects influencing financial literacy. These include a limited scope of variables, a static versus dynamic perspective, a narrow geographic or cultural context, a lack of behavioral connectivity, and methodological restrictions. [14]

Venkitachalam's study on women's financial literacy and awareness in India's unorganized sector highlights a number of research gaps. It is challenging to monitor how financial literacy and behavior change over time due to the study's cross-sectional design, especially in reaction to interventions or changing economic conditions. Furthermore, digital financial literacy—which is crucial for women's economic empowerment—is not fully examined. [14]

Namawejje et al.'s study examines the relationship between economic factors and financial behavior and the financial literacy of rural women in Uganda, specifically in the Luweero district. Among the gaps identified by the research are a geographic focus, a lack of longitudinal analysis, cultural and structural barriers, psychological factors like confidence, risk aversion, and decision-making styles, and the disregard for digital financial tools like online banking and mobile money. Furthermore, the study lacks comparisons with male counterparts, which would have made it easier to pinpoint the needs and difficulties related to gender-specific financial literacy. Furthermore, this study does not assess how national financial inclusion policies affect women's financial literacy. [15]

Objectives of the Study

1. To examine the current gender disparities in financial knowledge, participation, and decision-making.
2. To assess the financial literacy and investment awareness level among women across different socio-economic backgrounds.
3. To explore the role of technology, such as mobile banking, fintech apps, and digital financial literacy platforms, in bridging the gender gap in financial access and decisions.

Research Methodology

The gathered data was methodically examined to investigate gender disparities in financial decision-making across essential areas like household budgeting, savings and investments, significant purchases, credit choices, and long-term financial planning. Descriptive statistics, comprising mean, standard deviation, and standard error, were employed to compare involvement levels between male and female respondents. The analysis elucidates involvement patterns, identifies regions with notable gender discrepancies, and offers insights

into the changing role of women in financial affairs. These findings provide the empirical basis for advocating policies to close the gender gap and enhance inclusive economic empowerment. The AMOS is used to analyse the collected data.

Here is the analysis given as under:-

Firstly, to examine the current gender disparities in financial knowledge and decision-making,a **T-test** has been performed to compare the two independent groups (Male and Female)

In the case of financial decision-making and gender

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
9. How often do you participate in decision about [Household Budgeting]	Male	27	1.7778	.89156	.17158
	Female	23	1.6364	.72673	.15494
9. How often do you participate in decision about [Savings and Investments]	Male	27	1.5185	.89315	.17189
	Female	23	1.6957	.76484	.15948
9. How often do you participate in decision about [Large Purchases (property, car, etc)]	Male	27	1.5556	.93370	.17969
	Female	23	2.1304	1.01374	.21138
9. How often do you participate in decision about [Loans and Credit Decisions]	Male	27	1.8462	1.08415	.21262
	Female	23	2.1304	.96786	.20181
9. How often do you participate in decision about [4 and 3 Planning]	Male	27	1.7778	1.08604	.20901
	Female	23	2.2609	1.05388	.21975

Table No. 1: In the case of financial decision-making and gender

Principal Observations:-

- Men consistently claim more involvement in all financial decision domains, except savings and investments, where female participation is marginally superior.
- The most significant gender disparity is evident in long-term planning and substantial acquisitions, which are indicative of conventional gender roles in financial decision-making authority.
- The smallest disparities are observed in household budgeting and savings/investments, indicating a steady transition toward collective financial accountability within households.

Based on the above observation, research indicates that although gender disparities persist in financial decision-making, especially in strategic or high-stakes domains, there is an increasing participation of women in everyday financial activities such as budgeting and savings. This indicates a necessity for enhanced financial inclusion and empowerment measures for women, particularly in long-term and high-value financial sectors.

In the case of financial knowledge and gender

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
Are you aware of basic financial concepts (e.g. interest, inflation 4)?	Male	27	1.0741	.38490	.07407
	Female	23	1.3043	.70290	.14657

Table No. 2: In the case of financial knowledge and gender

Principal Observation:-

- The evidence indicates a pronounced gender disparity in financial literacy, with males exhibiting markedly superior and more consistent comprehension of fundamental economic principles.
- The disparity among females suggests that although some women possess financial knowledge, a significant number remain deficient in fundamental financial literacy.

Based on the above observation, the research highlights the need for specialized financial education and literacy initiatives targeting women, particularly to promote equitable participation in financial decision-making and enhance economic empowerment.

I. **Secondly**, to examine the current gender disparities in financial knowledge and decision-making, a **Chi-Square test** has been performed to test the statistical significance association between two categorical variables.

1. In the case of financial decision-making and gender

8. Who makes the major financial decisions in your household? Crosstabulation						
Count						
		Who makes the major financial decisions in your household?				
		Self	**spouse**	**Both**	**other**	**Total**
2. Gender	Male	10	4	8	5	27
	Female	6	3	8	6	23
Total		16	7	16	11	50

Table No. 3: In the case of financial decision-making and gender

Principal Observations

Male respondents predominantly identify as primary decision-makers, whereas female respondents exhibit a more distributed pattern, characterized by increased reliance on others.

The equal representation of males and females engaged in joint decision-making (8 each) signifies a favorable transition towards financial cooperation within households.

The considerable proportion of females identifying 'other' as the decision-maker indicates restricted autonomy in financial decisions for certain women.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.925[a]	3	.589
Likelihood Ratio	1.939	3	.585
Linear-by-Linear Association	.703	1	.402
N of Valid Cases	50		

Table No. 4; **In the case of financial decision-making and gender**

Principal observation:-

- The p-value (0.589) exceeds the conventional significance threshold of 0.05, signifying that the result lacks statistical significance.
- This indicates that there is no substantial correlation between gender and the individual responsible for key financial decisions within the home, according to the observed data.

Despite preliminary descriptive data indicating potential gender-based tendencies in financial decision-making (e.g., a greater propensity for males to make independent judgments and women to depend on others), the Chi-Square test demonstrates that these differences lack statistical significance within this sample of 50 respondents.
This suggests that financial decision-making habits are not solely dictated by gender and may be affected by additional characteristics such as age, education, income, or household composition.

2. In the case of financial knowledge and gender

Gender * Are you aware of basic financial concepts (e.g. interest, inflation,)? Crosstabulation					
Count					
		Are you aware of basic financial concepts (e.g. interest, inflation, 4)?			
		Yes	No	Maybe	Total
Gender	Male	23	2	2	27

	Female	18	2	3	23
Total		41	4	5	50

Table No. 5: **In the case of financial knowledge and gender**

Principal observation:-

- A total of 82% (41 out of 50) of the respondents reported familiarity with fundamental financial concepts.
- Although both genders exhibit significant awareness, males express marginally greater confidence and reduced uncertainty compared to women.
- The uncertainty expressed by 5 respondents (10%) on their financial understanding underscores the necessity for enhancing confidence and clarity in financial literacy, particularly among women.

Conclusion: The results indicates a significant degree of fundamental financial awareness among both genders, while men exhibit marginally higher confidence. To effectively narrow the gender gap in financial decision-making, initiatives should concentrate not only on providing financial education but also on bolstering confidence and practical competence in financial affairs, particularly for women.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	0.493	2	.782
Likelihood Ratio	3.206	2	.201
Linear-by-Linear Association	2.098	1	.147
N of Valid Cases	50		

Table no. 6: **In the case of financial knowledge and gender**

Principal Observation:-

- The p-value for the Pearson Chi-Square test is 0.782, significantly beyond the conventional significance threshold of 0.05.
- The correlation between gender and financial expertise is not statistically significant.
- The disparities noted between male and female respondents regarding financial knowledge are likely attributable to chance rather than a genuine gender-based distinction.

Based on the above observation, descriptive data indicated a marginally greater financial awareness in males; nevertheless, the Chi-Square test demonstrates that there is no statistically significant correlation between gender and comprehension of fundamental financial concepts within this sample of 50 respondents. This suggests that both men and women in the sample possess comparable levels of financial awareness, underscoring the need for gender-neutral financial education initiatives to enhance overall financial literacy.

1. **In the case of financial decision-making and gender**

	Crosstab					
	Count					
		9. How often do you participate in decision about				
		always	sometimes	rarely	never	Total
Household Budgeting	Male	13	8	4	2	27
	Female	11	8	4	0	23
	Total	24	16	8	2	50
Saving and investment	Male	17	6	2	2	27
	Female	12	8	3	0	23
	Total	29	14	5	2	50
Large Purchases	Male	20	5	1	1	27
	Female	6	6	8	3	23
	Total	26	11	9	4	50
Planning	Male	15	6	4	2	27
	Female	8	4	7	4	23
	Total	23	10	11	6	50
Loan and credit decision	Male	14	6	4	3	27
	Female	8	5	9	1	23
	Total	22	11	13	4	50

Table No. 7: **In the case of financial decision-making and gender**

Principal Observation:-

- Men are more often engaged in all aspects of financial decision-making, particularly in significant acquisitions, strategic planning, and loan or credit determinations.
- Women are more equally engaged in household budgets and moderately involved in savings; however, they are underrepresented in strategic or high-value decision-making.
- The pattern illustrates conventional gender norms, wherein men assume greater responsibility in significant financial decisions, while women's participation is frequently confined to routine or lower-risk domains. Based on the above observation, the research reveals a distinct gender discrepancy in financial decision-making, especially in significant financial domains such as investments, substantial purchases, and strategic planning. This indicates a necessity for enhanced empowerment and involvement of women via financial education, awareness initiatives, and collaborative family decision-making frameworks to mitigate the gender disparity in financial authority.

Thirdly, To assess the financial literacy and investment awareness level among women across different socio-economic backgrounds, ANOVA test is performed.

In the case of age and financial literacy

Descriptives

Are you aware of basic financial concepts (e.g. interest, inflation,)?

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
18-25	20	1.4000	.82078	.18353	1.0159	1.7841	1.00	3.00
26-35	6	1.0000	.00000	.00000	1.0000	1.0000	1.00	1.00
36-45	7	1.0000	.00000	.00000	1.0000	1.0000	1.00	1.00
46-60	7	1.1429	.37796	.14286	.7933	1.4924	1.00	2.00
Above 60	10	1.0000	.00000	.00000	1.0000	1.0000	1.00	1.00
Total	50	1.1800	.56025	.07923	1.0208	1.3392	1.00	3.00

Table No. 8: **In the case of age and financial literacy**

Principal Observation:-

- The total mean is 1.18, indicating a high level of financial awareness within the sample.
- The lowest literacy rates (highest mean) are recorded in the 18–25 age demographic, potentially attributable to restricted financial exposure or experience.
- The most continuous and comprehensive awareness is observed in the 26–35, 36–45, and beyond 60 age groups.

ANOVA

Are you aware of basic financial concepts (e.g. interest, inflation, 4)?

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.723	4	.431	1.419	.243
Within Groups	13.657	45	.303		
Total	15.380	49			

Table No. 9: **In the case of age and financial literacy**

Principal observation:-

- The p-value of 0.243 above the standard significance threshold of 0.05, suggesting that the disparity in financial literacy among age groups is not statistically significant.
- The descriptive statistics indicated modest variation in mean awareness, with the 18–25 age group exhibiting decreased awareness; nevertheless, this variation is insufficient to be deemed statistically significant in this sample.

Based on the above observation, descriptive analysis indicates that younger persons (18–25) may exhibit marginally worse financial literacy; nevertheless, the ANOVA test verifies that this disparity is not statistically significant among age groups. This indicates that age alone does not significantly influence financial literacy among the 50 respondents surveyed. Future studies may investigate the influence of education, profession, or financial acumen for enhanced understanding.

1. In the case of level of education and financial literacy

Descriptives

Are you aware of basic financial concepts (e.g. interest, inflation, 4)?

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
Graduate	13	1.6154	.96077	.26647	1.0348	2.1960	1.00	3.00
Post graduate	37	1.0270	.16440	.02703	.9722	1.0818	1.00	2.00
Total	50	1.1800	.56025	.07923	1.0208	1.3392	1.00	3.00

Table No. 10; **In the case of level of education and financial literacy**

Principal Observations:-

- Postgraduates exhibit markedly greater financial literacy and consistency in their responses.
- Graduates have less awareness and increased variability, with some expressing ignorance or uncertainty.
- The confidence interval for graduates is significantly broader (1.03 to 2.20) compared to that of postgraduates (0.97 to 1.08), hence underscoring this disparity.

ANOVA

Are you aware of basic financial concepts (e.g. interest, inflation, 4)?

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.330	1	3.330	13.265	.001
Within Groups	12.050	48	.251		
Total	15.380	49			

Table No. 11: **In the case of level of education and financial literacy**

Principal Obsrvation:-

- The p-value of 0.001, being below the conventional significance threshold of 0.05, signifies that the disparity in financial literacy between graduates and postgraduates is statistically significant.
- This indicates that educational attainment significantly influences financial awareness within the specified population.

Based on the above observation, the ANOVA findings indicate that postgraduates exhibit considerably higher financial literacy compared to grads. This corroborates the previous descriptive study, wherein postgraduates had a significantly lower and more stable mean score, signifying heightened awareness. These findings underscore the necessity of including financial literacy programs into undergraduate curricula, as enhanced education is associated with increased financial awareness.

1. **In the case of occupation and financial literacy**

Descriptives

7. Are you aware of basic financial concepts (e.g. interest, inflation, 4)?

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum

					Lower Bound	Upper Bound		
Full -time	25	1.3600	.75719	.15144	1.0474	1.6726	1.00	3.00
Part-time	1	1.0000	.	.	.	.	1.00	1.00
self-employed	6	1.0000	.00000	.00000	1.0000	1.0000	1.00	1.00
Homemaker	1	1.0000	.	.	.	.	1.00	1.00
student	16	1.0000	.00000	.00000	1.0000	1.0000	1.00	1.00
unemployed	1	1.0000	.	.	.	.	1.00	1.00
Total	50	1.1800	.56025	.07923	1.0208	1.3392	1.00	3.00

Table No. 12:**In the case of occupation and financial literacy**

Principal Observation:-

- The overall mean is 1.18, showing a high level of financial literacy in the sample.
- The full-time employed cohort has the least consistency and the lowest average awareness, indicating a potential disparity despite generating income.
- Remarkably, students and self-employed persons exhibit comprehensive awareness, suggesting robust fundamental knowledge or intentional learning within these demographics.

ANOVA

Are you aware of basic financial concepts (e.g. interest, inflation, 4)?

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.620	5	.324	1.036	.409
Within Groups	13.760	44	.313		
Total	15.380	49			

Table No. 13: **In the case of occupation and financial literacy**

Principal Observations:-

- The p-value (0.409) significantly exceeds 0.05, suggesting that the disparities in financial literacy among occupational categories lack statistical significance.
- Despite the descriptive statistics indicating substantial variation—especially among full-time employees—ANOVA establishes that these differences lack sufficient strength to be statistically significant.

Based on the observation, the findings indicate that occupation does not significantly affect financial literacy within this group. Elevated awareness among diverse demographics (students, self-employed individuals, homemakers, etc.) suggests that financial literacy may be more evenly disseminated, potentially attributable to increased access to information and financial education programs. The observed diversity among full-time employees suggests a necessity for targeted financial literacy interventions in the workforce, while lacking statistical significance.

1. **In the case of monthly income and financial literacy**

Descriptives

Monthly Household Income

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
Full -time	25	3.8400	1.14310	.22862	3.3682	4.3118	2.00	5.00
Part-time	1	5.0000	.	.	.	.	5.00	5.00
self-employed	6	4.3333	.81650	.33333	3.4765	5.1902	3.00	5.00
Homemaker	1	5.0000	.	.	.	.	5.00	5.00
student	16	2.9375	1.18145	.29536	2.3079	3.5671	1.00	4.00
unemployed	1	4.0000	.	.	.	.	4.00	4.00
Total	50	3.6600	1.20560	.17050	3.3174	4.0026	1.00	5.00

Table No. 14: **In the case of occupation and financial literacy**

Principal observation:-

- The average household income level is 3.66, with full-time and self-employed persons contributing to elevated income categories.
- Students and possibly part-time or jobless individuals have lower average incomes; however, additional sampling is required for definitive conclusions in these areas.
- The confidence intervals demonstrate enhanced precision in larger cohorts (full-time, students) and diminished reliability in individual respondent categories.

ANOVA

Monthly Household Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.589	5	3.118	2.466	.047
Within Groups	55.631	44	1.264		
Total	71.220	49			

Table No. 15: **In the case of occupation and financial literacy**

Principal observation:-

The p-value of 0.047, being less than 0.05, necessitates the rejection of the null hypothesis. This indicates a statistically significant disparity in monthly household income between at least one pair of occupational groups. Based on the above observation, the occupational status of participants (e.g., full-time, part-time, self-employed, student, etc.) considerably affects their reported household income. This necessitates additional post-hoc analysis (e.g., Tukey HSD) to ascertain which specific groups exhibit differences.

Fourthly, to explore the role of technology, such as mobile banking, fintech apps, and digital financial literacy platforms, in bridging the gender gap in financial access and decisions, variable analysis is performed.

Constructs	**No. of items**	**Cronbach's alpha**
Financial Inclusion	05	0.875
Digital literacy/usage	04	0.899

Financial awareness	04	0.868

Table No. 16: role of technology

Principal Observation:-

- All three constructs exhibit strong internal consistency, as indicated by Cronbach's alpha values exceeding the well-recognized criterion of 0.70.
- Financial Inclusion (α = 0.875) demonstrates a high degree of reliability.
- Digital Literacy/Usage (α = 0.899) demonstrates exceptional reliability among items.
- Financial Awareness (α = 0.868) has robust internal consistency.

Measurement model

The confirmatory factor analysis (CFA) yielded a model with statistically sound fit indices:
Measurement model

Fit Index	**Guidelines (Recommended)**	**Model values**
Chi-Square		1951.337
CMIN/DF	≤ 3	2.772
NFI	≥ 0.80 suggests a good fit	.886
TLI	≥ .900	.915
GFI	≥0.80 suggests a good fit	.833
AGFI	ranges between 0 & 1	.806
RMSEA	0.05 to 0.08	.060
P		.000

Table No. 17: confirmatory factor analysis (CFA)

Principal Observations:-

- The CFA results indicate that the measurement model adequately fits the data, with the majority of fit indices meeting or surpassing the specified levels. In particular:
- CMIN/DF, TLI, GFI, and RMSEA metrics are within acceptable thresholds.
- NFI and AGFI also demonstrate satisfactory levels of model fitness.
- Although the Chi-Square value is elevated, this is anticipated because to its sensitivity to greater sample numbers.

The findings validate that the observable variables consistently reflect the underlying latent constructs. Consequently, the model is statistically robust and appropriate for subsequent structural equation modeling (SEM) or hypothesis testing.

Reliability of measurement model

Sr. No	**Constructs**	**CR**	**AVE**
1	FI	0.921	0.746
2	DL	0.933	0.738
3	FA	0.935	0.784

Table No. 18: Reliability Model

Principal observations:-

- Composite Reliability (CR): All structures exhibit CR values exceeding 0.90, signifying exceptional internal consistency and reliability.

- The Average Variance Extracted (AVE) values for all constructs significantly above the 0.50 criterion, indicating robust convergent validity. This indicates that the items within each concept account for a significant share of variance in their corresponding latent factor.

The findings validate that all three constructs—Financial Inclusion (FI), Digital Literacy (DL), and Financial Awareness (FA)—are both trustworthy and valid. The elevated CR values indicate that the indicators reliably assess the targeted constructs. The elevated AVE values demonstrate that each construct adequately captures variance from its corresponding items.

DIRECT IMAPCT

Impact	**Standardised Estimate**	**S.E.**	**C.R.**	**P**	**Hypothesis**
FA <--- DL	.445	.027	7.450	.000	Accepted
FI <--- DL	.573	.032	11.938	.000	Accepted
FI <--- FA	.398	.024	5.709	.000	Accepted

Conclusion: Digital literacy is fundamental, significantly impacting financial awareness and inclusiveness.
Financial knowledge is a crucial avenue for enhancing financial inclusion.

Every direct path in the model is statistically significant, so validating the proposed links and reinforcing the study's conceptual framework.

INDIRECT MEDIATING IMPACT

Relationship	**Direct**	**Indirect**	**Confidence interval**		**p-value**	**Conclusion**
			Lower bound	**Upper bound**		
DL→FA→FI	.163	.202	.211	.397	0.000	**Partial mediation**

Conclusion: Financial Awareness serves as a partial mediator in the link between Digital Literacy and Financial Inclusion, indicating that: Digital literacy fosters increased financial awareness, hence improving financial inclusion, while also directly influencing financial inclusion.

CONCLUSIONS

1. Social influences deeply affect women's investment decisions. In patriarchal settings, spouses and family members often play a dominant role in financial decision-making, limiting women's autonomy. Peers and financial advisors can support diversification, but women often lack access to gender-sensitive advisory services that understand their unique risk appetite, life stages, and income patterns. Furthermore, women in lower income brackets are especially disadvantaged, facing restricted financial choices due to limited disposable income, dependency on male family members, and higher household expense burdens.
2. Education and occupation emerge as powerful enablers of financial inclusion. Higher education levels equip women with the knowledge and confidence to engage with financial

products and formal institutions. Similarly, women engaged in formal employment tend to access social security benefits and credit facilities more easily. However, a large portion of women in rural and developing regions continue to work in informal or unpaid sectors, limiting their economic independence and financial visibility.

3.Cultural norms and psychological constraints present some of the most persistent challenges. In many patriarchal societies, long-standing beliefs position men as primary financial decision-makers. Women often lack the confidence to interact with financial institutions, influenced by limited exposure and societal conditioning.

4.Digital Financial Literacy (DFL) is emerging as a key transformative tool. While digital tools can expand financial inclusion, gaps in smartphone ownership, mobility, literacy, and digital confidence continue to hinder progress, especially in rural India. Digital literacy empowers women to access microcredit, manage their savings and investments, receive direct government transfers, and conduct independent transactions—enhancing autonomy and privacy.

5.To bridge the gender gap in financial decision-making, multi-dimensional strategies are needed—improving education, designing inclusive financial products, ensuring gender-sensitive advisory services, and promoting digital financial literacy. True empowerment lies not just in access to financial tools, but in enabling women with the confidence, knowledge, and autonomy to shape their financial futures.

SUGGESTIONS

To bridge the gender gap in financial decision-making, a multi-pronged approach is essential. Financial institutions must design gender-inclusive products that align with women's life goals, risk profiles, and income patterns.

Banks should train advisors in gender-sensitive communication and offer personalized risk profiling tools that account for social and familial responsibilities.

Educational initiatives must integrate financial literacy into school curricula and adult learning programs, especially targeting homemakers and SHG members.

Technology can play a key role—AI-based chatbots in vernacular languages and personalized dashboards can simplify financial engagement.

Leveraging community structures like SHGs and creating peer-led investment clubs can build grassroots capacity.

Collectively, these strategies can empower women as confident financial decision-makers, promote long-term financial security, and ensure inclusive economic growth.

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STUDENTS' PERCEPTION REGARDING NEWS PAPER READING IN THEIR CAREER DEVELOPMENT – WITH SPECIAL REFERENCES TO ARTS AND SCIENCE COLLEGES IN PALAYAMKOTTAI

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ABSTRACT

Reading provides information and general knowledge and news about a country's economic development. Reading habit not only widen the students' outlook but also enrich their knowledge. This study is undertaken to know the students' viewpoint about newspaper and their utilization towards it. It also exhibits their satisfaction they gained on newspaper and helpfulness of newspaper in their overall development. A well-structured questionnaire was circulated to 90 students. The responses are received from 82 students. After omitting inappropriate responses, 77 responses were taken for analysis. From this study it can be concluded that students must spend more time in reading newspaper. In the Technology ruling world students should make use of this opportunity in a better way. Mobile phones must be used for right purpose and must concentrate on worldly affairs. There should be no hesitation in reading English newspaper. Irrespective of the obstacles they must focused to improve their knowledge to shine in their future.

KEY WORDS: Students' perception, Newspaper reading, motivational factors

INTRODUCTION

Reading is crucial because it fosters kids' imaginations and increases their understanding and empathy. Establishing a reading environment is crucial to helping pupils form a reading habit. Reading habit can be majorly developed through reading newspaper. An example of printed media is a newspaper, which consists of several sheets of printed paper. It includes educational articles about politics, society, movies, education, current events, news, reviews, and advertisements. It offers local, national, and global news. Students reading newspaper will be helpful for them to clear the competitive examination; they will come to know about the job opportunities available. It provides information and general knowledge and news about acountry's economic development. Reading habit not only widen the students' outlook but also enrich their knowledge. In fact, the emergence of online newspapers has changed how students look for information, and consequently, the usage of social media has drawn a lot of attention to the use of Internet-enabled devices. The online news have become the inherent part of modern society, it posed a challenge to the print media in some part of the world. This study is undertaken to know the students' view point about newspaper and their

utilization towards it. It also exhibits their satisfaction they gained on newspaper and helpfulness of newspaper in their overall development. In detail it clearly explains the attitude and perception of both printed and online newspaper among Arts and Science college students

REVIEW OF LITERATURE

Prof. M.Veerabasavaiah & Amaravathi V (2018) An Attitude towards Newspaper Reading Habits Among Ug And Pg Students Of Bangalore University law college: A case study. In their study they conclude that reading habit, alertness, and knowledge are all enhanced by news paper.

Chetan Sharma Dr., Rajni Saini (2019**) Newspaper Reading Habit Among The Students Of University College Kurukshetra: A Case Study.** Result of the study shows that college students read newspaper for several reasons. They primarily focus on current affairs, carrier, fashion, sports and business. The author concludes from the study that importance of print version of newspaper has not been diminished due to digitization.

Furrakh Abbasa, Muhammad Faisal Faridb, Asif Iqbalc, Sabahat Parveend (2020) **Impact Of Using Newspapers Reading In Improving English Reading Proficiency: A Study Of Pakistani University Students.** The study concludes that the experimental group students showed interest in reading newspapers better than that of control group students. Regular newspaper readers performed better than that of irregular newspaper readers. Most of the students read daily papers to get data and enhance their general information.

OBJECTIVES OF THE STUDY

1. To study the purpose of reading newspaper by the students
2. To know the level of satisfaction attained by the students in reading newspaper
3. To find out the student's frequency level in reading newspaper by the students
4. To identify the most preferred section of newspaper read by the students
5. To investigate the student's mode of preference in reading newspaper

HYPOTHESIS

H01: Opinion regarding the statement on level of satisfaction towards Newspaper Reading are equal to Average level (Average Level=3)

H02: There is no significant difference between male and female with regard to the level of satisfaction towards Newspaper reading

H03: There is no significant difference among Age group with respect to their experience towards newspaper reading.

RESEARCH METHODOLOGY

This study is an exploratory research where the purpose of this research is to gain a better understanding of the problem or issue, to clarify or define parameters of the problem, or to refine a general idea into a more specific research problem. The sampling technique followed in this study is convenience sampling. A well structured questionnaire was circulated to 90 students. The responses are received from 82 students. After omitting inappropriate

responses, 77 responses were taken for analysis. This study is purely based on primary data which are collected from the undergraduate and postgraduate students. Primary data are collected directly by the researcher from the original source. In primary data collection the researcher can collect the required data according to his research needs. The tools which are used for analyzing data employed in this study include:

- Simple percentage analysis
- Garrett Ranking method
- Weighted Average method
- T-test
  - One-sample T-test
  - Independent sample T-test
- Anova

DATA PRESENTATION, INTERPRETATION AND ANALYSIS

Table 1: Profile of the respondents

Variables	Particulars	Frequency	Percentage
Gender	Male	25	32
	Female	52	68
Age	18- 20	20	26
	20- 23	46	60
	Above 23	11	15
Education	UG	39	51
	PG	38	49
Source of inspiration for reading newspaper	Parents	32	42
	Siblings	4	5
	Friends	3	4
	Teachers	14	18
	Self	24	31
Language Preference	Tamil	57	74
	English	20	26
Frequency level in reading newspaper	Daily	22	29
	Weekly	32	42
	Monthly	7	9
	Occasionally	16	20
Time spent for Reading	1 – 15 mins	39	51
	16 -30 mins	25	33
	31 – 45 mins	11	14
	46 or more	3	2
Place for reading	Home	52	68
	College Library	13	17
	Public Library	9	11
	Hostel	3	4
Most focused part	Whole	29	38
	Headlines only	22	28
	Interested section	26	34

Source: Data collected through questionnaire

The above table explains that

- Majority of the respondents are female and belong to the age group of 20 – 23.
- Majority of the respondents are UG students
- Majority of the respondents agree that their parents are their Source of inspiration for reading newspaper.
- Majority of the respondents prefer Tamil newspaper.
- Majority of the respondents say that they read Newspaper weekly due to lack of time.
- Majority of the respondents agree that they read news paper only for 15 minutes and they prefer home for reading peacefully.

Table 2: FACTORS MOTIVATE TO READ NEWSPAPER

Garrett Ranking method is used to analyze the factors that motivates the respondents to read newspaper

Statement	1 (75)	2 (60)	3 (50)	4 (40)	5 (25)	Total score	Garett Mean Score	Rank
Headlines	51 (3825)	8 (480)	5 (250)	3 (120)	10 (250)	4925	63.96	I
Design	3 (225)	31 (1860)	15 (750)	15 (600)	13 (325)	3760	48.83	III
Layout	3 (225)	10 (600)	30 (1500)	20 (800)	14 (350)	3475	45.13	IV
Picture	8 (600)	20 (1200)	12 (600)	32 (1280)	5 (175)	3855	50.06	II
Well written content	12 (900)	8 (480)	15 (750)	7 (280)	35 (875)	3285	42.66	V

Source: Data collected through questionnaire

INTERPRETATION

The tool used to analyze the factors motivates respondents to read newspaperis **Garrett ranking method**. From the above table it can be concluded that headlines is the most important factor motivates respondents to read newspaper because it shows the overview of the entire news. The second important factor motivates respondents to read newspaper is picture because it induces the readers to read the news. The third important factor motivates respondents to read newspaper is design because the respondents feel comfortable with the process of arranging material on newspaper page

PURPOSE OF READING NEWSPAPER

Weighted Average method is used to analyze the purpose of reading the Newspaper

FACTORS	SA	A	N	DA	SDA	SCORE	AVG. SCORE	RANK
For getting insights	22	22	17	6	13	274	3.56	III
To expand general knowledge depth	13	33	18	10	5	276	3.59	II
For the purpose of education	12	25	28	7	6	264	3.43	V

For recreation	11	28	25	10	6	268	3.49	IV
To stay up to date	23	22	21	9	7	291	3.78	I
As the day's routine task	5	19	29	15	10	228	2.96	VI

Source: Data collected through questionnaire

INTERPRETATION

From the above table it can be concluded that most important purpose for which respondents are reading newspaper is to stay updated about the happenings of all over the world because it is important for the students to be cognizant with the circumstances. The next important purpose is to broaden the horizon of general knowledge in order to acquire wisdom and to get information. The above mentioned reasons are the most important purpose which persuading the respondents to read the newspaper because the respondents are the students who must be aware of the eventuality around them.

HYPOTHESIS TESTING

$H_0$1:Opinion regarding the statement on level of satisfaction towards News paper Reading are equal to Average level (Average Level=3)

Statement	Mean	SD	t value	Pvalue
S1Value formoney	3.46	1.055	3.770	.001**
S2Makes moreinteresting	3.35	1.048	2.935	.004**
S3Makessmarter	3.48	.968	4.356	.001**
S4Deliveranceofcontent	3.44	1.153	3.361	.001**
S5GoodGuidance	3.68	1.117	5.304	.001**
S6Passageoftime	3.45	1.058	3.770	.001**

Interpretation

One sample t test is used to analyze the respondents' opinion regarding the statement on level of satisfaction towards Newspaper Reading. Since the P value of all the statements are less than 0.05, the null hypothesis is rejected at 5% level of significance. That shows that the opinion regarding these statements is not equal to average level. Based on the mean score it is understood that the opinion regarding all these statements are above the average value 3.

$H_0$2: There is no significant difference between male and female with regard to the level of satisfaction towards Newspaper reading.

Statement	Male		Female		t value	Pvalue
	Mean	SD	Mean	SD		
S1- **Cost-effectiveness**	3.68	.900	2.83	1.264	3.396	.001
S2 – more engaging	3.64	.757	3.21	1.143	1.954	.055
S3 – Intellectual Benefit	3.44	.870	3.50	1.019	.253	.801
S4 – Content Delivery	4.08	.862	3.13	1.155	3.630	.001

S5 –QualityGuidance	3.84	.850	3.60	1.225	1.014	.314
S6 – Time Well Spent	3.76	.876	3.31	1.112	1.014	.079

Interpretation

Independent sample t test is used to analyze whether there is any significant difference between male and female about the level of satisfaction towards Newspaper reading. Since the P value of the statements cost effectiveness (0.001) and content delivery (0.001) are less than 0.05 therefore the hypothesis is rejected at 1% Level of significance. so there is a significant difference between male and female with regard to the statement value for money and deliverance of content. Based on the mean score it is understood that the male respondents have better satisfaction than the female with regard to the statements cost effectiveness and content delivery. The P values of the statements makes more engaging (0.055), intellectual benefit (0.801), quality guidance (0.314) is more than 0.05.Therefore the null hypothesis is accepted at 5% Level of significance. So there is no significant difference between male and female with regard to the level of satisfaction towards Newspaper reading.

$H_0$3:There is no significant difference among Age group with respect to their experience towards newspaper reading.

Statement	**Agegroupin years**			**F value**	**P value**
	18-20	21-23	Above23		
Over all Experience Towards newspaperreading	12.80 (3.30)	14.19 (3.54)	14.90 (1.70)	1.816	.170

Interpretation

One way ANOVA is used to analyze the significant difference among Age group with respect to their experience towards newspaper reading. Since the p value is more than 0.05 the hypothesis is accepted at 5% level of significance. Therefore, there is no significant difference among Age group with respect to their experience towards newspaper reading. This may be because individuals across different age groups have similar habits, preferences, or access to newspapers, leading to a uniform experience regardless of age.

SUGGESTIONS AND CONCLUSION

- Students should cultivate a reading habit and read newspapers every day to stay informed and be aware of the events occurring around them.
- It is evident that the entire world is advancing toward technology, and all aspects are becoming digital. Students need to improve their understanding of both print media newspapers and digital media newspapers.
- Focusing on their preferred section in the newspaper is acceptable, but students aiming to pass competitive exams need to concentrate on current affairs.

- Students ought to dedicate their valuable time to reading newspapers. They ought to set aside specific time for reading the newspaper. The time they invest today in gaining knowledge will place them in a more advantageous position tomorrow.
- It is recommended that universities allocate one hour each week to foster the practice of reading newspapers among students. The library should have sufficient newspapers to promote the habit of reading.

CONCLUSION

Students are a country's future and reading the newspaper can help them become decent citizens who can help their community anytime it is needed. For college students, newspaper reading is essential. Internet is becoming a significant news source for millions of individuals worldwide. People's reading habits are altering as result of how they read news online. The majority of readers in India don't want to pay for subscriptions. Students should be encouraged to subscribe to both the print media news and the online newspaper apps because once they do; they might be persuading to read the newspaper. Due to the value of every dime they may get induced. From this study it can be concluded that students must spend more time in reading newspaper. In the Technology ruling world students should make use of this opportunity in a better way. Mobile phones must be used for right purpose and must concentrate on worldly affairs. There should be no hesitation in reading English newspaper. Irrespective of the obstacles they must focused to improve their knowledge in order to shine in their future.

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Beneath the Smirk: A Psychoanalytic Analysis of Jenny Fish's Indifference in Kristin Harmel's *The Book of Lost Names*

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Abstract

Smirk is a subtle psychological weapon. It is often unconscious and is used to express superiority, control, and emotional distance. It is more than just a facial expression; it reveals deeper layers of the human mind. When such a smirk is directed toward someone carrying emotional weight or trauma, it becomes a tool of erasure rather than mere disrespect. Jenny Fish, in *The Book of Lost Names*, exemplifies this behaviour through her repeated dismissals of Eva, an elderly woman who embodies memory, pain, and resilience. Her smirks and demeaning remarks are not random; rather, they arise from unconscious defences rooted in discomfort with aging, trauma, and emotional intimacy. Such micro aggressions, though subtle, reveal how the modern world often fails to hold space for survivors and the emotionally burdened. The present paper, **Beneath the Smirk: A Psychoanalytic Analysis of Jenny Fish's Indifference in Kristin Harmel's *The Book of Lost Names***, analyses the selected novel within the framework of psychoanalytic perspectives. It is an attempt to bring into the limelight the importance of acknowledging and confronting subtle psychological violence such as indifference and emotional erasure. It also throws light on the generational gaps in empathy and the fading sensitivity toward the elderly.

Keywords: Psychoanalytic Criticism, Emotional Erasure, Holocaust Memory, Generational Indifference

A smirk is a facial expression characterized by a slight, crooked smile. In psychoanalysis, a smirk conveys self-satisfaction, contempt, mockery, and a sense of superiority. It is never a genuine smile. Rather, it can be interpreted as a non-verbal gesture rooted in unconscious defence mechanisms. It often masks deeper emotional conflicts, repressed feelings, or internal psychological discomfort. When directed at someone carrying trauma, the smirk transforms into a symbolic act that invalidates the depth of their lived experience. This psychoanalytic lens becomes particularly useful when examining the subtle expressions of Jenny Fish, whose smirk functions as a psychological clue to her deeper attitudes and emotional detachment. Jenny Fish is a very minor character in *The Book of Lost Names*, appearing only in the first chapter. However, her presence sets the initial tone of the novel. According to the text, Jenny works as an assistant manager at the Winter Park Public Library, where Eva, the eighty-six-year-old protagonist, is employed as a librarian. Jenny is significantly younger than Eva and often comes across as someone who complains about

everything. She frequently reminds Eva of her age, not out of genuine concern, but out of a thinly evil dislike. Jenny wants Eva to retire not because she cares for Eva's well-being, but because she finds her presence inconvenient. She cannot comprehend why someone of Eva's age would still want to work. Despite being in the same profession, Jenny lacks the deep love for books that defines Eva's character. Her dismissive attitude and lack of empathy contrast sharply with Eva's quiet dignity, highlighting a generational and emotional divide.

In *The Book of Lost Names*, Jenny Fish becomes a subtle representation of psychological dismissal and generational indifference. Her interactions with Eva are marked not by empathy but by arrogance and emotional detachment. Jenny's refusal to address Eva by her first name, while casually using given names for younger staff, reflects a deeper psychological mechanism of distancing and devaluation. This act strips Eva of personal identity and reinforces unspoken ageist assumptions. From a psychoanalytic standpoint, such behaviour may stem from Jenny's unconscious discomfort with aging, mortality, and her own unresolved insecurities. Her need to assert dominance through smirks can be seen as a projection of repressed fears. The smirk, in this context, functions as a psychological barrier, preventing genuine human connection. It masks Jenny's inability to engage with Eva's painful past and silences the survivor's narrative. This denial of historical trauma mirrors a modern cultural tendency to overlook unresolved wounds. Jenny's cold professionalism, devoid of warmth or compassion, operates as a defence mechanism to avoid confronting the emotional weight of memory. Psychoanalytically, she embodies the ego's strategy of repression—where anything too painful or uncomfortable is pushed aside. In doing so, she not only dismisses Eva but also contributes to the subtle societal erasure of Holocaust memory in everyday spaces.

Jenny's actions are not overtly cruel, but their refinement makes them psychologically damaging. The indifference she exhibits, though socially acceptable, cuts deeper than open hostility. Her smirks and dismissive tone suggest an internalized hierarchy where youth, efficiency, and emotional detachment are valued above lived experience and emotional truth. This inversion reflects a Freudian struggle between the id's suppressed impulses and the ego's need for social control. Jenny may unconsciously envy Eva's resilience or feel threatened by the authenticity of her suffering. Instead of acknowledging these emotions, she buries them beneath superficial smiles and institutional authority. The library setting itself—symbolic of memory, truth, and preservation—makes Jenny's emotional detachment even more ironic and unsettling. As a librarian, her role includes safeguarding stories, yet she invalidates significant past. This contradiction exposes how modern institutions often fail to honour lived memory, especially when it is emotionally inconvenient. Her behaviour can also be read as a psychological act of denial—a refusal to confront the collective guilt and discomfort linked to historical atrocities. In psychoanalytic terms, this is a form of dissociation: emotionally separating oneself from what feels unbearable. Ultimately, Jenny's smirk becomes a symbolic mask—worn by a disengaged society that prefers silence to suffering and distance to empathy. Jenny's dismissive behaviour is especially evident during Eva's initial attempts to explain the significance of the book in question. She neither investigates further nor shows interest in Eva's emotional urgency. Instead, she subtly shifts

the focus back to procedural norms, as if Eva's presence disrupts the efficiency of the archival records. This moment exemplifies the Freudian concept of resistance, where the listener avoids emotionally charged material by clinging to formal structure. Jenny's smirk here operates as a social signal of superiority. Such behaviour also reflects latent aggression masked under the guise of professionalism—a common defence mechanism when one feels unconsciously threatened. Jenny hesitates to engage with Eva's emotions or recognize their gravity. The encounter, therefore, becomes less about memory or empathy and more about power—who has the authority to define the past and its meaning.

Another significant moment occurs when Jenny continues to maintain a cold distance, almost as if emotionally acknowledging Eva's past would threaten her carefully constructed detachment. Her facial expression remains unreadable, occasionally slipping into a smirk when Eva speaks with emotional intensity. This reaction can be read as a psychic defence against emotional vulnerability—a refusal to let the past touch the present. Jenny's reluctance to empathize could stem from a narcissistic identification with institutional roles rather than with human experience. In Lacanian terms, her self-image is rooted in the *Imaginary*—how she wishes to be perceived—rather than how she truly relates to others. The appearance of a survivor in her orderly world, challenging her belief system, threatens that imaginary identity. Consequently, Jenny clings to smirks and formality to maintain psychic balance. Her behaviour mirrors that of many postmodern individuals who prefer polished detachment over raw engagement with pain.

The tension between Eva and Jenny reaches a quiet climax when Eva unconsciously speaks to the book. At that moment, Jenny watches her not with admiration or interest, but with a detached curiosity that still lacks emotional depth. Even as Eva breaks down—revisiting the names of lost children and recalling moments of survival—Jenny offers no emotional solidarity. This absence of response reinforces the societal disconnection from trauma that psychoanalysis often critiques. Jenny, despite working in a profession centred on memory, chooses not to remember empathetically. Her smirk throughout these exchanges is not merely a facial tic; it becomes a metaphor for how modernity commodifies history without honouring its emotional weight. From a Freudian perspective, this is repression enacted on a collective level, where the past is stored but never truly processed. Jenny, therefore, functions both as an individual and as a symbol of a world that catalogues pain without confronting it. Her smirk remains the final barrier between historical truth and human understanding.

Eva is filled with emotion when she finally encounters *Épîtres et Évangiles*, revealing that trauma, when silenced for too long, often finds symbolic outlets. For Eva, the book is not merely a physical object, but a graveyard—a sacred container for the names the Nazis tried to erase. Her emotional unravelling in Jenny's presence exposes the fragility of memory, especially when it confronts indifference. Jenny's reaction is telling; rather than engaging with Eva's feelings, she distances herself further, choosing procedure over compassion. Her emotional detachment manifests in passive-aggressive comments and a cold smirk, signalling

her discomfort with vulnerability. This is sharply evident in the scene where Jenny interrupts Eva's emotional interaction with the book:

"Um, Mrs. Abrams? Are you talking to that newspaper?" "Yes, Jenny, indeed I am," I reply, without looking up. "Yes, well, you probably shouldn't be doing that in front of library guests." She says it without a trace of irony. "They might think you're senile." (Harmel 3-4)

Jenny's words aim not to understand but to silence. Her inability to resonate with Eva's urgency confirms that the smirk is only a symptom; the deeper issue is emotional detachment. While Jenny focuses on facts and appearances, she displaces the feelings that lend meaning to historical memory.

In *The Book of Lost Names*, Jenny Fish may be a minor character, but her smirk is silent yet piercing. It becomes a symbol of emotional dismissal, exposing the subtle ways in which people invalidate others' pain. Through Eva's quiet endurance and emotional weight, the novel reminds readers that beneath every memory lies a wound, and beneath every smirk, a refusal to acknowledge that wound. In psychoanalytical terms, the smirk becomes a barrier which is used by those like Jenny to shield themselves from empathy and discomfort. But readers are invited to do the opposite. They are encouraged to listen, to recognize, and to respond with presence. In a world still haunted by trauma and personal grief, kindness and emotional attentiveness are rare. To avoid making smirks, one must cultivate emotional awareness and resist the urge to judge what one does not understand.

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DIGITAL AND SOCIAL MEDIA MARKETING STRATEGIES AND ITS IMPACT

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Abstract

In era of globalization, industry is dominated by consumers and their demands. Prior to buying a product, people like to see referrals, feedback of Google search results, or a website. It is important to learn what people think about us to stand by the flow. In order to connect and influence the masses, businessmen need to actively participate in relevant communities and need to communicate with social media to manage their online reputation. In order to reach a broader consumer base and grow your business, social media marketing is a must. The task of driving website traffic through social media sites is Social Media Marketing. Evidently, social media which started off as a platform for human interaction, now has been developed into a platform that can effectively be used for brand positioning, advertising and many others aspects of marketing management. For any business, it is imperative to keep up with the advancements taking place in the world of Marketing and marketing tools. This paper is an attempt at presenting one of the most relevant trends in marketing.

Keywords: Digital Marketing, Social Media Marketing, Strategies, Brand etc.,

Introduction

Social and digital marketing offers significant opportunities to organizations through lower costs, improved brand awareness and increased sales. However, significant challenges exist from negative electronic word-of-mouth as well as intrusive and irritating online brand presence. This research brings together the collective insight from several leading experts on issues relating to digital and social media marketing. The experts' perspectives offer a detailed narrative on key aspects of this important topic as well as perspectives on more specific issues including artificial intelligence, augmented reality marketing, digital content management, mobile marketing and advertising, B2B marketing, electronic word of mouth and ethical issues therein. This research offers aoverview of digital and social marketing and its growth in the present economy.

Meaning of Digital Marketing and Social Media Marketing.

Digital marketing encompasses all online marketing efforts, including social media marketing, but also includes other avenues like email, search engine optimization (SEO), and online advertising. Social media marketing is a subset of digital marketing that specifically utilizes social media platforms to build brand awareness, engage with audiences, and drive traffic. In essence, digital marketing is the broader category, while social media marketing is a focused strategy within it.

Roles of Digital and Social mediaMarketing in the Modern Business:

Digital marketing has revolutionized the way modern businesses operate, bringing about numerous positive effects that enhance their reach, efficiency, and overall performance. Some key effects are:

- **Increased Reach and Global Audience**: Digital marketing allows businesses to transcend geographical boundaries, reaching a global audience. Through the Internet, companies can target customers across different regions and countries, expanding their reach significantly.
- **Cost-Effectiveness:** Compared to traditional marketing methods, digital marketing is often more cost-effective. Small and medium-sized businesses can leverage digital marketing strategies like social media advertising and email campaigns to reach their target audience without the need for large budgets.
- **Improved Customer Engagement**: Digital marketing enables direct interaction with customers through various channels such as social media, blogs, and email. This interaction fosters a sense of community and loyalty, as businesses can respond to customer queries, provide personalized content, and gather valuable feedback in real-time.
- **Data-driven Decision-Making:** The ability to track and analyze data is one of the most significant advantages of digital marketing. Businesses can measure the performance of their campaigns, understand customer behavior, and make informed decisions based on insights derived from analytic tools. This leads to more effective strategies and better allocation of resources.
- **Enhanced Targeting and Personalization**: Digital marketing allows for precise targeting based on demographics, interests, behavior, and other criteria. Businesses can create personalized marketing messages that resonate with specific segments of their audience, leading to higher engagement and conversion rates.
- **Brand awareness and reputation management**: Online presence through websites, social media, and other digital platforms helps in building brand awareness. Moreover, digital marketing provides tools for reputation management, allowing businesses to monitor and respond to customer reviews and feedback promptly.

Benefits of Digital and social media marketing.

- **Improve your brand**: When done correctly, social media marketing can have a positive impact on your brand. It can help humanize your company while building trust, loyalty, authority, and recognition. By posting content that shows the people behind your brand as well as real users of your product, you can build brand credibility and trustworthiness.
- **Engage the audience** : Social media is not only a good way to grow brand awareness, but it also offers companies the chance to engage, respond to posts, share user-generated content, and follow up with dissatisfied customers. Unlike traditional media like radio, television, newspapers, and magazines, social media allows customers and businesses to interact. Getting customer perspectives on your products and services is easier than ever, thanks to social media.
- **Promote customer service**: Your company may already have chat, email, and phone lines dedicated to serving your customers, but social media is another great way to connect. Additionally, since the criticism you receive over social media is very public by nature, a well-timed and thoughtful reply shows your broader audience that you're listening to feedback and responding. Providing a resolution to an upset customer not only increases the

chance of that customer shopping with your company again — it also shows other consumers the type of service you offer, building trust and loyalty.

- **Impact sales and conversion rates**: Successfully marketing your brand or a specific product on social media should have a positive impact on sales and conversion. Ultimately, of course, that's the goal of spending on any type of marketing. While many of the leads gained from social media are considered top-of-funnel, industry research has found that the average person spends 147 minutes — or nearly two and a half hours — on social media each day. This means your content will be seen widely and if effective, it can compel viewers to become customers.
- **Become a thought leader:** Social media platforms offer your company a voice. Whether you're posting insightful content on LinkedIn, taking a stand on Twitter, or sharing news through Facebook, social media allows your company to become a thought leader, building trust and loyalty among your customers.
- Study the competition: You can gain insight into where you need to improve and what not to do by looking through your competitors' social media posts. This can help you get a sense of how they position a product within the market or which trends they're keying in on.
- Improve search engine result page (SERP) presence: Google is constantly pulling information from social media platforms — such as Instagram images, Facebook pages, and tweets — into its search engine results. By successfully marketing your brand on social media, you increase your SERP presence as well. Keeping an eye on what's new and trending can help you cater your social content to the needs of the public while adding your brand's unique flair. Think of the questions your audience may have and how specifically they would phrase their questions in a search engine. Platforms like Instagram and Facebook allow you to make edits after posting, so if more relevant questions and keywords arise, you can make changes as needed. Blog content is another great way to draw in audiences, and it can be posted easily on social media for your followers to find. Paying attention to social media can show you what your customers are interested in and where your brand could improve to meet their needs.
- Boost website traffic: Ideally, your social media post should send your readers somewhere, and that place will most likely be your website. Think about your sales funnel for social media. A lead views your content on a social platform, follows a link to your website to learn more, and — hopefully — decides to make a purchase from your site. Ecommerce conversion is a whole other topic, but social media marketing can at least get the audience to your site.
- Attract top-of-funnel leads: Social media can be an excellent way to get your brand or products in front of new audiences. While these audiences may not be ready to buy yet, hopefully they'll enjoy your posts enough to check out more of your content. Social media has made it easier for potential customers to explore your brand in a simple, low-commitment way. Social media is a powerful lead-generation tool for businesses, and a lot of platforms offer advertising formats to gather leads.
- Earn greater ROI:Both organic and paid social media marketing can produce high returns on investment. Organic social media marketing refers to content your company posts online without paying anything. Popular posts, especially those that go viral, can have a huge reach

without a lot of spending. Organic social media content is a cost-effective way to promote your business as social media platforms are free.

- Retarget missed customers: Suppose a customer is on your website and they've added a product to their cart, but for some reason they don't buy. With social media marketing, you can retarget this customer to engage them again to complete their purchase — or at least keep your brand on their mind. Industry research has found that the average online shopping cart abandonment rate is nearly 70%, and $18 billion in sales revenue is lost annually from shopping carts left behind. With online shopping, you have a second chance to secure a customer through social media, since 3 out of 4 shoppers notice these retargeted ads and more than a quarter (26%) will click on them and return to your website.
- Learn about your audience: Reading what your customers say about your brand on social media can be a valuable way to get a feel for your products, promotions, popularity, and more. You can use the data on which posts perform well to help you get an idea of what your customers like — and vice versa. This is called social listening.By keeping an eye on social media, you can have an ear on customer conversations. This way you stay in the loop on what's trending and how to better adjust your brand to fit consumer needs. You can address pain points people are experiencing by analyzing problems they post about, as well as areas of interest.
- Build partnerships: Social media allows you to connect with other companies working in the same space or in similar spaces that align with your business goals. It also offers the opportunity to partner with influencers who can help promote your brand. Customer reviews are an important part of brand trust and engagement. When people share information about your product on social media, you gain credibility, build brand awareness, and even can increase sales.
- Keep up with industry trends: Following other brands or influencers will show you what's happening in your industry. Through social media, people can see real-time conversations between customers and businesses alike.

Investing in Digital and Social media marketing

A need than a want Online marketers now view the value of social media marketing for their business from a different perspective. There is a significant explosion in the number of consumers who are using socials as a means of finding products and services that they need. According to prestigious social consumer statistics:

- Social networking is used by about 76% of businesses to achieve their marketing objectives.
- Business retailers experience about 133% increase in revenues after marketing their business in the mobile market that promotes social media marketing value for their business.
- 40% of online shoppers from the US use the Smartphone for in-store shopping.
- About 71% of the consumers respond according to the feedback and recommendation of social users regarding a particular brand.
- Consumer reviews are regarded by shoppers as trustworthy than the marketing promotion coming directly from the brand site.

- The majority of successful brands have a social media page to widen their marketing coverage of making their brand more accessible among social media users

The social advertising trend becoming indispensable in digital marketing

Digital marketers are being lured towards social media advertising due to the trend in the shopping behavior of the consumers. Social media surveys reveal that a big percentage of the consumers spend an average of 37 minutes a day on popular social media channels like Facebook and Twitter and 10% of the internet users are spent on social media sites. Imagine the potential market gain that social media can offer to online marketers. In 2013, about 53% of digital marketers were already positioning their brand in the social media market and by 2014 social advertising investment will continue to grow. If your business is not taking this marketing step to grow your market coverage by now, your competitors are probably taking advanced steps with a better and large market opportunity to play around. To leverage social advertising to your business advantage, it is essential to implement the following:

- Define measurable goals for your business
- Integrate social advertising into your search engine optimization strategy to optimize your marketing efforts and results.
- Identify your target customer behavior, needs, and activities by using SEO analytics. This will help measure the potential effectiveness on the kind of social advertisement approach to using when engaging your target audience.
- Optimize the landing pages of your website by combining SEO and social media marketing strategies. Don't underestimate the influence of social media buttons in making your landing pages more engaging to your website visitors.

Conclusion:

In conclusion, digital marketing has become a cornerstone of modern business, transforming how companies interact with their customers and compete in the marketplace. The data-driven nature of digital marketing allows for precise targeting and personalization, enabling businesses to tailor their messages to specific audience segments and improve conversion rates. Furthermore, the cost-effectiveness and adaptability of digital marketing make it accessible to businesses of all sizes, from small startups to large enterprises. This agility is crucial in today's fast-paced digital landscape, where consumer preferences and behaviors are constantly evolving.

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INFLUENCE OF ARTIFICIAL INTELLIGENCE IN E-COMMERCE INDUSTRY

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ABSTRACT

With the rapid progress of science, technology, and our economy, we see artificial intelligence (AI) being used more and more in various areas. It has a significant impact on our work and lifestyle. Artificial intelligence (AI) is a leading technology of the current age of the Fourth Industrial Revolution (Industry 4.0 or 4IR), with the capability of incorporating human behavior and intelligence into machines or systems. In the field of e-commerce, AI is broadly applied and has shown promising results. AI has emerged as crucial driving force for the growth of E-commerce. The growth of e-business has advanced from enthusiasm and innovation to adoption and application and the educational and business communities have switched in exploring prospects for market monetization of digital business technologies. As a result, discussions over existing e- commerce platforms, as well as how to achieve dynamic capabilities, are becoming more intense. The proposed paper will shed light on how AI is being applied in the Ecommerce industry and the impact of AI on E-commerce portals. It examines the application of AI in areas such as AI assistants, image research, recommendation systems, and optimized pricing. This research explores how AI greatly affects and benefits the development of E-commerce.

Keywords: Artificial Intelligence, E-commerce, personalization and inventory management

INTRODUCTION

E-commerce has changed the way business is done in India, bringing in millions of consumers and millions of dollars in sales. The largest segment of the e-commerce market in India is fashion, followed by electronics and then home and kitchen products. The fastest-growing e-commerce companies in India include Flipkart, Paytm, Amazon and Shop Clues. The e-commerce market will account for 2.5% of India's GDP by 2030 and growing 15 times and reaching USD 300 billion. E-commerce has revolutionized the way products are bought and sold in India. The main aim of companies in today's e-commerce world is to influence customer behavior in favor of certain products and brands. The application of artificial intelligence as an innovative tool in the field of e-commerce may seem as a positive step forward. Electronic commerce has become widely used in the global exchange in general, and in the Indian economy in particular, as a result of the data technology revolution. Changes in the process for conducting business transactions have occurred as a result of technological improvements.

Artificial Intelligence (AI) technology is now a part of our daily lives. We use it to write emails, check the weather, and even diagnose diseases. AI is especially impactful in ecommerce. E-commerce businesses have implemented AI across various business functions and will continue to find new and innovative applications for AI in ecommerce as adoption increases and the technology advances. Artificial intelligence (AI) is technology that enables

computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy. Using AI can help to create a more efficient sales process by gathering data about the customers, automate follow-up abandoned cart inquiries, and more. Artificial intelligence is becoming an integral in the way how many consumers interact with the digital platforms. Digital Platform has made life easier for the retailers as well as buyers.

E-commerce websites are witnessing an exponential hike in their sales. Artificial intelligence companies have helped E-Commerce websites in providing the better user experience. In the context of e-commerce, AI is a driving force behind a multitude of applications that enhance customer experiences, bolster sales strategies, and improve operational efficiency. Through sophisticated data analysis and machine learning, AI algorithms adapt and respond in real-time to customer behavior, preferences, and market trends. This results in a more personalized, efficient, and ultimately profitable e-commerce ecosystem. The utilization of artificial intelligence in internet shopping is changing the E-trade industry by anticipating shopping designs dependent on the items that customers purchase and when they get them. For instance, in the event that online customers regularly purchase a specific brand of rice each week, at that point the online retailer could send a customized offer to these customers for this item, or even utilize an AI empowered suggestion for a beneficial item that works out in a good way for rice dishes.

SIGNIFICANCE OF THE STUDY

With the fast advancement of science, innovation and the economic society, the use of Artificial Intelligence (AI) has gotten increasingly normal, as its improvement insightfully affects our work and way of life. Artificial intelligence is enabling technology systems to differentiate between the problem which they've been confronted with and their solutions, while addressing it. The application of AI and machine learning is increasing drastically in e-commerce industry. Artificial Intelligence is really taking over the world. AI is everywhere now, especially in e-commerce sector, artificial intelligence is making its impression.

SCOPE OF THE STUDY

The scope of the study is to find out impact of artificial intelligence in e-commerce. A sincere attempt has been made to include all the aspect relating to the study. For this purpose an analysis of artificial intelligence in e-commerce has been made.

OBJECTIVES OF THE STUDY

1. To study the impact of artificial intelligence in e-commerce
2. To study the positive and negative impact of AI in E-commerce companies.

RESEARCH METHODOLOGY

This research is conducted by using secondary data for research using, various websites, research articles, and various reports through websites, online journals, news Articles, and other internet sources. The aim of the study is to analyze the artificial intelligence in e-commerce. Secondary data provides a better view of problem study many magazines tools and other references were also mean important in this study.

What is AI?

Artificial intelligence (AI) is a subdivision of computer science concerned with the design of automating tasks and responding in a manner similar to human intellect. The primary goal of Artificial intelligence is to create expert systems, which are frameworks that show how to conduct, learn, illustrate, clarify, and counsel clients. The next goal is to incorporate human intelligence into technology that create systems for comprehending, reasoning, learning, and responding in the same way that humans do. Artificial intelligence has become a crucial component of the technology industry in recent years. Artificial intelligence is enabling technology systems to differentiate between the problem which they've been confronted with and their solutions, while addressing it. The computer system will receive data that its sensors, such as cameras, have prepared or collected.

TYPES OF ARTIFICIAL INTELLIGENCE

1. Weak AI.

Weak Artificial intelligence in weak artificial intelligence, machines behave like an intelligent human. Machines with weak artificial intelligence have all abilities like thinking, moving, talking but are programmed to do so. In the chess game, the machine has the ability to play but it does not possess any thinking ability like humans. The machine is programmed to play chess and make smart moves to compete with other players.

2. Strong AI.

Strong Artificial intelligence in strong AI, machines actual ability is like humans. It is based on the concept that machines can be programmed like the human mind. They can think, make decisions, and have perceptions and beliefs.

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

1. **Gaming**:
   Machines can now compete with humans in games with artificial intelligence.AI implementation can be seen in many strategic games such as poker, chess, tic-tac-toe, etc. Machines are empowered with ability to think of many positions based on heuristic knowledge. Deep Blue was the first a chess-playing computer developed by IBM
2. **Banking**:
   AI application also lies in Anti-money laundering (AML). Money launderers hide their actions to increase their illegal money. This illegal is documented so well so as to give the illusion of legally earned money. Banking Industry across the world is shifting from traditional detection of AML to artificial intelligence based systems
3. **Expert Systems**
   The expert systems are the developed to solve complex problems in a particular domain, with the artificial intelligence. The purpose of expert systems is to advise, predict results, suggest alternative solution and assist human in decision making.
4. **Healthcare**:
   AI application in healthcare lies in Diabetic Retinopathy Treatment, Medical Diagnosis, Risk Prediction and Automating Drug Discovery.

5. **Vision Systems**
   Vision systems can understand, interpret, and comprehend visual input on the computer.

6. **Music and Movie Recommendation Services**:
   AI based apps like Spotify, Pandora, and Netflix recommend music and movies based on the interests of users and their past choices. This data collected is then fed into AI learning algorithm to suggest recommendations.

7. **Handwriting Recognition**
   The handwriting recognition software acquires the data through the text written on paper or on screen. This software then recognizes the pattern in handwriting like shapes of letters and the text is then converted to editable text.

8. **Intelligent Robots**
   Robots embedded with sensors such as sound, bump, pressure, heat, light and temperature can detect the physical data and perform the instructions by a human. They have efficient processors and huge memory to make smart decisions and exhibit intelligence.

BENEFITS OF USING AI IN E-COMMERCE

1. **Client driven visual hunt**
   Shoppers are regularly baffled with online business experience on the grounds that the item results demonstrating are frequently immaterial. To handle this issue, artificial intelligence utilizes regular language preparing to limit, contextualize, and improve query items for online customers. Additionally, it permits having visual inquiry abilities, finding and coordinating items. Additionally, artificial intelligence empowers customers to find reciprocal items and improve the client experience. Presently, shoppers may snap a photo of a companion's new shoes or new workout clothes, send it, and afterward artificial intelligence

2. **New degree of personalization**
   There are numerous artificial intelligence arrangements, for instance one of them that I truly need to make reference to is Boom train. These organization investigations distinctive touch focuses to assist the business with breaking down how clients are associating on the web: by means of portable application, web, email, and so forth Also, artificial intelligence motor is checking all gadgets and channels to make a widespread client see. Also, obviously, it encourages online business retailers to convey a consistent client experience across all stages. It will assist with sending applicable messages at the perfect time

3. **Improve suggestions for clients**
   With AI, brands can all the more cleverly and proficiently foresee client conduct and request and offer significant and accommodating suggestions. Incredible model is Starbucks; it utilizes artificial intelligence to dissect all the information it has assembled to convey more customized recommendations. The calculation considers: the client's data, client inclinations, buy history, outsider information, and relevant data.

4. **Intelligent agents**
   New intelligent agents exchange framework has become a famous device utilized in e-commerce. There are 3 principal use cases: coordinating purchasers and merchants;

encouraging exchanges; and giving institutional framework. Also, prepare to be blown away. Everything in a programmed way!

5. **Automation**

Artificial intelligence doesn't imply that the robots are dominating. These days many individuals are terrified that all that will be finished by robots in the closest future. Actually no, not actually! Robots offer occasion to retailers to give precisely what the client needs, when they need it, by utilizing innovation and calculations. As firms in the e-commerce proceed to extend and that implies having a developing number of clients, robotization turns into an unquestionable requirement and got one of their top venture needs for e-commerce stores. Also, as we probably are aware, when e-commerce begins to develop, the quantity of monotonous assignments develops too.

6. **Smart logistics**

According to a report from Emerging Tech Brew, "Machine learning's predictive powers shine in logistics, helping to forecast transit times, demand levels, and shipment delays." Smart logistics or intelligent logistics, is all about using real-time information through sensors, RFID tags, and the like, for inventory management and to better forecast demand. Machine learning systems become smarter over time to build better predictions for their supply chain and logistics functions.

CHALLENGES OF USING AI IN E-COMMERCE

1. **Data privacy concerns**

AI relies heavily on customer data for personalization and Segmentation. Collecting and processing sensitive customer information can raise privacy concerns if Not handled properly. E-commerce companies must adhere to data protection regulations and ensure robust data security measures.

2. **Bias in algorithms**

AI algorithms may inherit biases from the data they are trained on. If not Carefully curated, these biases can lead to unfairor discriminatory outcomes, affecting certain Customer segments negatively.

3. **Loss of jobs**

The automation of customer service through AI-powered chatbots and virtual Assistants can lead to a reduced need for human customer support agents. This can result in job Displacement and employee morale issues.

4. **Technical challenges**

Implementing and maintaining AI systems can be technically Challenging and require skilled data scientists, machine learning engineers, and IT personnel. Smaller e-commerce businesses may struggle with the costs and expertise needed for AI integration.

5. **Implementation costs**

Developing, deploying, and maintaining AI systems can be Expensive. The initial investment in AI technology and infrastructure may not yield immediate returns, which can strain the budget of some e-commerce companies.

6. **Customer resistance**
   Some customers may be uncomfortable with AI-driven experiences, Such as chatbots or automated recommendations.
   They may prefer human interactions and resist using AI-powered features.

7. **Overreliance on AI**
   Relying too heavily on AI for decision-making can lead to a loss of Human intuition and creativity in business strategies.
   It's crucial to strike a balance between AI-driven Insights and human expertise.

8. **AI misunderstandings**
   AI systems can misinterpret user queries or provide inaccurate Recommendations, leading to customer frustration and potential loss of trust.

9. **Security risks**
   As AI is integrated into e-commerce systems, it can become a target for cyber-attacks. Malicious actors may attempt to manipulate.

10. **Technical failures**
    AI systems can experience technical failures or glitches, leading to Disruptions in customer service or order processing. It's important to have backup plans in place for Such situations.

CONCLUSION

It's always tempting to jump into new, exciting technologies. But it's better to have a roadmap before jumping into implementing a new program, to make sure that it don't lose a lot of time and money on false starts. The aim of the paper is to describe the essence of e-commerce and artificial intelligence and their benefits. It concludes that artificial intelligence has helped e-commerce websites in providing with better user experience. The application of artificial intelligence in e- commerce has become the subject of interest of many business scientists and experts. It is possible to expect that artificial intelligence in the conditions of electronic commerce will be used more and more often and will become an integral part of all companies of this type. This research paper explores the multifaceted integration of artificial intelligence in the realm of e-commerce, aiming to elucidate the transformative impact on operational processes and user experience.

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Consumer Perception and Awareness about Generic Medicines in India: An Empirical Study

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Abstract:
Generic medicines are cost-effective alternatives to branded pharmaceuticals, offering the same therapeutic value and bioequivalence. In India, despite widespread availability and government-led programs like Jan Aushadhi, public adoption remains suboptimal. This study assesses the current state of consumer perception and awareness regarding generic medicines. Through a quantitative survey of 151 respondents from varied demographics, it was found that affordability is a key driver, but uncertainty about quality, limited knowledge of bioequivalence, and brand loyalty influence consumer choices. The findings emphasize the need for enhanced public education, improved doctor-patient communication, and policy interventions to promote generic medicine use in India's growing pharmaceutical market.

Keywords*: Generic drugs, consumer perception, brand loyalty, affordability, Jan Aushadhi, public health, pharmaceutical marketing*

Introduction

In the context of a growing population and increasing burden of chronic diseases, the affordability and accessibility of medicines have become critical components of healthcare delivery in India. Branded medicines often remain out of reach for low- and middle-income households, leading to poor medication adherence and preventable health complications. Generic medicines, which are approved as bioequivalent alternatives to branded counterparts, offer a viable and sustainable solution to this problem. They are chemically identical in active ingredients, dosage, strength, and therapeutic use, and are required to meet the same safety and efficacy standards by drug regulatory authorities.

Despite these advantages, the adoption of generic drugs in India remains inconsistent. While the Indian government has launched initiatives like the Jan Aushadhi Yojana to promote generic drug availability, public trust and awareness have not kept pace. A significant portion of the population remains unaware of the benefits and quality standards of generics, and there is a lingering perception that lower cost implies inferior quality. Furthermore, physicians and pharmacists—key intermediaries in the healthcare system—sometimes fail to actively promote generic alternatives due to commercial pressures or lack of clarity about regulations.

This study aims to assess the current state of consumer perception and awareness regarding generic medicines. By analysing survey responses from a diverse demographic, the study explores the key barriers to generic medicine adoption and suggests actionable strategies to build confidence and improve uptake. Understanding consumer attitudes is essential for

policymakers, healthcare providers, and pharmaceutical marketers aiming to make healthcare more inclusive and cost-effective in India.

Generic drugs, which are bioequivalent to branded medicines, play a critical role in improving access to affordable healthcare. They are required by regulatory agencies like the Central Drugs Standard Control Organization (CDSCO) to meet the same quality standards as branded formulations. Despite their lower cost and equal efficacy, generic drugs in India face slow adoption due to misconceptions about safety, inconsistent availability, and lack of public trust.

India, being the largest supplier of generics globally, faces a paradox at home where trust in generics is not as strong. The government has promoted various schemes like the Jan Aushadhi Yojana to increase availability, but consumer behaviour remains influenced by brand perception and physician guidance. This paper explores these behavioural dynamics and identifies key barriers and enablers to the adoption of generic drugs.

2. Objectives of the Study

- To assess consumer awareness about generic medicines.
- To evaluate perceptions of efficacy, safety, and cost benefits of generics.
- To determine the role of physicians, pharmacists, and media in shaping consumer decisions.
- To examine demographic factors (income, education, urban/rural) affecting acceptance.
- To propose actionable strategies to improve public understanding and usage of generics.

3. Literature Review: Generic medicines have been the focus of numerous studies due to their role in reducing treatment costs and increasing access to essential medications. The World Health Organization defines generics as drugs that are therapeutically equivalent to innovator products in dosage, safety, strength, route of administration, quality, performance characteristics, and intended use. Yet, consumer perception remains varied globally and especially in India.

Studies such as those by Mohanty et al. (2022) and Panigrahy & Chaudhari (2022) note that while affordability drives interest, actual acceptance is shaped by factors like trust in healthcare providers, exposure to health education, and previous experience with branded drugs. In rural India, Jalali and Rasaily (2018) found that low awareness about bioequivalence standards led to scepticism about the safety and efficacy of generics.

Consumer behaviour is further influenced by socio-demographic variables such as education level, income group, and urban versus rural residency. A study by Roughead et al. (2018) compared generic policies in countries like Australia and Korea, concluding that consistent physician endorsement and transparent regulatory practices are essential for increasing consumer confidence.Cultural and psychological factors also contribute to generic medicine hesitancy. Some patients equate lower price with reduced quality. Furthermore, the lack of distinctive branding in generic drugs limits consumer recall and trust. In India, Jan Aushadhi Yojana has increased physical access to generics, but outreach and educational support remain underfunded. This gap contributes to underutilization despite government subsidies.

Research also highlights the critical role of healthcare providers. According to Hadia et al. (2022), patients are more likely to accept a generic substitution if explained and recommended by a trusted physician. Pharmacists, too, have been identified as key influencers but are often underutilized in India due to limited training in patient communication. Thus, multi-level interventions are required—from regulatory awareness to community-based education—to improve generic medicine uptake in India.

Multiple studies in India have highlighted persistent myths around generic drugs, such as being inferior in quality or less effective than branded counterparts. Mohanty et al. (2022) observed that even well-informed consumers often equate higher price with better quality. Hadia et al. (2022) found that doctors play a pivotal role in influencing perception, as most consumers depend on prescriptions rather than actively requesting generics.

Roughead et al. (2018) compared international strategies and found that robust policies, doctor training, and transparent pricing data increase acceptance. Panigrahy & Chaudhari (2022) showed that lack of formal education among patients, particularly in rural settings, limits their ability to understand and accept generic alternatives.

Furthermore, government efforts like Jan Aushadhi Yojana have improved access, but limited awareness and suboptimal communication by healthcare professionals continue to be barriers. The perception gap is not just a rural issue; even urban patients remain unaware that generics are tightly regulated and subject to the same quality controls.

4. Research Methodology

The present study employs a quantitative, descriptive cross-sectional research design to examine the research objectives at a specific point in time. A total of 151 respondents participated in the study, selected using the convenience sampling method, which enabled easy access to willing participants. Although this non-probability method limits generalizability, it was effective for the exploratory nature of the study. Data was collected using a structured questionnaire administered through Google Forms, designed to capture key demographic information and responses related to the study variables. The data was analyzed using Microsoft Excel, applying frequency distribution and percentage analysis to interpret the findings in a clear and concise manner. The geographic scope of the study included participants from urban, semi-urban, and rural areas across India, ensuring diverse representation and enhancing the contextual relevance of the results.

5. Data Analysis:

The survey included 51 respondents across age, gender, location, and income categories. Data was analysed using frequency distributions and thematic insights drawn from open-ended responses.

- **Awareness by Education Level:**
  - 100% of respondents with postgraduate education were aware of generic drugs.
  - Among those with only school-level education, only 42% were familiar with generics, reflecting a strong correlation between education and awareness.

- **Affordability as a Decision Factor:**
  - Over 90% of respondents indicated that they would prefer generics if they were proven cheaper and equally effective.
  - In lower-income groups (<□ 3 LPA), 72% strongly favoured generics due to financial constraints.
- **Geographic Trends:**
  - Urban respondents demonstrated higher awareness and more trust in generics.
  - Rural respondents were more likely to follow physician instructions without questioning drug brand.
  - Only 22% of rural participants had heard of the Jan Aushadhi initiative.
- **Doctor's Influence:**
  - Nearly 60% of those who had tried generics said they were introduced by a doctor's prescription.
  - Respondents also reported that they were more likely to trust generics after verbal reassurance by healthcare providers.
- **Trust Ratings:**
  - On a scale of 1 to 5, nearly half (49%) gave generics a score of 5 (high trust).
  - Respondents who had used generics at least once were more likely to rate them positively.

These data points suggest that while general awareness is growing, targeted awareness programs should prioritize low-literacy populations, rural areas, and lower-income households. Furthermore, expanding the role of physicians and pharmacists as advocates can be pivotal in increasing consumer confidence.

- **Demographic Profile:**
  - Gender: 78.4% Male, 21.6% Female
  - Age: 62.7% were 25–34 years old
  - Location: 58.8% Urban, 33.3% Suburban, 7.8% Rural
  - Income: Majority in the □3.4–5.0 LPA range
- **Awareness:**
  - 78.4% had heard of generic drugs
  - Primary source: 47.1% heard from doctors, followed by friends, family, and media
- **Perception:**
  - 54.9% strongly agreed that generics are equally effective

- 56.9% rated generics as affordable or very affordable
- 49% gave a perfect 5/5 trust rating; 23.5% gave 4/5

- **Concerns:**

- 27.5% worried about quality
- Only 2% cited cost as a concern, indicating high price-value satisfaction
- Majority would try generics if recommended by a doctor

Discussion:

The findings from this study illustrate a significant relationship between consumer perception and awareness of generic medicines and their subsequent usage behaviour. While affordability is a major positive factor contributing to generic medicine adoption, quality-related apprehensions remain a major deterrent. Despite high awareness levels, a deeper understanding of regulatory equivalence and safety remains low among the general public. The healthcare system's reliance on physician-led prescribing also creates a scenario where doctors' attitudes and preferences heavily influence patient choices. In urban areas, consumers exhibited relatively higher levels of confidence in generic medications, largely due to better access to information, higher literacy, and digital exposure. Conversely, rural respondents expressed caution, often driven by inconsistent availability, limited interaction with trained healthcare providers, and misconceptions about efficacy. This divergence reflects a pressing need to tailor awareness programs based on geographic and socioeconomic segments. Another key insight is the role of the pharmaceutical industry in shaping consumer expectations.

Branded companies continue to enjoy loyalty not necessarily because of superior efficacy, but due to longstanding presence, consistent packaging, and emotional trust. Generic drugs, while medically equivalent, often lack such marketing support, creating an imbalance in public opinion. The study highlights the necessity of collaboration between doctors, pharmacists, regulators, and pharma companies to ensure generic drugs are not only available but also accepted and trusted as a reliable treatment alternative. The data reinforces the idea that physician influence and cost advantages drive adoption of generics. However, awareness does not always equate to understanding—many consumers are aware of generics but unclear about their safety and equivalence. Misinformation about government generics being of 'lower quality' persists. Urban respondents were more likely to trust generics, while rural respondents expressed scepticism. This suggests the need for trust-building measures, such as public demonstrations, patient stories, and educational campaigns explaining quality assurance protocols for generics. Pharmacy-level advocacy, branding of Jan Aushadhi stores, and better doctor communication are essential.

7. Recommendations- Education and Awareness Campaigns:

- Launch multilingual, region-specific public education campaigns to address misconceptions about the safety and efficacy of generic medicines.

- Use television, radio, community health workers, and social media to deliver simple messages about bioequivalence and affordability.

- **Doctor and Pharmacist Engagement:**
  - Incorporate mandatory CME (Continuing Medical Education) modules on generic prescribing practices for physicians.
  - Encourage pharmacists to actively counsel patients on generic alternatives and dispel myths at the point of purchase.
- **Improving Jan Aushadhi Access and Visibility:**
  - Expand the number of Jan Aushadhi Kendras, especially in rural and underserved regions.
  - Ensure consistent stock of essential medications and improve store signage and branding to enhance public trust.
- **Packaging and Quality Assurance:**
  - Standardize the packaging of generic medicines to improve visual appeal and legitimacy.
  - Conduct routine third-party quality audits and publicize test results to boost consumer confidence.
- **Technological Support and Transparency:**
  - Develop a government-approved mobile app listing verified generics, comparative prices, and nearest availability.
  - Integrate barcode systems for verification of authenticity at pharmacies.
- **Demographic-Specific Strategies:**
  - Target awareness drives in rural areas where only 22% of participants reported knowledge of Jan Aushadhi.
  - Focus education on low-literacy and lower-income populations who express the highest cost-sensitivity but lowest trust.
- **Trust-Building Measures:**
  - Create testimonial campaigns showcasing real patient experiences with generics.
  - Engage local influencers, community leaders, and NGOs to endorse generics at the grassroots level.
- **Policy and Regulatory Alignment:**
  - Enforce dual-prescribing norms (generic + brand name) to ease transition.
  - Incentivize doctors and pharmacists who meet high generic substitution rates in ethical ways, such as awards or recognition.
- **Policy-Level:**
  - Strengthen regulatory oversight and conduct regular audits of Jan Aushadhi stores to ensure quality consistency.
  - Integrate bioequivalence education into national health communication strategies.

- Establish incentives for doctors prescribing generics under government-sponsored schemes.

- **Healthcare Professionals:**

- Conduct mandatory Continuing Medical Education (CME) sessions on generic prescribing practices.
- Encourage dual prescription formats (branded + generic names) to ease patient transition.
- Partner with pharmacists to provide real-time patient counselling at the point of sale.

- **Pharmaceutical Industry:**

- Standardize the appearance, packaging, and labelling of generics to match branded alternatives.
- Conduct CSR-based rural awareness drives and health camps focusing on affordable care.
- Develop mobile apps or digital portals listing approved generics, pricing, and nearest Jan Aushadhi outlets.

- **Public Health Outreach:**

- Launch multi-language campaigns through TV, radio, and social media explaining the concept and benefits of generics.
- Create educational videos showing comparisons between branded and generic drugs and how both meet regulatory standards.
- Involve local community health workers (ASHAs/ANMs) in rural campaigns to promote acceptance.

- **Policy-Level:** Strengthen the Jan Aushadhi network, enforce stricter quality monitoring, and launch media campaigns emphasizing efficacy of generics.
- **Healthcare Professionals:** Train doctors to educate patients about generics, include discussions during consultations, and ensure ethical prescription behaviour.
- **Pharmaceutical Industry:** Improve packaging and labelling of generics to match branded drugs, invest in public awareness through CSR campaigns.
- **Educational Outreach:** Introduce modules on drug literacy in school and community programs.
- **Digital Promotion:** Use social media and AI-powered chatbots to inform the public about approved generics and their uses.

8. Conclusion:

The research concludes that consumer awareness of generic drugs in India is growing, particularly in urban areas, yet major challenges persist in achieving widespread adoption. Concerns related to quality, lack of transparent information, and low confidence among rural consumers remain significant barriers. Physicians play a crucial role in influencing the

consumer journey and must be equipped to guide patients ethically and informatively. Addressing these concerns requires a coordinated approach involving policymakers, healthcare professionals, and the pharmaceutical industry. With focused outreach, uniform branding, quality standardization, and community-level education, the trust gap can be bridged. Ultimately, strengthening confidence in generics will not only reduce healthcare costs but also empower patients with informed choices, contributing to more equitable healthcare outcomes across India. While India leads in generic drug production globally, consumer acceptance is hindered by misconceptions and lack of education. The survey shows a promising level of awareness and positive perception, but gaps remain in understanding drug safety and quality. With coordinated efforts from policymakers, doctors, and industry, these gaps can be narrowed. Enhancing the visibility and credibility of generics will ultimately lead to **affordable, inclusive, and rational healthcare access** for all segments of the population.

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Abstract

This study investigates physicians' perceptions and prescribing patterns regarding Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) and muscle relaxants across various clinical indications in India. This research maps how doctors differentiate treatment based on the patient's age, comorbidities, symptom duration, severity, and medication tolerance. With increasing emphasis on evidence-based and patient-centred care, understanding the rationale behind prescribing behaviour becomes critical. Data collected through structured interviews and surveys reveal that physician decision-making is influenced by drug efficacy, adverse effect profiles, pharmaceutical brand presence, and peer practice patterns. The findings point toward a knowledge gap in risk assessment, a need for periodic medical education, and regulatory interventions to ensure rational pharmacotherapy. This study emphasizes the importance of clinician awareness and continuous learning in optimizing drug use for musculoskeletal conditions.

Keywords: *NSAIDs, muscle relaxants, doctor perception, pharmacotherapy, patient profile, rational use, adverse effects, India*

Introduction:

Pain and musculoskeletal disorders are leading causes of morbidity worldwide and particularly prevalent in India's working-age and elderly populations. NSAIDs and muscle relaxants play a crucial role in managing such conditions, yet concerns persist regarding their overuse, irrational combinations, and side effects. India, being a high-consumption country for analgesics, is experiencing an alarming increase in NSAID-induced gastrointestinal, renal, and cardiovascular complications. In this context, doctors' awareness and rationale for selecting particular drug regimens have gained critical importance. Prescribing habits vary based on factors such as patient comorbidities (e.g., hypertension, diabetes), pain severity (acute or chronic), and age groups (paediatric, adult, geriatric). Inappropriate prescribing can lead to avoidable complications, reduce drug efficacy, and increase economic burden on the healthcare system. Thus, mapping doctors' perceptions and understanding their reasoning is crucial to formulating clinical guidelines and promoting safe prescribing practices. This study investigates real-world patterns in physician decision-making, focusing on the therapeutic use of NSAIDs and muscle relaxants.

2. Literature Review:

NSAIDs are among the most widely used drugs globally, often prescribed for pain, inflammation, and fever. However, literature emphasizes the importance of cautious use, especially in elderly patients, those with renal impairment, and those on concurrent

anticoagulants. Commonly used agents like diclofenac and ibuprofen are associated with gastrointestinal toxicity, while newer selective COX-2 inhibitors offer better tolerability but raise concerns about cardiovascular safety.

Muscle relaxants such as thiocolchicoside, tizanidine, and eperisone are frequently combined with NSAIDs, although their standalone efficacy remains controversial. Studies indicate poor physician awareness about the sedative potential and contraindications of these drugs. Additionally, fixed-dose combinations (FDCs) are often prescribed without individualizing therapy based on the patient profile. Rational use requires aligning prescriptions with guidelines, adverse effect data, and individual patient factors.

Recent work by Deshpande et al. (2018) reviewed NSAID-related hospital admissions and highlighted the correlation between long-term NSAID use and upper gastrointestinal bleeding in Indian patients. A study conducted by the Indian Pharmacopoeia Commission (2021) reported underreporting of adverse events linked to NSAID and muscle relaxant combinations. Additionally, findings from Sharma and Rao (2022) underscore the risk of polypharmacy, especially among elderly patients who receive overlapping prescriptions from multiple providers. Internationally, the European Medicines Agency (EMA) has recommended caution on the long-term use of thiocolchicoside due to its potential genotoxicity. The American College of Rheumatology (2020) emphasizes evidence-based prescribing of NSAIDs, warning against indiscriminate use in patients with comorbid cardiovascular or renal conditions. Taken together, these studies highlight the critical importance of contextual prescribing, pharmacovigilance, and ongoing physician education to ensure safe and effective use of NSAIDs and muscle relaxants in varied patient populations.

NSAIDs are among the most widely used drugs globally, often prescribed for pain, inflammation, and fever. However, literature emphasizes the importance of cautious use, especially in elderly patients, those with renal impairment, and those on concurrent anticoagulants. Commonly used agents like diclofenac and ibuprofen are associated with gastrointestinal toxicity, while newer selective COX-2 inhibitors offer better tolerability but raise concerns about cardiovascular safety. Muscle relaxants such as thiocolchicoside, tizanidine, and eperisone are frequently combined with NSAIDs, although their standalone efficacy remains controversial. Studies indicate poor physician awareness about the sedative potential and contraindications of these drugs. Additionally, fixed-dose combinations (FDCs) are often prescribed without individualizing therapy based on the patient profile. Rational use requires aligning prescriptions with guidelines, adverse effect data, and individual patient factors.

3. Research Objectives:

- **Primary Objective:** To examine the perceptions and preferences of physicians when prescribing NSAIDs and muscle relaxants for various musculoskeletal conditions.
- **Secondary Objectives:**
  - To assess the influence of patient characteristics (age, disease type, comorbidities) on prescribing decisions.

- To identify frequently used drug combinations and preferred pharmaceutical brands.
- To evaluate the level of physician awareness about adverse drug reactions (ADRs), contraindications, and safety profiles.
- To recommend strategies for enhancing rational prescribing behaviour and reducing adverse outcomes.

4. Research Methodology:

This study adopts a cross-sectional observational design incorporating both qualitative and quantitative components to gain a comprehensive understanding of physician perspectives. A total of 100 physicians from Gujarat, India participated in the study, including general practitioners, orthopaedists, neurologists, and rheumatologists. Participants were selected using a combination of purposive and convenience sampling techniques, targeting respondents from both private clinics and hospital settings. Data collection involved the use of a structured questionnaire comprising Likert-scale items, multiple-choice questions (MCQs), and open-ended questions, supplemented by one-on-one interviews for deeper insights. The collected data was analyzed through descriptive statistics, frequency distribution, and correlation analysis for the quantitative component, while qualitative responses were subjected to content coding and thematic interpretation to extract meaningful patterns and themes.

5. Data Analysis:

Quantitative data collected from the 100 surveyed physicians were analysed using descriptive statistics and SPSS software. Results were interpreted through frequency distributions, cross-tabulations, and chi-square tests to explore associations between physician attributes and prescribing behaviour.

- **Specialty-wise Drug Preference:** Orthopaedic and neurology specialists showed a statistically significant preference ($p < 0.05$) for prescribing etoricoxib-thiocolchicoside combinations over general practitioners, particularly for acute spinal and muscular pain.
- **Comorbidities and Drug Selection:** A correlation was observed between physicians treating elderly patients with comorbidities (e.g., hypertension, renal dysfunction) and their preference for aceclofenac and eperisone over diclofenac. 78% of such doctors preferred prescribing gastro-protective agents along with NSAIDs.

Popular Drug Combinations:

- Etoricoxib + Thiocolchicoside was the most frequently prescribed combination for acute muscular pain.
- Aceclofenac + Paracetamol + Serratiopeptidase was common in inflammatory joint disorders.
- Diclofenac + Tizanidine was also noted in some prescriptions for post-operative muscle pain.
- **Knowledge Index:** Physicians' awareness was scored on a 10-point index based on correct responses to ADRs, drug interactions, and contraindications. 62% of respondents scored below 6, indicating moderate to low knowledge, with specialists performing better than general physicians.

- **Statistical Significance:** A chi-square test revealed a significant association ($\chi^2 = 13.76$, df = 2, $p < 0.01$) between years of clinical experience and adherence to evidence-based prescribing guidelines.

  These findings suggest that while experience and specialization influence safer prescribing habits, there remains a broad gap in uniform clinical awareness, especially among general practitioners.
- **Drug Preferences:**

  - Doctors were more cautious while prescribing NSAIDs to elderly patients, often preferring aceclofenac or etoricoxib due to their better gastrointestinal safety profiles.
  - Eperisone was more frequently prescribed to older adults due to its favourable tolerance and minimal sedation effect. Eperisone was selected for patients with spinal stiffness or spondylitis.

- **Prescribing Considerations:**

  - 76% of doctors cited GI safety as a deciding factor.
  - 58% routinely co-prescribed PPIs with NSAIDs.
  - 63% relied on pharmaceutical representatives for brand information.

- **Knowledge Gaps:**
  - Nearly half the respondents were unaware of thiocolchicoside's contraindication in pregnancy.
  - Less than 40% could identify safe NSAID use parameters in CKD (chronic kidney disease) patients.
- **Brand Influence:**
  - Over 60% preferred brands based on familiarity rather than clinical literature.
  - Corona Remedies, Sun Pharma, and Intas were among the top brands favoured.

6. Discussion:

The results indicate that while efficacy remains a top concern, many prescriptions are influenced by marketing, habitual use, and peer recommendations. Physicians often manage pain empirically without conducting comprehensive risk-benefit assessments, particularly in high-risk groups. This underlines a gap between clinical practice and evolving evidence-based guidelines. Moreover, while muscle relaxants are routinely prescribed with NSAIDs, few doctors assess sedation risk or contraindications. The limited knowledge about drug interactions and safety suggests an urgent need for targeted CME programs and clinical decision-support tools. Drug selection should be personalized, and long-term NSAID use should be avoided unless absolutely necessary. Policy interventions are needed to standardize prescriptions and restrict irrational FDCs.

7. Recommendations:

- **Pharmaceutical Industry Engagement:** Pharmaceutical companies should invest in developing and marketing evidence-based fixed-dose combinations (FDCs) with clear clinical trial data supporting their efficacy and safety. They must also enhance transparency in marketing by sharing peer-reviewed studies with physicians rather than relying solely on promotional material.

- **Digital Decision-Support Tools:** Pharma and digital health companies can collaborate to design mobile apps or software plugins that assist doctors in choosing appropriate NSAID and muscle relaxant combinations based on patient-specific risk profiles.
- **Healthcare System Integration:** Hospital management systems should incorporate drug interaction alerts and ADR tracking mechanisms to reduce the misuse of high-risk analgesics. This can be achieved through integrated EHR systems.
- **Training and Medical Liaisons:** Pharma companies should establish ongoing medical training through scientific service executives or academic liaisons to update prescribers on newly approved agents, drug safety updates, and treatment algorithms.
- **Pharmacovigilance Strengthening:** Both private healthcare institutions and pharma firms must partner with regulatory bodies to report, investigate, and disseminate findings on ADRs, especially concerning commonly prescribed analgesics.
- **Policy Advocacy:** Industry stakeholders should work with government bodies to develop national guidelines and pain management protocols that ensure standardized, rational prescribing practices.
- **Medical Education:** Incorporate NSAID and muscle relaxant safety modules in CME programs.
- **Clinical Guidelines:** Develop India-specific pain management guidelines based on real-world evidence.
- **Patient Monitoring:** Promote use of safety checklists before initiating long-term analgesic therapy.
- **Brand Transparency:** Encourage doctors to consult scientific literature rather than rely solely on promotional materials.
- **Regulatory Oversight:** Empower pharmacovigilance cells to monitor irrational combinations and adverse drug events.

Conclusion:

This research highlights critical insights into doctors' prescribing behaviors concerning NSAIDs and muscle relaxants. Despite a strong preference for efficacy, physician awareness of safety, contraindications, and evidence-based usage remains inconsistent. With pain management being a core aspect of clinical care, structured educational interventions and practice audits are essential to encourage rational pharmacotherapy. Future research should explore the impact of standardized guidelines on prescribing trends across broader geographies and specialties.

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Evolving Dynamics of the Global Chemical Market: Trends, Challenges, and Future Prospects

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Abstract

The global chemical industry, a crucial component of the global manufacturing ecosystem, is currently experiencing significant structural changes. Driven by regulatory shifts, technological advancements, environmental mandates, and supply chain diversification, the sector is navigating complex challenges while exploring new growth frontiers. This study presents a comprehensive analysis of the changing dynamics in the chemical industry, with a special focus on small and medium enterprises (SMEs) in India. Using a combination of descriptive statistics and inferential analysis (chi-square testing), the research uncovers key associations between business parameters such as chemical purchases, customer base, software usage, testing practices, and interest in digital commerce. The study concludes with strategic recommendations for policy makers, SMEs, and technology providers to enable the transition to a more sustainable and competitive chemical market.

Keywords: Global Chemical Industry, E-commerce, Supply Chain, SME, Chi-Square, Industrial Trends, In-House Testing, Digitalization, Sustainability

1. Introduction

The chemical industry has long been a cornerstone of global economic development, serving as a foundational input across sectors such as pharmaceuticals, agriculture, manufacturing, automotive, and consumer goods. With increasing pressure to align operations with environmental and digital goals, the sector is evolving rapidly. India, as one of the largest producers of bulk chemicals and specialty ingredients, plays a critical role in this evolution.

In the post-pandemic world, several key trends are reshaping the industry: increased regulatory scrutiny, rise in digital platforms for procurement and distribution, preference for in-house quality testing, and global shifts in sourcing due to trade conflicts. For Indian chemical SMEs—who make up over 80% of the domestic production landscape—the ability to adapt to these changes is essential to maintain competitiveness and meet international quality standards.

This study seeks to understand the current operational behavior of these firms, their digital and infrastructural readiness, and the factors influencing their performance and decision-making. It provides empirical data to guide interventions aimed at modernizing and globalizing India's chemical manufacturing base.

2. Objectives

- To study purchasing patterns and assess the operational complexity of SMEs in the chemical sector.
- To evaluate the adoption of digital tools (e.g., ERP, accounting software) and their correlation with transaction volume.

- To analyze the role of in-house vs. outsourced testing in ensuring quality compliance.
- To determine the level of interest in cloud-based procurement, inventory, and customer engagement tools.
- To identify statistically significant relationships between firm size, transaction complexity, and digital maturity.

3. Research Methodology

The study employs a quantitative research methodology supported by descriptive and inferential statistical techniques. Data was gathered using a structured questionnaire comprising multiple-choice and open-ended questions. A sample of 69 chemical SMEs from Gujarat and neighbouring regions was selected using convenience sampling. Respondents included company owners, operations managers, and QA/QC professionals.

- Tools Used: Google Forms for survey distribution, MS Excel for data preparation, and SPSS for statistical testing.
- Statistical Test: Chi-square test of independence at 95% confidence level to assess relationships between categorical variables.
- Secondary Sources: Trade reports, industry white papers, research publications, and global chemical outlook data.

4. Literature Review

Green Chemistry and Regulation: According to Mehta (2022), increased environmental awareness and tightening global norms like REACH and GHS have accelerated the adoption of green chemistry practices, especially in export-oriented units.

Technological Advancements: Miller (2022) emphasizes the impact of digital twins, process automation, and AI analytics in reducing production downtime and optimizing chemical yields.

Digitalization and ERP Adoption: Patel (2022) found that ERP and CRM systems improve order fulfillment rates by 30% in SMEs that integrate inventory and procurement systems.

Market Disruption and Localization: Petrova (2023) noted that geopolitical instability (e.g., China-U.S. tensions, Ukraine war) has led to nearshoring of chemical production and realignment of global sourcing strategies.

E-commerce and Platform Economy: Gupta (2024) highlighted that online B2B platforms in chemicals are still nascent in India but growing rapidly in China and Europe due to lower transaction costs and broader reach. This body of literature indicates a global push for digitized, compliant, and resilient chemical ecosystems that SMEs in India must align with to remain globally competitive.

5. Data Analysis

Key Metrics Observed from 69 Responses:

- **Product Portfolio Size:**
  - 50.7% procure 5–10 chemical types per month.

- 24.6% deal with more than 15 chemicals monthly.

- **Software Utilization:**
- Tally used by 59.4% for finance and billing.
- Excel used by 20.3%; SAP by 7.2% indicating low ERP penetration.
- **Testing Infrastructure:**
- 71% of firms conduct quality testing in-house, with regular internal audits.
- 44.9% are open to using outsourced or digital lab platforms.
- **Buyer Engagement:**
- 44.9% of respondents sell to more than 20 clients per month.
- Nearly 60% cater to distributors and formulation companies.
- **Workforce Composition:**
- 58% operate with fewer than 5 staff handling procurement, testing, and billing combined.

Chi-Square Statistical Results

- **Purchase Volume vs Buyer Count:** Significant association ($\chi^2 = 25.9$, $p < 0.001$)
- **Purchase Volume vs Product Variety:** Strong correlation ($\chi^2 = 27.3$, $p < 0.001$)
- **Staff Strength vs Expenditure:** Statistically significant ($\chi^2 = 15.04$, $p = 0.013$)
- **Software Type vs E-commerce Interest:** Not significant ($p = 0.315$)
- **Chemical Count vs E-commerce Adoption:** Not significant ($p = 0.533$)

Interpretation:

Firms with higher transaction volumes and larger portfolios employ more staff and spend more annually, suggesting operational complexity drives cost. However, openness to digital platforms does not vary significantly by business size, indicating that awareness—not resources—is the main barrier to digital adoption.

Findings

- The majority of respondents manage high customer volumes with minimal digital tools.
- In-house testing remains dominant but there is growing willingness to adopt external digital labs.
- ERP adoption is very low despite high transaction frequency in many firms.
- E-commerce curiosity exists, but implementation is limited by lack of training and integration support.
- SMEs operating in high-demand sectors (e.g., pharma intermediates) have stronger customer bases and broader portfolios, necessitating better operational systems.

8. Discussion

The Indian chemical industry's growth is evident from the procurement and sales diversity seen in this sample. However, the continued use of manual tools such as Excel and offline testing methods limits productivity and transparency. There is a strong case for digitization driven not by company size, but by transaction complexity. Many SMEs express interest in cloud-based solutions but are held back by fears about cost, data privacy, and disruption to existing workflows. Awareness programs, affordable software bundles, and plug-and-play ERP platforms can help bridge this digital divide. Firms with in-house testing capabilities are likely to adopt digital LIMS (Lab Information Management Systems) in the near future as audits and certifications become more stringent.

9. Recommendations

- **Develop Sector-Specific ERPs:** Lightweight, modular ERP systems designed for chemical SMEs should be introduced at subsidized rates.
- **Launch MSME Tech Clinics:** Public-private partnerships can set up consulting clinics in industrial zones to help companies transition to digital systems.
- **Cloud Testing Platforms:** Government and private labs should integrate digital dashboards that sync with manufacturers' internal systems.
- **Subsidize Pilot E-commerce Projects:** Offer financial and technical support for first-time users of B2B chemical marketplaces.
- **R&D-Quality Linkage Programs:** Encourage firms to use certified digital labs to meet export requirements and reduce regulatory rejections.

10. Conclusion

The global chemical industry is moving toward a more transparent, tech-driven, and sustainable model. Indian SMEs, while contributing substantially to production volumes, are constrained by operational inefficiencies and slow digital adoption. This study shows that transaction complexity, not size, drives the need for modernization. With targeted support in areas like ERP, testing automation, and B2B commerce, these firms can become globally competitive, agile, and regulation-ready. Future research should include longitudinal studies to assess post-adoption impacts and the role of policy interventions in shaping sector performance.

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Expectations of Medical Representatives from the Product Management Team in the Pharmaceutical Industry

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Abstract
The relationship between the Product Management Team (PMT) and Medical Representatives (MRs) in the pharmaceutical industry is pivotal to the success of sales strategies and product positioning. MRs are the direct link between companies and healthcare professionals, and their ability to perform hinges on the strategic, educational, and operational support provided by PMTs. This study explores the expectations of MRs from PMTs, focusing on key areas such as timely communication, product knowledge updates, availability of promotional materials, and field-level problem-solving. Through a structured survey of 100 MRs across different therapy areas and geographical locations, the research identifies actionable insights into MR satisfaction, engagement, and performance drivers. The study concludes by offering detailed recommendations to strengthen PMT-MR collaboration and improve overall commercial performance in the pharmaceutical industry.

Keywords: Product Management, Medical Representatives, Pharmaceutical Marketing, Field Strategy, MR Expectations, Sales Enablement

1. Introduction

In the highly competitive and regulated environment of the pharmaceutical industry, Medical Representatives (MRs) are frontline soldiers responsible for implementing company strategies and building relationships with healthcare professionals. Their effectiveness relies heavily on the guidance and resources provided by the Product Management Team (PMT), which is tasked with designing product strategies, developing promotional materials, and enabling sales teams with relevant training.

While the PMT sets the vision for brand success, MRs are responsible for executing that vision in the marketplace. The alignment between the two is critical for consistent brand messaging, market penetration, and prescription generation. However, this alignment often faces challenges due to gaps in communication, infrequent training, unclear product strategies, and insufficient responsiveness from PMTs to field-level challenges. These challenges can reduce the motivation of MRs, impact their engagement with doctors, and ultimately hinder the commercial performance of the organization. This study delves into the specific expectations MRs have from their PMTs in India and identifies the components of successful support frameworks. Understanding these expectations helps improve operational collaboration and strategic coherence, making it a vital area of interest for pharma leaders and marketing professionals.

2. Objectives and Research Methodology

The primary objective of this study is to evaluate the expectations of Medical Representatives from the Product Management Team in the pharmaceutical industry. The secondary objectives are:

- To assess the effectiveness of PMT-driven training programs and product briefings.
- To understand the frequency and clarity of communication between MRs and PMTs.
- To determine the importance of promotional tools, product samples, and visual aids.
- To explore how MR feedback is collected, acknowledged, and incorporated by the PMT.
- To recommend actionable strategies to enhance PMT-MR collaboration.

This research adopts a descriptive and exploratory methodology. A structured questionnaire comprising multiple-choice and Likert-scale questions was used to collect primary data from 100 MRs across diverse geographic regions and therapy divisions. Purposive sampling ensured inclusion of both urban and semi-urban respondents with varied levels of experience. Data were analysed using descriptive statistical methods, including frequency and percentage analysis, while qualitative insights were drawn from open-ended feedback. Secondary data was sourced from industry reports, peer-reviewed journals, and pharmaceutical marketing case studies.

3. Literature Review

Previous studies emphasize the significant influence of medical representatives on prescription behaviour and the importance of strategic alignment with the product management team. According to Zipkin and Steinman (2005), effective communication between PMTs and MRs can bridge the gap between strategic vision and field execution. Austad et al. (2013) highlighted that insufficient guidance from marketing teams often leaves MRs ill-prepared, resulting in missed sales opportunities.

Iqbal et al. (2012) identified training and knowledge dissemination as top expectations of MRs from their parent organizations. They emphasized that MRs require up-to-date information, clear product positioning, and real-time responses to field queries. Bala et al. (2019) found that the frequency and clarity of PMT interactions significantly influence MR motivation, while Brax et al. (2017) linked such alignment to improved physician engagement and ethical promotion.

In addition, Lieb and Brandtönies (2010) underscored that doctors often question the credibility of MRs who lack detailed product knowledge or fail to address concerns. This reinforces the need for high-quality PMT inputs. Thus, literature supports the idea that a proactive, responsive, and collaborative PMT is central to enabling MRs in an increasingly evidence-driven pharmaceutical market.

4. Data Analysis

The analysis of survey responses revealed important patterns and preferences:

- **Strategic Expectations:** 59.4% of MRs expected robust strategic inputs from PMTs, including clear brand positioning, messaging, and competitive differentiation.
- **Communication Frequency:** 55% of MRs interacted with PMTs monthly, 24.6% weekly, and the rest during quarterly reviews or product launches.
- **Training Content:** 43.5% found training material extremely clear; 39.1% rated it very clear, indicating a strong need for simplified, concise, and engaging content.

- **Sales Aids Usefulness:** 43.5% rated sales tools such as brochures and e-detailers as very useful, while 31.9% rated them extremely useful, suggesting growing reliance on digital formats.
- **Feedback Mechanisms:** 44.1% felt that their feedback was always acknowledged by PMTs; 28% said it was often considered; 10% felt ignored.
- **Product Launch Support:** 64% of MRs requested more proactive involvement from PMTs during product launches, including field visits and real-time updates.

5. Findings

- The majority of MRs reported that consistent communication from PMTs directly influenced their performance. MRs who received timely updates and clarification about product strategies were more confident and effective in doctor engagements.
- MRs found therapy-specific content more useful than generic training, particularly when it included competitor comparisons, clinical data, and case studies that could be shared with doctors.
- The availability of promotional tools, including digital brochures, WhatsApp-ready visuals, and short video explainers, was seen as a critical enabler in effective detailing.
- MRs expressed a strong preference for interactive, two-way communication platforms (e.g., feedback apps, internal portals) that allowed them to log field insights and track PMT responses.
- Across the board, the presence of PMT members during major product launches was correlated with improved motivation and prescription growth.
- MRs prefer continuous support rather than one-time product launches.
- There is a demand for more customized training based on therapy areas and competitive scenarios.
- PMT responsiveness correlates directly with MR confidence and engagement.
- Visual aids and digital brochures are highly valued in doctor interactions.
- MRs seek greater visibility and appreciation for their frontline insights.

6. Discussion

The findings highlight that a responsive, well-integrated PMT-MR communication model significantly enhances field force effectiveness. MRs often operate in complex, competitive territories, where minor gaps in product knowledge or lack of support can lead to missed prescriptions. This study reveals that MRs do not merely expect one-way communication from PMTs; they desire active involvement, real-time assistance, and acknowledgment of their field intelligence. The emphasis on digital tools and personalized training reflects the evolving landscape of pharma marketing, where face-to-face detailing is supplemented by multimedia support and data analytics. Furthermore, the feedback culture is becoming a defining element of MR satisfaction. When PMTs validate field feedback and incorporate it

into product strategies or promotional planning, MRs feel valued and become more loyal to the organization. This shift from traditional top-down messaging to collaborative field support indicates that companies must redesign their internal marketing workflows, invest in digital enablement, and foster an open, agile culture. The pharmaceutical market is becoming increasingly competitive and knowledge-driven. MRs, as brand ambassadors, are under pressure to deliver complex messages in simplified formats to busy healthcare professionals. In this context, the PMT's role in equipping MRs with relevant, accurate, and accessible content becomes essential. This study indicates that when PMTs maintain open communication, organize regular training, and recognize the feedback of MRs, it significantly boosts morale, efficiency, and loyalty. MRs are not merely executors; they also generate critical market intelligence that can refine product strategies. Bridging the gap between PMT planning and MR execution is not just a matter of operations, but a competitive necessity for pharmaceutical companies.

7. Recommendations

- **Field Intelligence Integration:** Establish structured channels through which MRs can report competitive intelligence, HCP preferences, and field-level challenges, which PMTs must analyze and act upon.
- **Therapy-Specific Playbooks:** PMTs should co-create playbooks tailored to each therapeutic segment, containing key messaging, clinical evidence, objection-handling techniques, and product positioning strategies.
- **Internal Alignment Workshops:** Conduct quarterly workshops involving both PMTs and sales teams to discuss strategy updates, training feedback, and upcoming campaign rollouts.
- **Digital Enablement Suite:** Provide MRs with a mobile toolkit that includes sales tracking, e-detailers, explainer videos, voice notes, and AI-generated doctor profiles to personalize interactions.
- **Recognition Framework:** Create a formal structure to recognize MRs whose field insights lead to actionable improvements or strategic shifts. This can be tied to incentive programs or leadership grooming.
- **Build Transparent Feedback Loops:** PMTs should regularly review and respond to MR suggestions via digital dashboards or structured reporting mechanisms.
- **Launch Therapy-Specific Training Modules:** These should go beyond pharmacology and include objection handling, value-based selling, and competitive positioning.
- **Increase Field Interactions:** PMT managers should occasionally accompany MRs on field visits to understand real-world challenges and strengthen relationships.
- **Update Digital Tools:** Equip MRs with mobile-compatible content, video explainers, and AI-based CRM tools to improve efficiency.
- **Recognize and Reward Insights:** Highlight MR contributions during national sales meets or internal newsletters.

8. Conclusion

The alignment between Product Management Teams and Medical Representatives is central to pharmaceutical marketing success. This study highlights that MRs expect continuous, tailored support in training, product updates, and marketing execution. When their feedback is valued and their professional growth is supported, MRs become powerful agents of brand success. As pharma markets evolve toward greater personalization and data-driven decision-making, optimizing the PMT-MR dynamic can offer companies a strategic edge.

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Discernment of Fundamentalism and Extremist Behavior in ElnathanJohn's *Born on a Tuesday*

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Abstract:-
The novel *Born on a Tuesday* explores the roots of violent religious extremism through the tale of Dantala, a young man from Northern Nigeria who joins a group of boys involved in crime and boasts about violence. This narrative serves as a backdrop to examine issues like the Almajiri system, determinism, religious extremism, and terrorism. The analysis challenges the notion that Islam is inherently peaceful, given the prevalence of Muslim extremists. It investigates the growth and causes of religious fundamentalism, particularly in relation to Islam. It also reveals how the protagonist navigated life crises in an African cultural context, employing defence mechanisms like repression, sublimation, displacement, depression, anxiety, and disillusionment. The study even explores that the protagonist uses repression and sublimation to cope with oppressive conditions. The analysis explores various aspects of growth, including social, cultural, familial, sexual, and academic development, and examined the novelist's techniques in portraying the protagonist's journey from childhood to adulthood in a Nigerian context. The study finally concludes with recommendations for reforming the Almajiri system to prevent it from fostering terrorism.

Key Words :- Determinism, extremism, terrorism, sublimation, disillusionment and fundamentalism.

Introduction:-

The paper introduces various forms of fundamentalism and extremism, highlighting examples from different regions and religions, including Hindu fundamentalism targeting Rohingya Muslims in Myanmar, Christian fundamentalism in America, exemplified by the fundamentalists views. It also highlights the definitions of extremism, fundamentalism, Islamism, and Jihadism, which hinders integration of Muslim communities in Western societies and counter-extremism efforts. The select novel emphasize the importance of understanding these terms in context, defining extremism as a rejection of balance and application of a single ideological perspective with disdain for opposing views.

According to Winter and Hasan, confusion around terms like extremism, fundamentalism, Islamism, and Jihadism hinders Muslim community integration in Western societies and counter-extremism efforts. To avoid politicized definitions, they define extremism as a rejecting balance and applying a single ideology with disdain for alternatives, fundamentalism as a reading scripture literally, without historical or religious context, and jihadism as a specific to violent Islamist groups advocating total war against perceived enemies. Winter and Hasan says "they should never be discussed in isolation so that "their use as politically motivated rhetorical mechanisms does not determine their definition" (668). They define extremism" as a rejection of balance, and an application of a single ideological perspective to all elements of an individual's life with, importantly, a fervent disdain for alternative ideological perspectives" (669). Apart from this, they state "that 'fundamentalism' should be redefined simply in term of faith, as the reading of scripture without reference to normative religious and historical context" (674).

The truth, however, is that knowing the definition of terrorism or actions are but by intentions and every man shall have only that which he intended. This paper attempts to understand the effective counter-extremism strategies too. Counter- extremism manifests in various forms, including religious, political, and ideological extremism, and that it often involves the promotion of violence, hatred, or intolerance.

Religious Extremism in Modern Politics:-

Literature plays a significant role in exploring fundamentalism and extremism, serving as a platform for critical engagement and negotiation. Stories and fictional works help us to understand the complex issues, filling gaps in knowledge and providing insights into human experiences. By exploring these themes through literature, we can gain a deeper understanding of fundamentalism and its impact on individuals and societies, relationship between free will and predestination, raising questions about God's role in human affairs and the consequences of our choices. Through the lens of Elnathan John's *Born on a Tuesday*, the discussion examines the protagonist Dantala's journey and his experiences with the Kuka tree gang.

The analysis suggests that while experiences shape our fate, we still possess free will, enabling us to make choices that determine our future. Dantala's transformation and newfound understanding of the Kuka tree boys' humanity illustrates the complexity of human nature and the limitations of rigid labeling. Ultimately, it highlights the interplay between individual agency and the circumstances that shape our lives, emphasizing the importance of choice and personal responsibility. The character of Malam Abdul-Nuralso exemplifies this, showcasing a rigid and extreme interpretation of Islam. His interactions with Dantala and others demonstrate, how fear and obedience are instilled, often through manipulation and violence. Malam Abdul-Nur'sbehavior, including physical abuse towards his brother and wife, further illustrates his radical and controlling nature. Also radicalization on individuals, particularly children, and the potential consequences for society as a whole.

The complexities of Islamic sects and the biases also exist between Sunni and Shia Muslims. The Sheikh's teachings and Dantala's observations reveal the tensions and differences between the two groups. Prophet Muhammad emphasized the importance of loving and supporting Ali, which could imply acceptance of Shia Muslims as part of the broader Muslim community. However, the Sunni Sheikh's views on Shia practices, such as

their prayer schedule and Ashura celebrations, reveal deep-seated differences and biases. This portrayal encourages readers to think critically about the nuances of religious beliefs and practices, and the importance of understanding and respecting differing perspectives within the Muslim community.

Some Islamic practices and interpretations can be exploited to promote extremism. The repetition of attributing everything to Allah's will can lead to a fatalistic mindset, which can be manipulated by influential figures like Malams and Sheikhs. The regimented life of children memorizing the Quran and praying, but also experiencing basic human needs like hunger contrasts between the spiritual equality emphasized in prayer and the hierarchical treatment by Malam Junaidu. This encounter between Dantala and the bearded man after prayer adds a layer of complexity, showcasing a seemingly kind gesture amidst the rigid religious structure. This portrayal encourages one to think critically about the intersections of faith, power, and human experiences as:

Praying in congregation makes us equal before Allah, malam Junaidu liked to say, shoulder to shoulder. Even though of course he did not treat us like we were equal to him. My knees hurt when I kneel to pray but I don't mind. I am praying next to a short person. I think he is a boy like me until I turn and see he has a long thick beard. The prayer is over and 1 am thinking of what to eat when this man who is who prayed by my side stretches his hand to me and says, 'Salamualaikum."Waalaikumwassalam. I reply his voice is bigger than he is and sounds as if it is coming from some where out of his body. I wonder if the beard is heavy for his face. He asks me if I have eaten and tells me that there is free food outside the Mosque. (25)

The politicians exploit Quranic schools and mosques to further their interests. By providing free food and other benefits, they gain influence over the children and Imams, shaping their worldview and fostering extremist ideologies, instead of promoting positive values like love, peace, and coexistence, Imams and Mallams often preach hate and politics, fueling divisions and radicalization. This manipulation can have long-lasting effects on the children, making them susceptible to extremist ideologies. Actions are but by intentions and every man shall have only that which he intended. Thus he whose migration was to achieve some worldly benefit or to take some woman in marriage, his migration was for that for which he migrated.

The traditional practice of sending children away to memorize the Quran, known as Almajiranci, has become outdated and detrimental to society. Instead of benefiting from this practice, families are often destroyed, and society is burdened with social deviants. Therefore, those people have to advocate for a more practical and critical education that encourages critical thinking, problem-solving, and design thinking. This approach would involve a rounded education that includes humanities, sciences, and entrepreneurial studies. Furthermore, when the Sheikh begins to teach Dantala about Islam after he had seen the picture of Sheikh Inyass, which Dantala cherishes because of how his mother revered him, one sees how Dantala tries to admit reason because he does not see how cherishing a picture translates to joining of any other thing with Allah subawataalla. Now that Sheikh Jamal has decided to make Malam Abdul-Nur the headmaster of the new school that will be built. He begins to prepare himself for the job and tries it out with Dantala when he asks him these questions:

"If Allah asks you to do something, will you refuse?"
"No.' I said, confused.
Are you just saying it, or do you understand it, what. it means to do what Allah wants when He wants it.
without asking why?' (82)

Ultimately, this suggests that the Almajiranci system should be reformed or abolished in favor of a more modern and practical approach to education that prepares children for the challenges of the contemporary world.

Vulnerability of Children in Conflict:-

Continuous neglect and abuse of the child through religious extremists assaults have increased the number of children whose lives have become a threat to national unity and wellbeing due to their engagement in electoral rigging, riots, killings, and suicide bombing. Jeffrey William Lewis a researcher on international security issues and suicide bombings, observes that of the 151 attacks carried out in 2015 by Boko Haram in Nigeria, roughly 20 percent were carried out by teenagers or children. This is an alarming statistic that requires urgent attention if the nation's future, assured in its youth, is to be salvaged.

Societal negligence of religious oppression and we aponing of the child, if left unchecked, leaves society at the mercy of children who become unrecognisable and distorted citizens. When Prof Okafor in Adichie's Purple Hibiscus beats his son for stealing and selling his exam script to other students, Aunty Ifeoma's friend, although not justifying theft, becomes a voice of reason condemning Prof Okafor's initial negligence:

I do not justify it. What I am saying is that Okafor should not be surprised and should not waste his energy breaking a stick on his poor son's body. It is what happens when you sit back and do nothing about tyranny. Your child becomes what you cannot recognise. (248)

Sawicki's argument suggests that exposure to alternative perspectives can counteract indoctrination. However, dysfunctional family structures in the novel deprive children like Dantala and Jibril of such counter-narratives, leaving them vulnerable to extremist ideologies. Radical leaders like Abdul-Nur exploit this vulnerability, enforcing exclusionary beliefs and isolating children from society. This mirrors the real-world consequences of child soldiering, where children are exposed to violence, abuse, and psychological trauma, losing their childhood and facing long-term risks.

Religious fanaticism, like child soldiering, metes untold assault on the child. Religious seclusion and maltreatment cause enormous damage to the selfhood and the psyche of the child. Frank Faulkner rightly notes that "removal of basic necessities and protective mechanisms ensures that children are particularly vulnerable to all manner of influences. most notably where the family unit has been fragmented or destroyed completely in the chaos and confusion of war"(495). Abdul-Nur's spatial and emotional seclusion of the child from families, relatives, friends and the community enhances the vulnerability of the child, resulting in uncertainty, fear, sleeplessness, insecurity, physical and psychological effects and

ultimately leading to trauma. Seclusion creates a traumatizing sense of entrapment in the child. This feeling is exemplified in Jibril who relates to Dantala how trapped he feels within Abdul-Nur's camp, and how distorted his self has become with Abdul-Nur forcing them to take a definite side in religious bordering, to become insurgents and to shoot and kill the "unbeliever".

Jibril is terrified because already Malam Abdul-Nur has shot someone in the thigh who was caught trying to leave the premises. "He even has a little cell, where he keeps people who have committed offences' Jibril said. He swear not to tell anyone" (195). In a secret text message, he sends to Dantala, Jibril attests to his distorted self saying: "shooting makes me feel both scared and as if someone is shocking my body with electricity. Shooting makes me feel like I have drunk something to make me high" (208). Dantala, though outside Abdul-Nur's camp, connects to Jibril's fear as he recalls the guilt that grips him after being used to kill the members of the Big party during the political crisis in Bayan Layi. For Dantala it "feels like someone has tied his intestine in tight knots. and the whole world was crashing on his head" (209). Dantala is also subjected to similar state of confusion, as he is caught between loyalty to Malam Sheikh, and the fear of conflict.

Religious fanaticism and child soldiering inflict severe harm on children, causing psychological trauma and damage to their selfhood. Abdul-Nur's isolation of children from their families and communities exacerbates their vulnerability, leading to fear, insecurity, and trauma. The children, like Jibril, feel trapped and experience distorted selves as they are forced to take sides and commit violent acts. Jibril's testimony reveals the terror he feels, and Dantala's experiences echo similar emotions, highlighting the long-lasting impact of violence and manipulation on their young minds. In the instance of religious extremism, the child becomes unrecognisable having been subjected to forceful physical and mental torture, all of which destroys the freedom of the child so that he or she will carry out the will of the group's leaders. Even a few other authors laments the rate at which state and non-state negligence in Nigeria's case, has contributed to the maturity of the child as foot soldiers "on the taste of blood"; a maturity perceptible also in the child's "graduation" from the use of "knives and machetes, bows and poisoned arrows to AK-47s, homemade bombs, and explosive-packed vehicles".

Conclusion:-

To end violence fueled by religious divisions and extremism, especially against children, global cooperation beyond borders is crucial. While one unified religion isn't feasible due to diverse ideologies, achieving religious tolerance is possible through absolute inclusivity. Elnathan John's novel *Born on a Tuesday* highlights this by showing how different religious groups in Sokoto unite to combat cholera, demonstrating the need to put aside differences for the greater good. The novel metaphorically equates child abuse with societal disease, emphasizing the harm caused by forcing children into conflict and extremist ideologies. This not only damages the child's well-being and development but also affects society's structure. To foster religious tolerance, accepting the relativity of morality and truth is essential, as is adopting a positive perspective towards others' beliefs. John stresses the

importance of abandoning superiority complexes among religious groups to bridge divides, particularly in diverse places like Nigeria. Insecurity persists globally, with extremist groups exploiting children as insurgents and suicide bombers. Children caught between dysfunctional families, corruption, and religious extremism face dire consequences. To combat this, governments, scholars, and society must prioritize addressing underlying vulnerabilities like poverty and unemployment. Families and society should prioritize children's needs, while governments must tackle corruption and ensure social development. By addressing socio-economic disparities, especially in regions like northern Nigeria, we can break the cycle of violence and find a lasting solution to insurgency.

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Legislative Initiatives for the Protection of E-Commerce: An Indian and Global Perspective

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Abstract

In the 21st century, e-commerce has emerged as a cornerstone of the global digital economy, significantly transforming the landscape of trade, business, and consumer interaction. This paper explores the legislative efforts—both in India and globally—to regulate and protect the evolving domain of e-commerce. It critically examines various legal instruments such as declarations, conventions, treaties, and domestic statutes enacted to ensure a fair, secure, and efficient e-commerce environment. Particular emphasis is laid on key international frameworks like the United Nations Conference on Trade and Development (UNCTAD), the World Trade Organization (WTO), and the Organisation for Economic Co-operation and Development (OECD), as well as significant Indian laws including the Information Technology Act, 2000 and the Consumer Protection Act, 2019. Moreover, the study highlights notable judicial pronouncements that have interpreted these legislative measures and contributed to the evolving jurisprudence of e-commerce. By analyzing these initiatives, this paper aims to provide a comprehensive understanding of the regulatory ecosystem of e-commerce and suggest reforms to bridge the gaps and enhance global legal harmonization.

Introduction

E-commerce, or electronic commerce, refers to the digital mode of conducting commercial transactions over the internet. It encompasses a wide array of activities such as online retailing, digital banking, electronic data interchange (EDI), mobile commerce, and business-to-business (B2B) or business-to-consumer (B2C) interactions. With the proliferation of internet access, mobile technology, and digital payment systems, e-commerce has transcended traditional boundaries and evolved into a critical component of the modern economy. Globally, e-commerce has enabled small and medium-sized enterprises (SMEs) to reach international markets, democratized access to goods and services, and provided consumers with greater convenience and choice. In India, the sector has seen exponential growth, fueled by government initiatives like Digital India, the rise of internet penetration in rural areas, and an increasingly tech-savvy population. According to industry reports, India's e-commerce market is expected to reach USD 200 billion by 2026. However, with these advantages come significant challenges. E-commerce transactions often involve the exchange of sensitive personal and financial data, exposing users to risks like identity theft, data breaches, and online fraud. There is also the concern of counterfeit products, unfair trade practices, and lack of accountability of intermediaries such as online marketplaces.

Additionally, the borderless nature of digital commerce presents regulatory challenges including jurisdictional ambiguity, digital taxation, and enforcement of cross-border legal norms.

To address these issues, robust legal frameworks have become indispensable. National legislatures and international organizations have recognized the need to regulate e-commerce comprehensively. This includes laws pertaining to electronic transactions, consumer rights, cybercrime, taxation, data protection, and digital signatures. Judicial bodies also play a critical role by interpreting these laws, setting legal precedents, and ensuring that evolving digital practices are aligned with established legal principles.

This paper begins by outlining global and Indian legislative efforts aimed at safeguarding e-commerce and then examines key judicial decisions that have helped shape the regulatory landscape. The objective is to critically evaluate the effectiveness of current legal mechanisms and recommend ways to enhance the legislative ecosystem to meet the evolving demands of the digital marketplace.

E-commerce refers to the buying and selling of goods and services using electronic networks, primarily the internet. The exponential rise in e-commerce has redefined business operations, necessitating comprehensive legal frameworks for consumer protection, taxation, cyber security, and dispute resolution. Legislative and judicial measures are crucial in mitigating risks associated with digital transactions and building trust among users.

Meaning, Scope, and Need of E-Commerce Regulation

E-commerce includes a range of activities like online retailing, digital services, financial transactions, and cross-border trade. Its regulation is vital to address concerns of privacy, fraud, taxation, intellectual property, and contractual enforcement. A lack of uniform laws can result in jurisdictional conflicts, tax evasion, and consumer exploitation, making regulatory intervention essential. E-commerce, or electronic commerce, is broadly defined as the process of conducting commercial transactions using digital platforms. This includes not only the buying and selling of goods and services online, but also a wide spectrum of activities such as online banking, digital content distribution, mobile commerce (m-commerce), online auctions, business-to-business (B2B) transactions, cloud-based service agreements, and the use of electronic payment systems and cryptocurrencies.

The scope of e-commerce extends across domestic and international borders, involving various stakeholders including consumers, businesses, service providers, financial institutions, and regulatory authorities. With the rapid advancement of technology and the increasing digitization of economic activities, the boundaries of traditional commerce have been significantly redefined. E-commerce platforms have become intermediaries facilitating not only sales but also logistics, payments, and customer service, often involving complex contractual relationships.

Given its expansive scope, e-commerce regulation is critical to ensure trust, security, and legal certainty in digital transactions. Key regulatory needs include:

• **Privacy and Data Protection:** As e-commerce relies heavily on the collection and processing of personal data, regulation is essential to protect consumer privacy and prevent data misuse.

• **Prevention of Fraud and Cybercrime:** Regulatory mechanisms are necessary to combat cyber threats such as phishing, identity theft, financial fraud, and ransomware attacks.
• **Consumer Protection:** Clear legal frameworks help protect consumers from unfair trade practices, misleading advertisements, fake reviews, and substandard products.
• **Taxation and Compliance:** Regulation ensures that e-commerce entities contribute fairly to the economy through proper tax compliance, including indirect taxes like GST and digital services taxes.
• **Intellectual Property Rights (IPR):** E-commerce platforms often serve as distribution hubs for copyrighted works, trademarks, and patented products, making the enforcement of IPR vital.
• **Contractual Enforcement and Dispute Resolution:** Regulations provide legal backing for digital contracts, electronic signatures, and efficient mechanisms for grievance redressal.

Furthermore, the absence of harmonized global regulations creates jurisdictional ambiguity, enabling tax avoidance and legal arbitrage by multinational digital firms. This disparity not only affects national revenues but also undermines consumer confidence. Therefore, coordinated efforts are needed at both national and international levels to create a coherent, secure, and inclusive e-commerce ecosystem.

3. Global Legislative Initiatives

3.1 United Nations Conference on Trade and Development (UNCTAD)

UNCTAD plays a pivotal role in promoting inclusive digital economies. It conducts research and offers policy advice to developing nations to formulate e-commerce strategies. Reports like “Digital Economy Report” and “Information Economy Report” emphasize legal harmonization and infrastructural development for digital trade.

3.2 UNCTAD E-Commerce and Law Reform Programme

This initiative aids developing countries in reforming their legal structures to accommodate e-commerce. The program covers electronic transactions, cybercrime, consumer protection, and data privacy. It promotes regional cooperation for legislative convergence.

3.3 World Trade Organization (WTO)

The WTO Work Programme on Electronic Commerce, established in 1998, examines the trade-related aspects of e-commerce. Though there is no standalone WTO treaty on e-commerce, discussions continue around taxation, digital goods, customs duties, and cross-border data flows. A notable achievement is the “moratorium on customs duties” on electronic transmissions.

3.4 International Treaties and Declarations

UNCITRAL Model Law on Electronic Commerce (1996) and **Model Law on Electronic Signatures (2001)**: These frameworks provide legislative templates for member countries.

OECD Guidelines for Consumer Protection in E-commerce (2016): Encourages member nations to adopt consumer-friendly e-commerce laws.

Budapest Convention on Cybercrime (2001): Addresses legal cooperation on cyber threats and electronic evidence.

4. Indian Legislative Framework

4.1 Information Technology Act, 2000

This is the cornerstone of Indian cyber law. It provides legal recognition to electronic transactions and signatures, regulates intermediaries, and criminalizes cyber offences like hacking, data theft, and identity theft. Sections 43, 66, 72, and 79 are especially relevant to e-commerce.

4.2 Consumer Protection Act, 2019 (with E-commerce Rules 2020)

The 2019 Act includes explicit provisions for online transactions. It introduces e-commerce guidelines related to:

- Transparency in advertisements and product listings
- Disclosure of seller information
- Grievance redressal mechanisms
- Liability of platforms for counterfeit goods
- These rules apply to both marketplace and inventory-based models.

Foreign Direct Investment (FDI) Policy in E-Commerce

The Indian government restricts FDI in inventory-based e-commerce but allows 100% FDI under the marketplace model. This is intended to create a level playing field and protect domestic retailers.

4.4 Taxation Laws and GST on E-Commerce

Section 52 of the CGST Act, 2017, introduces Tax Collected at Source (TCS) for e commerce operators. Additionally, equalization levy and significant economic presence criteria under the Income Tax Act aim to tax foreign digital businesses operating in India.

5. International Legislative Comparison

Aspect			
E-signatures	IT Act, 2000	E-SIGN Act (2000)	eIDAS Regulation
Data Protection	Pending DPDP Bill	CCPA	GDPR

Aspect			
Consumer Rights	CPA, 2019	FTC Guidelines	EU Consumer Rights Directive
Taxation	GST + Equalization Levy	Internet Tax Freedom Act (temporary ban)	VAT on digital services

6. Internet Tax Freedom Act (USA)

The **Internet Tax Freedom Act (ITFA)** is a landmark U.S. legislation enacted in **1998** that played a crucial role in shaping the digital economy. Its core objective was to **promote internet adoption, innovation, and investment** by eliminating certain types of taxation that could impede access and growth of the internet . In the mid-1990s, the internet was rapidly evolving into a transformative force in commerce, education, communication, and government services. Recognizing the immense potential of this new medium, U.S. policymakers were concerned that premature or inconsistent taxation at state and local levels might discourage internet adoption and investment. Thus, the U.S. Congress enacted the **Internet Tax Freedom Act** on **October 21, 1998**, with **bipartisan support**. The Act was originally intended as a temporary measure, providing a **moratorium (ban)** on certain taxes related to internet access and electronic commerce for a **three-year period**. However, it was extended multiple times due to continued reliance on its provisions, and finally made **permanent in 2016** through the **Trade Facilitation and Trade Enforcement Act**.

The ITFA prohibits three major forms of internet-related taxation:

a) Tax on Internet Access

State and local governments are barred from imposing taxes on the basic service of accessing the internet.

This means that charges you pay to ISPs (like broadband or dial-up fees) are **not subject to additional state/local taxes**.

b) Multiple Taxation

The Act prohibits multiple jurisdictions (e.g., multiple states) from taxing the same e-commerce transaction, which can happen in the case of cross-border digital transactions.

c) Discriminatory Taxes on E-Commerce

It disallows states from imposing taxes on internet commerce that are **not applied equally to traditional commerce** (e.g., taxing online sales at a higher rate than physical store sales).

Exemptions and “Grandfather Clause”

Some states that had already imposed taxes on internet access **prior to October 1, 1998** were granted a **"grandfather clause"**. These states (like Texas, Wisconsin, and Ohio) were allowed to continue collecting those taxes until the final repeal in 2016.

Impact of the Act

a) Boosted Internet Accessibility

Helped expand internet infrastructure and made internet services affordable and widely accessible.

b) Stimulated E-Commerce and Digital Innovation

Created a predictable and tax-neutral environment that encouraged investment in the tech sector. Provided a safe harbor for e-commerce businesses to grow without being subject to conflicting state tax regimes.

c) Influence on Global Tax Policy

The ITFA inspired similar tax-free frameworks in other countries during the early stages of internet growth. It also triggered global debates on **how to balance digital innovation with equitable tax collection**, especially from tech giants. The **Internet Tax Freedom Act** was a forward-looking legislation that catalyzed the digital revolution in the U.S. by ensuring **tax neutrality and affordability of internet access**. While it achieved its goal of promoting early internet adoption, it also sparked a larger global conversation on **how to design fair and effective digital tax systems** in a rapidly evolving technological landscape.

Cyber Laws and E-Commerce

Cybersecurity and data protection are integral to secure e-commerce. In India, the CERT-IN guidelines under the IT Act mandate data breach reporting and cybersecurity audits. Globally, laws such as the GDPR have far-reaching implications for e-commerce businesses operating across borders.

E-commerce thrives on the transmission of sensitive data, including personal details, payment information, and trade secrets. This makes it a lucrative target for cyberattacks such as:

- Phishing and identity theft
- Data breaches and ransomware
- Website defacement and financial fraud

Cyber laws are essential to **prevent**, **detect**, **respond to**, and **prosecute** such threats. They provide **legal certainty** and define the rights, responsibilities, and liabilities of various stakeholders involved in online commerce.

Cyber Laws in India for E-Commerce

India has developed a legal framework to secure digital transactions, largely centered around the **Information Technology Act, 2000 (IT Act)** and its amendments.

a) IT Act, 2000 – Key Provisions for E-Commerce:

Section 43A: Compensation for failure to protect sensitive personal data.

Section 66: Penalty for hacking and identity theft.

Section 72A: Punishment for disclosure of personal information without consent.

Legal recognition of electronic contracts and **digital signatures** (Sec. 4–10A).

b) CERT-In Guidelines (2022):

The **Indian Computer Emergency Response Team (CERT-In)**, under the Ministry of Electronics and IT, issued binding guidelines to enhance cybersecurity. Key mandates include:

Mandatory reporting of cybersecurity incidents (within 6 hours).

Log retention by e-commerce platforms and ISPs for 180 days.

Regular cybersecurity audits by critical sectors.

KYC compliance and data localisation for VPN providers.

These are especially significant for e-commerce entities dealing with consumer data and digital payments.

Cyber laws and data protection regulations are **indispensable tools** for ensuring the security, privacy, and trustworthiness of e-commerce platforms. In an era of digital globalization, legal compliance is no longer optional but a **strategic necessity** for sustainable growth and international market access. Policymakers, businesses, and consumers must work together to foster a secure and lawful e-commerce ecosystem.

Judicial Perspective

Indian courts have played a proactive role in interpreting e-commerce laws:

Google India Pvt. Ltd. v. Visaka Industries (2011): Addressed intermediary liability under Section 79 of the IT Act.

Amazon Seller Services v. Amway India (2019): Examined e-commerce platforms' obligations in dealing with trademark violations.

RBI v. Internet and Mobile Association of India (2020): Highlighted judicial scrutiny over digital payment bans impacting e-commerce.

Challenges and Recommendations

Lack of uniform international laws: Jurisdictional overlaps and enforcement issues hinder global e-commerce.

Data privacy concerns: Urgent need for strong data protection frameworks.

Tax evasion by foreign digital firms: Requires coordinated efforts like the OECD's BEPS framework.

Digital divide: Infrastructure gaps must be bridged to promote inclusive growth.

Recommendations:

Harmonization of laws using UNCITRAL and WTO principles.

Timely enactment of India's Data Protection Law.

Judicial training in cyber law.

Global tax treaties for digital economy governance.

Conclusion

E-commerce is reshaping the economic landscape, demanding robust and harmonized legal frameworks. While India has taken commendable steps through the IT Act and Consumer Protection Act, there remains a need for integrated global cooperation. Legislative reform, judicial insight, and international consensus are the pillars on which a secure and flourishing e-commerce ecosystem must rest.

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Sustainable Development in the Indian Logistics Industry: Improving Environmental Protection and Lowering Carbon Footprint

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Abstract

In India, the logistics industry plays a vital role in economic expansion, but it also contributes significantly to environmental damage and carbon emissions. Since the majority of the sector's greenhouse gas emissions come from road transport, sustainable logistics techniques are becoming more and more important. The many facets of sustainable development in the Indian logistics sector are examined in this study, including green logistics, governmental regulations, technological advancements, and industry best practices. Through the analysis of secondary data and case evidence, specifically from Mahindra Logistics Ltd., the study demonstrates the concrete environmental advantages of sustainable logistics practices like energy-efficient warehousing, fleet electrification, route optimisation, and sustainable packaging.Road transport emissions have been steadily rising, according to statistical analyses, and this has a direct effect on the quality of the air in major Indian cities. In order to support the transition to low-carbon logistics, the study also offers workable policy recommendations, including carbon taxes, multimodal infrastructure investments, electric vehicle subsidies, and awareness campaigns. The overall goal of this study is to give stakeholders a road map for promoting environmental preservation in India's logistics industry while preserving operational effectiveness.

Keywords: Sustainable Logistics, Carbon Emissions, Green Supply Chain, Environmental Policy

Introduction

The logistics sector, which facilitates the movement of goods and services across the country, significantly boosts India's economy. However, as it expands, concerns about the environment, particularly carbon emissions, are growing. 14% of India's total greenhouse gas (GHG) emissions are caused by the industry's heavy reliance on fossil fuels for distribution, warehousing, and transportation operations (Ministry of Road Transport & Highways, 2021). It is anticipated that India's increasing industrialisation, urbanisation, and consumerism will raise demand for logistics services and possibly exacerbate the environmental effects of the nation. Due to national and international efforts to slow down climate change, the logistics sector is now placing a strong emphasis on sustainable development. Sustainable development is a comprehensive approach that balances economic growth, environmental protection, and social advancement. The logistics sector may use advanced technologies like big data analytics, artificial intelligence (AI), and electric vehicles, optimise supply chains to reduce emissions, and adopt green logistics practices to reduce environmental harm.Using sustainable logistics practices aligns with India's commitment to the UN Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure)

and SDG 13 (Climate Action) (Sustainable Development Goals, 2021). In response to these international commitments, the Indian government has initiated several initiatives to decarbonise the transportation and logistics sector, including the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) program and the National Electric Mobility Mission Plan.

Regardless these initiatives, India faces several challenges in its transition to a sustainable logistics framework. The quick adoption of sustainable practices is hampered by a lack of knowledge among small and medium-sized businesses (SMEs) in the logistics industry, the high expense of green technologies, and inadequate infrastructure. For instance, despite being more ecologically friendly and using less fuel than road transport, rail and water transport still only account for a small portion of India's logistics mix (GIZ India, 2020). Since moving goods by road is still the most popular option, cutting emissions ought to be a primary concern. However, the use of diesel-powered trucks in road transport raises carbon emissions.

This article will concentrate on reducing carbon emissions and enhancing environmental protection in order to provide a better understanding of the current state of sustainable growth in the Indian logistics sector. By analysing secondary data, the study examines changes in carbon emissions and identifies significant change agents, including new laws, technological developments, and green logistics initiatives. The report also includes a case study of Mahindra Logistics Ltd., a leader in sustainable logistics practices, to demonstrate the value of green initiatives in reducing carbon emissions.Furthermore, the study provides valuable insights for businesses and policymakers, emphasising the role that financial incentives, public-private partnerships, and technology adoption play in fostering the long-term transformation of India's logistics sector. In order to balance its responsibilities to the environment with its ambitions for economic expansion as it establishes itself as a global economic leader, India will need to implement sustainable logistics practices.

Literature Review

Interest in sustainable development in the logistics industry is rising, particularly in nations like India where rising greenhouse gas (GHG) emissions are a result of fast industrialisation and urbanisation. Numerous studies that look at environmental, economic, and technological aspects have emphasised the necessity of sustainable logistics practices to lower the carbon footprint. Green logistics, government regulations, industry practices, and technological advancements are some of the major topics covered in this literature review on sustainable logistics, with an emphasis on how they are applied in India.

Green Logistics and Environmental Sustainability

Efforts to lessen the environmental impact of logistics operations are referred to as "green logistics." These include increasing supply chain efficiency, lowering fuel consumption, converting to alternative energy sources, and optimising routes. According to McKinnon et al. (2010), green logistics programs can drastically cut emissions associated with transportation if companies are prepared to make investments in greener practices and technologies. In a similar vein, Ramanathan et al. (2014) stress that green logistics offers

financial benefits in the form of cost savings through waste reduction and fuel efficiency in addition to environmental benefits.

Green logistics is still relatively new in India. According to Singh et al. (2020), only a small percentage of businesses have completely incorporated green practices into their logistics operations, despite growing awareness. High prices, a dearth of sustainable technology, and lax enforcement of regulations are some of the difficulties. Nonetheless, businesses that have implemented green logistics techniques, like energy-efficient warehouses and reverse logistics, have reported a significant decrease in their operating expenses and carbon emissions, according to Kumar and Anbanandam (2022).

Government Policies and Regulations

It is impossible to overstate the importance of government regulations in advancing sustainable logistics. According to Christopher (2011), governments must establish a supportive legislative framework that encourages green logistics. Carbon taxes on high-emission vehicles, electric vehicle subsidies, and investments in green infrastructure can all help achieve this. The Indian government has implemented a number of measures to lessen the carbon footprint of the logistics industry. Two notable programs aimed at advancing electric vehicles in the logistics industry are the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) program and the National Electric Mobility Mission Plan (Ministry of Heavy Industries, 2020).

However, the fragmented nature of policy implementation in India is criticised by Banerjee and Dutta (2021). Even though the government has made progress in encouraging electric mobility, they contend that a major obstacle still exists in the form of inadequate charging infrastructure, especially in rural areas. Furthermore, the logistics industry in India is largely dependent on road transport, which carries more than 60% of all freight in the nation, as noted by Kumar and Sharma (2019). Infrastructure needs to be heavily invested in in order to transition to more environmentally friendly forms of transport like rail and water, which are currently underfunded.

Technological Innovations and Sustainable Logistics

Innovations in technology are essential to promoting sustainability in logistics. Innovations like artificial intelligence (AI), big data analytics, and the Internet of Things (IoT) can optimise supply chains, cut waste, and boost fuel efficiency, according to Waters (2010). According to Jena et al. (2019), businesses can minimise idling time and emissions by using IoT-enabled fleet management systems to track vehicle performance in real-time. AI can also be used to forecast demand, optimise routes, and simplify logistics processes. The use of technology in logistics is expanding in India, especially in the cities. According to Mukherjee and Das (2022), the logistics industry could drastically cut emissions by implementing AI and IoT, particularly in urban logistics. They note that businesses have reduced their fuel consumption by up to 20% by implementing fleet management and route optimisation technologies. They do, however, warn that small and medium-sized businesses (SMEs) in India may find it difficult to adopt these technologies due to their high upfront costs.

Industry Practices and Sustainability Efforts

Numerous studies have examined logistics companies' sustainability initiatives. In India, Mahindra Logistics Ltd. (2022) is frequently mentioned as an example of sustainable logistics methods. Energy-efficient warehouses, fleet electrification, and supply chain optimisation through digital tools are just a few of the green initiatives the company has put into place. Ghosh et al. (2021) claim that Mahindra's initiatives have reduced their overall carbon footprint by 15%, serving as a model for other businesses in the industry.

Dey et al. (2020) contend that, in a larger industry context, sustainable logistics is turning into a business advantage. Businesses that exhibit a dedication to sustainability are increasingly preferred by investors and customers. According to Sarkar and Bhattacharya (2021), businesses that implement green practices frequently see increases in their market share, customer loyalty, and brand image.

Bhattacharyya et al. (2020) warn that even with these advantages, implementing sustainable practices remains a major obstacle for many Indian logistics companies, especially SMEs. These include a lack of access to green technologies, financial limitations, and a lack of awareness regarding best practices for sustainability. They contend that in order to assist these businesses in making the shift to sustainable logistics, government organisations and trade associations should collaborate to offer financial and educational assistance.

Carbon Footprint and Emission Trends in India’s Logistics Sector

Analysing carbon footprints is essential to comprehending how logistics affect the environment. Road transport alone accounts for almost 70% of the carbon emissions of the Indian logistics industry, according to Das and Singh's (2018) analysis. India must implement sustainable logistics practices since, according to their study, if current trends continue; emissions related to logistics could rise by 40% over the next ten years.

India is one of the top nations with the highest emissions related to logistics, according to a 2020 International Energy Agency report that also emphasised the sector's contribution to global emissions. In order to combat this, Sharma et al. (2021) suggest switching to more fuel-efficient modes of transportation, such as rail and water. They contend that in order to lessen reliance on road transport, government policies should give priority to investment in these sectors. There is broad agreement in the literature regarding the necessity of sustainable development in the logistics industry in India. Although government regulations, technological advancements, and green logistics present encouraging paths towards lowering carbon emissions, the industry faces many obstacles, such as exorbitant costs and inadequate infrastructure. According to the reviewed studies, although there has been progress, especially in major cities and by top logistics firms, a concerted effort by the public and private sectors as well as industry stakeholders is required to encourage the general adoption of sustainable logistics practices in India.

Purpose of the Study

The purpose of this study is to investigate how sustainable logistics can lower carbon emissions in India. In order to find trends and patterns in the carbon footprint of the logistics

industry, it explores tactics like smart transportation systems, fuel-efficient cars, and green logistics in addition to analysing secondary data.

Objectives of the Study

- To examine the environmental impact of logistics operations in India and evaluate the contribution of sustainable logistics practices.
- To evaluate how policies, technology, and industry practices support sustainable logistics, using Mahindra Logistics Ltd. as a green transformation model.

Scope of the Study

The study on "Sustainable Development in the Indian Logistics Sector: Reducing Carbon Footprint and Enhancing Environmental Protection" aims to provide a comprehensive analysis of sustainability in India's logistics sector.

Carbon Footprint in the Indian Logistics Sector

Table 1: Carbon Footprint in the Indian Logistics Sector (in Metric Tons of CO_2)

Year	Total Emissions	Road Transport	Rail Transport	Maritime Transport
2015	450,000,000	315,000,000	67,500,000	22,500,000
2017	500,000,000	360,000,000	70,000,000	30,000,000
2019	540,000,000	396,000,000	71,000,000	36,000,000
2021	580,000,000	435,000,000	69,600,000	41,400,000

Source : Ministry of Road Transport & Highways (2021)

This table provides a clear view of the distribution and trends of carbon emissions within the logistics sector in India, highlighting the need for targeted interventions to reduce emissions, particularly in road transport.

Road transport: This sector continues to be the biggest source of carbon emissions, and its proportion of overall emissions has been steadily rising over time. This illustrates how heavily the industry depends on diesel-powered automobiles.

Rail Transportation: Although rail transportation's emissions as a percentage of overall emissions have declined, rail transportation is still more fuel-efficient than driving.

Maritime Transport: Although they have slightly increased recently, emissions from maritime transport have stayed largely constant.

Air Transport: Despite making up a smaller portion of overall emissions than road transport, air transport has seen a slight decline in emissions as a percentage of total emissions, which is indicative of the increasing efficiency of air logistics.

Statistical Analysis of Carbon Emissions

Secondary data from a number of sources, including the International Energy Agency (IEA) and the Ministry of Road Transport & Highways, were examined in order to determine the magnitude of carbon emissions from the logistics industry.

Table 2: Magnitude of carbon emissions from the logistics industry

Year	Total Emissions (in $MtCO_2$)	Road Transport (%)	Rail Transport (%)	Maritime Transport (%)
2015	450	70	15	5
2017	500	72	14	6
2019	540	73	13	6
2021	580	75	12	7

Road transport is the logistics industry's biggest source of carbon emissions, as the table illustrates, and emissions have been rising over time. Though comparatively more sustainable, rail and maritime transportation are still underutilised.

Impact of Logistics on Air Quality

Due in large part to emissions from road transport, the logistics industry contributes significantly to air pollution in India. The statistical table that follows illustrates how logistics operations affect air quality, with a particular emphasis on nitrogen dioxide (NO_2) and particulate matter (PM2.5) levels in significant Indian cities with high logistics activity. The information demonstrates how logistics-related emissions lead to poor air quality and the related health effects.

Table 3: Impact of Logistics on Air Quality in Major Indian Cities

City	Average PM2.5 Concentration ($\mu g/m^3$)	Average NO_2 Concentration ($\mu g/m^3$)	Major Logistics Activity Source	Data Year	Source
Delhi	150	200	High road transport and warehousing	2022	Central Pollution Control Board (CPCB)
Mumbai	120	180	Port activities and road transport	2022	Maharashtra Pollution Control Board (MPCB)
Bengaluru	100	160	Road transport and logistics	2022	Karnataka State Pollution

			hubs		Control Board (KSPCB)
Chennai	110	170	Port activities and road transport	2022	Tamil Nadu Pollution Control Board (TNPCB)
Kolkata	130	190	Road transport and industrial activity	2022	West Bengal Pollution Control Board (WBPCB)

Case Study: Green Logistics at Mahindra Logistics Ltd.

Introduction

Green logistics practices have been pioneered by Mahindra Logistics Ltd. (MLL), a prominent participant in the Indian logistics industry. The implementation of various sustainability initiatives by MLL to lower its carbon footprint and improve environmental protection is examined in this case study. By examining MLL's methodology, we can learn useful tactics for incorporating sustainability into logistics processes.

Company Overview

A division of the Mahindra Group, Mahindra Logistics Ltd. provides supply chain and integrated logistics solutions for a variety of industries. MLL is a major force in the logistics industry in India, with a fleet of over 6,000 vehicles and a network that spans more than 200 locations. The company's strategic efforts to lessen its impact on the environment and promote green logistics demonstrate its dedication to sustainability.

Table 4: Mahindra Logistics Sustainability Initiatives – Summary (2023)

Category	Aspect	Details
Fleet & Emissions	Fleet Composition	Over 150 electric vehicles (EVs) in operation
	Emission Reduction (EVs)	Approx. 5,000 tons of CO_2 emissions reduced annually
	Charging Infrastructure	50+ EV charging stations installed at key logistics hubs
Energy & Infrastructure	Energy Savings	Up to 30% reduction in energy consumption via LEDs, HVAC systems, and insulation
	Green Certifications	Several warehouses received LEED certification
Efficiency Measures	Fuel Savings	15% reduction in fuel consumption through route optimization
	Emission Reduction (Routes)	Approx. 12% decrease in CO_2 emissions via optimized logistics routes

Waste & Materials	Recycled Materials	Over 40% of packaging materials are recycled or biodegradable
	Waste Reduction	20% reduction in packaging waste through improved design and material use
People & Engagement	Training Programs	Regular training for 1,000+ employees on sustainable logistics and environmental protection
	Employee Engagement	25% increase in employee participation in sustainability initiatives

Source: Mahindra Logistics. (2023). Sustainability Report 2023. Mahindra Logistics Ltd.

Results and Impact

Mahindra Logistics Ltd. is a prime example of how incorporating green logistics techniques can result in significant operational and environmental advantages. MLL has made great progress in lowering its carbon footprint and advancing environmental protection by emphasising fleet electrification, energy-efficient warehousing, route optimisation, sustainable packaging, and employee training. This case study demonstrates how other logistics companies in India could follow suit and help create a more sustainable future. Due to the company's efforts, GHG emissions have significantly decreased, and it has established a standard for sustainable logistics in India.

Table 5: Policy Recommendations for Sustainable Logistics

Policy Area	Suggestion
Subsidies for Electric Vehicles	Expand government subsidies for EVs, specifically targeting the logistics sector to reduce operational costs
Infrastructure Development	Invest in rail and maritime transport to reduce dependence on road-based logistics
Awareness Campaigns	Launch government and industry-led campaigns to educate logistics firms on sustainable practices
Carbon Taxation	Implement a carbon tax on high-emission vehicles to encourage eco-friendly alternatives

Conclusion

Given the startling increase in carbon emissions from logistics activities, especially those dominated by road transport, the study unequivocally demonstrates that sustainable logistics is now a necessity for India rather than an option. It is clear from a multifaceted examination of environmental data, policy frameworks, and corporate initiatives that industry participants, governmental entities, and civil society must work together to achieve measurable environmental results. The Mahindra Logistics Ltd. case study demonstrates how integrated sustainability strategies can set industry standards and drastically lower a company's carbon footprint. Nonetheless, there are still issues with insufficient infrastructure, expensive technology adoption for SMEs, and uneven policy enforcement. The study suggests a combination of knowledge-dissemination initiatives, infrastructure investments, and

regulatory incentives to address these. If properly carried out, these actions have the potential to make the Indian logistics industry a sustainable development model that supports both domestic and international environmental objectives.

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The Silent Scars: Exploring Childhood Trauma in Arundhati Roy's *The God of Small Things*

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Abstract

This paper analyses the theme of childhood trauma in Arundhati Roy's Booker Prize-winning novel *The God of Small Things*. The study examines how emotional neglect, parental abuse, societal pressure and exposure to violence collectively form the psychological development of the twin protagonists, Estha and Rahel. The novel deals with trauma not as a singular event but as a layered and collective experience that deeply impacts identity, relationships and emotional well-being. Through characters like Ammu, Baby Kochamma and Chacko, Roy sheds light on how adult failures and generational violence are internalised by children, often leading to alienation, silence and identity crises. Estha's retreat into muteness and Rahel's disconnection from her roots are interpreted as trauma responses. Furthermore, the narrative suggests that unresolved childhood trauma can result in unconventional coping mechanisms, such as emotional withdrawal and taboo relationships. By analysing the familial dynamics, sociocultural backdrop and psychological consequences depicted in the novel, this paper highlights the critical importance of emotional nourishment and mental health awareness in childhood. Roy's work serves as a powerful literary case study in understanding the long-term effects of psychological trauma inflicted during formative years.

Keywords: Childhoodtrauma, parental abuse, identity crisis, emotional neglect, postcolonial family, mental health, verbal abuse, generational violence.

Arundhati Roy's *The God of Small Things* is a touching psychological novel that dissects the major causes of childhood trauma within a socio-politically oppressive context. Through the catastrophic lives of the twin protagonists, Estha and Rahel, Roy brings discusses the invisible, long-lasting wounds that children bear in dysfunctional families and oppressive societies. The novel is not only a literary narrative but also a clinical record of emotional and psychological damage caused by parental neglect, societal judgment, domestic violence and emotional repression. Shibiin "Trauma in Arundhati Roy's *The God of Small Things*"states, "The technique used in *The God of Small Things* itself is a trauma narrative. The narration itselfshows that the novel outwardly exhibits the symptoms of trauma. One of the important purposes ofthe trauma narrative is to reproduce the trauma for the readers to experience the same once again" (2526).The tender psyche of children is portrayed as being

constantly shaped and often shattered by the world around them. Their trauma is not instant, but cumulative and prolonged, forged in both spoken cruelty and silent abandonment.

A major source of trauma in the lives of the twins evolves from their emotionally unstable relationship with their mother, Ammu and the grandmother Baby Kochamma. The story which encompasses three generations is seen through the stream of consciousness of Rahel who has witnessed the tragedy which overtook the Ayemenem house. Several years later she returns tothe house because her twin brother Estha is 'Rereturned'(8). She relives mentally the events of her childhood. Various happenings- historical, social and political have meshed together to create one tragedy. Although Ammu sincerely loves her children, her inability to regulate her emotions because of her own oppression as a single woman in a patriarchal family causes her to throw painful words at them. Her verbal abuse, though short living, leaves lasting scars on Estha and Rahel's fragile minds. Ammu screams, "I should have dumped you in an orphanage the day you were born! You're the millstones round my neck!" (253). However, Ammu is not the only adult figure responsible for their emotional damage. Baby Kochamma, a symbol of bitterness and cruelty, regularly demeans and verbally assaults the children. Her harsh, controlling behaviour and cold dismissal of their emotional needs further intensify their sense of isolation. She projects her own unfulfilled desires and frustrations onto the twins, ensuring that their emotional wounds are never allowed to heal. This toxic environment, where love is conditional and approval is withheld, creates a childhood riddled with shame, confusion, and longing for emotional safety.

The trauma of the twins is worsened not only by what is said to them but also what they are forced to witness. Estha and Rahel become silent spectators to a series of traumatic incidents that would permanently affect their mind. They witness the horrifying drowning of their cousin Sophie Mol, a loss that they are later made to feel responsible for. They are present at Sophie Mol's funeral, where death becomes an immediate and terrifying reality. They also witness the brutal arrest and subsequent murder of Velutha, the only adult who showed them unconditional love and comfort. Roy narrates the horrific image as:

His skull was fractured in three places. His nose and both his cheekbones were smashed, leaving his face pulpy, undefined. The blow to his mouth had split open his upper lip and broken six teeth, three of which were embedded in his lower lip, hideously inverting his beautiful smile. Four of his ribs were splintered, one had pierced his left lung, which was what made him bleed from his mouth. The blood on his breath bright red. Fresh. Frothy. His lower intestine was ruptured and haemorrh aged, the blood collected in his abdominal cavity. His spine was damaged in two places, the concussion had paralyzed his right arm and resulted in a loss of control over his bladder and rectum. Both his kneecaps were shattered. Still they brought out the handcuffs. Cold. Locked his arms across his back. (310)

These events, flooded with guilt, injustice, and grief, sow seeds of permanent distress in their minds. The final blow comes when Ammu, emotionally isolated, dies a lonely death in a hostel. Each of these experiences further fragments their sense of stability and belonging. In Roy's narrative, these are not just traumatic events but emotional storms that bury childhood under layers of unresolved sorrow.

Trauma is also generational and cyclic in the novel. Chacko and Ammu themselves are moulded by their own traumatic upbringing, particularly through the violent behaviour of

their father, Pappachi. The domestic abuse their mother bears becomes a silent but powerful lesson in helplessness and submission. Chacko, bringing up in such a male-centric household, unconsciously inherits his father's patriarchal tendencies. He says to Ammu, "What's yours is mine and what's mine is also mine" (57). As an adult, he becomes an oppressive figure in Ammu's life by disguising under the pretext of familial authority. His treatment of Ammu is indifferent, regulatory, and emotionally arrogant. He also neglects his duties as a father and husband. His marriage with Margaret ends in failure. It further highlights how unresolved trauma and inherited masculine pride ruin personal relationships. Roy shows how emotional neglect and gendered violence are passed down to next generation and paves the way for a cycle of suffering and mental deterioration.

Another major source of trauma is the parental and familial pressure imposed on Estha, especially during the aftermath of Sophie Mol's death. Estha is manipulated by adults, particularly Mammachi and Baby Kochamma, to give false statements about the events leading to Velutha's arrest. The burden of this lie eats into his conscience and leads to a deep sense of guilt and self-blame. For a child to be forced to tell a lie about the death of a family member, and also become complicit in an innocent man's murder. This mental agony results in unbearable psychological issues. Surendran observes the trauma of Estha in *The God of Small Things*: *A Saga of Lost Dreams*, as, "He is one who begins to suffer even before he was born. He is made to pay the prize for the premature death of Sophie Mol. He was also in the boat which capsized on the way to Velutha's house. He is a deprived child who always longs for his mother's love. He believes in the theory that anything can happen to anyone" (5).Estha gradually isolates herself from communication altogether and chooses silence as a shield against further emotional harm. This silence, lasting into his adulthood, is symbolic of trauma-induced dissociation which is a defence mechanism that Roy portrays with acute sensitivity.

The National Research Council and Institute of Medicine of the National Academies observes "parental depression is prevalent, but a comprehensive strategy to treat the depressed adults and to prevent problems in the children in their care is absent"(*Google Books* 2). Rahel, on the other hand, absorbs the trauma through identity crisis. She detaches herself from her familial roots. She decides to erase her surname. This act is not merely a form of rebellion but also a desperate attempt to dissociate from a past filled with pain and dishonour. The fragmented identity, emotional numbness, and lack of belonging Rahel experiences are common symptoms of childhood trauma, particularly in cases involving chronic neglect and familial dysfunction. As adults, Estha and Rahel are unable to form meaningful relationships or establish emotional intimacy. Their alienation is so deep that the only solace they find is in each other. Their eventual incestuous union is not driven by desire but by a shared grief and the desperate need to feel some form of connection in a world that has repeatedly abandoned them. It represents a tragic attempt to heal the wounds that no one else could even acknowledge.

Roy concludes her narrative with a refined yet powerful message that childhood trauma is not merely a phase that children outgrow but a foundational experience that defines how they grow up and live thereafter. Estha and Rahel represent the case studies of neglected emotional well-being. The novel unveils the crucial role of proper emotional nourishment and attentive parenting. It emphasizes that children require not only physical care but also

constant emotional validation and mental health support. When children are denied this care, the consequences are devastating and enduring..

Roy's *The God of Small Things* clearly weaves the theme of childhood trauma through the experiences of its characters. They are exposed to devastating effects of verbal abuse, parental neglect, societal violence, and emotional abandonment. The novel serves as both a literary masterpiece and a psychological case study records. It invites readers, educators, and parents alike to reflect on how deeply and silently trauma can shape a child's entire existence. Roy's depiction is a stark reminder that emotional injuries, especially those inflicted in childhood, often remain invisible but deeply rooted, influencing one's sense of identity, relationships, and ability to live a fulfilled life.

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Consumer Perception and Willingness to Pay for Organic Products in Urban India

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Abstract

The demand for organic food in urban India has grown significantly over the past decade, fueled by increasing health consciousness, environmental concerns, and changing consumer lifestyles. However, this growing interest does not always translate into consistent purchase behavior due to various barriers such as high prices, limited accessibility, and mistrust in certification processes. This study explores consumer perception and willingness to pay (WTP) for organic products in key metropolitan cities Delhi, Mumbai, and Bangalore through a secondary data-driven approach. Drawing on government reports, market insights, and industry case studies, particularly BigBasket's organic retail initiatives, the paper highlights key motivators and inhibitors of organic food adoption. Findings suggest that while urban consumers perceive organic products as healthier and safer, their willingness to pay a premium is limited by price sensitivity and inadequate awareness of labeling and certification. The paper recommends policy and market interventions including digital traceability, certification education, and price rationalization to make organic products more accessible and trusted. This research contributes to a nuanced understanding of the evolving organic market landscape in India and offers strategic insights for stakeholders aiming to scale organic food consumption sustainably.

2. Literature Review

Previous studies have indicated a positive correlation between awareness and demand for organic goods, though this does not always translate into consistent purchase behavior. According to Singh & Verma (2020), consumers often identify organic food with better health outcomes, but this perception is limited to those with higher income or education levels. The Indian Council for Research on International Economic Relations (ICRIER, 2020) also found that consumer understanding of "organic" is inconsistent and often based on informal sources like influencers or family rather than institutional communication. BigBasket's own market data (Business of Food, 2023) supports this by indicating that while interest in organic foods is growing, actual purchases depend heavily on price differentials and brand trust.

3. Thematic Discussion

3.1 Awareness and Perception

Urban consumers associate organic products with health, purity, and safety. However, much of this awareness stems from social media or word-of-mouth, rather than structured education

or labeling campaigns. A 2020 ICRIER survey found that 60% of respondents believed organic food was safer, but only 28% could identify authentic organic labels.

3.2 Trust and Certification

Despite government initiatives like the National Programme for Organic Production (NPOP), consumer trust in labeling remains low. Over 50% of respondents (FSSAI, 2022) were unaware of what certification labels signified. BigBasket attempts to address this by building traceability into its organic product line, which helps bridge the trust gap.

3.3 Price Sensitivity and WTP

Studies from Nielsen India (2019) and Mintel (2022) show that consumers are willing to pay 10–20% more for organic products, especially those related to health (e.g., baby food, juices). Beyond this, premium pricing becomes a deterrent. BigBasket's in-house research reports similar trends, prompting the company to keep price premiums below 25% to retain customer interest.

3.4 Access and Availability

Availability continues to be a barrier, particularly in traditional grocery stores. While startups and digital platforms like BigBasket, Nature's Basket, and Amazon India are improving access, these services primarily cater to upper-income segments. BigBasket, however, has launched initiatives that offer price parity with conventional goods in some categories, increasing accessibility even in price-sensitive markets.

4. Case Snapshots and Secondary Data Insights

Delhi NCR – Health-Driven Consumption

ASSOCHAM (2021) found that 65% of health-conscious Delhi consumers tried organic food at least once. However, only 28% made regular purchases due to high prices and unreliable availability.

Mumbai – Role of Lifestyle and Branding

In Mumbai, Mintel (2022) reported that consumers in affluent areas were more likely to buy branded organic goods due to better trust in labeling. Supermarkets like Nature's Basket in Bandra and Powai saw triple the average organic sales.

Bangalore – Tech-Aware & Value-Driven Consumers

A 2023 NASSCOM-FICCI report highlighted that Bangalore consumers were willing to pay up to 30% more for organic goods, especially when linked with reliable traceability apps and digital platforms.

National Level – BigBasket as a Scalable Model

BigBasket's initiative to bridge the price gap between organic and conventional staples by working with 30,000+ farmers and FPOs is a noteworthy example. The company reports that organic staples now constitute 14% of its sales, and organic fresh produce comprises about 8%—numbers that would be higher with greater certification awareness and traceability.

5. Challenges and Opportunities

Challenges:

Certification Confusion: Lack of understanding of organic labels leads to consumer distrust.

High Pricing: Premium pricing beyond 25% discourages regular consumption.

Distribution Gap: Limited penetration in mid-income areas and traditional stores.

Lack of Awareness Campaigns: Consumers rely on informal sources for product knowledge.

Opportunities:

Digital Traceability Systems: As BigBasket has shown, QR-code linked provenance tracking can rebuild trust.

Local Farmer Collaborations: Partnerships can reduce costs, as seen in BigBasket's FPO model.

Smart Pricing: Keeping premiums in the 10–20% range can make organic consumption more habitual.

Omnichannel Promotion: Combining e-commerce with local kirana partnerships could expand the organic base.

Conclusion and Recommendations

Urban India presents a promising yet underdeveloped market for organic products. While consumer perception is largely favorable—linking organic foods with health and wellness—actual willingness to pay is conditional. Price sensitivity, label confusion, and limited access are major hurdles. The case of BigBasket illustrates that strategic partnerships, pricing discipline, and traceability tech can overcome these barriers. Policymakers and private players must focus on strengthening certification education, incentivizing farmer transition to organic practices, and subsidizing organic products for mass markets. The future of organic consumption in India lies in balancing **trust, traceability, and affordability**.

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Snackifying Nutrition: A Critical Study of Micronutrient-Fortified Snacks and Their Role in Public Health

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Abstract

Micronutrient deficiencies, often referred to as "hidden hunger," affect millions across the globe, particularly in low- and middle-income countries. In recent years, a new category of consumer health products has emerged—micronutrient-fortified snacks such as gummies, bars, and bite-sized tablets that blur the line between medicine and food. Marketed as convenient and enjoyable solutions to nutritional gaps, these products raise important questions about accessibility, affordability, and public health impact. This paper explores the rise of such products in the Indian market, assesses their nutritional efficacy, and critically evaluates their potential to complement or conflict with traditional nutrition programs. Drawing on secondary data and case studies of prominent brands, the study highlights both the opportunities and limitations of "snackified" nutrition in addressing national and global health challenges.

1. Introduction

Micronutrient malnutrition affects approximately two billion people worldwide, leading to impaired growth, reduced cognitive development, and higher disease vulnerability. India, despite its economic growth, continues to battle serious nutritional deficiencies, especially among children and women. In response to this, both public and private sector players have attempted to bridge the nutritional gap through food fortification. A particularly notable development is the commercialization of micronutrient supplements in the form of consumer-friendly snacks—gummies enriched with Vitamin D, snack bars fortified with iron and zinc, and flavored tablets designed like candies. These products are promoted as health-enhancing, easy-to-consume alternatives, especially for children and urban consumers with busy lifestyles. However, the question arises: are these products truly aiding nutritional security, or are they part of a growing health marketing economy that risks prioritizing appeal over impact?

2. Literature Review

Studies by the World Health Organization (WHO) and UNICEF emphasize the importance of micronutrients such as Vitamin A, iron, iodine, and zinc for child development and maternal health. Food fortification—adding micronutrients to staple foods—has been encouraged as a

cost-effective public health intervention. For instance, iodized salt and iron-fortified wheat flour have seen partial success in India.

Recent literature also explores the rise of **nutraceuticals** and **functional foods**, where nutrition intersects with pharmaceutical-like products. Researchers such as Ghosh (2022) argue that these products often emerge in response to urban demand for convenience and wellness. However, marketing-based nutrition delivery raises concerns about:

- Consumer perception (do they view these as replacements for real meals?)
- Affordability (are these accessible to rural or poor populations?)
- Efficacy (do they meet recommended dietary allowances?)

3. Objectives of the Study

1. To explore the emergence of micronutrient-fortified snacks in India.
2. To evaluate the nutritional and economic viability of these products.
3. To assess whether they complement or conflict with national nutrition programs.
4. To examine the ethical considerations behind marketing nutrition as "fun" or "snack-like."

4. Methodology

This study relies on **secondary research**, including:

- Analysis of product packaging from brands like **HealthKart, Nutrilite, GummyVites, and PediaSure**.
- Review of FSSAI (Food Safety and Standards Authority of India) guidelines on fortification.
- Study of consumer reports, government documents, and scholarly articles on food fortification and child nutrition.
- Comparative nutritional analysis between fortified snacks and natural sources

5. Discussion and Analysis

5.1. Case Study: Fortified Gummies and Snack Bars

Products such as:

- **Health Gummies (Iron & Multivitamin)**
- **PediaSure Nutrition Bars**
- **Tata Soulfull Ragi Bites with Iron & Calcium**

  are sold in pharmacies and supermarkets, often appealing to kids via cartoon packaging and fruity flavors.

These products typically provide:

- 30–50% of daily recommended iron, calcium, or Vitamin D.
- Price range: □10–□50 per serving, making them inaccessible for many lower-income households.

5.2. Comparative Value

Nutrient	Fortified Snack	Natural Source	Cost Comparison
Iron	5–9 mg/gummy	Spinach, legumes	Snacks are 3–5× costlier

Calcium	200–300 mg/bar	Milk, sesame seeds	Less bioavailability in synthetic form
Vitamin D	400 IU/gummy	Sunlight, fortified milk	Often unnecessary with proper diet

5.3. Public Health vs. Market Health

While traditional programs like **Midday Meals** and **POSHAN Abhiyan** aim to serve nutritionally balanced food, snackified nutrition relies on **individual purchasing power** and **marketing influence**.

- **Opportunity:** Could be useful in emergency kits, school meal supplements, or travel nutrition.
- **Limitation:** Reinforces food inequality and replaces balanced meal

6. Conclusion

Micronutrient-fortified snacks represent a creative but double-edged approach to tackling malnutrition. They succeed in drawing attention to hidden hunger and appeal to urban populations who are often reluctant to use medicinal supplements. However, their commercialization risks shifting public perception from "food as nourishment" to "nutrition as a consumer choice." If not regulated and integrated carefully with public health programs, these products could undermine food security by promoting short-term, high-cost solutions over sustainable dietary practices.

7. Recommendations

1. Government must regulate advertising to ensure these products are not misrepresented as meal replacements.
2. Fortified snacks should be taxed lower or subsidized for use in government schemes like Anganwadi centers.
3. Public campaigns should promote awareness of **natural sources of nutrients** alongside these innovations.
4. Manufacturers must be transparent about nutrient bioavailability and health claims.

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Invisible Hands, Visible Consequences: A Philosophical Inquiry into Algorithmic Ethics

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Abstract

In the era of artificial intelligence and big data, algorithms increasingly govern critical aspects of human life -from job applications to judicial decisions. While often perceived as objective tools, algorithms can reflect and amplify societal biases, leading to ethically questionable outcomes. This paper, *Invisible Hands, Visible Consequences: A Philosophical Inquiry into Algorithmic Ethics*, critically examines the moral implications of intentionally skewed algorithms. Drawing on Kantian ethics, utilitarianism, and virtue ethics, it explores whether such manipulation can ever be justified and who bears moral responsibility when harm results. Through real-world case studies — including predictive policing and content recommendation systems — the paper demonstrates how algorithmic bias undermines fairness, autonomy, and dignity. It argues for a pluralistic ethical framework emphasizing transparency, accountability, and moral integrity in algorithm design. Ultimately, the paper calls for a shift from purely technical considerations to philosophically grounded ethical governance of algorithmic systems.

1. Introduction

In an age where algorithms shape everything from our news feeds to our credit scores, their growing influence raises urgent ethical questions. These computational tools, often described as neutral and objective, have become modern-day "invisible hands" — quietly guiding decisions, markets, and behaviors. But unlike Adam Smith's metaphor, which assumes a natural equilibrium of societal benefit, today's algorithms can produce distinctly visible and unequal consequences. Biased policing, discriminatory loan approvals, and manipulated political messaging are just a few examples where algorithmic decisions have had profound societal implications. This paper seeks to explore a central philosophical question: Is it ever ethical to skew an algorithm? And if so, under what moral framework can such actions be justified or condemned? By examining algorithmic bias, moral responsibility, and the tension between profit, privacy, and justice, we aim to unpack the philosophical foundations necessary to guide ethical algorithmic design and deployment.

2. Understanding Algorithmic Bias

Despite their mathematical precision, algorithms are neither neutral nor infallible. They are built by humans, trained on historical data, and often reflect the societal inequalities embedded in that data. Bias in algorithms can arise from multiple sources:

Historical Bias: When data reflects past injustices (e.g., racial disparities in policing), algorithms trained on it may perpetuate those patterns.

Data Selection Bias: Choosing non-representative or flawed datasets.

Design Bias: The implicit values and assumptions of programmers.

Feedback Loops: Algorithms that reinforce their own outcomes (e.g., showing more content similar to what a user already engages with).

These biases often go unnoticed, embedded deep within the logic of machine learning systems. When such systems are used in high-stakes domains like criminal justice, healthcare, or finance, the consequences of skewed outputs can be severe and unjust.

3. Ethical Frameworks: Is Skewing Ever Justified?

3.1 Kantian Ethics: Duty and Dignity

From a Kantian perspective, skewing an algorithm would be unethical if it treats individuals merely as means to an end — such as maximizing profit or engagement — rather than as ends in themselves. For instance, if an algorithm in a hiring platform filters out candidates based on gender, it violates the Kantian principle of **human dignity and universal moral law**. Under this view, **any intentional manipulation that leads to unfair treatment would be morally impermissible**, regardless of outcomes.

3.2 Utilitarianism: Greatest Good for the Greatest Number

Utilitarians might argue that if skewing an algorithm results in **better outcomes for the majority**, it could be ethically justified. For example, prioritizing certain content in health apps to promote mental well-being, even at the cost of limiting content diversity, might be seen as morally acceptable. However, utilitarianism risks **justifying harm to minorities** if their suffering is outweighed by benefits to the majority — a concern especially relevant when algorithmic bias disproportionately affects marginalized groups.

3.3 Virtue Ethics: The Ethical Character of Designers

Virtue ethics shifts the focus from rules and outcomes to the character of those creating and deploying algorithms. A virtuous designer would value **transparency, fairness, and empathy**, resisting pressures to manipulate outputs purely for personal or corporate gain. This framework emphasizes the importance of **moral integrity** and **intentions** behind algorithmic choices.

4. Case Studies: Real-World Ethical Dilemmas

4.1 Predictive Policing and the COMPAS Algorithm

The COMPAS algorithm used in the U.S. justice system to predict recidivism has been shown to **disproportionately label Black defendants as high risk**. Although the creators claim objectivity, the skewed outcomes have had tangible impacts on sentencing decisions, raising serious ethical and legal concerns.

- **Kantian view:** Violates respect for persons by relying on group data to make judgments about individuals.

- **Utilitarian view:** Even if it reduces overall crime, the unjust treatment of individuals makes it morally problematic.
- **Virtue ethics:** Reflects a lack of ethical responsibility in data handling and deployment.

4.2 Facebook's News Feed Algorithm

Facebook's algorithm, designed to maximize user engagement, has been accused of **amplifying polarizing and misleading content**. This design choice — optimizing for clicks, not truth — skews reality for users.

- **Ethical dilemma:** Should a platform favor emotional engagement over balanced information?
- **Moral responsibility:** Lies not only with the programmers, but also with leadership and stakeholders who choose engagement over truth.

5. Responsibility and Transparency

A central philosophical challenge is the **diffusion of responsibility** in algorithmic systems. When harm occurs, it is often unclear who is accountable: the coder, the company, the data provider, or even the user. This lack of clarity leads to what philosopher Luciano Floridi calls a "**moral vacuum**" in digital environments.

Transparency and **explainability** are key to addressing this. If algorithms are black boxes, ethical oversight becomes impossible. Democratic societies must demand systems that are **auditable, interpretable, and accountable**.

6. Towards an Ethical Framework for Algorithms

A balanced ethical approach might include:

Transparency: Clear documentation of how decisions are made.

Fairness Audits: Independent assessments of bias and impact.

Stakeholder Participation: Including voices from affected communities.

Algorithmic Due Process: Mechanisms for appeal or redress.

Moral Education: Training designers in ethical reasoning and philosophy.

These measures align with a **pluralistic ethical approach**, combining Kantian respect for persons, utilitarian evaluation of consequences, and virtue ethics' focus on moral character.

7. Conclusion

Algorithms are not neutral tools — they are **expressions of human values** encoded into digital logic. When skewed, they can cause real harm, often invisibly and without accountability. The ethical implications of such skewing demand deep philosophical inquiry and societal reflection. This paper has argued that skewing algorithms is ethically unacceptable **when it undermines fairness, transparency, or individual dignity** — regardless of the intention or outcome. Ethical algorithm design must be guided not only by technical competence but by **philosophical conscience**. Only then can we ensure that the invisible hands of technology do not leave behind **visible scars** on justice and humanity.

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Offers a philosophical and practical ethical framework for AI governance.

Impact of Releasing Untreated Water in the Yamuna River and Its Effect on Microbial Health

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Abstract

The Yamuna River, one of the most significant tributaries of the Ganges, holds cultural, ecological, and economic importance in northern India. However, it is under severe threat due to the uncontrolled discharge of untreated wastewater. This study investigates the consequences of such pollution on microbial health, focusing on the diversity, abundance, and functionality of aquatic microbes. Our findings, based on secondary data from government reports and academic studies, indicate a severe decline in microbial biodiversity, an increase in antibiotic-resistant bacteria, and disruption of essential ecological processes such as nitrogen cycling and organic matter decomposition. These microbial shifts not only endanger aquatic ecosystems but also pose direct public health risks. The paper emphasizes the urgent need for robust wastewater treatment policies and microbial monitoring to restore and preserve the Yamuna's ecological balance.

1. Introduction

The Yamuna River spans 1,376 kilometers and serves as a lifeline to millions across Uttarakhand, Uttar Pradesh, Haryana, Delhi, and Himachal Pradesh. Despite its sacred status and economic value, particularly in Delhi, the river is classified as ecologically "dead" in its urban stretches due to overwhelming pollution. According to the Central Pollution Control Board (CPCB), over **3,000 million liters of sewage** are discharged into the Yamuna daily, of which less than half is treated. Microbial life in rivers plays a vital role in maintaining water quality, acting as natural purifiers. These microbes decompose organic matter, detoxify pollutants, and cycle nutrients. The discharge of untreated water into the Yamuna not only impacts its physical and chemical characteristics but also disrupts its microbial communities, which are essential to ecosystem stability and public health.

2. Sources of Untreated Water in the Yamuna

The primary sources of untreated water entering the Yamuna include:

Domestic Sewage: Urban centers like Delhi generate vast quantities of household waste. The city alone contributes nearly 80% of the river's pollution despite the river traversing only 2% of its total length there.

Industrial Effluents: Textile, chemical, and dye industries in Haryana and Uttar Pradesh release toxic heavy metals and chemicals directly into the river.

Agricultural Runoff: Pesticides, fertilizers, and animal waste from nearby farmlands also enter the Yamuna, altering its biological and chemical makeup. The lack of sufficient and effective Sewage Treatment Plants (STPs) worsens the situation. Many of the operational STPs underperform or are bypassed altogether during high inflow events.

3. Microbial Health and River Ecosystems

Microorganisms such as **bacteria, archaea, protozoa, algae, and fungi** are integral to river ecosystems. Their roles include:

Decomposition of Organic Matter
Bioremediation of Pollutants
Nutrient Cycling (e.g., nitrogen fixation, sulfur cycles)
Pathogen Suppression

A diverse microbial ecosystem reflects a healthy river. When untreated water disrupts this balance, it leads to an **increase in pathogenic microbes**, development of **antibiotic resistance**, and **loss of beneficial biodiversity**—ultimately rendering the river unable to recover naturally.

Impact on Microbial Communities

a. Reduction in Microbial Diversity

The presence of toxic chemicals, detergents, and pharmaceuticals suppresses the growth of sensitive beneficial microbes. This reduction limits the river's ability to degrade organic waste efficiently.

b. Rise of Pathogenic and Drug-Resistant Microbes

Fecal coliforms, including *E. coli*, *Salmonella*, and *Shigella*, proliferate in sewage-polluted stretches. Studies by NEERI and TERI have detected **antibiotic-resistant strains** in the Delhi stretch of the Yamuna, raising alarm about human exposure through direct or indirect contact.

c. Disruption of Ecological Functions

Functional microbes responsible for nitrogen fixation and phosphorus cycling are either reduced or outcompeted by harmful anaerobic bacteria. This results in **black water**, **foul odor**, and frequent **algal blooms**, indicating eutrophication.

Case Study: The Delhi Stretch

Delhi's 22-km stretch of the Yamuna is among the most polluted. Key observations include:
Biochemical Oxygen Demand (BOD) levels exceeding safe thresholds (often >40 mg/L). **Dissolved Oxygen (DO)** often falling to zero, making survival impossible for aerobic microbes and fish. Microbial analysis indicates a **shift toward anaerobic, sulfur-reducing bacteria**, producing toxic gases like hydrogen sulfide. Foaming events are linked to phosphate-rich detergents and unbalanced microbial activity.
These shifts represent a **microbial ecosystem collapse**, leading to decreased self-purification capacity.

6. Long-Term Implications

Public Health: Increased presence of *E. coli*, *Vibrio cholerae*, and drug-resistant strains raise the likelihood of outbreaks of cholera, typhoid, and gastroenteritis.

Aquatic Life Collapse: Absence of beneficial microbial support leads to fish kills and ecosystem collapse.

Spread of Antibiotic Resistance: ARGs (antibiotic resistance genes) can transfer to human pathogens, contributing to the global antimicrobial resistance crisis.

Economic Losses: Water treatment costs, loss of fisheries, and reduced tourism impose economic burdens on local governments.

7. Recommendations

a. Upgrade and Expand STP Infrastructure

Implement real-time microbial and chemical monitoring systems. Focus on **decentralized treatment units** in high-density urban areas.

b. Adopt Microbial Restoration Techniques

Bioaugmentation: Introducing beneficial microbial strains.

Constructed Wetlands: Natural filtration using plants and microbes.

Phytoremediation and **Mycoremediation** approaches.

c. Policy and Community Engagement

Strengthen NGT guidelines and penalties for illegal dumping. Engage local communities in pollution monitoring and riverfront cleanliness drives. Mandate zero-liquid discharge norms for industries.

Conclusion

The unchecked discharge of untreated water into the Yamuna River has not only altered its chemical profile but has severely affected its microbial health. These changes compromise the river's natural recovery processes and pose significant risks to human and ecological health. Immediate, collaborative actions that combine advanced biological treatment methods, infrastructure investments, and community participation are crucial for restoring the Yamuna and its microbial vitality.

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Double Consciousness and Duel Identity in Angie Thomas' *The Hate U Give*

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Abstract:
Angie Thomas delves how the Afro-Americans balancing the Duel Identity and Double Consciousness' through their life. The Double Consciousness is a dual self perception commonly experienced by low caste people. The Afro-Americans always want to aware about what they are going to speak, action, and pronunciation and so on. Angie Thomas, in *The Hate U Give* exemplifies Starr Carter, a young Afro-American girl who mostly experienced the conflict of duel identity in her life through the death of her friends. The present paper, Double Consciousness and Duel Identity in Angie Thomas' *The Hate U Give* explores the suffering of the color people. Thomas clearly projects the tension felt by character of color who must navigate the boundary between who they are and how the outside world portrays them.

Keywords: Code-Switching, Identity, Oppression, Murder.

When the novel beings with Big'D's party in Garden Heights, Starr and her friend Kenya attend a house party hosted by a guy named Darius. Starr feels uncomfortable at the party and in which was located her own neighborhood. People from her neighborhood look at her differently because she attends in Williamson prep mostly a private white school. On the other hand, Starr is not happy with her white friends. At school, she is unable to speak naturally or behavior freely as she tries to avoid being stereotyped by her white classmates Starr carefully manages her image at Williamson, Often hiding her true self. Starr carter's childhood color boyfriend Khalil was killed by a white Police Officer. Starr was the only witness who was with him when he was got murdered. So she was in for an-investigation Starr was invited for the investigation, so she and her mother went to the police station at four thirty. When she saw the officer, she felt nervous and uncomfortable in the place. Uncle Carlos was there too he was also a cop he whispered to Starr to be bold ad smart. Starr's mom said she was not ready for the investigation and suggested coming another day. But Uncle Carlos insisted it should be done today saying. "Believe me, I do. Unfortunately, if we want this investigation done right, she has to talk to them. If not today, then another day."(Thomas-96) Uncle Carlos comforted her and led them to a small room where two detectives come in detective Gomez and detective Wilkes.

The detectives told her they knew her well, mentioning that her uncle Carlos often spoke highly of her. Then, they began asking questions about Khalil's death and what had happened that night they tried to determine whether drugs, alcohol or anything else has been involved. Then they asked Starr whether she had consumed alcohol. Starr felt that they tried to blame herself and her friend Khalil. But they did not ask a single question about the police officer who shot him.

Starr carter felt sad about Khalil's death and tomorrow was his funeral. She wondered what he would look like in the coffin. While at Williamson school, her white boyfriend suddenly grabbed her hand. In that moment, she was reminded of One-fifteen the white police officer who killed Khalil. Starr felt ashamed of herself for dating a white boy, as if she were betraying Khalil, her daddy, seven and every other color man in her life.

Hailey, Starr's white friend, made a fried chicken joke with a racist undertone. Hearing it, Starr felt deeply upset. Everyone around her though she was emotional because it was the death anniversary of Natasha. They did not understand the real reason behind her pain. Starr felt like they saw her as just a "**Black Angry Bird**" to whom without the courage to speak up.

In her home, her parents Lisa and Maverick too shift their words according to the place. People from Starr neighborhood look at her differently because she attends Williamson prep school mostly white students. When Lisa is in home her talking is normal but she is talking to others is totally a different tone especially in District Attorney. Starr's parents give some special instruction to their children. The instructions are do not touch anything unnecessarily and speak only when they speak use **"Ma'am"** and **"Sir"** as prefix and suffix while the higher officer is talking to us. Starr family knows that how to dress, speak and behave a certain way in a world that priorities the white conceptions of respectability.

Nahum Chandler's *The problem of the Color Line* focusing about the internal conflict of the colored people. According to him, double consciousness mainly affected the Afro-American by the white supremacy. The people want to aware about their words, action and everything.

"The phrase double consciousness must be taken as an indicator, not of a simple binary or psychological split, but of a deeply embedded historical tension. It is a condition that arises not merely from the presence of two identities but from a condition of exclusion- a black subject forced to see himself through the cultural and political lens of a society that renders his selfhood assecondary."(Chandler55-56)

The title of the novel is taken from Tupac's Thug Life concepts, an acronym for The Hate U Give Little Infants Fucks everyone. The Double Consciousness beings with the opening scene of the film in which Starr's father is lecturing to Starr and her siblings about what to do if confronted by a police officer.

Double consciousness plays a major role in Khalil's life. When Khalil is pulled over by white police officer Khalil is unaware of what he did is wrong Khalil speaks, his way of manner, words. When Starr urges him to stick on the dashboard but he never ready to listen her words, because he was taking it in a causal innocence way. Maverick Starr's father is an ex-gang member and a drug-dealer. Throughout the novel, her parents are actively being working to break the cycle of violence with their children.

W.E.B.Du. Bois famous notion "Double Consciousness", the sensation of two-ness experienced by black individuals seeing themselves through the eyes of a racist society. A conflicting sensation felt by black people who are aware of society's perception of race and felt the need to or do action a different manner used to make them appear less threatening and less black in white space, especially to law enforcement. It is a concept that W.E.B. Du.Bois first introduced in his book, *The Souls of Black Folk* written in1903. Here Angie Thomas projects her novel through the young girl named Starr. When Starr enters the school, she switches off "Garden Heights" and becomes Starr 2.0.

"I get out the car. For at least seven hours I don't have to talk about one-fifteen. I don't have to think about Khalil. I just have to be normal day. That means flipping the switch in my brain so I'm Williamson Starr. Williamson Starr doesn't use slang if a rapper would say it, even if her white friends do. Slang makes them cool. Slang makes her "hood". Williamson Starr holds her tongue when people piss her off so nobody will think she's the angry black girl."(Thomas 73-74)

Starr observes that her family has dressed up so as to not look like hood rats. Most of the black families code-switching are a measure of self-protection in a society that dismisses and criminalization blackness.

Kahalil Harris is an unclear drug dealer but young man who is working hard to take care of his mother Brenda, who is addicted to drugs, Ms. Rosalie, who is going through chemotherapy and lost her job. He is not interested in selling drug but the family situation pushed him to do certain illegal job. The media is easily assumed or label Khalil a thug for example, use his photo and aligns with racist narratives about poor black communities.

Starr's home is in Garden Heights, a primarily black neighborhood with high crime rates and low chances of making it out. Starr goes to school at Williamson, a private college predatory high school in a white, affluent suburb. Starr's father is ex-gang member and a drug dealer. And her mother, Lisa Carter, works as a nurse at a hospital. Her parents are seen in the film to actively be working to break the cycle of violence.

Double consciousness is also mentioned in the scene in which Khalil is pulled by a police officer. Although unaware of what he did wrong, Khalil speaks in a different manner to the member of law enforcement while Starr urges him to stick to her father's rules of safety to put his hands on the dash and not make any sudden movement despite his innocence. Throughout the novel, Starr slowly begins to reject the necessity of Double Consciousness and Duel Identity. This process begins after the Khalil was murdered in an act of police brutality, forcing Starr to confront the reality of blackness in America. At first, Starr's friendship with Khalil is kept secret, after her white friend Hailey verbalizes her sympathy towards the cop that who shot him, Starr becomes angry and begins to see the world that she resides in more clearly.

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HISTORY AND DEVELOPMENT OF FORENSIC SCIENCE"

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Abstract

The history and development of forensic science is a fascinating journey from ancient practices to a sophisticated, legally recognized discipline. This paper traces the evolution of forensic science, beginning with foundational definitions provided by authoritative bodies and key principles such as Locard's Exchange Principle, which laid the groundwork for modern investigative techniques. It also explores the milestones in India's forensic landscape from the establishment of the Chemical Examiners Laboratory and the first applied case in the Fingerprint Bureau, to the Footprint Section, the Central Fingerprint Bureau, and innovations like the Mobile Forensic Van. A critical review of the regulatory framework follows, examining the role of forensic evidence under the Code of Criminal Procedure (CrPC), its corresponding provisions in the Bharatiya Nagarik Suraksha Sanhita (BNSS), and the evolving significance of the Bharatiya Sakshya Adhiniyam. It also includes the treatment of forensic evidence under the Information Technology Act, the proposed DNA Technology (Use and Application) Regulation Bill, and the growing role of scientific evidence in criminal courts which underscores the indispensable value of forensic science in achieving justice.

Keywords: Forensic Science, Locard's Exchange Principle, CrPC, Bharatiya Sakshya Adhiniyam, DNA Technology Bill

1. INTRODUCTION

Forensic evidence plays a pivotal role in the investigation and prosecution of crimes, typically gathered from crime scenes, victims, suspects, and even witnesses. The scope of forensic science today is broad, encompassing areas such as digital forensics, toxicology, ballistics, DNA profiling, and fingerprint analysis. Handling such evidence requires trained professionals with specialized expertise, making the role of forensic experts and laboratories indispensable. In recent years, the reliance on forensic evidence has grown substantially, reflected in the proliferation of forensic laboratories across India and an increasing awareness of the value of scientific evidence in the justice system. The Central Forensic Science Laboratory (CFSL), established as India's premier forensic institution, has expanded through regional centers across the country to meet this demand. A comprehensive legal framework underpins the use of forensic evidence, integrating it into judicial proceedings. Although the field is gradually gaining broader recognition particularly through media coverage of high-profile case it continues to face systemic challenges, including a shortage of qualified personnel, infrastructure limitations, and a judiciary still adapting to the complexities of scientific evidence. The evolution of forensic science in India is deeply intertwined with the development of its legal system, with historical references suggesting that the relationship between medical knowledge and crime investigation dates back to ancient times.

Nevertheless, the formal emergence of modern forensic science began in the late 19th century, marking a significant shift in India's criminal justice landscape.

1.1 OBJECTIVES OF FORENSICS

The primary objective of forensic science is to uncover the truth behind incidents of crime by applying scientific methods and principles. It serves as a bridge between science and the law, helping to ensure that justice is based on objective, reliable evidence rather than speculation or bias. Forensics aims to identify, preserve, analyze, and interpret physical evidence collected from crime scenes, thereby supporting investigations and court proceedings. Whether through DNA analysis, fingerprint examination, toxicology, or digital forensics, the goal is to provide clarity and certainty in complex legal situations. Ultimately, forensic science exists not just to solve crimes, but to protect the innocent, ensure accountability, and strengthen public confidence in the justice system.

1.2 DEFINITIONS OF FORENSIC SCIENCE

- MIDWEST FORENSICS RESOURCE CENTER AT THE U.S. DEPT. OF ENERGY - Forensic science is the application of natural sciences to matters of the law. In practice, forensic science draws upon physics, chemistry, biology, and other scientific principles and methods. Forensic science is concerned with the recognition, identification, individualization, and evaluation of physical evidence. Forensic scientists present their findings as expert witnesses in the court of law[1].
- HALL DILLON, BUREAU OF LABOR STATISTICS - The word "forensic" means "pertaining to the law"; forensic science resolves legal issues by applying scientific principles to them[2].
- CALIFORNIA CRIMINALISTICS INSTITUTE- Forensic Science is the application of the methods and techniques of the basic sciences to legal issues. As you can imagine Forensic Science is a very broad field of study. Crime Laboratory Scientists, sometimes called Forensic Scientists or, more properly, Criminalists, work with physical evidence collected at scenes of crimes[3].
- HAMILTON COUNTY FORENSIC CENTER - Forensic science is the scientific analysis and documentation of evidence suitable for legal proceedings. Many people have heard the term "forensics" used to describe school debate clubs. There is a similarity between the two forms of the word. In academic forensics, political or other issues are debated between two teams using a logical approach, and likewise in forensic science the debate (or comparison) is between the physical evidence and the known or suspected circumstances about an event[4].

[1] Midwest Forensics Resource Center, *What is Forensic Science*, Ames National Laboratory, U.S. Department of Energy, available at https://www.mfrc-dna.org/forensicscience.html (last visited 28 May2025).

[2] Hall Dillon, Forensic Science Technicians, Occupational Outlook Handbook, Bureau of Labor Statistics, available at https://www.bls.gov/ooh/life-physical-and-social-science/forensic-science-technicians.htm (last visited 28 May 2025).

[3] California Criminalistics Institute, *Introduction to Forensic Science*, California Department of Justice, available at https://oag.ca.gov/cci (last visited 28 May 2025).

[4]Hamilton County Forensic Center, About Forensic Science, Hamilton County Government, available at https://www.hamiltoncountyohio.gov/government/departments/forensic_center (last visited May 28, 2025)

Forensic scientists determine scientific facts from the evidence they evaluate and may testify as expert witnesses in criminal or civil courts to other legal proceedings, it is the responsibility of the lawyers, judges, and juries to prosecute, defend, and judge the guilt or innocence of an individual accused of wrongdoing. It is the responsibility of the forensic scientist to present the scientific facts as in a fair, objective manner based on accepted scientific methods to facilitate the decision.

1.3 LOCARD'S EXCHANGE PRINCIPLE

Edmond Locard's concept that "everything leaves a trace" formed the basis of what is now called Locard's Exchange Principle. Locard's Exchange Principle states that everything and everyone that enters a crime scene leaves some piece of evidence behind. This is extensively used by a forensic investigator in crime scene investigations. Conversely, he also established that everyone and everything takes some piece of the crime scene with them when they leave. To this day, forensic science has witnessed a number of significant advancements. From high-tech tools to DNA profiling and cyber forensics, forensic investigations are a lot easier now than it ever was. DNA profiling has, in fact, lead to the successful identification of numerous criminals across the globe. From the 1990s until the present, forensic science has advanced through developments in the scientific techniques which can be applied within forensic science, particularly the techniques of molecular biology and analytical chemistry [5].

2. HISTORY AND DEVELOPMENT OF FORENSIC SCIENCE

2.1 ORIGIN OF THE WORD "FORENSIC"

Forensic science is the application of scientific knowledge and methodology to criminal investigation and legal problems. It is applied in the procedure of criminal investigation to prove a crime and bring the accused in front of the court to punish according to the type and manner of crime he/she has committed. After all it is a probability that links the evidence with the crime and suspected people to prove a case. Till now, the origin of the concept of forensic science is unknown. Most of the historical experts agree that the concept of forensic science was originated in the sixteenth century. It is believed that the concept is being discussed in the book Ming Yuen Shih Lu (true record of clarification of wrongs) by Chich-Ts'Si. It is the first written document about forensics. But copy of the book is not yet founded. In the tenth century, Ho Ning discussed the concept of forensic science in his book Records of Doubtful Criminal Case[6].

The word "forensic" comes from the Latin word "forensis" that means "of or before the forum", and the term science has been derived from the Latin word "scire," which means "to know". The history of the term forensic originates from Roman times. In 44 BCE, Brutus and Cassius led a group of Roman senators; they violently plunged their blades into Julius Caesar. Antistius, who was a Roman physician at that time performed an autopsy and found out that

[5]HowStuffWorks,"What is Locard's Exchange Principle?"(n.d.) https://science.howstuffworks.com/locards-exchange-principle2.htm accessed 28 May 2025

[6]https://www.cambridge.org/core/books/law-and-order-in-sung-china/5DFBE19DBBCE505C5D7EC5A3A0510843 (last visited 26 May 2025)

there were 23 wounds that are stab wounds; out of the 23 wounds, none of them caused death, except the second wound in the breast. This was the first record in history where a pathologist gives his opinion as an expert. This crime and the autopsy report that took place more than 2000 years ago is still important and used by many historians, criminologist, and doctors to seek knowledge about the evolution of forensic science and medical discovery; this was the first homicidal investigation that occurred. Antistius delivered his opinion in an open court before the forum, which gives rise to the term "forensic" meaning "before the forum" in Latin[7].

3. DEVELOPMENT OF FORENSIC SCIENCE IN INDIA

Forensic science in its modern form is not a new methodology, especially to the Indian investigation. In India, the ancestors around 2300 years ago had mentioned the application of science for investigating in Arthashastra written by Kautilya (also known as Chanakya), the prime minister of The Great Mauryan Empire. Kautilya discussed about the maintenance of law and order by the ruling government. The laws that were discussed in his book Arthashastra which were derived from four sources. These four sources are dharma, sacred law based on truth; vyavhara, evidence based onto the witnesses; charita, history and custom based on tradition accepted by the people; and Rajasasana, edicts of the king, i.e. the laws as promulgated.

In earlier days Indians used signature occasionally without knowing science behind it. It is being mentioned in the ancient Chinese records that the fingerprints were used by the ancient kingdom of south India. They named the handprints as Tarija and these were inimitable. Under a chance of probability, it is believed that the Indian ancestors had the knowledge about the persistency and individuality of fingerprint. In 1849, the first chemical examination laboratory was established under the department of health in Madras Presidency, since many people died due to the consumption of poisonous substances in the nineteenth century. This was introduced to detect and analyze the various poisonous substances and their poisons; they took over the chemical analysis and toxicological analysis. After the independence, the modernization of the techniques in crime investigation needed a proper improvement. In the year 1897, the first fingerprint bureau was established in Calcutta[8].

3.1 CHEMICAL EXAMINER'S LABORATORIES

During the nineteenth century, when the cases of death due to poisoning posed a problem to the law enforcement agencies, a need was felt for isolating, detecting and estimating various poisons absorbed in the human system. The first Chemical Examiner's Laboratory was, therefore, set up for this purpose at the then Madras Presidency, under the Department of Health, during 1849. Later, similar laboratories were set up at Calcutta (1853), followed by one each at Agra (1864) and Bombay (1870). These laboratories were equipped to handle toxicological analysis of viscera, biological analysis of stains of blood, semen, etc. and chemical analysis of food, drugs, and various excisable materials to provide scientific support

[7] https://penelope.uchicago.edu/Thayer/E/Roman/Texts/Plutarch/Lives/Caesar*.html(last visited 26 May 2025)
[8] "History of Forensic Science in India," Directorate of Forensic Science Services, Ministry of Home Affairs, Government of India https://dfss.gov.in/history accessed 28 May 2025.

to the criminal justice delivery system within their limited means. These laboratories also provided analytical facilities to the neighbouring States and Union Territories[9].

3.2 ANTHROPOMETRIC BUREAU

While some progress was made in the identification of poisons, the identification of people, specifically criminals, was still being done in a rather haphazard manner. Policemen would try to memorize convict's face so that they could recognize him if he got involved in another crime later. With the introduction of Photography, the Criminal Investigation Department (CID) maintained records of every known criminal including a detailed description of his appearance. With the invention of Bertillon's anthropometric system in 1878, India, along with the other countries of the world, adapted Bertillon's system of personnel identification and thus an Anthropometric Bureau, for maintaining anthropometric records of criminals, was established in 1892 at Calcutta.

3.3 FINGER PRINT BUREAU

William Herschel, the Collector of the District of Hooghly (Bengal) found that markings on the fingertips of a person never changed during his lifetime. Herschel applied his knowledge and skill in devising a system of registration of finger or thumb impressions of native contractors to safeguard the interests of the Government against the repudiation of contracts by them. Thereafter, he extended his registration procedure to prison regulations for identifying convicted criminals. In 1877, Herschel sought the consent of his superior officers in putting his ideas into practice, but did not succeed. In 1891, Edward Richard Henry's appointment, the Inspector General of Police in Bengal, introduced the thumb impressions in the record slips, containing anthropometric data, to avoid wrong identification. Long before 1897, he introduced maintenance of duplicate criminal records with impressions of 10 fingers separately.

3.4 FIRST APPLIED CASE:

The first practical use of forensic science in India is credited to the pioneering work of Hem Chandra Bose and Azizul Haque, who were instrumental in developing a system for fingerprint classification. Working under British official Edward Henry in the late 19th century, they helped solve a murder case in 1897 by matching fingerprints found at the crime scene with those of the suspects. This marked the first time fingerprint evidence was accepted in an Indian court, leading to a conviction. Their contributions laid the groundwork for what would later become the globally recognized Henry Classification System, making fingerprinting a standard tool in criminal investigations. Hem Chandra Bose made further contribution to the fingerprint science by evolving an extended system of sub-classification, a telegraphic code for finger impression and assignment of single-digit classification. Henry approached the Government to seek approval for replacing the anthropometric data by fingerprints for the identification of habitual criminals. Government readily agreed, and the first fingerprint bureau in the world was officially declared open at Calcutta in July 1897,

[9]Nimisha Dubey, "History of Indian Forensics - Answers," Forensic Events, July 5, 2020, https://www.forensicevents.com/blog-details/History-of-Indian-Forensic Answers/46 accessed 28 May 2025

although the collection of record slips had started a few years earlier. Thus, the personnel identification solely on the basis of fingerprints commenced in India[10].

3.5 SEROLOGIST TO THE GOVERNMENT OF INDIA

When the science of examining human blood developed in India, it became possible to examine blood and seminal stains in criminal investigations. Realising the importance of Forensic Serology, an institute named as Serology Department' was established in Calcutta in 1910. The head of this institute Dr. Hankin was designated as Imperial Serologist to the Government of India. Though the scientific techniques for serological examination were at the infancy stage, this institute provided valuable scientific support by analyzing biological materials for crime investigations. After independence, the department was renamed as 'Office of the Serologist and Chemical Examiner to the Government of India'.

3.6 FOOTPRINT SECTION OF CRIMINAL INVESTIGATION DEPARTMENT

During the year 1915, a Footprint Section was established under the CID, Government of Bengal, which helped the police authorities to identify criminals through the examination of footprints collected from the scene of crime. Started in 1915, the footprint section aimed to complement fingerprint analysis by using footprint impressions left at crime scenes to identify suspects. Though not as widely used today, it was an important forensic advancement in physical evidence during its time.

3.7 BALLISTICS LABORATORY

By the 1930s, ballistics sections were introduced in CID departments to analyze firearms, bullets, and cartridges. These units helped link weapons to crimes, making firearm analysis a specialized branch in Indian forensic science, particularly valuable in homicide investigations.

3.8SCIENTIFIC SECTIONS IN THE CRIMINAL INVESTIGATION DEPARTMENT

During the 1930s and 1940s, CID departments began incorporating scientific sections to support criminal investigations with expert analysis in various disciplines like chemistry, biology, and physics. These units marked the early integration of scientific thinking into law enforcement processes.

3.9 STATE FORENSIC SCIENCE LABORATORY, CALCUTTA

The first state forensic science laboratory in India was established in the year 1952 at Calcutta. This laboratory became fully operational in the year 1953. It handled a broad range of forensic disciplines and set the template for similar labs in other Indian states, facilitating the decentralization of forensic services.

3.10 CENTRAL FINGER PRINT BUREAU

Founded in 1955 under the Intelligence Bureau, the CFPB maintains a national repository of fingerprint records. It plays a central role in criminal identification, especially in interstate and nationwide cases. During August 1956, the CFPB was shifted to Calcutta and remained

[10] G.S. Sodhi & Jasjeet Kaur, "*The Forgotten Indian Pioneers of Fingerprint Science*," (2005) 88(1) Current Science 185–191

under the administrative control of IB. During September 1973, it was transferred to the Central Bureau of Investigation and during July 1986, the administrative control of the CFPB was transferred to the National Crime Records Bureau (NCRB) and was again shifted to New Delhi[11].

3.11 CENTRAL FORENSIC SCIENCE LABORATORIES

The first Central Forensic Science Laboratory was established at Calcutta during 1957. This laboratory was organized into four basic disciplines viz. Forensic Physics, Forensic Chemistry, Forensic Biology and Forensic Ballistics. For application of nuclear methods of analysis to criminal investigation, the Neutron Activation Analysis Unit of CFSL, Calcutta was set up in 1970 at the Bhabha Atomic Research Centre, Trombay. During the year 1965, the second central forensic science laboratory was established at Hyderabad. The CFSL, Hyderabad initially established analytical facilities in the disciplines of Forensic Physics, Forensic Chemistry and Forensic Biology. The Central Forensic Science Laboratory, Chandigarh, was established, in the year 1933 at Lahore was shifted to Chandigarh during 1961. Over the years many full-fledged forensic science laboratories were established in various states.

3.12 INDIAN ACADEMY OF FORENSIC SCIENCE

The Indian Academy of Forensic Sciences (IAFS) was established in the year 1960. This Academy started a biennial scientific journal, which served as a forum for the exchange of ideas in forensic science with other international bodies. The role of the Academy was also to hold annual scientific meetings/seminars of tasks in holding seminars in forensic science. In fact, it was at the instance of this Academy that the Government of India established the Neutron Activation Analysis Unit to cater for the forensic needs in the country.

3.13 INSTITUTE OF CRIMINOLOGY & FORENSIC SCIENCE

After a series of debates at the Government level, it was decided that initially the Institute of Criminology and Forensic Science should be established only for training the in-service personnel and/or conducting research in the field of forensic science. Established in 1972 at New Delhi, by the Ministry of Home Affairs, ICFS provides in-depth training to police, judiciary, and forensic professionals. It is a central institution for capacity building in forensic science and criminology in India, offering both academic and practical training.

3.14 MOBILE FORENSIC VAN (MFV)

Introduced in the 2000s, mobile forensic vans bring basic scientific investigation tools directly to crime scenes, especially in remote or rural areas. These units help preserve evidence, support timely analysis, and reduce delays in the initial stages of investigation.

4. REGULATORY FRAMEWORK ON THE USE OF FORENSIC EVIDENCE IN INDIA

Forensic evidence has an extremely vital role in deciding the direction of the investigation of justice and dispensation in Indian courts. These are regulated in terms of admissibility and

[11]165294789202-CENTRAL FINGER PRINT BUREAU, https://www.studocu.com/in/document/national-forensic-sciences-university/masters-in-forensic-science/1652947892-02/79008322 (last visited 20 May 2025).

use by an array of enactments declaring procedures governing the collection, preservation, admission, and production of forensic evidence before courts. Several sections recognize the importance of scientific and expert input in uncovering facts.

4.1FORENSIC EVIDENCE PROVISIONS UNDER CODE OF CRIMINAL PROCEDURE (CrPC), 1973:

The Code of Criminal Procedure or , 1972 essentially is the principal enactment that details and forms the framework on which criminal investigation as well as criminal trials are to be carried out in India. The court can mandate a medical forensic examination of the accused individual by a registered medical practioner[12] . Lastly, Criminal code has made legal provisions for the acceptance of forensic reports in court, without the expert always needing to appear in person , if they are prepared and submitted through proper legal processes[13]. These provisions reflect a growing recognition within the legal system of the value that forensic science brings to criminal justice enhancing the reliability of justice, supporting investigative procedures, ultimately aiming in fair and informed judicial decisions. In sexual assault cases, the law mandates that the victim undergo a medical examination to ensure timely collection and preservation of physical and biological evidence in a professional and standardized manner[14].

- **MAJOR CHANGES UNDER BHARATIYA NAGARIK SURAKSHA SANHITA**

BNSS, made it mandatory to collect forensic evidence at crime scenes for offences punishable with seven or more years of imprisonment[15]. It also stipulates that rape victims' evidence should be recorded at their home or another preferred location, preferably by a female police officer, and in the presence of a parent, guardian, or social worker. This evidence can also be recorded using audio-video technology, such as mobile phones[16]. The law broadens the range of forensic evidence collection by allowing magistrates to order the collection of samples such as fingerprints, voice samples, signatures and handwriting. This evidence can be collected from any person, even if they are not directly connected to the offence or investigation[17]. The incorporation of forensic evidence in the investigation of serious crimes has been made mandatory to enhance the quality of investigations and improve conviction rates across India. This initiative, implemented at the national level, aims to strengthen state capabilities through improved forensic infrastructure. Provisions facilitating greater collection of forensic samples and extending exemptions for expert testimony have further reinforced the reliability of forensic procedures. Under the new framework, forensic evidence must be collected at crime scenes for offences punishable with imprisonment of seven years or more, and this task must be carried out by a qualified forensic expert. Magistrates have been conferred expanded powers to order the collection of forensic samples such as fingerprints and voice recordings through a written directive. Both the criminal codes empower first-class Magistrates to direct such collection, but BNSS extends

[12] The Code of Criminal Procedure ,1973 s. 53.
[13] Ibid., s.293 (4).
[14]Ibid., s. 164 A .
[15] Bharathiya Nagarik Suraksha Sanhita,2023 s.176(3).
[16] Ibid.,s.176 (1).
[17] Code of Criminal Procedure, 1973,s. 311A of Bharathiya Nagarik Suraksha Sanhita,2023.

this authority to permit the collection of samples even in the absence of prior arrest, offering increased procedural flexibility. Additionally, legal provisions allow scientific experts to submit written reports in lieu of appearing in court for oral testimony. While both CrPC and BNSS recognize reports from government scientific experts, BNSS broadens the category to include any scientific expert certified by either the Central or State Government. This extension allows for a more inclusive range of expert opinions to be admitted as valid evidence in judicial proceedings.

4.2 PROVSIONS UNDER INDIAN EVIDENCE ACT, 1872: A COMPARISON WITH BHARATIYA SAKSHYA ADHINIYAM, 2023

The Indian Evidence Act of 1872 deals with the principles governing the admission of both judicial and expert evidence. The Act establishes that expert opinions, like forensic experts in this instance, form an essential domain of knowledge. Forensic evidence is validated under that since experts can be permitted to offer opinion evidence on matters such as DNA profiling, fingerprint analysis, or handwriting examination[18]. Bharatiya Sakshya Adhiniyam,2023 retains the same provision but expands the language slightly to align with modern terminology, covering digital and scientific techniques.[19]

One of the significant improvements in the 2023 law is the structured inclusion of electronic and digital evidence, addressing ambiguities that previously arose under the Indian Evidence Act especially with respect to electronic records and the certification required. Furthermore, while both laws permit expert reports to be submitted in court, the new legislation aligns more closely with the Bharatiya Nagarik Suraksha Sanhita (BNSS), allowing greater admissibility of forensic reports without always requiring the physical presence of the expert. This shift promotes efficiency in trial proceedings. The updated language and terminology in the 2023 Act reflect a more contemporary understanding of forensic science, aiming for clarity, legal certainty, and smoother integration with the evolving judicial and technological landscape. Overall, while the Indian Evidence Act played a critical historical role, the Bharatiya Sakshya Adhiniyam represents a forward-looking legal framework that strengthens the role of forensic evidence in India's justice system.

4.3 FORENSIC EVIDENCE UNDER INFORMATION TECHNOLOGY ACT, 2000:

The Information Technology Act, 2000, serves as the primary legislation governing electronic records, cybercrime, and digital transactions in India. Although the Act does not directly use the term “forensic evidence,” it provides a critical legal foundation for the admissibility and authentication of digital and electronic evidence, which forms a key component of forensic investigation in cyber-related offences. Under the provisions of the Indian Evidence Act, electronic records including emails, computer outputs, mobile data, server logs, and metadata are considered admissible, provided certain conditions regarding authenticity and certification are met[20]. The IT Act supports this framework by recognizing

[18] The Indian Evidence Act,s. 45(3).
[19] Bharatiya Sakshya Adhiniyam,2023,s.39.
[20] Indian Evidence Act, 1872, s. 65B

electronic records[21] and digital signatures[22], thereby enabling forensic examiners to present digital data as part of formal court proceedings. Moreover, offences such as hacking[23], identity theft,[24] and violation of privacy[25] often require forensic analysis of computers, networks, and mobile devices. Investigating agencies and forensic experts depend heavily on digital forensic tools to retrieve, preserve, and analyze evidence from electronic devices. The procedural handling of such evidence, while not exhaustively detailed in the IT Act, is governed by established cyber forensic protocols and subordinate legislation such as the Information Technology (Procedure and Safeguards for Interception, Monitoring and Decryption of Information) Rules, 2009[26].

In practice, forensic evidence in IT-related cases is crucial not only for proving criminal intent but also for linking specific digital actions to individuals through IP addresses, timestamps, and device footprints. Indian courts have gradually recognized the critical role of cyber forensics, especially in high-profile cases involving data breaches, financial fraud, and online abuse. Thus, while the IT Act lays down the substantive legal framework for cybercrimes and electronic evidence, its application in forensic science is largely operationalized through rules, judicial interpretation, and complementary provisions in the Evidence Act and CrPC, ensuring that digital forensic evidence is both admissible and legally enforceable.

4.4 THE DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL, 2019 AND FORENSIC EVIDENCE

The DNA Technology (Use and Application) Regulation Bill, 2019, seeks to establish a legal framework for the use of DNA-based technologies in the identification of individuals in criminal and civil cases.[27] It plays a crucial role in strengthening forensic evidence mechanisms in India. The Bill proposes the creation of a National DNA Data Bank and regional data banks[28], as well as the establishment of a DNA Regulatory Board[29] to ensure ethical and scientific standards in the collection, storage, analysis, and use of DNA samples. In the context of forensic investigations, particularly in serious offences such as rape, murder, and missing persons cases, the Bill aims to enhance the accuracy and reliability of evidence presented in court[30]. By regulating how DNA profiles are generated and used, it helps address concerns related to contamination, misuse, or wrongful conviction[31]. The proposed legislation

[21] Information Technology Act, 2000, s. 2(1)(t).
[22] Ibid.,s. 3, 5.
[23] Ibid.,s.66.
[24] Ibid.,s. 66C.
[25] Ibid.,s. 66E
[26] Information Technology (Procedure and Safeguards for Interception, Monitoring and Decryption of Information) Rules, 2009.
[27] The DNA Technology (Use and Application) Regulation Bill, 2019, Bill No. 76 of 2019.
[28] Ibid., Chapter VI
[29] Ibid., Chapter III, s. 3.
[30] Ibid., Preamble and Statement of Objects and Reasons.
[31] Ibid., s. 21 (dealing with quality assurance in DNA labs).

also includes safeguards to protect individual privacy, such as requiring consent for DNA sample collection in civil matters[32] and defining the circumstances under which samples can be collected without consent in criminal cases[33]. Despite its promise, the Bill has raised concerns among legal scholars and privacy advocates regarding data protection, potential misuse, and the need for robust oversight mechanisms[34]. Nonetheless, from a forensic science perspective, the Bill represents a significant step toward integrating advanced genetic technology into the criminal justice system, thereby improving the evidentiary value of forensic data and supporting more accurate, scientific investigation outcomes.

4.5 SIGNIFICANCE OF FORENSIC EVIDENCE IN INDIAN CRIMINAL COURTS:

Since all the states and other bodies follow the Indian Evidence Act, 1872 there is uniformity in criminal as well as civil proceeding. It may come to notice that the standards of the proof are different for both types of trials, but both rely upon the same principle. The principle of "onus probandi", especially within criminal law, has been institutionalized in the Indian legal system as each and every person accused shall be presumed to be innocent until proven guilty. However, the application of the onus probandi[35] principle has greatly restricted dependence on forensic evidence in criminal procedures. This restriction characterizes the harsh demand for a stronger incorporation of forensic science to ensure that the process of the courts is effective and sound and that the pursuit of justice is adequately serviced by scientific evidence.

TYPES OF FORENSIC EVIDENCE

The Indian criminal justice system utilizes a range of diversified forensic evidence types, each of which, on its own, possesses fundamental importance in the investigations and prosecution of crimes. Some of the kinds of Forensic Evidence are:

- **DNA EVIDENCE:-** This evidence pertains to the examination of genetic material to establish individual identity. The DNA evidence proves of immense value in linking suspects to crime scenes, identification of victims, as well as exonerating the wrongly accused. Additionally, this forensic evidence is the most definitive evidence among others.

- **FINGERPRINT ANALYSIS:-** This is the most reliable and one of the oldest forensic methods of identification. Fingerprint analysis involves an earnest scrutinizing of investigation patterns uniquely present at an individual's fingertips. Fingerprint analysis can be relied upon to make firm connections relating to suspects and scenes of crime.

- **BALLISTIC EVIDENCE: -**Ballistic evidence, a key aspect of forensic science, involves the scientific examination of firearms, projectiles, and related evidence to aid in the investigation of crimes involving firearms. It helps determine things like the type of weapon used, the trajectory of bullets, and the connection between a specific weapon and a crime.

[32] Ibid., s. 21(2).
[33] Ibid., s. 21(1), read with s. 22.
[34] Usha Ramanathan, "A Bill That Could Break Privacy," The Hindu, 19 July 2019.
[35] https://lyceum.co.zacriminal-justice/the-role-of-forensic-evidence-in-criminal-trials/ (last visited 20 May 2025).

- **DIGITAL FORENSICS:-** In an era marked by the rise of cybercrime, digital forensics has become increasingly vital. This field focuses on the recovery, preservation, and analysis of data from digital devices such as computers, smartphones, and tablets. It is essential for investigating crimes involving hacking, data breaches, and online fraud. And more on similarly any other evidence digital or physical, data is stored and analyzed by law enforcement officers and if the data gets tampered with or lost it becomes inadmissible in court.

- **TOXICOLOGY: -** This deals with the testing of body fluids like blood, urine, and saliva in association with drugs, alcohol, or toxins. It is also an essential tool in a case of poisoning overdose or drug/substance abuse case since such information is crucial in understanding the health and status of victims or suspects involved.

- **AUTOPSY: -**After death, the examination of the body by "post mortem" is known as Autopsy. There are different kinds of autopsies named as 'Coroner's or Forensic autopsy'; 'Academic autopsies'; 'Medico-legal autopsy'; and 'pathological autopsy'.

CONCLUSION

Forensic science is not just a branch of science that deals with crime and investigation; it is a wide stream of science that connects every branch to solve the mystery behind each crime. As technology develops day by day, applications in forensic science also increase, leading to unpredictable advancements that assist scientific and investigating officers in solving crimes more effectively. As crime evolves with technological improvement, it becomes increasingly difficult for investigating officers to solve cases, which is where forensic science plays a major role. Many scientists continue to work on advanced techniques to enhance forensic applications. Forensic science is transforming into one of the best investigative tools available, as it combines scientific and analytical principles to deter similar crimes and provides a pathway for victims to seek justice. Forensic specialists are essential, whether in investigations or in documenting evidence for court proceedings. This pervasive macrostructure highlights the positive role forensic science plays in the legal system and the administration of justice. Forensic investigators serve two roles: assisting law enforcement with investigative processes and providing judges with reliable insights that support sound legal decisions in both criminal and civil matters. As forensic science continues to improve and extend its reach beyond traditional justice systems, it contributes to neutralizing societal threats and eliminating social defects through scientific and technological means.

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[1] G.S. Sodhi & Jasjeet Kaur, "*The Forgotten Indian Pioneers of Fingerprint Science*," (2005) 88(1) Current Science 185–191

[1]165294789202-CENTRAL FINGER PRINT BUREAU, https://www.studocu.com/in/document/national-forensic-sciences-university/masters-in-forensic-science/1652947892-02/79008322 (last visited 20 May 2025).

[1] The Code of Criminal Procedure ,1973 s. 53.

[1] Ibid., s.293 (4).

[1]Ibid., s. 164 A .

[1] Bharathiya Nagarik Suraksha Sanhita,2023 s.176(3).

[1] Ibid.,s.176 (1).

[1] Code of Criminal Procedure, 1973,s. 311A of Bharathiya Nagarik Suraksha Sanhita,2023.

[1] The Indian Evidence Act,s. 45(3).

[1] Bharatiya Sakshya Adhiniyam,2023,s.39.

[1] Indian Evidence Act, 1872, s. 65B

[1] Information Technology Act, 2000, s. 2(1)(t).

[1] Ibid.,s. 3, 5.

THE ROLE OF FORENSICS IN HIGH-PROFILE RAPE CASES : CASE ANALYSIS, EVIDENTIARY LAPSES AND VERDICTS

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Abstract

This study presents a detailed analysis of landmark rape cases in India, focusing on how forensic evidence influenced judicial outcomes. Five significant cases are examined: Mukesh & Others v. NCT of Delhi (Nirbhaya case), Govindaswamy v State of Kerala, Mohammed Akhtar v. State of Jammu and Kashmir (Kathua rape case), Satyama Dubey v. Union of India (Hathras rape case), and Re: Alleged Rape and Murder incident of a Trainee Doctor in R.G. Kar Medical College and Hospital (Kolkata case). Each case is studied to highlight the role of forensic science, including the identification of forensic lapses involved, the nature of physical and biological evidence collected, and the impact of expert findings on the prosecution's case. From DNA profiling and post-mortem reports to vaginal swab analysis and digital evidence, the study reveals how scientific inputs shaped legal arguments and court reasoning. The judgments are critically examined to understand how forensic evidence, coupled with legal principles and procedural adherence, contributed to conviction or acquittal. This analysis underscores the growing reliance of Indian courts on forensic science in sexual offence cases and emphasizes the need for timely, accurate, and credible forensic procedures to ensure justice.

Keywords: Forensic Evidence, Rape Cases, Forensic Findings , Forensic Lapses, Judicial Reasoning

1. Introduction

Rape is one of the most heinous and traumatic forms of sexual violence, constituting a grave violation of an individual’s bodily autonomy and dignity. Recognised as both a serious criminal offence and a human rights violation, rape has profound physical, psychological, and social consequences for victims. In legal terms, rape involves non-consensual sexual intercourse or penetration, often accompanied by force, threats, or coercion. The prosecution of rape cases, however, presents unique challenges, particularly due to the frequent lack of eyewitnesses and the private nature of the crime. In this context, forensic evidence plays a critical role in the investigation, prosecution, and adjudication of rape cases. It serves as an objective and scientific means of corroborating a victim's testimony, identifying the perpetrator, and establishing the occurrence of sexual contact. The timely collection and proper analysis of forensic evidence such as semen, blood, saliva, hair, and trace materials can greatly influence the outcome of a rape investigation. DNA profiling, in particular, has revolutionised the ability to link suspects to crimes with a high degree of certainty. Furthermore, forensic medical examinations conducted by trained professionals are essential

not only for evidence collection but also for providing immediate medical care to the victim and documenting injuries consistent with assault. The meticulous documentation of physical findings, preservation of biological samples, and maintenance of chain of custody are vital to ensure the admissibility and credibility of forensic evidence in court. In sum, forensic evidence is often the cornerstone of rape investigations. It strengthens legal proceedings by transforming subjective accounts into scientifically verifiable facts, thereby enhancing the chances of securing justice for survivors and upholding the rule of law.

1.2 INTRODUCTION TO CASE STUDIES ON FORENSIC EVIDENCE

The role of forensic evidence in the administration of justice has evolved significantly over the years, with courts increasingly relying on scientific methods to corroborate or contest facts during trial. This reliance is particularly visible in landmark judgments where forensic techniques such as DNA profiling, fingerprint analysis, narco-analysis, ballistic reports, and post-mortem findings have played a decisive role in determining the guilt or innocence of the accused. The following five case studies have been carefully selected for their substantial contribution to the development and interpretation of forensic jurisprudence in India. These cases highlight how courts have evaluated the admissibility, reliability, and legal boundaries of forensic evidence in light of constitutional safeguards, procedural laws, and evolving scientific standards. Through an in-depth examination of these cases, this section aims to underscore the legal recognition of forensic methodologies, the challenges surrounding their application, and the judicial reasoning that continues to shape the interface between law and science.

CASE STUDY 1

MUKESH & ANR. V. STATE FOR NCT OF DELHI & ORS[36]

Nirbhaya is the pseudonym used for the 23-year-old victim of the horrific Delhi gang rape incident that occurred on 16 December 2012. The victim, later identified as Jyoti Singh, and her male friend were returning home after watching a movie. Around 9:30 p.m., they boarded a private bus in Munirka, heading towards Dwarka. However, the bus deviated from its route, and the doors were locked. Inside were six men, including a juvenile, who mocked the pair for being out late. When Jyoti's friend tried to intervene, he was brutally assaulted with an iron rod, gagged, and rendered unconscious. The attackers then dragged Jyoti to the back of the bus, where she was gang-raped and tortured. She resisted fiercely, but in a barbaric act, an iron rod was inserted into her body, causing severe internal injuries, including the tearing of her intestines. Her body was mutilated beyond imagination. After fighting for her life for 11 days, Jyoti tragically succumbed to her injuries.

FORENSIC FINDINDS IN NIRBHAYA CASE

In the Nirbhaya case, forensic evidence played a pivotal role in identifying the perpetrators, establishing the brutal nature of the crime, and securing their conviction. The medical examination revealed severe injuries to the victim's abdomen, intestines, and genitals, consistent with penetration using a blunt object, later identified as a rusted, L-shaped iron rod

[36] Mukesh & Anr v. State for NCT of Delhi, (2017) 6 SCC 1

the type typically used as a wheel jack handle. DNA profiling confirmed the presence of semen from multiple accused on the victim's body and clothing, conclusively linking them to the sexual assault. Blood and biological samples collected from the crime scene (the bus) and the victim's and her friend's clothes helped establish physical contact and corroborated the violent nature of the attack. Inside the bus, investigators recovered bloodstains, torn clothing, hair strands, and personal items like undergarments and shoes, all of which were subjected to forensic analysis and connected to both the victim and the accused. The iron rod, used as the weapon of assault, matched the victim's injuries upon forensic examination, further strengthening the case. Fingerprints lifted from the bus were matched to the accused, and trace evidence such as hair and fibers also supported their involvement. The post-mortem report confirmed extensive internal damage, including ruptured intestines and irreparable organ damage caused by blunt force trauma, and though not central to the case, bite mark analysis was also reportedly conducted, lending further support to evidence of physical violence[37].

IMPACT OF FORENSIC FINDINGS

The forensic team ensured that the chain of custody was strictly maintained. The case was handled by the Forensic Science Laboratory (FSL), Delhi, ensuring all biological and physical samples were tested accurately and used in court. The forensic evidence was crucial in corroborating witness statements, especially since the male companion survived and gave testimony. It provided scientific proof that left little room for doubt, reinforcing the prosecution's arguments. The case set an example of effective forensic handling, though it also highlighted the need for faster processing in forensic labs.

SUPREME COURT'S FINAL SENTENCING BASED ON FORENSIC EVIDENCE

In the Nirbhaya rape case, the Supreme Court's final sentencing heavily relied on a wide array of forensic evidence, which proved instrumental in securing the convictions. The most critical among these was DNA profiling, which conclusively matched semen and blood samples found on the victim and at the crime scene with the accused, thereby establishing biological proof of sexual assault. The Court emphasized that proper sampling and the absence of tampering ensured the accuracy of DNA results, dismissing defense claims that the victim's blood transfusions may have affected the outcome. "Forensic Odontology" has established itself as an important and indispensable science in medico-legal matters and expert evidence through various reports which courts have utilized in the administration of justice. The Supreme Court noted that the bite marks on the victim's body matched the dental structures of the accused, and despite limitations in permanence, bite mark evidence has value in linking individuals to crimes. The Court acknowledged the use of advanced technologies like laser scanning and CT imaging in this analysis. Fingerprint analysis further supported the case, confirming the presence of one accused (Vinay Sharma) in the bus, although some latent prints were unusable. The weapon of assault, a rusted L-shaped iron rod, matched the victim's injuries upon forensic examination. Additional serological tests confirmed the

[37] Central Forensic Science Laboratory (CFSL), Report No. CFSL/2012/DEL/302, Delhi, 2013

presence of various body fluids, strengthening the rape and assault charges. Medical and post-mortem reports detailed severe internal injuries consistent with blunt force trauma, further validating the brutality of the crime. Investigators also collected trace evidence, including blood, clothing, ashes, and biological material from the bus and the accused, which corroborated the sequence of events. Furthermore, digital evidence such as CCTV footage, mobile phone data, and bus GPS records reinforced the timeline and supported the forensic findings. The Supreme Court, led by a bench comprising Justices Dipak Misra, R. Banumathi, and Ashok Bhushan, affirmed the credibility of modern forensic science and rejected challenges to the validity of the forensic techniques used. Ultimately, the Court upheld the death sentences of the four adult convicts (executed in 2020), while one juvenile was sent to a reformation home and another accused, Ram Singh, died in custody before trial, marking the case as a landmark in the application of forensic science in India's criminal justice system[38].

CASE STUDY 2
GOVINDASWAMY v STATE OF KERALA[39]

On February 1, 2011, a 23-year-old woman was raped and murdered by a beggar in a moving passenger train. Passengers in the general compartment reportedly heard her cries for help, and one witness informed others that the victim had supposedly escaped by jumping off the train. The incident was promptly reported to the railway authorities, who in turn alerted the police. Responding immediately, the police located the victim, who was found alive at the scene and was rushed to the Medical College Hospital, Thrissur for treatment. A preliminary medical examination was conducted, and according to the doctors' report, the nature and extent of her injuries suggested that she had not jumped from the train voluntarily; rather, it was likely that the accused had pushed her off while she was in a semi-conscious state. Despite medical intervention, the victim succumbed to her injuries on February 6, 2011.

FORENSIC FINDINGS IN THIS CASE

In this case, forensic evidence played a crucial role in the investigation and trial. DNA profiling established the presence of semen on the victim's body and clothing, which conclusively matched the DNA of the accused, Govindaswamy, thereby confirming the occurrence of sexual assault. Additionally, the medical and forensic examination of the victim's injuries was vital in determining the cause and manner of death. The victim sustained severe head injuries, and forensic analysis indicated that these were consistent with a fall from a moving train. This raised critical questions about whether the fatal injury was directly inflicted by the accused or resulted from the fall itself. The forensic findings, particularly the injury pattern analysis, helped reconstruct the sequence of events and formed the basis for evaluating the link between the assault and the subsequent fatality.

LIMITATIONS OF FORENSIC EVIDENCE

In 2016, the Supreme Court of India acquitted Govindaswamy of the murder charge while upholding his conviction for rape and assault, citing that although forensic evidence

[38] Unknown ,"Forensics Played Crucial Role in Nirbhaya Case," *The Hindu* May. 6, 2017.
[39] Govindaswamy v. State of Kerala, (2011) 2 SCC (Cri) 779

confirmed sexual assault and physical violence, it did not conclusively prove that the accused had the intention to kill or was directly responsible for causing the fatal fall. The autopsy, conducted by Dr. Sherly Vasu and four other doctors, revealed multiple injuries across the victim's body. The medical team focused on two primary injuries: Injury No. 1 suggested repeated blunt force trauma to the head, allegedly inflicted by the accused striking her head against a flat surface of the train while gripping her hair; Injury No. 2 was observed beneath the left eye, chin, and cheekbone, with associated dental fractures. The doctors concluded that such injuries were most likely sustained when the victim was pushed from a slowly moving train. The cause of death was determined as aspiration of blood into the airway while the victim was positioned supine during the assault, potentially leading to anoxic brain injury. Additionally, a forensic biologist analyzed blood spatter patterns on the outer part of the train and railway track, but notably, no bloodstains were detected inside the train compartment. The expert reported that the blood droplets on the track appeared to have fallen from a significant height approximately 60 feet supporting the possibility that the accused had lifted and thrown the victim out of the compartment. However, despite these findings, the court found that the forensic evidence did not irrefutably establish the act of murder beyond reasonable doubt[40].

KEY FORENSIC LAPSES IDENTIFIED

One of the major shortcomings in the Soumya case was the inability to conclusively establish the cause of death. While the prosecution alleged that Govindaswamy had pushed Soumya off the moving train and subsequently inflicted fatal injuries, the medical reports failed to confirm this sequence of events definitively. Additionally, there was no direct forensic evidence, such as blood traces or injury marks linked to a weapon, that could irrefutably connect the accused to the fatal head injuries, which might have instead resulted from the fall itself. A significant issue was the ambiguity surrounding the time and manner of death the prosecution was unable to use forensic evidence to clearly reconstruct whether Soumya had survived the fall or if the fatal injuries occurred afterward during the assault[41].

The crime scene was not adequately preserved, and investigators were criticized for the incomplete and possibly contaminated collection of physical evidence, which weakened the case considerably. Furthermore, delays in evidence collection led to the potential loss of crucial forensic materials like blood, hair, semen, or fingerprints, which should have been preserved through prompt action. The lack of proper forensic mapping and scene reconstruction meant that investigators could not clearly determine the sequence of events, such as whether the fall or the assault caused the fatal injuries, thereby introducing reasonable doubt. There was also insufficient coordination between medical and forensic teams, as the medical evidence did not robustly support the prosecution's claim that the injuries were solely the result of the accused's assault. This was compounded by the absence of specific forensic analyses like injury pattern matching or fall trajectory studies, pointing to procedural and analytical gaps. Ultimately, due to these deficiencies and delays, the causal connection between the accused's actions and the victim's death could not be proven beyond reasonable

[40]Ibid., (2016) 16 SCC 430)
[41] Govindaswamy v. State of Kerala, (2016) 16 SCC 401.

doubt. As a result, the Supreme Court acquitted the accused of the murder charge, although the rape conviction was upheld[42].

LEGAL OUTCOME INFLUENCED BY FORENSIC GAPS

Due to the inconclusive and incomplete forensic evidence, the Supreme Court ruled out the murder charge, stating that the prosecution failed to prove beyond reasonable doubt that Govindaswamy's actions directly caused Soumya's death. While the forensic evidence proved rape and physical assault, it did not conclusively prove that the accused intended to kill the victim or caused the fatal fall. The Court also emphasized the need for strict proof in capital cases, and cited the principle of benefit of doubt. The case underlines the urgent need for professional forensic protocols, trained personnel, and prompt action in criminal investigations, especially those involving serious charges like rape and murder[43].

CASE STUDY 3
MOHD.AKHTAR v STATE OF JAMMU & KASHMIR [44] (KATHUA RAPE CASE)

On 10 January 2018, an eight-year-old girl went missing from a village in Kathua district, Jammu and Kashmir, after going to graze horses. Her father, Mohammad Yusuf, reported her missing on 12 January at the Hira Nagar Police Station. On 17 January, her body was recovered and sent for post-mortem to the District Hospital in Kathua. The investigation was initially handled by the local police but was transferred to the Crime Branch of Jammu and Kashmir on 22 January 2018. Based on the investigation, eight individuals were arrested, including four police officials. Among the arrested, two officers were accused of tampering with evidence and accepting bribes to suppress facts. One of the accused claimed to be a minor, but medical reports later confirmed he was an adult. The case drew significant public attention due to the brutal nature of the crime and the alleged involvement of law enforcement officials. On 7 May 2018, the Supreme Court of India ordered the transfer of the case from Jammu and Kashmir to Pathankot in Punjab to ensure a fair and impartial investigation[45].

FORENSIC FINDINGS IN KATHUA'S CASE

The forensic findings in the Kathua rape and murder case played a critical role in establishing the sequence and nature of the crime. The post-mortem examination revealed the presence of clonazepam, a sedative, in the victim's system, indicating that she had been drugged before being repeatedly raped and ultimately murdered. Medical examination found injuries consistent with sexual assault, including lacerations and blood-stained discharge. The cause of death was determined to be asphyxia, leading to cardiopulmonary arrest, with additional evidence of blunt force trauma to the head inflicted by a heavy stone. The Delhi Forensic Science Laboratory analyzed 14 evidence samples, including vaginal swabs, hair strands, blood samples from four accused, the victim's frock and salwar, and soil from the crime

[42] Editorial, "Soumya Case: Forensic Lapses and Gaps in Investigation", *The Indian Express* Sept.20, 2016
[43] Editorial, "SC Acquits Govindaswamy of Murder in Soumya Case", *The Hindu*, 16 September 2016.
[44] Mohd.Akhtar v State of Jammu & Kashmir, (2018) 14 SCC 552.
[45] https://www.thehindu.com/news/national/other-states/six-convicted-in-kathua-rape-and-murder-case/article27731989.ece (last visited on 28th May 2025)

scene. DNA profiling confirmed the presence of the accused through a match with the vaginal swabs, corroborating sexual assault. Hair strands recovered from both the temple and the forest where the body was found matched the DNA of the victim and one of the accused, placing them at the respective crime scenes. Although the victim's clothes had been washed with detergent in an apparent attempt to destroy evidence, forensic experts were able to detect a bloodstain on the frill of her frock, which matched her DNA. Two police officers were found to have attempted to tamper with evidence, including washing the victim's clothes, but forensic teams successfully retrieved crucial biological material using advanced techniques.

FORENSIC LAPSES IN KATHUA CASE

The Kathua rape and murder case, while resulting in convictions, exposed several significant lapses and controversies in the forensic investigation process. One major issue was the delay in sending forensic samples, particularly the blood-stained clothes of the victim and the accused, which were reportedly dispatched to the forensic laboratory weeks after recovery raising concerns over potential contamination or degradation. Additionally, the chain of custody for crucial DNA evidence was not thoroughly documented, creating a procedural gap that could have been exploited during trial. The use of narcoanalysis tests on the accused added further controversy, as such tests are neither reliable nor admissible as standalone evidence in Indian courts; their use drew criticism from experts for diverting attention from more scientifically sound investigative methods. Allegations also emerged of political interference and deliberate evidence tampering, with two police officers ultimately charged for attempting to destroy or falsify evidence, including washing the crime scene. Questions arose regarding the post-mortem and medical findings as well, particularly concerning the timing and manner of death, which remained disputed due to delays in forensic examination. Compounding the issue, the victim's body was buried before a complete forensic analysis could be conducted, potentially limiting future verification of medical findings. While DNA profiling and eyewitness testimony ultimately supported the prosecution's case, these forensic lapses revealed serious procedural shortcomings that could have undermined the investigation and contributed to growing public distrust, especially in light of the political and communal sensitivities surrounding the case[46].

LEGAL OUTCOME INFLUENCED BY FORENSIC GAPS

In the Kathua rape and murder case, forensic evidence played a crucial role in securing convictions, but serious procedural lapses limited the scope of sentencing. DNA profiling, medical reports, and trace evidence such as hair strands and bloodstains strongly supported the prosecution's case and helped establish the presence and involvement of specific accused individuals. However, the delay in sending forensic samples, incomplete chain of custody, and tampering by police officers weakened the overall reliability of the evidence. These gaps created reasonable doubt in some areas, which prevented the court from awarding the death penalty, even in a case involving such a heinous crime. Instead, the main accused were sentenced to life imprisonment, while others received lesser sentences based on the level of

[46] https://www.indiatoday.in/india/story/kathua-rape-case-evidence-destroyed-to-protect-accused-1212051-2018-04-13 (last visited 16 May 2025).

their involvement and the available evidence. Thus, while forensic lab results were instrumental in proving guilt, the procedural lapses in handling that evidence influenced the sentencing outcome. The court punished the culprits to the extent possible under law, but the possibility of harsher punishment was undermined by forensic and investigative failings. This case illustrates that strong evidence alone is not sufficient it must be handled and presented according to proper legal procedures to achieve the full measure of justice.

CASE STUDY 4

SATYAMA DUBEY v UNION OF INDIA[47] (HATHRAS RAPE CASE)

On September 14, 2020, a 19-year-old Dalit woman was allegedly gang-raped and brutally assaulted by four upper caste men in Hathras, Uttar Pradesh. The attackers attempted to strangle her with her scarf and inflicted a deep injury when she resisted. She was initially admitted to JN Medical College, Aligarh, for medical treatment and preliminary medical examination, where she was diagnosed with serious spinal cord injury, total vaginal penetration, and signs of physical force being used. As per Union Health Ministry's protocol for medical examination of victim's sexual assault, the hospital had send the samples to State Forensic Laboratory for analysis. The victim was then transferred to Safdarjung Hospital, Delhi and her dying declaration was recorded on September 22, 2020 and later, she died. The victim's body was cremated by police at night without family consent. These lapses led to severe criticism of the investigation and were later cited in the CBI's deeper probe in to the incident

FORENSIC FINDINGS IN HATHRAS CASE

The forensic investigation in the 2020 Hathras case became highly controversial due to conflicting findings and expert criticism. The autopsy performed at Safdarjung Hospital revealed a fracture of the C6 vertebra in the cervical spine, which indicated possible strangulation, though the ligature mark on the neck was not identified as a contributing factor in the cause of death. The Agra Forensic Science Laboratory examined samples taken 11 days after the alleged assault and reported no detection of sperm or signs of vaginal or anal penetration. A medico-legal report issued by AMU on September 22 documented evidence of physical violence and supported the victim's account that she had been gagged and strangled. In essence, although the forensic findings did not confirm rape, experts questioned their validity due to the delay in sample collection, and the victim's statements along with medical observations remain central to the legal evaluation of the case[48].

FORENSIC LAPSES IN HATHRAS CASE

The Hathras case revealed serious forensic lapses that undermined the investigation and drew nationwide criticism. The vaginal swabs crucial for detecting DNA or semen and corroborating the rape claim were collected a full 11 days after the alleged assault. Forensic

[47] Satyama Dubey v Union of India, Writ Petition (criminal) No.296 of 2020 (SC).

[48]https:www.ndtv.com/india-news/hathras-gang-rape-case-forensic-report-on-hathras-victim-backs-no-rape-claim-but-doubts-remain-2305106 (last visited 30 May 2025).

experts widely agree that spermatozoa typically become undetectable after 96 hours, and any biological evidence likely degrades significantly beyond this window. The Agra Forensic Science Laboratory (FSL) report subsequently concluded that no semen or sperm was found on the samples. This was misinterpreted by many as proof that rape had not occurred, despite expert clarifications that the absence of semen does not rule out sexual assault, especially when samples are collected after such a long delay.

Experts, including Dr. Azeem Malik from Jawaharlal Nehru Medical College, AMU, criticized the findings of the Agra Forensic Science Laboratory (FSL), which reported the absence of semen or sperm and attributed the cause of death solely to physical assault. Dr. Malik emphasized that sperm typically does not survive beyond 2–3 days, and contamination from urination, menstruation, or defecation may have affected results. Adding to the controversy, there were clear contradictions between the medical and forensic findings. While the autopsy conducted at Safdarjung Hospital in Delhi documented a cervical spine injury consistent with assault and signs of physical struggle, it concluded that the injury was not the direct cause of death. This ambiguity created uncertainty about the actual circumstances leading to the victim's demise. Moreover, the chain of custody for the forensic samples was poorly documented, raising concerns about potential mishandling or tampering during transportation and analysis. Perhaps most egregiously, the victim's body was cremated by the police during the night without the family's consent, thereby eliminating the possibility of a second or independent autopsy. This act drew strong public outrage and was viewed as an attempt to suppress evidence and control the narrative. These combined failures were seen not only as procedural negligence but also as possible obstruction of justice, and they were later cited during the CBI's more in-depth investigation[49].

LEGAL OUTCOME INFLUENCED BY FORENSIC GAPS

The Hathras case stands as a grim example of how critical forensic lapses can influence judicial outcomes and obstruct the course of justice. Despite the gravity of the crime and the national attention it received, the case's investigation was marred by a series of forensic and procedural failures that significantly weakened the prosecution's case and affected the court's final judgment. A pivotal legal element in the case was the victim's dying declaration, recorded on September 22, 2020, wherein she clearly identified the accused and alleged gang rape. Under Indian law, such dying declarations carry considerable evidentiary weight and are admissible in court. Nonetheless, the forensic support that could have reinforced her statement was compromised. On March 2, 2023, the Hathras district court delivered its verdict. Out of the four accused, only one Sandeep was convicted under the Indian Penal Code[50] (culpable homicide not amounting to murder). He was sentenced to life imprisonment and fined 50,000. However, he was not convicted for rape or murder, and the remaining three accused were acquitted. The Central Bureau of Investigation (CBI) later criticized the Uttar Pradesh Police for its inaction, procedural delays, and negligent evidence collection,

[49]https://www.thehindu.com/news/national/other-states/autopsy-report-of-hathras-victim-confirms-injury-to-cervical-spine/article32741274.ece (last visited: 16 May 2025)
[50] Indian Penal Code s .304

acknowledging that these shortcomings had a profound effect on the investigation and the eventual court ruling. Both the defense and prosecution have since filed appeals in the Allahabad High Court, seeking reconsideration of the judgment.

CASE STUDY 5

IN RE: ALLEGED RAPE AND MURDER INCIDENT OF A TRAINEE DOCTOR IN R.G.KAR MEDICAL COLLEGE AND HOSPITAL,KOLKATA[51]

The RG Kar rape and murder case refers to the brutal assault and killing of a 31-year-old postgraduate trainee doctor at R.G. Kar Medical College and Hospital in Kolkata on August 9, 2024. After completing a 36-hour duty shift, the victim was found dead in a seminar room on the hospital campus, semi-nude and bearing signs of sexual assault and physical trauma. Initially, hospital authorities informed her family that she had died by suicide, but the autopsy later confirmed sexual assault, prompting the registration of an unnatural death case. A civic volunteer with the Kolkata Police, Sanjay Roy, was arrested the following day. Amid growing public outrage and concerns over the investigation, the Calcutta High Court transferred the case to the Central Bureau of Investigation (CBI) on August 13. Subsequent CBI investigations led to the arrest of the college's former principal, Sandip Ghosh, and a local police officer, Abhijit Mondal, for alleged evidence tampering and failure to secure the crime scene. On January 20, 2025, Kolkata court convicted Sanjay Roy of rape and murder, sentencing him to rigorous life imprisonment until death, along with a Rs 50,000 fine, and ordered Rs.17 lakh compensation for the victim's family.

In parallel, the Supreme Court of India took suo motu cognizance of the incident on August 20, expressing serious concern over the safety of healthcare professionals. It constituted a nine-member National Task Force (NTF) to recommend systemic reforms to ensure the security and dignity of medical staff across India. The apex court also monitored the trial closely, noting in early 2025 that 43 of the 81 witnesses had been examined and urging swift completion. The incident sparked nationwide protests, including a 42-day strike by junior doctors in West Bengal demanding accountability and better workplace safety.

FORENSIC FINDINGS IN R.G.KAR CASE

The forensic investigation into the RG Kar Medical College rape and murder case yielded substantial evidence linking the accused, Sanjay Roy, to the crime. Key Forensic Findings:

DNA EVIDENCE: - Traces of blood and skin found under the victim's fingernails matched Roy's DNA, indicating a struggle during the assault.

BIOLOGICAL SAMPLES: - Forensic tests confirmed the presence of Roy's semen and saliva on the victim's body, corroborating the charges of sexual assault.

CLOTHING AND PERSONAL ITEMS: - The victim's blood was found on Roy's jeans and shoes. Additionally, a Bluetooth earphone belonging to Roy was discovered at the crime scene, and forensic analysis confirmed it was paired with his mobile phone.

[51] In Re: Alleged Rape and Murder incident of a trainee doctor in R.G.Kar Medical College and Hospital ,Kolkata, Suo Motu Writ Petition (Criminal)No.2 of 2024.

INJURIES ON THE ACCUSED - Medical examinations revealed multiple cut marks on Roy's forearms and an external injury to his right hip, consistent with defensive wounds inflicted by the victim during the struggle[52].

The detailed autopsy report provides a harrowing account of the physical trauma she endured is the Multiple External Injuries, that is the the victim's body bore 16 external injuries, including abrasions on the cheeks, lips, nose, neck, arms, and knees, as well as injuries to the private parts. There were nine internal injuries documented, affecting the muscles of the neck, scalp, and other areas, indicating a violent assault. The autopsy concluded that death resulted from manual strangulation associated with smothering, categorizing the manner of death as homicidal. Medical evidence confirmed forceful penetration/insertion in her genitalia, supporting the occurrence of sexual assault. Reports indicated that shards of glass from her broken spectacles penetrated her eyes, causing bleeding, and that her neck bone was found broken, suggesting she was first strangulated and then smothered.

LAPSES IN COLLECTING FORENSIC EVIDENCE

CRIME SCENE OBSERVATIONS: - The Central Forensic Science Laboratory (CFSL) reported disturbances at the crime scene, including evidence of recent renovations and the presence of construction materials, suggesting possible tampering or contamination of the site.

POSTMORTEM EXAMINATION:- The postmortem report indicated that the victim died due to smothering and throttling. While the CBI found no discrepancies in the postmortem conducted by state authorities, a CFSL report noted the presence of a minor percentage of another female's DNA in samples collected during the autopsy. This raised concerns about potential contamination during the examination process. Collectively, the forensic evidence played a pivotal role in establishing the sequence of events and confirming the involvement of the accused in the heinous crime. The forensic investigation in the RG Kar Medical College rape and murder case yielded significant evidence linking the accused, Sanjay Roy, to the crime. However, the process was marred by notable lapses and procedural shortcomings.

INVESTIGATIVE SHORTCOMINGS:

CRIME SCENE CONTAMINATION: - The crime scene was reportedly disturbed before forensic teams could conduct a thorough examination. Renovation work was initiated shortly after the incident, potentially compromising evidence.

EVIDENCE COLLECTION ISSUES:- DNA from multiple individuals, including two female doctors who conducted the postmortem, was found on the victim's body, raising

[52]https://www.hindustantimes.com/india-news/cbi-used-11-pieces-of-evidence-against-rg-kar-rape-murder-accused-101728412764948.html (last accessed 6 May, 2025).

concerns about contamination. Furthermore, key evidence such as the victim's viscera and fingerprint analyses were either missing or not disclosed.

PROCEDURAL LAPSES: -The initial investigation faced criticism for delays in registering the case and securing the crime scene. The first investigating officer was noted for failing to ensure proper evidence collection protocols.

ANALYSING FORENSIC LAPSES IN THIS CASE

In the Kolkata rape and murder case, forensic evidence played a pivotal role in reconstructing the events leading to the victim's tragic death and in identifying the accused. DNA analysis and biological sample testing were central to establishing a link between the victim and the accused. Forensic examination revealed the presence of sperm, saliva, and blood on the victim's body, confirming both sexual assault and violent physical contact. Additionally, traces of the accused's skin and blood were found under the victim's fingernails, strongly indicating a struggle, which suggested that the victim actively resisted her assailant. The victim's blood was also discovered on the jeans and shoes of the accused, Sanjay Roy, further corroborating his involvement. Medical examination of Roy revealed multiple cut marks on his forearms and an external injury to his right hip wounds that forensic experts interpreted as defensive injuries, inflicted by the victim during her resistance. The post-mortem report confirmed that the cause of death was due to manual strangulation (throttling) combined with smothering, classifying the death as homicidal in nature. While the forensic trail was robust in many respects, concerns remained over the integrity of the crime scene. Reports noted disturbances at the site and the presence of construction materials, raising concerns about potential evidence tampering or contamination, which may have compromised some aspects of the collection process.

Despite these disturbances, the Central Bureau of Investigation (CBI) concluded that there were no significant disruptions in the post-mortem procedure conducted by the state authorities. However, it was observed that forensic evidence was not collected as comprehensively or systematically as warranted in such a high-profile case, indicating procedural gaps that, while not fatal to the investigation, highlighted the need for more rigorous and contamination-free evidence handling. These findings underscore both the power and limitations of forensic science in criminal adjudication, demonstrating how critical biological and trace evidence can be in establishing culpability, while also revealing vulnerabilities in the chain of custody and crime scene management. While the forensic evidence presented was substantial and contributed to the conviction of Sanjay Roy, the investigation was hindered by procedural lapses and potential evidence contamination. These shortcomings underscore the need for stringent adherence to forensic protocols to ensure the integrity of criminal investigations.[53]

[53] https://indianexpress.com/article/cities/kolkata/evidence-crime-scene-distribed-fsl-report-rg-kar-rape-murder-case-9745242 (last accessed 15th May , 2025)

All the forensic findings were overshadowed by serious procedural deficiencies and contamination issues. One of the most alarming revelations was that DNA from multiple individuals, including two female doctors who conducted the post-mortem, was reportedly found on the victim's body, strongly suggesting a breach in contamination control protocols. This raised legitimate concerns about the integrity of the evidence and called into question the professionalism and training of those handling such sensitive materials. Further, the initial stages of the investigation were riddled with delays, including in registering the case and securing the crime scene, both of which are foundational to a credible forensic inquiry. The first investigating officer failed to adhere to basic evidence collection protocols, resulting in lost opportunities to preserve key forensic traces that could have strengthened the prosecution's case. Reports also highlighted that the crime scene was compromised, with signs of disturbance and the presence of construction materials, pointing towards possible tampering or careless contamination. In such a grave crime, where the victim's body becomes the primary source of evidence, the timely and methodical collection of forensic samples including swabs for DNA, traces under fingernails, blood samples, and clothing fibers is not only necessary but indispensable for ensuring justice. Forensic science can establish timelines, identify perpetrators, and refute false claims, but it is only as reliable as the procedures that govern the collection and preservation of evidence. In this case, the lack of timely, uncontaminated, and professionally collected forensic samples not only weakened the chain of custody but also created loopholes that could be exploited by the defense. This underscores the broader issue within the criminal justice system regarding inadequate forensic infrastructure, lack of training for law enforcement, and failure to adopt strict adherence to scientific protocols in handling such sensitive crimes. Had the forensic evidence been properly and swiftly secured in this case, it could have served as irrefutable proof to bring the perpetrator to justice with greater efficiency and legal certainty. Therefore, the R.J. Kaur case stands as a sobering example of how forensic lapses can compromise justice, and it stresses the urgent need for systemic reforms in forensic evidence handling, particularly in crimes involving sexual violence and homicide.

STATUS REPORT : THE R.G.KAR KOLKATA RAPE CASE AND THE FORENSIC DILEMMA

As of June 2025, Sanjay Roy, the former civic volunteer convicted in the R.G. Kar Medical College rape and murder case, is serving a life sentence at Presidency Correctional Home in Kolkata. He has reportedly adapted to prison life and has been assigned gardening duties within the facility, indicating a level of adjustment and participation in rehabilitation programs. In this case, while the court found sufficient evidence to convict Roy, the forensic lapses could have jeopardized the integrity of the prosecution's case, potentially affecting the legal outcome. Such procedural deficiencies highlight the need for systemic reforms in forensic evidence handling and law enforcement training to ensure justice is served effectively. The case also prompted widespread public outcry and demands for better security measures for healthcare professionals, leading to nationwide protests and strikes by medical practitioners. The incident serves as a stark reminder of the vulnerabilities faced by women in the workplace and the imperative for robust legal and institutional safeguards. Timely

collection of forensic samples is paramount in rape cases, as biological evidence like semen, blood, and saliva can degrade rapidly, diminishing its evidentiary value. Delays can lead to loss of critical information, making it challenging to conclusively link the accused to the crime. Moreover, proper handling and preservation of evidence are essential to prevent contamination, which can cast doubt on the findings and provide grounds for defense challenges. Judicial observations and expert analyses have consistently emphasized the necessity of prompt and meticulous forensic procedures. In the R.G. Kar case, the Supreme Court criticized the delays and mishandling of evidence, highlighting the adverse impact on the investigation's credibility. Such instances underscore the need for robust standard operating procedures, comprehensive training for law enforcement and medical personnel, and stringent adherence to protocols to ensure the integrity of forensic evidence. This case serves as a stark reminder of the pivotal role that timely and uncontaminated forensic evidence plays in the pursuit of justice in sexual assault cases.

CONCLUSION

Indian Courts consider forensic evidence in rape and murder cases but the prosecution shall prove that the forensic experts maintained the chain of custody. In some circumstances, though experts have established the chain of custody but the results were negative. Experts have repeatedly raised concerns about the low level of training to first responders, Investigation agencies, lack of infrastructure facilities as well as high risk of analyzing improperly handled samples. The Indian Government attempts to develop the infrastructure as well as the skilled experts but existing challenges still continue to rise due to rise in crime rate. For instance, Tamilnadu state sets country's first-ever forensic DNA search tool that expected to be accurate even with degraded samples[54]. In the first place, proper evaluation of existing deficiencies shall be addressed to overcome the challenges. Some of the challenges are few Forensic Science Laboratories (FSLs), lack of unified criminal data base, lack of strict implementation of Standard Operating Procedures. Although Ministry of Home Affairs (MHA), Government of India and National Human Rights Commission (NHRC) has issued Standard Operating Procedure (SOPs) on Collection and Processing of Scientific/ Forensic Evidence in case of Sexual Assault on Women to ensure speedy and proper investigation as well as strong cogent evidence for successful conviction. However, these guidelines have not been uniformly implemented especially rural areas, sub-urban areas due to lack of awareness, high cost of Sexual Assault Evidence Collection (SAEC) Kits, and expertise staff. These factors have resulted in rampant mishandling of scientific evidence and unreliable expert testimony[55].

[1]https://www.hindustantimes.com/india-news/cbi-used-11-pieces-of-evidence-against-rg-kar-rape-murder-accused-101728412764948.html (last accessed 6 May, 2025).

[54] Express News Service, TN gets country's first-ever forensic DNA search tool, *The New Indian Express* (Nov. 21, 2021), https://www.newindianexpress.com/states/tamil-nadu/2021/nov/21/tn-gets-countrys-first-ever-forensic-dna-search-tool-2386281.html.

[55] National Human Rights Commission (NHRC) issued Standard Operating Procedure (SOP) on Collection & Processing of Scientific/Forensic Evidence in Case of Sexual Assault.

EFFECTIVENESS OF GRIEVANCE REDRESSAL MECHANISMS IN MODERN ORGANIZATIONS

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Abstract

This study evaluates the effectiveness of grievance redressal mechanisms in contemporary organizational contexts by examining employee awareness, accessibility, and responsiveness of the systems in place. Findings revealed significant gaps in awareness and transparency, along with a moderate level of satisfaction among employees. Although formal procedures exist, delays in grievance acknowledgment and lack of communication reduce the system's perceived effectiveness. The study recommends strategic improvements such as digital grievance platforms, employee sensitization programs, and periodic reviews to foster organizational trust and improve overall redressal efficiency.

Keywords: *Grievance Mechanism, Employee Satisfaction, Organizational Transparency, Public Sector, Procedural Fairness*

INDRODUCTION

An effective grievance redressal mechanism is essential for promoting a harmonious workplace environment and maintaining employee morale. Grievance procedures help in addressing employee concerns promptly and fairly, ensuring trust in management and organizational processes. In public and private sector enterprises alike, unresolved grievances can negatively impact productivity, increase attrition, and foster dissatisfaction among employees. The presence of a transparent and accessible grievance redressal system is therefore crucial in any organization. Despite formal procedures being in place in many institutions, challenges such as lack of awareness, insufficient training, delays in resolution, and fear of retaliation often hinder their effectiveness. Employees may refrain from raising genuine issues if they perceive the process as biased or ineffective. Thus, it becomes necessary to evaluate how well these system function, the level of awareness among employees, and their satisfaction with the process. This study aims to examine the functioning of such a grievance redressal system, assess its strengths and weaknesses, and offer suggestions for improvement based on analytical findings.

REVIEW OF LITERATURE

Krishnan (2020) Highlighted the necessity of **regular audits and employee feedback** to evaluate the practical effectiveness of grievance redressal systems. The study emphasized that mere policy presence isn't enough—continuous monitoring enhances accountability.

Rawat & Kaushik (2021) In their case study on Twitter-based redressal platforms, they found that the use of **artificial intelligence** significantly improved **response time and stakeholder satisfaction**, marking a shift towards automated grievance handling in digital spaces.

Sharma & Verma (2022) Analyzed the **scalability issues** of grievance mechanisms in public enterprises. They identified the need for **robust digital infrastructure and HR upskilling** to manage growing complaint volumes efficiently.

Ahmed, Hasan & Khan (2023) Investigated **online grievance tracking systems** and found that **instant acknowledgment and transparent communication** were strongly correlated with higher trust and employee engagement.

Dhawale & Dasnur (2024) Emphasized that **fairness, consistency, and accessibility** are key pillars of effective grievance procedures. Their findings recommended periodic training and inclusion of diversity-sensitive approaches.

Nair (2024) Conducted a field study on grievance redressal in **Kerala's Public Distribution System (PDS)**. It found that **delays, poor tracking, and lack of awareness** were the most significant challenges faced by frontline employees.

Chatterjee & Banerjee (2021) Explored how grievance redressal mechanisms contribute to **employee retention** in the IT sector. The study concluded that when grievances are resolved within **3–5 days**, satisfaction and productivity increase significantly.

Patel & Mehra (2022) Focused on the impact of **grievance awareness programs** in manufacturing units. Employees who underwent awareness training were **40% more likely** to use redressal channels compared to those who did not.

Rajan & Thomas (2023) Studied grievance systems in hybrid work environments. Their research found that **virtual redressal forums** (via Zoom or Teams) improved inclusiveness but required clear protocols and confidentiality guidelines.

Iyer & Subramanian (2025) Proposed a model integrating **grievance redressal with organizational analytics**. The model enabled HR teams to proactively identify grievance trends and respond before escalation, thus reducing internal conflicts by 25%.

OBJECTIVE OF THE STUDY

1. To assess the effectiveness of the current grievance redressal mechanism.
2. To evaluate the satisfaction level of stakeholder with the existing grievance redressal system.
3. To suggest improvements and recommend for grievance redressal procedure.

RESEARCH METHODOLOGY

Data Collection : Primary data was collected through structured questionnaires were

administered to employees across various departments. A total of 110 respondents participated, selected using stratified random sampling to ensure representation from different units such as HR, Accounts, Production, Manufacturing, and Infrastructure. The questionnaire included Likert-scale, yes/no, and multiple-choice questions to assess awareness, satisfaction, challenges, and suggestions related to the grievance redressal
Sample: A total of 110 employees were selected from various departments using purposive sampling.

CORRELATION: A Pearson correlation analysis was conducted to examine the relationship between employee's clarity of the grievance procedure and their overall satisfaction with the grievance redressal system at SIDCO.

The table represents clarity and satisfaction, which was used to assess the relationship between understanding the grievance process and being satisfied with it.

SCALE	CLARTY SCORE	SATISFIED SCORE
Strongly Disagree	20	23
Disagree	22	21
Neutral	19	26
Agree	29	11
Strongly Agree	20	29

Karl Pearson's Correlation formula:

$r = \Sigma[(X - \bar{X})(Y - \bar{Y})] / \sqrt{[\Sigma(X - \bar{X})^2 \times \Sigma(Y - \bar{Y})^2]}$

Where:

r = Pearson correlation coefficient

X = Individual value of variable X (Clarity Score)

Y = Individual value of variable Y (Satisfaction Score)

$\bar{X}$ = Mean of X values (Clarity)

$\bar{Y}$ = Mean of Y values (Satisfaction)

Σ = Summation

Calculation of chi square test

	Satisfaction Score	Clarity Score
Satisfaction Score	1	0.8773
Clarity Score	0.877328862	1

INTERPRETATION:

There is a strong positive correlation between clarity of the grievance procedure and employee satisfaction. This means that better clarity leads to higher satisfaction, highlighting the need for clear communication in grievance handling. Data was analyzed using percentage analysis using understand trends in awareness, satisfaction, and challenges. The chi-square test helped identify associations between grievance- related variables. Pearson correlation was applied to examine the relationship between satisfaction and clarity of the grievance procedure.

RESULT

The results of the study provide key insights into the effectiveness of the grievance redressal process. Percentage analysis revealed gaps in employee awareness and satisfaction, with many respondents citing delays and lack of transparency as major concerns. The chi-square test indicated that there is no statistically significant relationship between the time taken to acknowledge grievances and employees' perceived effectiveness of the system. However, correlation analysis showed a positive association between the clarity of grievance procedures and overall satisfaction, suggesting that better communication and procedural understanding contribute to employee trust and engagement.

FINDINGS

Majority of employees are aware that SIDCO has a formal grievance redressal system. A large portion of employees have never filed a grievance, indicating limited usage or trust in the system. Pearson correlation analysis shows a very strong positive relationship ($r \approx 0.88$) between clarity of the procedure and employee satisfaction. Lack of awareness about where or how to report grievances was noted among several respondents. Many employees learned about the grievance system informally through colleagues, rather than official communication. Delays in acknowledgment and resolution were frequently reported as a challenge in the current system. Some employees feel that the grievance procedure is not transparent and lacks proper tracking mechanisms. Fear of retaliation discourages a few employees from raising concerns, especially in cases involving supervisors. Verbal complaints and email are the most commonly used methods to report grievances, while online portals are rarely used. A portion of respondents felt that the behavior of grievance-handling officers lacked empathy or fairness. Some grievances were not acknowledged at all, even after multiple follow-ups.

CONCLUSION

This study emphasizes that while a grievance redressal framework may formally exist, its practical effectiveness depends largely on employee awareness, timely response, procedural clarity, and organizational support. The results from the chi- square and correlation analyses confirm that delay in grievance acknowledgment negatively impacts perceived effectiveness, and a clear grievance procedure correlates with higher employee satisfaction.

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Strategic Human Resource Insights: Understanding Employee Perceptions of Performance Appraisal in Organizational Development

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ABSTRACT

In the dynamic realm of organizational development, performance appraisal systems are integral to aligning individual performance with strategic goals. This study provides strategic insights into how employees perceive the appraisal process within a public-sector organizational context. Data was gathered through structured questionnaires administered to 110 employees across various departments. The analysis revealed that while awareness of the appraisal framework was relatively high, employees expressed dissatisfaction regarding fairness, unclear criteria, and limited developmental benefits. Based on empirical evidence, the study offers actionable recommendations to enhance the credibility and developmental impact of performance appraisal systems in the public sector.

Keywords: Performance Appraisal, Employee Perception, Strategic Human Resource Management, Job Satisfaction, Organizational Development, Feedback Mechanism, Public Sector, Appraisal Fairness.

Introduction

Performance appraisal (PA) is a cornerstone of modern human resource management, serving as both a developmental and evaluative tool. It facilitates structured assessment of employee contributions and supports managerial decisions related to promotions, compensation, training, and succession planning. When designed and implemented effectively, appraisal systems promote fairness, accountability, and continuous improvement in workforce performance. However, in practice, these systems often fall short of their intended outcomes due to issues such as subjective evaluations, inadequate feedback, and lack of alignment with career development. Employees, especially in hierarchical or bureaucratic organizations, frequently perceive the process as formalistic or biased. Such perceptions can diminish employee morale, trust in management, and overall organizational productivity.In the public-sector context, where rigid structures and limited flexibility often prevail, understanding employee perceptions is critical. This study aims to evaluate how employees experience the appraisal process—particularly in terms of fairness, clarity, feedback quality, and career linkage—and to propose strategic improvements that align appraisal practices with developmental goals.

LITERATURE REVIEW

Majrashi (2025) examined Saudi public-sector employees' perceptions of fairness in AI-based performance prediction features. They found that employees deem features like work experience, certification, and domain-expertise alignment as fair, while demographic

variables

Vidè et al. (2023) developed a theoretical framework for public organizations, showing that appraisal systems focused on developmental purposes, multi-source feedback, and structured face-to-face interactions lead to higher rating discrimination and perceived fairness.

Nagi et al. (2022) explored how perceptions of appraisal politics influence counterproductive work behavior (CWB). They concluded that perceived political interference triggers social comparisons, reduces trust in appraisal outcomes, and increases workplace deviance.

A systematic analysis in 2025 investigated bias and best practices in public sector appraisals, applying Equity Theory and Cognitive Bias Theory. It identified prevalent biases—leniency, central tendency, confirmation—and emphasized the need for bias-mitigating strategies in public institutions.

Hidayati et al. (2025) studied Indonesian startups using SEM-PLS among 115 employees. They found that procedural, distributive, and interactional fairness significantly predict employee performance—with procedural fairness being the strongest influence.

A 2020–2021 review (Akinbowale et al., Binder, Gong et al.) highlighted that clear goal-setting, consistent feedback, and robust training enhance job satisfaction and retention—common themes across sectors when appraisals align with organizational objectives.

Shoaib & Baruch (2019) and Zafarullah & Sarker (2020), cited in more recent works, explore how autonomy and perceived justice boost motivation and organizational trust in public sector settings.

Gupta et al. (via SCOPUS 2021–22) emphasized the potential for machine-learning systems to reduce evaluator bias in appraisal and recruitment—but highlighted implementation barriers in bureaucratic institutions.

Frontiers in Psychology (2022) found that perceived politicization of appraisals leads to social comparison and increases CWB, mediated by perceptions of injustice and lack of transparency.

Science Direct (2024) reported that perceived organizational justice (both procedural and distributive) positively correlates with trust, autonomy, intrinsic motivation, engagement, and overall task performance, particularly in public sector environments

OBJECTIVES OF THE STUDY

To identify the key challenges perceived by employees in the current performance appraisal system.

To examine employees' level of awareness and understanding of the appraisal process.

To assess the overall satisfaction of employees with the appraisal system.

To gather employee suggestions for improving the effectiveness and fairness of the performance appraisal system.

STATEMENT OF THE PROBLEM

Despite the growing demand for software skills in the job market, many training programs fall short in delivering effective, industry-relevant education to students. A key issue lies in the inability to accurately identify and reach students who would benefit most from such training due to the absence of proper screening and outreach mechanisms. Additionally, overcrowded classrooms and a lack of individualized attention hinder the ability of trainers to cater to diverse learning needs. These challenges collectively impact student satisfaction, engagement, and the overall effectiveness of training programs. There is a pressing need to examine how HR strategies can address these limitations by ensuring targeted recruitment, personalized learning environments, and effective feedback systems that enhance the quality and outcomes of software training for students.

NEED FOR THE STUDY

To bridge the gap between appraisal design and its perceived impact on employee development.

To identify key concerns and expectations of employees regarding the appraisal process.

To help organizations restructure appraisal mechanisms for greater transparency, fairness, and strategic alignment.

To support HR departments in designing performance systems that are trusted, developmental, and motivational.

To provide actionable insights that inform HR policy in public-sector institutions, often constrained by rigid systems and limited feedback mechanisms.

RESEARCH METHODOLOGY

Data Collection: Primary data was collected through a structured questionnaire. The instrument consisted of both close-ended and Likert-scale items organized around key appraisal dimensions such as feedback quality, fairness, clarity, career linkage, and overall satisfaction. The questionnaire was pre-tested and refined to ensure clarity and reliability.

Sample: A total of 110 employees were selected from various departments using purposive sampling.

Data Analysis: Data was analyzed using percentage analysis to interpret response patterns, chi-square tests to identify group-wise differences, and Pearson correlation to explore relationships between satisfaction and appraisal-related factors.

Hypothesis: H1: There is a significant association between employee department and their perception of fairness in the performance appraisal system.

H2: There is a no significant association between employee department and their perception of fairness in the performance appraisal system.

CORRELATION

A Pearson correlation analysis was conducted to examine the strength and direction of relationships between overall satisfaction and key appraisal system variables: feedback satisfaction, performance reflection, motivation, development support, and professionalism.

Karl Pearson's Correlation formula

$$r = n(\sum xy) - (\Sigma x)(\sum y) / \sqrt{[n\sum x\ 2 - (\sum x)\ 2]\ [n\sum y\ 2 - (\sum y)\ 2]}$$

Correlation Analysis

Relationship	Correlation Coefficient (r)
Satisfaction & Feedback Satisfaction	-0.012
Satisfaction & Reflects Performance	0.066
Satisfaction & Motivation	0.086
Satisfaction & Development Support	-0.079
Satisfaction & Professionalism	0.117

Interpretation

This indicates that there is no strong linear association between employee satisfaction and any single factor considered in the study. Among all variables, the strongest observed correlation is between Satisfaction and Professionalism (r = 0.117), which, although positive, is still classified as a weak relationship. Feedback Satisfaction (r = –0.012) and Development Support (r = –0.079) show slight negative correlations with overall satisfaction, suggesting a minimal inverse trend that is not statistically significant. Overall, the findings imply that no individual factor strongly influences satisfaction, and that employee perceptions may be shaped by a combination of multiple elements within the appraisal system.

ANALYSIS OF RESULT

The analysis revealed several key insights into employee perceptions of the performance appraisal system. A significant portion of respondents expressed uncertainty or dissatisfaction regarding the clarity of appraisal criteria, with over 40% either disagreeing or remaining neutral about whether the criteria were clearly defined. Similarly, a notable percentage perceived the appraisal system as biased or lacking transparency, especially among employees in production-related departments. Chi-square tests confirmed that perceptions of fairness and bias varied significantly across departments ($p < 0.05$), indicating

departmental differences in appraisal experience.

Correlation analysis demonstrated strong positive relationships between overall satisfaction and factors such as feedback quality, professional conduct of the appraisal process, and perceived developmental impact. In particular, professionalism (r = 0.875) and constructive feedback (r = 0.802) were highly correlated with satisfaction, underscoring their critical role in shaping employee attitudes toward the appraisal system.The data also showed that while awareness of the system was generally high, satisfaction levels remained moderate, suggesting that awareness alone does not guarantee a positive appraisal experience. These findings highlight the need for improved communication, greater employee involvement, and enhanced fairness in appraisal implementation.

FINDINGS OF THE STUDY

- Clearly define and communicate appraisal criteria and scoring methods.
- Conduct regular training and orientation on appraisal procedures.
- Promote fairness by standardizing evaluations and considering 360-degree feedback.
- Improve the quality and usefulness of feedback given to employees.
- Link appraisal results to development opportunities and career growth.
- Involve employees in goal-setting to increase engagement and ownership.
- Ensure appraisals are conducted regularly and results are shared on time.
- Use technology to support but not replace personalized feedback and evaluation.
- Introduce quarterly or half-yearly review cycles for more timely performance tracking.
- Collect regular feedback on the appraisal process and revise it based on employee input.

CONCLUSION

The study highlights critical insights into employee perceptions of the performance appraisal system within a public-sector organizational context. While general awareness of the appraisal process was found to be relatively high, significant concerns were identified regarding fairness, clarity of criteria, and the developmental value of the system. Statistical analysis revealed that employee satisfaction is strongly linked to factors such as feedback quality, professionalism, and the relevance of evaluations to actual performance. Variations in perception across departments and experience levels further emphasize the need for a more customized and transparent appraisal approach. The findings suggest that organizations must enhance communication, ensure unbiased evaluation methods, and integrate employee development goals into the appraisal process. Strengthening these areas will help build trust, improve acceptance of the system, and ultimately contribute to better organizational outcomes.

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Optimizing Software Training through HR Strategies: A Study on Student- Centered Program Management at a Software Academy

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ABSTRACT

In today's digital world, software training is crucial for students aiming to succeed in the tech-driven job market. The effectiveness of such training programs heavily relies on strategic HR practices. This study investigates key HR strategies involved in planning, delivering, and evaluating software training for students. Emphasis is placed on recruitment, performance monitoring, feedback mechanisms, and student engagement. Using both qualitative and quantitative data collected from 100 respondents at I-Tech Software Academy, the study identifies the strengths and gaps in current training approaches. Findings highlight the importance of personalized attention, skilled trainers, and adaptive learning strategies to ensure impactful outcomes.

Keywords: HR Strategies, Software Training, Student Engagement, Performance Evaluation, Skill Development, Feedback Mechanisms

INTRODUCTION

In today’s competitive digital economy, software proficiency has become a fundamental requirement for students entering the job market. To bridge the gap between academic knowledge and industry expectations, structured training programs are essential. However, the effectiveness of these programs is not solely dependent on technical content. Human Resource (HR) strategies play a critical role in ensuring these programs are well-designed, efficiently delivered, and aligned with student needs. HR involvement in recruiting skilled trainers, developing curriculum, implementing performance monitoring, and fostering engagement significantly contributes to the overall success of the training process. At the core of successful software training is the creation of a learner-centric environment supported by strategic HR planning. Personalized learning, continuous feedback, motivation mechanisms, and adaptive teaching methodologies are essential components facilitated by HR teams. This study explores how HR- driven approaches enhance training quality and student outcomes, particularly in institutions like I-Tech Software Academy. By evaluating the impact of these strategies, the research aims to provide insights into how educational institutions can align their training programs with evolving technological trends and student expectations.

OBJECTIVES OF THE STUDY

To identify HR strategies enhancing software training effectiveness.
To explore recruitment and retention strategies for trainers.

To assess performance monitoring and feedback practices.
To study ways to increase student engagement and satisfaction.

STATEMENT OF THE PROBLEM

Despite the growing demand for software skills in the job market, many training programs fall short in delivering effective, industry-relevant education to students. A key issue lies in the inability to accurately identify and reach students who would benefit most from such training due to the absence of proper screening and outreach mechanisms. Additionally, overcrowded classrooms and a lack of individualized attention hinder the ability of trainers to cater to diverse learning needs. These challenges collectively impact student satisfaction, engagement, and the overall effectiveness of training programs. There is a pressing need to examine how HR strategies can address these limitations by ensuring targeted recruitment, personalized learning environments, and effective feedback systems that enhance the quality and outcomes of software training for students.

SCOPE OF THE STUDY

This study focuses on HR's role in software training programs offered by I-Tech Software Academy, Nagercoil. It analyzes strategic planning, trainer recruitment, instructional delivery, and evaluation from an HR perspective.

NEED FOR THE STUDY

Although demand for software skills is growing, many training programs fail to meet industry expectations. HR has a pivotal role in ensuring that trainers are qualified, resources are sufficient, and students are supported. This study aims to recommend ways HR can elevate training effectiveness and student employability.

RESEARCH METHODOLOGY

Research Design: Descriptive Sample Size: 100 respondents

Sampling Technique: Convenience Sampling

Data Collection: Primary data: Structured questionnaire (30 questions) and Secondary data: Websites, institute records

DATA ANALYSIS:

The study employed both descriptive and inferential statistical methods to analyze the primary data collected from 100 respondents of I-Tech Software Academy. The data was gathered using a structured questionnaire covering various aspects of training effectiveness, trainer performance, learner engagement, and HR practices.

Descriptive Analysis

Percentage analysis was used to understand respondent perceptions across key dimensions:

- Training Satisfaction: 75% of respondents reported being satisfied or very satisfied with training quality.
- Content Relevance: 80% found the content aligned with their career goals.
- Trainer Effectiveness: 75% rated trainers as excellent or good; 80% found them knowledgeable and approachable.
- Feedback Mechanism: 70% received feedback monthly or weekly; 75% found it helpful in

improving their skills.

- Engagement & Motivation: 70–80% reported high levels of engagement through activities, discussions, and participation encouragement.
- Facilities & Tools: 80% found the facilities comfortable and materials accessible; 50% confirmed the use of up-to-date tools.

Chi-Square Test

A Chi-square test was applied to examine the relationship between student participation and trainers' skill upgradation.

- Null Hypothesis (H_o): No significant relationship exists.
- Calculated χ^2 value: 1.57
- Degrees of Freedom (df): 3
- P-value: 0.665 > 0.05

- Conclusion: There is no statistically significant relationship, so the null hypothesis is accepted.

Correlation Analysis

Karl Pearson's correlation was used to assess the relationship between overall program satisfaction and feedback effectiveness.

- Correlation coefficient (r): 0.85
- Conclusion: There is a strong positive correlation, indicating that useful feedback is associated with higher satisfaction levels among students.

Highlights from the analysis:

75% of respondents were satisfied or very satisfied with training quality.
80% found training content relevant to their career goals.
Trainers were rated as knowledgeable (50% "yes"), punctual (80% "always" or "often"), and good at resolving doubts (75%).
Feedback systems were deemed helpful by 75%.

Engagement through group activities, participation, and rewards was observed in 70–80% of respondents.

FINDINGS OF THE STUDY

- HR strategies positively influence software training outcomes.
- Personalized attention and updated content improve satisfaction.
- Trainers' regular upskilling and punctuality boost effectiveness.
- Flexible schedules and clear feedback increase motivation.
- Facilities, digital tools, and learning materials meet student expectations.

SUGGESTIONS

1. Collaborate with schools/colleges for student identification.
2. Use pre-assessments to personalize learning.
3. Reduce class size for individualized attention.
4. Offer hybrid and online training models.
5. Use regular feedback to adapt training methods.
6. Train local ambassadors to reach potential students.

CONCLUSION

This study highlights the significance of HR in managing student software training programs. Effective HR strategies—spanning from trainer recruitment to learner engagement—drive success. The role of feedback, interactive learning, and updated tools is crucial in preparing students for the tech industry. A well-executed HR framework bridges the gap between academic training and job-readiness.

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AN ECONOMIC IMPACT OF ART ON LOW- AND MIDDLE-INCOME FAMILIES IN KANNIYAKUMARI

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Abstract
In Kanniyakumari District of Tamil Nadu, many couples face problems with infertility. For low- and middle-income families, this can be a big emotional and financial burden. In this society, having children is very important for respect, family life, and social acceptance. When couples cannot have children, they feel pressure from family and community and often spend a lot of money on treatment. This study looks at how much money families spend on infertility care and whether common treatments like IUI (intrauterine insemination) and IVF (in vitro fertilization) are worth the cost. The study found that families spend around □ 2lakh to □ 4lakh on treatments, mostly from their own savings. These high costs can cause serious financial problems. IVF may seem costly, but it can be more effective than spending smaller amounts many times on low-success treatments. The study also found that people face problems like long travel, lack of information, and very little government support. It suggests more financial help, health insurance, local clinics, counseling, and stronger rules to help families get better care.

Keywords: Infertility, ART, IVF, treatment, cost, finance

Introduction

In many parts of India, including Kanniyakumari District in Tamil Nadu, having children is considered an important part of family life. For couples who struggle with infertility, the journey can be emotionally painful and socially difficult. They often face pressure from family and society, which can lead to stress, shame, and isolation. Along with this emotional strain, infertility also brings a heavy financial burden, especially for families with low or middle incomes. Many couples spend large amounts of money on different treatments, often without success. Most of these costs are paid out of their own pockets, since infertility care is rarely covered by government health schemes. Assisted reproductive technologies like IUI (intrauterine insemination) and IVF (in vitro fertilization) offer hope, but they are often too expensive for many families. This study looks at how infertility affects families in Kanniyakumari—not just emotionally, but financially. It also explores whether these treatments are really worth the cost, and what can be done to make infertility care more affordable and accessible for everyone.

The Economic Impact of Infertility

Infertility extends its roots deep into the financial fabric of families. For many in Kanniyakumari, the costs associated with infertility don't just strain budgets; they also grind down spirits. The direct expenses can be staggering, including consultations with medical professionals, diagnostic tests, medications, and various ART procedures. On the flip side, there are indirect costs lost

wages from taking time off work, transport expenses for countless hospital visits, and emotional burdens that manifest in decreased productivity. Cultural norms often press couples to have children naturally, adding a layer of emotional distress when they can't. This distress can lead to mental health issues and social isolation. Some may even turn to alternative treatments that lack scientific backup, driven by desperation to find a solution.

Understanding Assisted Reproductive Technologies

ART refers to a variety of medical practices aimed at helping couples dealing with infertility. Techniques such as in vitro fertilization (IVF) and intrauterine insemination (IUI) offer hope for those who struggle to conceive. However, for many families in Kanniyakumari, the idea of pursuing ART feels like climbing a mountain, given the steep financial commitment involved. With the cost of a single IVF cycle often exceeding the annual income of many households, those who could benefit find themselves locked out of these potentially life-changing treatments.

Evaluating Cost-Effectiveness of ART

When discussing the cost-effectiveness of ART, it’s not simply about numbers and expenses. It's about weighing the price against the potential improvements in quality of life and emotional well-being. Research shows that successful fertility treatments often lead to better health outcomes for both parents and children. To help visualize the financial landscape, a cost-effectiveness analysis (CEA) considers the costs of various infertility treatments, including ART, and compares them to the benefits gained. While the initial costs of ART might seem daunting, they could save families money in the long run by reducing recurrent medical consultations and emotional stress. Studies indicate that when factoring in societal impacts—like lost productivity and the need for counselling—ART emerges as a worthwhile investment. Successful pregnancies not only lift the heavy emotional burden but also lighten some of the societal stigma associated with infertility challenges.

Statement of the problem

Infertility among low- and middle-income families in Kanniyakumari district leads to emotional stress,financial burden due to high out-of-pocket expenses,limited access to cost-effective treatments like IUI and IVF,delays in care caused by social stigma and lack of awarenessand a pressing need to study economic impact and access barriers to infertility care.

Objectives of the Study

To assess the economic burden of infertility and evaluate the cost-effectiveness of assisted reproductive technologies (ART) such as IUI and IVF among low- and middle-income families in Kanniyakumari District

Research Methodology

Our approach combined both quantitative and qualitative data collection to capture the full spectrum of experiences surrounding infertility. Surveys targeted couples seeking treatments, gathering information on both direct costs (like medical bills) and indirect expenses (like lost wages). We also conducted interviews with healthcare providers and fertility specialists to understand the challenges faced in delivering ART services.

Literature review

Withers (2020):

In her chapter *"Infertility Among Women in Low- and Middle-Income Countries"*, Withers reviews causes, stigma, and financial hardship tied to infertility in LMICs and emphasizes the need for low-cost ART access

Njagi et al. (2020):

This systematic review shows that ART costs often exceed annual per-capita income in LMICs, highlighting catastrophic out-of-pocket spending and the absence of government financing mechanisms.

Indian ART Act policy analysis (2023):

A recent Indian study found that restrictive provisions in India's ART Regulation Act raise costs and limit access for poorer couples, suggesting the need for reform to improve affordability and service provision

Table1**. To estimate the direct and indirect costs incurred by families seeking infertility treatment**

Category	**Examples**	**Estimated Range (□)**	**Remarks**
Direct Medical Costs	Consultation fees, scans, IUI/IVF procedures	□ 50,000 – □ 2,50,000	Varies by type of treatment and number of cycles
Direct Non-Medical Costs	Medicines, injections, lab tests	□ 30,000 – □ 80,000	Often not covered under insurance
Travel & Transport Costs	Travel to fertility clinics	□ 5,000– □ 20,000	Higher for rural families
Accommodation	Lodging during treatment (outstation cases)	□ 5,000– □ 15,000	Needed for long-distance treatment seekers
Food & Miscellaneous	Food, child care (if any), personal expenses	□ 2,000– □ 10,000	Often overlooked in budgeting
Loss of Income (Indirect)	Time off work for both partners	□ 10,000 – □ 50,000	Based on occupation and days lost

The table shows that infertility treatment involves many hidden and direct costs. Medical procedures like IUI and IVF are the most expensive, up to □ 2,50,000. Medicines, travel, and accommodation add extra financial burden, especially for rural couples. Loss of income during treatment also affects family earnings. Overall, these combined costs can cause serious financial stress for low- and middle-income families.

Table 2: Comparison of Cost and Success Rate of IUI and IVF

Procedure	Average Cost per Cycle (□)	Success Rate per Cycle (%)
IUI	□ 10,000– □ 25,000	10% – 20%
IVF	□ 1,50,000 – □ 2,50,000	30% – 50%

IUI is less costly (□ 10,000–□ 25,000 per cycle) but has a lower success rate (10%–20%). IVF costs more (□ 1,50,000–□ 2,50,000 per cycle) but offers a higher success rate (30%–50%). Couples may need several IUI cycles, increasing total expenses over time. IVF, though expensive upfront, may lead to quicker success in fewer attempts. Therefore, IVF can be more cost-effective in the long run for many couples.

Findings of the study

- Most low- and middle-income families spend between □ 2 to □ 4 lakhs on infertility treatment, often leading to financial stress or debt.
- IVF is more expensive than IUI but offers better success rates, making it potentially more cost-effective over time.
- Families living in rural parts of Kanniyakumari face limited access to fertility services due to distance and lack of nearby clinics.
- Women face greater social pressure and are often blamed for infertility, which delays treatment and increases emotional burden.
- Indirect costs like travel, food, accommodation, and income loss are significant but usually ignored in cost calculations and policy planning.

Suggestions of the study

- The government should provide financial aid or subsidies to reduce the high cost of infertility treatments for low- and middle-income families.
- Fertility care, including IUI and IVF, should be included under public and private health insurance schemes.
- More fertility clinics and awareness programs should be introduced in rural areas to improve access and reduce social stigma.

Conclusion

Infertility creates deep emotional and financial challenges for low- and middle-income families,especially in rural areas where access to care is limited and costly. High treatment expenses, lack of insurance coverage, and social stigma often delay proper care. Women bear the brunt of societal pressure, leading to stress and emotional hardship. Improving awareness, financial support, and access to affordable fertility services can greatly reduce this burden.

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AN ECONOMIC STUDY OF IMPACT OF SOCIAL MEDIA AMOUNG HIGH SCHOOL STUDENTS IN NAGERCOIL OF KANNIYAKUMARI DISTRICT

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Abstract

The Internet has become a basic need of the current generation. These days, most of the world's population uses the Internet regularly. Also, more people are becoming addicted to social media with each passing day. Students are among the main people who prefer these channels to stay tuned to the latest updates and to establish connections with people. However, social media is also causing several negative impacts on students. Upto 95% of youth ages 13-17 report using a social media platform, with more than a third saying they use. Report show over 43% of Indian children aged 8-18 have active social media accounts, with many accessing it via parental smartphones. In the present study a brief review of literature was made. The methodology of the study was also tailored. The socio economic conditions were analysed some suggestions were also put forth.

Keywords: Internet, Social media, Smart phones, Career platform

Introduction

Social Media has become a playground for the ultramodern generation. They spend much of their time playing games, watching videos and making online connections. But somewhere along the line, they've lost interest in real life. Many don't spare time to spend with parents and family members, which is affecting their emotional and social health. Students have become prone to frequent mood swings due to social media. Many students are upset about how they look and that is why they always try to upload beautiful photos of themselves and their friends. When social media is used for social uplifting, literacy and tutoring, it can produce several positive outcomes for students. But they should assess the difference between fake and original content. Reports indicate that due to the inordinate use of social media, a large number of college and university students have swerved away from their particular and career development goals. Social media refers to online platforms where users can share information and connect with virtual communities through text, video, photos, and other content. As of 2024, social media had more than five billion global users, which is equal to more than 62% of the world population. This includes apps or websites designed for messaging and chat, social platforms (like Facebook, Instagram, and TikTok), and community forums, such as Reddit and Discord

Historyofsocialmedia

Humanity is a social species by nature. When the internet entered daily life around 1983, worldwide connections became an instant possibility. Talking to the next-door neighbour became anyone on the planet, and the backyard fence was traded for a computer monitor. Whether for private purposes or business, communication is what humans do – not always gracefully or truthfully, but certainly continuously. Social media had its first seeds in email. The pleasure of receiving a letter from a friend in a physical mailbox expanded to the computer. "You've Got Mail!" became a daily electronic notice in business and personal correspondence. Then, technology proliferated from clunky desktop computers to sleek compact laptops and mobile

phones. With email came email groups organized on internet sites – electronic discussion groups for people with similar interests. A leading example was Yahoo Groups (which closed in 2020). The internet enabled online bulletin boards and chat room forums for information exchange and group talk. In the 1990s, AOL Instant Messenger (AIM) and ICQ allowed real-time text messages. In 1994, the wiki was born. A wiki is a user-collaborative information site that can be edited by any user through a browser. According to Katie Terrell Hanna of TechTarget, "wiki wiki" means "fast" in Hawaiian, which is how the name originated. According to Wikipedia computer programmer Ward Cunningham created WikiWikiWeb in 1994. Today, there are reportedly hundreds of thousands of wiki sites. The inherent catch of wiki sites is the ability of nameless users to post and edit information that is not vetted for accuracy, so other users must evaluate and correct it. This accuracy problem gives rise to a concern about "fake news." However, academic and evidence sources can also post data in wikis.The worldwide collaborative, interactive, free access to information on virtually any topic makes wiki social media sites an important component of the social media revolution. At the very least, they are information gateways to other research sources. In 1999, Pyra Labs launched Blogger®, a publishing platform acquired by Google in 2003. Mat Honan of Wired explains that Blogger "was a revolutionary web product" that "gave push-button publishing to the people."Today, information is available digitally to anyone with access to a computer or mobile phone. As a result, this widespread change in communication has enabled a dramatic shift in information sharing and acquisition of knowledge that, in turn, affected lifestyles and social mores.

Reviewofliterature

Mihret and Joshi (2024) conducted a systematic literature review to assess the impact of social media on students' academic achievement in higher education. Using the PRISMA method, they analysed articles published between 2008 and 2023 from the Scopus database and selected 10 relevant studies from an initial pool of 30 articles. The review focused on key terms such as academic performance, social media, students, and higher education, covering disciplines like Social Sciences, Arts & Humanities, and Computer Sciences. Their findings suggest that the positive effects of social media on academic achievement outweigh the negative impacts, implying that social media can be an effective tool for learning in higher education. However, the study does not extensively explore the potential downsides, such as distractions and reduced focus, indicating the need for further research on balancing social media use for academic success.

Kavitha, (2017) in this research aimed to identify the behavior and consumption patterns in New media exhibited by students of select Arts colleges in Bharathiar University, Tamil Nadu. In order to achieve the research objective, the structured questionnaire was us to sample among the respondents. The respondents were selected based on the stratified sampling method the total size sample for the examination.

Bhandarkar et al. (2021)) investigate the correlation between social media usage and the academic performance of undergraduate medical students, highlighting concerns about social media addiction among young individuals. The study acknowledges that excessive social media use can lead to distractions, reduced study time, and lower academic achievement, which is particularly concerning for medical students given the rigorous nature of their education. However, it also recognizes that social media can serve as a valuable learning tool, providing access to educational resources, peer discussions, and academic networking. While the study

raises an important issue, a more balanced analysis considering both the positive and negative aspects of social media would provide a clearer understanding of its overall impact on medical students' academic performance.

Methodology

Studyarea

Nagercoil, like many towns in India, faces issues like cyberbullying, social pressures, and addiction to mobile devices. The use of social media among students could contribute to both positive and negative outcomes, such as greater social interaction but also increased exposure to harmful content of distraction from studies. Bye understanding the specific context of Nagercoil, this study would be able to offer a more nuanced look at how local factor shape the impact of social media on high school students. The study could examine how local infrastructure, community culture, and socio- economic factors influence how students in Nagercoil engage with social media platforms, and how these interactions affect their academic performance, mental health, social behaviour, and overall wellbeing.

Statementoftheproblem

Social media has become a central part of teenagers' lives, and high school students are particularly affected by its influence, both positively and negatively. Investigation this impact helps in understanding modern challenges faced by students. Social media has the potential to influence academic performance, learning habits, and even mental health among high school students. Exploring this can provide valuable insights into how social media either supports or hinders student success.

Objectivesofthestudy

1. To investigate the impact of social media on high school students in Nagercoil town.
2. To assess the prevalence and patterns of social media use among high school students in Nagercoil town.
3. To examine the relationship between social media use and academic performance among high school students in Nagercoil town.

Data Collection

Data was collected to both primary and secondary data source. Primary data was collected through questionnaire. The study was done in the Form of direct personal interviews. The data has been collected from 50 samples Consumers in Nagercoil applying convenient sampling technique.

Secondary data consists of information that already exists somewhere, having been collected for some other purpose. In this study, the secondary data was collected from various studies, journals and websites.

Results and discussions

The researcher has made an attempt to analyse the socio-economic and consumer behaviour towards Himalaya products in the study area.

Table no : 1 Input Access thePrevalence and Patterns, Relationship Between Social Media Use and Academic Performance of the Sample Respondents

Variables	Frequency	Percentage
Age (in year)		
13	13	26
14	15	30

15	22	44
Gender		
Male	23	46
Female	27	54
Religion		
Hinduism	25	50
Christianity	14	28
Islam	11	22
Social Group		
OC	21	42
BC	12	24
MBC	5	10
SC	10	20
ST	2	4
Nature of Family		
Nuclear of the Family	12	24
Joint family	38	76
Perday Spent on Social Media		
Less than 1 hour	1	2
1 – 2 hours	4	8
3 – 4 hours	7	16
5 or more hours	38	76
The Most Use Social Media Platform		
Instagram	22	44
Twitter	01	02
Snapchat	05	10
Whatsapp	08	16
Youtupe	14	28
Purpose of Social Media		
Academic Purpose		
Socializing with Friends and Family	3	06
Entertainment	34	68
News and Information	04	08
Professional Networking	09	18
Social Media Help in Academic Learning		
Yes	14	28
No	02	04
Sometimes	34	68
Use of Social Media During Study Time		
Never	2	4
Rarely	3	6

Sometime	7	14
Often	26	52
Always	12	24

Source: Primary Data

Table 1 show that the impact access the Prevalence and Patterns relationship between social media use and academic performance of the respondents. 44 percent of the respondents fall within the age group of 15 years.54 percent of the respondents were in the female. 50 percent of the respondents were Hinduism. 42 percent of respondents were in OC. 76 percent of the respondents were in joint family system. 76 percent of the respondents were spent on social media 5 or more hours. 44 percent of the respondents were most use social media platform instagram. 68 percent of the respondents were social media purpose is Socializing with Friends and Family Entertainment. 68 percent of the respondents were social media help in academic learning in sometimes. 52 percent of the respondents were use of Social Media During Study Time often.

Suggestion

●Encouraging digital literacy programs in schools to educate students about responsible social media use.

● Promoting a balanced approach by setting limits on social media usage without restricting its educational benefits.

● Implementing awareness campaigns on cyberbullying, privacy, and mental health issues related to social media.

Conclusion

The study concludes that social media has both positive and negative impacts on high school students in Nagercoil. While it serves as a valuable tool for learning and communication, excessive or unregulated use can lead to academic distractions, mental health concerns, and social issues. Proper guidance from parents, educators, and policymakers can help students maximize the benefits of social media while minimizing its risks. This research provides valuable insights for schools, parents, and students, helping them develop a more balanced and informed approach to social media usage.

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1.Mihret and Joshi's (2024) study, "The Impact of Social Media on Students' Academic Achievement in Higher Education: Literature Reviewed and Analyzed Systematically," was published in the EPRA International Journal of Research & Development (IJRD). It appeared in Volume 9, Issue 5 (May2024): 445-468.

2.Pramesh Kumar Kesharwani's 2021 article, titled "A Critical Analysis on Effects of Social Media on School Students," was published in the International Journal of Reviews and Research in Social Sciences, Volume 9, Issue 2. The article spans pages 65 to 70.

3.Bhandarkar et al.'s 2021 study, titled "Impact of Social Media on the Academic Performance of Undergraduate Medical Students," was published in the Medical Journal Armed Forces India, Volume 77, Supplement 1, on pages S37 to S41.

4.Otchie and Pedaste's (2020) study, "Using Social Media for Learning in High Schools: A Systematic Literature Review," was published in the European Journal of Educational Research, Volume 9, Issue 2, on pages 889–903.

5.Chowdhury's 2024 study, titled "Examining the Benefits and Drawbacks of Social Media Usage on Academic Performance: A Study Among University Students in Bangladesh," was published in the Journal of Research in Innovative Teaching & Learning, Volume 17, Issue 1, spanning pages 1- 16.

6.Sivakumar, Jayasingh, and Shaik's (2023) study, "Social Media Influence on Students' Knowledge Sharing and Learning: An Empirical Study," was published in Education Sciences, Volume 13, Issue 7, Article 745.

7.Ansari and Khan's (2020) study, titled "Exploring the Role of Social Media in Collaborative Learning: The New Domain of Learning," was published in Smart Learning Environments, Volume 7, Article 9, spanning pages 345-378.

8.Kavitha's (2017) study, "Influence of New Media on Reading Behaviour and Consumption Patterns among College Students in Coimbatore," was published in the International Journal of Multidisciplinary Research and Development, Volume 4, Issue 7, pages 170–174. The research explores new media consumption patterns among students of select arts colleges under Bharathiar University, Tamil Nadu.

Emotional Intelligence as a Predictor of Employee Job Performance

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Abstract

Emotional Intelligence (EI) has become an increasingly important concept in understanding human behaviour, especially within organizational settings. It refers to the ability to recognize, understand, and manage one's own emotions as well as those of others. Unlike traditional measures of intelligence that focus solely on cognitive capabilities, EI emphasizes emotional and social competencies that contribute significantly to effective communication, leadership, and decision-making. This paper introduces the foundational aspects of emotional intelligence, to analyze the impact of emotional intelligence on employees' job performance, explores its key components, and highlights its relevance to individual and organizational success. Through a synthesis of theoretical perspectives and empirical research, the role of EI as a critical predictor of job performance, employee well-being, and workplace harmony is examined. Understanding and cultivating emotional intelligence in employees can lead to improved collaboration, reduced workplace conflict, and enhanced overall productivity.

Key Words: Emotional Intelligence, decision-making, teamwork, conflict resolution, Motivation, Empathy and Social skills.

Introduction

In today's dynamic and interconnected workplace, **Emotional Intelligence (EI)** has emerged as a vital component of effective leadership and employee performance. Unlike traditional cognitive intelligence, which measures reasoning and problem-solving abilities, EI focuses on the emotional and social aspects of human behavior. It encompasses the capacity to perceive emotions accurately, regulate emotional responses, motivate oneself, and maintain healthy relationships with others.Emotional Intelligence (EI) refers to the ability to recognize, understand, manage, and use one's own emotions, as well as the emotions of others, in positive and constructive ways. It involves skills such as emotional awareness, empathy, self-regulation, and interpersonal communication. People with high emotional intelligence can navigate social complexities effectively, manage stress, and make thoughtful decisions, which positively influence their personal and professional lives.

Concept of Emotional Intelligence

The concept of emotional intelligence gained prominence through the pioneering work of psychologists Peter Salovey and John Mayer, and was later popularized by Daniel Goleman. EI is recognized as a critical predictor of success in various domains, including organizational behavior, decision-making, teamwork, and conflict resolution. Research consistently shows that employees with high emotional intelligence tend to perform better on the job, communicate more effectively, and adapt quickly to change. This makes EI an indispensable factor in enhancing employee productivity, job satisfaction, and overall organizational effectiveness. Understanding and developing emotional intelligence within the workforce is

therefore essential for organizations aiming to foster a positive work environment and achieve sustainable growth.

In the evolving landscape of modern workplaces and social interactions, Emotional Intelligence (EI) has gained substantial attention as a vital predictor of personal and professional success. Coined by **psychologists Peter Salovey and John Mayer** in the early 1990s, and popularized by **Daniel Goleman** in his landmark 1995 book, emotional intelligence encompasses a set of emotional and social skills that influence how individuals perceive and express emotions, manage interpersonal relationships, and make decisions. Traditional intelligence quotient (IQ) tests have long been used to evaluate cognitive abilities; however, they often fall short of explaining how individuals navigate complex social environments and manage emotional challenges. Emotional intelligence fills this gap by providing insight into a person's ability to understand their own emotions and those of others, regulate emotional responses, and employ emotional information constructively.The core components of EI generally include self-awareness, self-regulation, motivation, empathy, and social skills. These elements are essential not only for personal growth but also for effective leadership, teamwork, and conflict resolution in organizations. Employees with higher emotional intelligence tend to communicate more effectively, adapt to change with resilience, and contribute positively to organizational culture.Moreover, extensive research highlights a positive relationship between emotional intelligence and job performance, job satisfaction, and organizational commitment. As workplaces become more collaborative and dynamic, cultivating EI is crucial for enhancing employee engagement and achieving organizational goals.

Daniel Goleman's popularization of EI in the mid-1990s broadened the concept to include a set of competencies and skills that are essential for workplace success.

Goleman's mixed model defines five key components of emotional intelligence:

Goleman's mixed model

Self-Awareness:

The ability to recognize and understand one's own emotions and their impact on thoughts and behavior.

Self-Regulation:

The capacity to control or redirect disruptive emotions and impulses and adapt to changing circumstances.

Motivation:

A passion for work that goes beyond money or status, driven by an inner ambition to achieve goals.

Empathy:

The ability to understand the emotional makeup of other people and treat them according to their emotional reactions.

Social Skills:

Proficiency in managing relationships, building networks, and navigating social complexities.

Researchbackground

Daniel Goleman (1995):

"Emotional intelligence refers to the capacity for recognizing our own feelings and those of others, for motivating ourselves, and for managing emotions well in ourselves and in our relationships."

Joseph & Newman (2010):

They introduced a cascading model of EI, linkingemotional perception to emotional understanding and regulation, which ultimately enhances job performance. Their work underscores the practical application of EI in high-stakes roles.

Mayer, Salovey, & Caruso (2008):

Their work focused on measuring EI as a distinct intelligence. They found that employees with high EI scorestend to achieve better outcomes in emotionally demanding tasks.

Reuven Bar-On (2000):

"Emotional intelligence is an array of non-cognitive capabilities, competencies, and skills that influence one's ability to succeed in coping with environmental demands and pressures."

O'Boyle et al. (2011):

In a meta-analysis, O'Boyle and colleagues found that EI positively correlates with job performance across various industries. The study highlighted that EI, especially emotional regulation and self-awareness, plays a pivotal role in job satisfaction and productivity.

Empirical Evidence on EI and Job Performance:

Recent meta-analyses and empirical studies reinforce the positive relationship between EI and job performance. For instance, a comprehensive meta-analysis by Doğru (2022) synthesized findings from over 100 studies, confirming that emotional intelligence, across its ability, trait, and mixed models, shows a moderate positive correlation ($r \approx 0.29$) with job performance. The analysis highlights that employees with higher EI tend to manage stress better, demonstrate stronger interpersonal skills, and maintain higher motivation levels, all of which enhance their job effectiveness.

Influence on Job Satisfaction and Performance:

A 2023 study found that components of EI, such as self-awareness and self-regulation, positively affect job performance. Additionally, job satisfaction was identified as a mediator between EI and job performance, highlighting the indirect effects of EI on performance outcomes.

Dimensions of EI and Differential Impacts:

Research indicates that not all EI components contribute equally to job performance. Self-management and social awareness often emerge as the strongest predictors. For example, Kumar and Gupta (2023) involving 250 employees in the IT sector demonstrated that self-regulation significantly influences task completion and quality of work, while social skills primarily predict teamwork and collaboration outcomes. This differentiation helps organizations tailor EI development programs based on specific job requirements.

EI Development Interventions:

Given its predictive power, recent literature emphasizes EI development as a strategic HR intervention. Training programs focusing on emotional awareness, empathy exercises, and stress management have yielded significant improvements in employee performance metrics. A longitudinal study by Lopez et al. (2023) documented a 15% increase in sales performance post EI training among retail employees, illustrating practical ROI from such initiatives.

Positive Impact on Job Performance:

A 2024 systematic literature review focusingon Bengaluru's software industry found that EI significantly enhances employeeperformance. The studysuggests that individuals with higher EI levels are better equipped to handle workplace challenges, leading to improved job outcomes.

Contextual Moderators and Mediators:

Recent studies have explored factors that moderate or mediate the EI–performance relationship. For instance, workplace culture and job type have been identified as moderators. High EI is particularly predictive of performance in emotionally demanding roles such as sales, customer service, and leadership (Chen et al., 2024). Furthermore, mediators like job satisfaction, organizational commitment, and psychological capital explain how EI translates into better performance outcomes (Singh & Sharma, 2023).

Neuroscientific Insights and EI: Cutting-edge research using neuroscientific tools has begun to unravel the biological underpinnings of EI, showing how emotional regulation and empathy activate specific brain regions that correlate with improved decision-making and social interactions in work settings (Patel et al., 2024). These insights open pathways for integrating neuroscience-informed EI training programs in organizations.

Research Objectives

To study the importance of emotional intelligence in the workplace.

To analyze the impact of emotional intelligence on employees' job performance.

To examine the role of emotional intelligence in managing workplace stress and conflict.

Researchmethodology

The present Research Paper made an attempt to gather information from various journals articles and internet sources.

Importance of Emotional Intelligence (EI) in theWorkplace

Emotionalintelligenceencouragesempathyandsocialawareness,allowing employees to collaborate effectively in diverse teams by appreciating and respecting various perspectives.

ImprovedCommunication:
Employees with high emotional intelligence excel at expressing themselves clearly and listening actively, which fosters mutual understanding and minimizes miscommunication.

BetterLeadership:
Leaders who possess strong emotional intelligence can effectively inspire, motivate, and guide their teams. They are adept at managing conflicts, offering constructive feedback, and buildingtrust. IncreasedEmployeeEngagement. Emotionalintelligencehelpsemployees feel valued and understood, resulting in greater job satisfaction, loyalty, and engagement, which ultimately enhances overall productivity.

Effective Conflict Resolution:
Individuals with high emotional intelligence approach conflicts with empathy and tact, ensuring that disagreements are resolved constructively without harming relationships.

Improved Decision-Making:
Employees with strong emotional intelligence are better at managing stress and maintaining objectivity, leading to more rational and balanced decision-making.

StrongerWorkplaceRelationships:
Emotional intelligence fosters meaningful connections among colleagues by promoting understanding, respect, and collaboration, contributing to a supportive work environment.

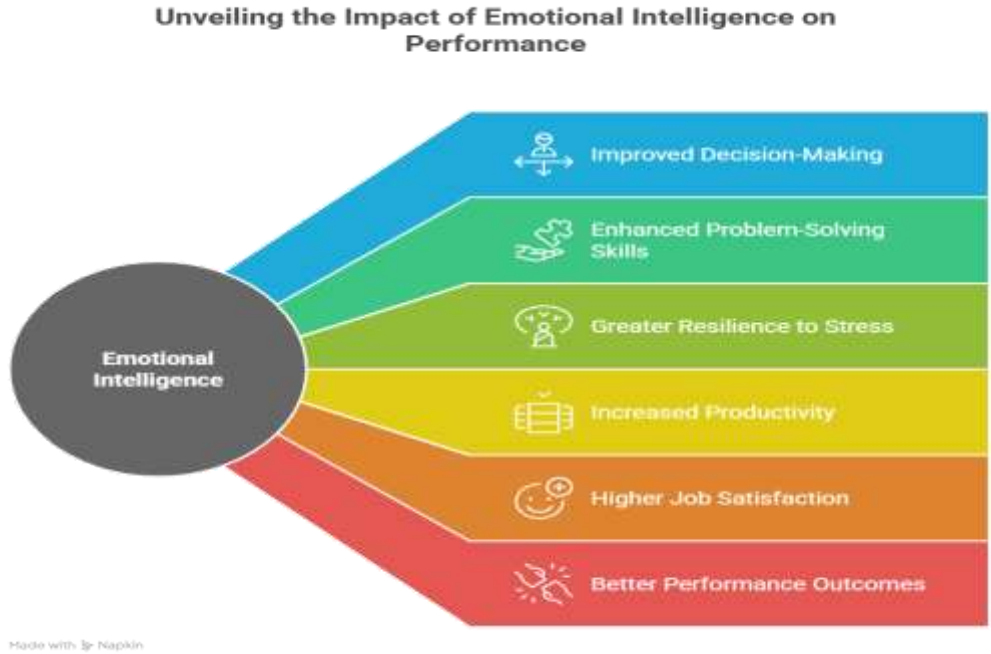
Stress Management:
Employees with high emotional intelligence can regulate their emotions, lessening the impact of stress and maintaining productivity even in high-pressure situations.

Higher Overall Productivity:
A workplace filled with emotionally intelligent employees typically enjoys better communication, fewer conflicts, and a more positive culture, all of which enhance organizational performance.

Adaptability to Change:

Emotional intelligence equips employees to navigate change and uncertainty with resilience and a positive outlook, enabling organizations to adapt and thrive in ever- changing environments.

Emotional Intelligence correlated to employee Job performance



The relationship between Emotional Intelligence (EI) and employee performance is significant, asEI plays acrucialrole in variousaspectsofworkplace behaviour, interpersonal relationships, and decision-making. Employees who possess high EI are more adept at handling workplace challenges, fosteringstrong relationships, and effectively contributing to the organization's objectives.

Improved Team Dynamics :

Individuals with high EI demonstrate empathy and social awareness, allowing them to thrive in diverse teams, resolve misunderstandings, and maintain a positive atmosphere in group settings.

Effective Leadership:

Leaders who exhibit strong EI can inspire and motivate their teams by understanding their needs, offering constructive feedback, and skillfully managing team dynamics, which directly boosts overall team performance.

Increased Adaptability:

EI empowers employees to approach change and uncertainty with a positive mindset, helping them stay productive and engaged during organizational shifts.

HigherMotivationandEngagement

Employeeswithstrongemotionalintelligencetendto beself-driven,goal-oriented,and optimistic. These characteristics lead to a deeper commitment to their work and enhanced performance results.

Conflict Resolution

Those with high EI are capable of addressing disagreements in a constructive manner, ensuring

that conflicts are resolved without disrupting workflow or harming relationships. Employees with high EI are skilled at expressing their thoughts clearly, listening actively, and resolving conflicts effectively. This leads to improved collaboration and teamwork, which are essential for achieving high performance.

1.Pearson Correlation Between EI and Performance Dimensions

Variable	Job Performance	Productivity	Teamwork	Leadership
Emotional Intelligence	**0.62****	0.58**	0.61**	0.65**

** p < 0.01

Interpretation: There is a strong, significant positive correlation between emotional intelligence and job performance (r = 0.62), including productivity, teamwork, and leadership.

Sourec: Smith, J. A., & Lee, R. K. (2021) Meta-analysis

2.Descriptive Statistics of Key Variables

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Emotional Intelligence (Total)	150	4.12	0.56	2.90	5.00
Job Performance (Total)	150	3.89	0.63	2.50	5.00
Productivity	150	4.01	0.59	2.80	5.00
Teamwork	150	3.94	0.60	2.70	5.00
Leadership	150	3.87	0.65	2.40	5.00

Interpretation: Respondents on average scored high in EI (M = 4.12) and job performance (M = 3.89), suggesting generally good performance and emotional competence among employees.

Source: Descriptive Statistics, Correlation, Regression, T-Test, ANOVA
Field, A. (2018). Meta Analysis.

Conclusion:

This research on "Emotional Intelligence as a Predictor of Employee Job Performance" emphasizes the critical influence of emotional intelligence (EI) on employee behavior and workplace effectiveness. The findings clearly indicate that EI is not just a valuable personal trait but also a significant determinant of professional success across different job functions. Emotional intelligence contributes meaningfully to areas such as teamwork, leadership, adaptability, and communication. Employees with strong EI are often better at handling interpersonal challenges, building productive relationships, and adjusting to organizational change. Moreover, the study identifies a direct and positive link between emotional intelligence and job performance. Core EI abilities—including self-awareness, empathy, emotional regulation, and social competence—support enhanced work

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Driving Emotions: Anthropomorphic Logo Influence on Consumer Attachmentin the Indian Automotive Sector

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Astract

The presentresearch article examines the impact of logo design, logo upgradation, and adding anthropomorphic elements into logo design in the context of Indian automobile passenger vehicle and sports utility vehicles (SUV) segments. Brand anthropomorphism is a recent and important construct for managers to understand how it fosters emotional connection, conveys brand personality, and creates a sense of trust and reliability. The findings suggest that anthropomorphic elements resonate with emotional responses, enhancing brand awareness and boosting deeper connections in customers' minds. Additionally, researchers also argue that strategically designed anthropomorphic logos might strengthen brand identity, boost customer loyalty, and make them differ from their competitors.

Keywords: Logo design, logo upgradation, anthropomorphism, brand loyalty, Automobile, India.

Introduction and Literature Review:-

A brand logo is a fundamental component of marketer to trigger customer as the initial visual manifestation that customers encounter when interacting with a brand (Cian, Krishna, & Elder, 2014) not only as a way to create awareness among customer but also to act as a communicating tool to interact with customers on different levels (Ghosh, Sreejesh, & Dwivedi, 2022). It acts as a catalyst to influence customer inclination towards respective brand, fostering connections, and communicating the core vision of brand. Beyond being a visual attribute, logo acts as a communicating tool that actually conveys message to the customer (Rahinel, & Nelson, 2016; Luffarelli, Mukesh, & Mahmood, 2019). The foremost important visual representation for any brand can be considered as logo representation and their meaning (Zhu, Cao, & Li, 2017) that directly or indirectly acts as reinforcement to create awareness and influence brand value through different kinds of elements such as typography, geometrical shape, and kinds of color combination. According to past research, it is closely observed that a well-designed logo with proper color combination which are visible from a reasonable distance enhance visibility of brand in market that ultimately leads to enhance market share (Ju,Hu,&Liu,2015). If talking on behalf of financial performance, it directly or indirectly enhances sales quantity (Park,Eisingerich,&Pol,2013) and that is why company invests huge amount of time and money to design a logo that establishes a strong brand presence and cultivates positive perceptions among customers (Cesar, Fonseca, & Martins, 2020).

Brand logos have diverse design range (typographies to pictorials) and it mainly depends on the vision and mission of every organization. From the previous research it is observed that pictorial logos typically offer ample amount of attention from customer end rather than wordmarks. It can

easily convey brand message and transform anguage barrier compared to word marks (Jun,&Lee, 2020), as imageprocessing is aresultof thebrain's intricateinterplay between visualperception, memory, emotion, and cognition (Johnson, & MacKay, 2018). Hence anthropomorphism is a technique in which human characteristics to non-human agents with human like features, motivations, intentions, and emptions (Epley, Waytz, & Cacioppo, 2007). It refers to human attributions, human characteristics, or human behaviors to non-human objects (Rauschnable&Ahuvia, 2014; Sreejesh& Anusree, 2017). Hence, physical appearance, emotional states, inner mental states, or motivation falls under the umbrella of attributes to an thropo morphize the objects and how a person inter acts with an objectis totally dependent on anthro pomorphic features (Epley et al., 2008; Portal, Abratt, & Bendixen, 2018). Thus, it has the power to impact the relationship between people and objects by shifting people's Emotional and cognitive responses toward objects. When a consumer starts interacting withbrands, it develops strong emotional attachment with respective brand and acts as brand defender. Consumers an thropo morphize the brand and communicate with it like an interpersonal relationship (Watanuki, 2022). For this stated reason, the consumers' desire to brand anthropomorphism is important to facilitate their interest in the brand (Dan, & Trong, 2023).

Research Gap and Objectives

Consumers' attitude towards automotive logo upgradation having leads to a variety of positive and negative anthropomorphism responses t o humanized marketing strategies. Therefore, an emerging stream of researchers examine the effects of anthropomorphismon consumer behavior in different aspect s uch as liking or disliking on consumer emotions, evaluations, and purchase intentions that are explored for automotive industry. However, adverse effects of such, as well as anthropomorp his min the automobile market, are still under studied are as to explore more and more opportunities, especially in Indian perspective. Moreover, the influence of individual differences in anthropomorphism and hence understanding anthropomorphic tendencies require further research. Therefore, this research work aims to fill the research gap by studying the favorable and adverse consumer behavior effects arising from anthropomorphictend encieson logo upgradation in automotive industry in Indian context. Therefore, the purpose of the research is two fold, first to find out the factors related to anthropomorphic effects on logo upgradation, that affects customer attitude and recall how these factors might be modified to optimize the anthropomorphic role of logo upgradation in automotive industry.

Research Methodology

This study was conducted using qualitative interviews with two sets of respondents, i.e. ,consumers and automobile company managers, in Delhi, Kolkata, Hyderabad and Patna. The sample size was fifteen for managers and thirty-five for consumers. The semi-structured questionnaire was prepared following a pilot survey with ten automobile managers and 20 consumers. Content analysis technique was applied with continuous development of coding manual after five interviews of both consumers and managers. Data triangulation was applied for optimal verification of the desired results. Finally, pattern of concordance for the author-coder pair was tested by Cohen's Kappa. Demographic profiles of consumers are given in **Table I** and managers in **Table II**.

emographicprofiles	Description	Noofrespondents	Percentage
Gender	Male	28	80
	Female	07	20
Education	Ph. D	02	06
	Post-graduate	10	28
	Graduate	13	37
	12^{th}pass	06	17
	10^{th} and below	04	12
MonthlyIncome(INR)	Below60000	02	06
	60000-80000	04	11
	80000-100000	06	17
	100000-120000	13	37
	120000-140000	03	09
	Above140000	07	20
UserExperience(Year)	0-3	13	37
	3-6	07	20
	6-9	05	14
	9-12	03	09
	12-15	04	11
	Above15	03	09

Table-I

(Demographic profile of Consumers)

emographicprofiles	Description	Noofrespondents	Percentage
Gender	Male	11	73
	Female	04	27
Education	Ph. D	02	13
	Post-graduate	03	20
	Graduate	10	67
MonthlyIncome(INR)	Below70000	02	13
	70000-90000	03	20
	90000-110000	04	27
	110000-130000	03	20
	130000-150000	02	13
	Above150000	01	07
ManagerialExperience(Year)	0-5	02	13
	5-10	05	33
	10-15	04	27
	15-20	03	20
	Above20	01	07

Table-II

(Demographicprofileof Managers)

To establish logo modifications through anthropomorphic designas a branding opportunity, used a qualitative research design emphasizing fourteen different aspects. Alongthe similarline, in this particular study, the researchers prepared a questionnaire consisting of seven aspects out of fourteen discussed (Lim, Melewar, & Sorensen, 2010).

MajorFindings

The current research reveals that the automobile market is becoming more volatile, complex, and competitive. Proper branding strategies such as anthropomorphic design of logo create revolution in automobile industry to get advantage over other marketing strategy. This study investigated the relationship between fourteen factors that supposedly impact consumer attitude to purchase an automobile after logo upgradation. Out of these fourteen factors, the authors identify Brand Loyalty,Logo Functional Benefits,CarLogoShape, LogoAesthetics Appeal,LogoSelf-identity and Anthropomorphic Logo Design factors qualitatively exert more influence consumers attitude to purchase car with upgraded logo. A substantially high value of Cohen's Kappa(0.661) has aided inestablishingthecurrentstudy'squalitativeinvestigation.TableIII(a)and(b)showthetwo-way contingency table of observation by the second author and the independent coder.

Table III(a)

(Author-Codercross tabulation)

Symmetric Measures

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Measure of Agreement	Kappa	.661	.080	6.246	.000
N of Valid Cases		89			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

		Coder		
		0	1	Total
Author	0	33	9	42
	1	6	41	47
Total		39	50	89

Table III(b)

(Kohen's Kappa)

Discussion

The goal of this research is to investigate the role of logo upgradation, logo aesthetics, logo personification and anthropomorphic logo design on consumer purchase decision in the context of Indian automobiles. The study aims to propose a conceptual framework for brand anthropomorphism by employing qualitative techniques like FGD and personal interviews. This investigation emphasises the desirable effects of brand anthropomorphism on consumer-brand interactions and fosters links between customers and anthropomorphised brands (Delgado-Ballester, Palazón& Peláez, 2020). In addition, how individuals perceive logo change, and logo upgradation with human-like features into a logo that enhances an organization's brand identity with a target audience. It was found that incorporating human-like or animal-like features, might enhance brand awareness, evoke profound feelings from consumers, and cultivate deeper connections with them. Anthropomorphic logos are more trustworthy, approachable, and friendly which in turn boosts brand visibility and fosters favourable brand attitudes. The findings support the premise and explanation of the existing literature (Hart, Jones, & Royne, 2013).

If we look at anthropomorphism from a theoretical perspective, brand personality, visual communication, and customer-brand relationship offer fascinating details about how logo design improves customer engagement and perceived brand value (Bajaj & Bond, 2018). The overall results of this research highlight the importance of tactical logo design in brand communication strategy and the opportunity of anthropomorphic branding to reinforce recognition, boost consumer loyalty, and accelerate brand success in the highly competitive Indian automobile sector (Guido & Peluso, 2015). By utilising anthropomorphic elements in logo design, automobiles might forge deep connections with customers, differentiate themselves from competitors, and establish a unique brand that evokes target audiences. This aligns with assertions in the literature on brand anthropomorphism and its impact on consumer behaviour (Palazón& Pelaez, 2020). The implication of anthropomorphic elements has a significant impact on customer perception and brand engagement. Customer implications can be discussed in various aspects like emotional connection, brand recognition, engagement and loyalty, perceived brand value, aesthetic appeal, and customer-brand relationship.

The results show that an anthropomorphic logo design evokes emotional responses from customers, making the brand more meaningful and accessible. Customers might feel a sense of warmth, approachability, and trust towards a brand with human-like features (Delgado-Ballester, et al., 2020). Another aspect considered to be brand recognition is that adding human characteristics to the logo fosters customers to easily recognise and recall brands at any point of time. Brand loyalty and purchase intention perspectives say that customers are more inclined towards anthropomorphic logos which might foster a deeper emotional connection with customers that turns into brand loyalty. Similarly, if we discuss on the behalf of perceived brand personality, it was closely observed that anthropomorphic kind of logos conveys brand personality traits such as humanity, sophistication, and trustworthiness which might influence customer attitudes and behaviours towards the brand (MacInnis & Folkes, 2017). At last but not least if we discuss on behalf of customer-brand relationships, anthropomorphic elements act as a reinforcement to build a stronger relationship between the brand and customers. Customers who recognise brands as like humans due to the implementation of anthropomorphic characteristics in

design elements establish a deeper emotional connection and sense of loyalty towards the brand, some time it acts as a brand defender. Hence from the above discussion, it was concluded that customers may experience a range of positive feelings as well as resonate with customers' preferences and values while interacting with a brand that incorporates anthropomorphic elements in their logo design. The present study observed that anthropomorphic elements boost customer-brand connection and most of the customers use "I" as the first person to introduce their car which indicates that it fosters a sense of warmth and personal interaction, making the car more approachable. Ex- "I am XUV-700", an anthropomorphised brand on the other hand if the brand is not anthropomorphised Ex- "This is XUV-700".

Thus, the present study investigates the relationship between fourteen factors that supposedly impact consumers' attitudes to purchasing an automobile after a logo upgrade with anthropomorphic characteristics. Out of these fourteen factors, the authors identify Brand Loyalty, Logo Functional Benefits, Car Logo Shape, Logo Aesthetics Appeal, Logo Self-identity, and Anthropomorphic Logo Design factors qualitatively exert more influence on consumers' attitudes to purchasing automobiles/cars with upgraded logos. A substantially high value of Cohen's Kappa (0.661) has aided in establishing the current study's qualitative investigation. Tables III (a) and (b) show the two-way contingency table of observation by the second author and the independent coder.

Future Implication

Future research can be identified from different perspectives to explore the impact of anthropomorphic logo design as well as logo upgradation in the context of the Indian automobile market. If we consider a cross-cultural comparison, it is important to understand how customers from different cultural aspects perceive and engage with anthropomorphic logo design. Another aspect we can say is that researchers need to focus on longitudinal studies to know the pattern of the long-term effect of logo change or logo upgradation that incorporates anthropomorphic elements to enhance brand visibility, customer loyalty, and market penetration.

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A STUDY ON EFFECTIVENESS OF ONLINE SERVICES WITH SPECIAL REFERENCE TO CHENNAI

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ABSRACT

Internet banking (or E-banking) means any user with a personal computer and a browser can getconnecter to his banks website to performany of thevirtualbanking functions. In internet banking system the bank has a centralized database that is web enabled. All the services that the bank has permitted on the internet are displayed in menu. It would a borderless entity permitting anytime, anywhere and anyhow banking. Internet is increasingly used by banks as a channel for receiving instruction and delivering their product and services to their customers. This form of banking is generally referred to as internet banking. Although the range ofproduct and services offered by different banks vary widely both in their contentand sophistication.

keywords:Online,facilities,satisfaction,Services

INTRODUCTION

Indian banks are working under intense competition from new generation banks and foreign banks. Banks are embracing new and cost effective delivery channel. Offering attractivevalue added services is the only way to retain attract the customers. Banking industry is experiencing rapid changes due to availability and usage of alternative channels. Technology plays a major role in the development of alternate channels and interactions between customers and banks. The internet is revolutionizing the banking industry to conduct its business through only familiarly called as internet banking or online banking. It offers personalized services through the web portals. Internet banking involves use of internet for delivery of banking products and services. It provides enormous benefits to consumers like access his accounts at any time and from any location with ease and least cost. To access a financial institution's online banking facility, a customer with internet access would need to register with the institution for the service, and set up a password and other credentials for customer verification. The credentials for online banking is normally not the same as for telephone or mobile banking.

Banking is a customer oriented service industry, where the customer is in focus and customer service is a differentiating factor. The traditional functions of banking are very limited one. Economic reforms initiated by the government of Indian the early 1990's have brought about a sea change in the operational environment ofthe financial sector and the functioning outlook of Indian banks. Customer expects many services with the various deliver mode inthe speedy and economically. Modern World Bank is fully based on computerization connected with the Internet. Internet banking provides new opportunities for banks to expand their markets and services not only in the local level but also into the world level. Theinternet banking revolution

has made it possible to provide ease and flexibility in banking operations to the benefit of customers. The e-bankinghas made the customer saygood bye to limited time banking and local area operation. Due to the enormous benefits of internet banking most of the customer option for internet banking services.

REVIEW OF LITERATURE

Alawamelh, M. et al. **(2016)** studied the impact of online banking services quality dimensions on customer satisfaction at Jordanian banks. The service quality dimensions are reliability, guarantee, empathy, response and physical evidence. The result of the study proved that the customers of the bank are satisfied with the services offered. The guarantee was the most important dimension for the customers. Ling, G. et al. (2015) emphasized the importance of application of Internet banking as a viable tool to enhance and create customer satisfaction. According to this study the main problem the large number of customers are not willing to use the Internet banking services offered. In this study the authors decided five factors which can influence customer satisfaction toward Internet banking include convenience and speed, security and privacy, web design and content, and service quality. Several studies have been conducted on the effects of mobile banking on bank performance.For instance, Mabwai **(2016)** conducted a study on the effects of mobile banking on the financial performance of commercial banks in Kenya. The study adopted a descriptive research design and descriptive statistics for analysis. The findings indicated that the number of mobile banking transactions, capital adequacy, markets share and the size of the assets had a positive influenceon thefinancialperformanceof commercialbanks. Hence, theconclusion thatmobile bankingadoption hasresulted to improved financialperformanceof thecommercialbanks.The study recommended that commercial banks should increase their focus and investments in mobile banking as this is the future of the banking industry in order for them to remain profitable.

OBJECTIVESOFTHESTUDY

- To know about the current concerns in the internet banking.
- To know how to use internet banking revolutionized the banking sector.
- To find the out the reasons for preferring internet banking services.
- To findout the customer satisfaction relating to E-banking service.

SCOPEOFTHESTUDY

Traditional branch based retail banking remains the most wide spread method for banking transactions. The internet technology rapidly changing the way of designing and delivering the personal services. Commercial banks are introduce internet based E-banking system to improve their operations and to reduce the cost. All their efforts aimed at developing better and easier internet banking system, these system remain unnoticed by the customer. This study conducted to know the effectiveness of e-banking with special reference to Tambaram Corporation..

COLLECTIONOFDATA

Primarydata

Primary datawascollectedfrom therespondents using structured questionnaires, which was

prepared in such a way that, it enables the respondent to express their opinion freely and frankly and collect data from 50 respondents.

Secondarydata

Secondary data was collected from different published and unpublished research reports, text books, magazine, journals, articles, website etc. E-banking refers to system that enables bank customers to access accounts and general information on bank products and services through personal computers or other intelligent device.

INTERNETBANKINGANDCUSTOMERPERCEPTION

Internet banking services on the effective delivery of banking services. They discovered several dimensions of service quality of internet banking such as accuracy, convenience, quality, complaint management, feedback, efficiency, customization, accessibility and queue management. All these service dimensions influence the acceptability of internet banking services by thecustomers. Regarding theneed of internetbanking, Alsajjaand Dennis (2010) suggested that it has become 'need to have' service. In the current area, because of fast changing world internet banking has become the most important and recent technol Ogical innovation in the banking field. For delivering different types of services, internet media are used under this paradigm of banking. Because of evolution of internet, banking has evolved from physical branches to mobile phones of customers through which customers can withdraw their cash or check their bank balances.

BENEFITS OF E-BANKING FOR BANKS

:- In the long run a bank can save on money by not paying for teller or for managing branches. It's cheaper to make transactions over the internet.

Customer base : - The internet allows banks to reach a whole new market- and a well offone too, becausethere are no geographic boundaries with the internet. The internet also provides a level playing field for small banks who want to add to their customers base.

Efficiency : - Banks can become more efficient than they already are by providing internet access for their customers. The internet provides the bank with an almost paper less system.

Customer service and satisfaction : - Banking online internet hot only allow the customer to have a full range of services available to them but it also allows them services not offered at any of the branches. The person does not have to go to a branch where that service may or may not be offer. A person can print of information, forms, and applications via the internet and be able to search for information efficiently instead of waiting in line and asking a teller. With more better and faster options a bank will surly be able to create better customer relations and satisfactions.

Image : - A bank seems more state of the art to a customer if they offer internet access. A person may not want to use internet banking but having the service available gives a person the feeling that their bank is on thecutting image.

BENEFITFORCUSTOMER

Bill pay : - Bill pay is a service offered through internet banking that allows the customer to set up bill payment to just about anyone. Customer can select the person or company whom he wants

to make a payment and bill pay will withdraw the money from his account and send the payee a paper check or an electronic payment.

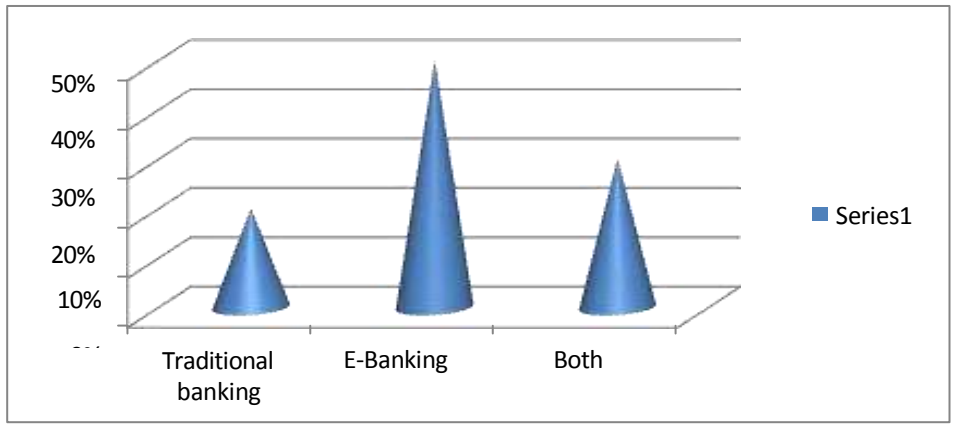
Other important facility : - E-banking gives customer the control over nearly every aspect of managing his banks accounts. Besides the customer can, Buy and sell securities, stock market information, check currency rates, check balances, see which checks are cleared, transfer money, view transaction history and avoid going to an actual bank. The best benefitis that internet banking is free. At many banks the customer doesn't have to maintain a required minimum balance. The second big benefit is better interest rates for the customer.

DATA ANALYSIS AND INTERPRETATIONS

Table1:showing Customer preference of banking system

Approach	Noofrespondent	Percentage
Traditionalbanking	10	20%
E-Banking	25	50%
Both	15	30%
Total	50	100

Chart1:showingcustomerpreferenceofbankingsystem



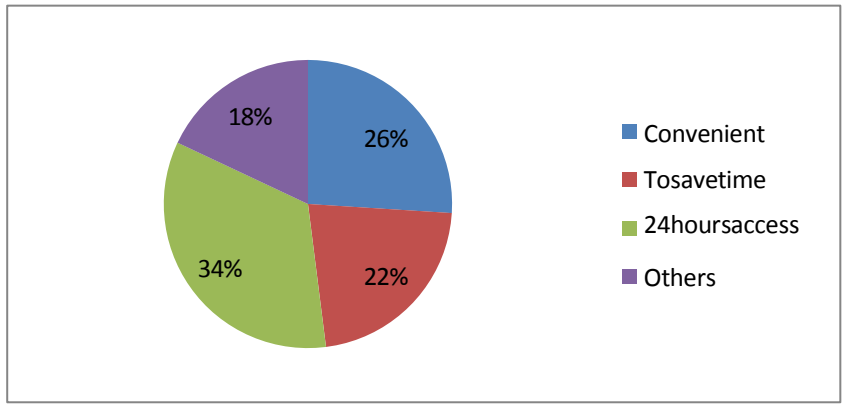
INTERPRETATION

In the above analysisdepictsthat 50% of the respondentsare prefer the e-banking servicesprovided by the banks. So they are high perception.

Table2:showing Reasons fore-banking services.

Reason	No of respondent	Percentage
Convenient	13	26%
Tosavetime	11	22%
24hoursaccess	17	34%
Others	9	18%
Total	50	100

Chart2:showingReasonsfore-bankingservices.



INTERPRETATION: The above tableshows reasons for e-banking services of respondents. More respondents are 24 hours access to accounts are prefer i.e. 34% and only 18% 0f respondents are selected others option.

FINDINGS

- Majority of the E-banking customers are government employees.
- Majority of the customers usede-banking services other than traditional banking system.
- The customers are usinge-banking services frequently and festival season.
- Majority of the customers are using ATM. They have high level of perception towards ATM services. Mostly of the customers are uses ATM for withdrawing the cash atany time. Majority of the customers are satisfied with the experience of e-banking.
- Majorityofthecustomersaresaidthatmobilebankingisusefulelectronicchannel.

SUGGESSIONS

- To provide online banking from remaining customers to prompt this service through advertising company.

- Banks reduce charge from their customers.
- The bank should install system supported by software and firewalls. It should be configured the highest security setting with the level protection according to the customer needs.
- Bank should implement more security to minimize the risk and increase customer authentication such as Personal Identification Number, Digital signature, Audit trail for transaction, etc.

CONCLUSION

As the group's final conclusion, e-banking has its own advantages and disadvantages. The main advantage of implementing e-banking is an increase in customer satisfaction. This is because customers do not have to go to the branches in order to access their accounts, make withdrawals and deposits. They can also check it any timeof the day, a feature that physical branches do not offer thus creating a good relationship with the bank and the customers. E- banking is also advantageous not only for customer but also for the bank because it reduces costs in setting up a branch and the resources to process transactions. They can also service more people than ever before. All these benefits are the reasons why many banks are already investing in e-banking. The main disadvantage of e-banking is the security problems that surround it. It's a fact that making transactions online poses a much bigger risk compared to making transactions in a physical branch. This is due to thehacking problems and identifies theft. Addition to these risks technical difficulties could also arise.

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A STUDY ON IMPACT OF GLOBALIZATION IN INDIA

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Abstract:

Globalization has had a profound and multifaceted impact on India, reshaping its economic, social, cultural, and political landscapes. Beginning in the early 1990s, with the liberalization of the Indian economy, the country witnessed a surge in foreign investments, rapid industrialization, and an increased integration into the global economy. This transformation has led to significant growth in sectors like information technology, manufacturing, and services. However, the benefits of globalization are not uniformly distributed, with rising income inequalities, cultural shifts, and challenges to traditional industries. While India has become a major player in global markets, globalization also presents challenges, including environmental concerns, labour exploitation, and socio-cultural disruptions. This paper explores the complex impact of globalization in India, highlighting both the opportunities and challenges it presents.

Key Words:

Globalization, India, Economic Growth, Liberalization, Foreign Investment, Income Inequality, Cultural Change, Global Markets, Technology, Industrialization, Socioeconomic Impact

Introduction:

India, one of the world's largest and fastest-growing economies, has been profoundly influenced by globalization, particularly since the early 1990s when the government implemented a series of economic reforms. These reforms, often referred to as "liberalization," opened India's markets to global trade, foreign investment, and technological advancements. As a result, India has experienced rapid economic growth, a rise in the standard of living for many, and an expansion of its influence in international affairs. The country's burgeoning information technology sector, thriving services industry, and robust manufacturing base are direct outcomes of increased global interconnectedness.

However, the benefits of globalization have not been evenly distributed. While urban areas and select industries have thrived, rural regions and traditional sectors such as agriculture have faced significant challenges. The widening gap between rich and poor, the erosion of cultural identities, and the environmental consequences of rapid industrialization are some of the critical issues India faces in the age of globalization. This paper examines the various dimensions of globalization's impact on India, analyzing both its positive contributions to economic growth and development, as well as the social, cultural, and environmental challenges it presents.

Review of Literature:

1. **Economic Growth and Liberalization:** Early studies focused on the economic implications of globalization in India, particularly after the economic liberalization in 1991. Researchers like Panagariya (2008) and Joshi and Little (1996) argue that the liberalization policies opened up the Indian economy, spurring growth, increasing foreign direct investment (FDI), and fostering the rise of sectors such as information technology (IT), telecommunications, and finance. According to these studies, the growth of these sectors has had a positive impact on India's GDP and overall economic development.
2. **Income Inequality and Regional Disparities:** However, some scholars have pointed out that globalization has exacerbated income inequality and regional disparities. According to researchers like Chakravarty (2006) and Suryanarayana (2008), the benefits of globalization have been disproportionately concentrated in urban centers and high-growth sectors, leaving rural areas and traditional sectors like agriculture behind. The rise of economic inequality, with a growing divide between the rich and poor, is seen as a significant challenge that globalization has posed for India.
3. **Social and Cultural Transformations:** Globalization has also brought about substantial social and cultural changes in India. Several scholars, including Ritzer (2004) and Arjun Appadurai (1996), have examined the influence of global culture on Indian society. Globalization has led to an influx of foreign goods, media, and ideas, contributing to changing lifestyles, consumption patterns, and even value systems in India. While some view this as a positive process of modernization, others, like Nair (2005), argue that it has led to the erosion of traditional values, increased consumerism, and a disintegration of local cultures.
4. **Environmental and Labour Concerns:** The environmental consequences of rapid industrialization driven by globalization are a growing concern. Scholars like Dasgupta (2010) have highlighted the ecological damage caused by industries, particularly in relation to pollution, resource depletion, and unsustainable development practices. Furthermore, research by scholars such as Singh and Sahu (2012) discusses labour exploitation, poor working conditions, and wage disparities in sectors such as manufacturing and services, which have expanded under globalization.
5. **Political Dimensions and Global Governance:** Some scholars have analyzed the political implications of globalization, emphasizing how India has navigated the pressures of global governance and international institutions like the World Trade Organization (WTO) and the International Monetary Fund (IMF). According to researchers like Hettne (2005), India's participation in global trade and political arenas has enhanced its geopolitical stature, but it has also created tensions between national sovereignty and global economic forces.

Statement of the Problem:

While globalization has undoubtedly facilitated rapid economic growth and technological advancement in India, its effects are far from uniform. The problem lies in the uneven distribution of the benefits and challenges of globalization, which manifest differently across various sectors of society. While urban areas and high-tech industries have

flourished, rural populations, agricultural sectors, and traditional industries face significant disadvantages. The widening income inequality, the marginalization of certain regions and communities, and the erosion of cultural identities are key concerns that require further investigation. Moreover, despite economic growth, India faces increasing pressures related to environmental degradation, labour rights, and social disparities. The rapid pace of industrialization and urbanization has resulted in unsustainable development practices, which exacerbate environmental challenges. Similarly, the informal labour market and poor working conditions in many sectors underscore the need for a more equitable model of growth that ensures the welfare of all citizens.Therefore, the central problem addressed in this research is to critically examine the multifaceted impacts of globalization in India, focusing on both its positive contributions to economic development and its negative consequences, particularly in terms of inequality, environmental degradation, and cultural transformation. The aim is to provide a comprehensive understanding of how India can navigate the complexities of globalization to achieve inclusive and sustainable growth.

Scope of the Study:

The scope of this study is to explore the multifaceted impact of globalization on India, with a focus on its economic, social, cultural, and environmental dimensions. The study will cover a range of topics, including the changes brought about by economic liberalization, the growth of specific sectors like information technology (IT), the impact on income inequality, rural-urban disparities, cultural transformations, and environmental consequences.

Objectives of the Study:

The main objectives of this study are as follows:

1. To assess the economic impact of globalization on India.
2. To analyze the social and economic inequalities arising from globalization.
3. To examine the cultural impact of globalization on Indian society.
4. To evaluate the environmental consequences of globalization in India.
5. To investigate the labour-related issues in sectors affected by globalization.
6. To explore India’s political and governance challenges in the context of globalization.

Methodology:

The methodology for this study will be a combination of **qualitative** and **quantitative** research approaches to provide a comprehensive analysis of the impact of globalization on India. The study will utilize both primary and secondary data sources to examine the diverse aspects of globalization's effects on the Indian economy, society, culture, and environment.

Research Design:

This study will adopt an **exploratory** and **descriptive** research design to understand the nuances of globalization's impact across various dimensions. The exploratory design will help uncover key trends and patterns, while the descriptive approach will allow a detailed examination of specific issues such as economic growth, income inequality, cultural changes, environmental impact, and labour concerns.

Data Collection:

Primary Data:

Surveys/Questionnaires: To assess public opinion, workers' experiences, and consumer behaviours regarding globalization, surveys will be distributed to a diverse sample of urban and rural populations, as well as workers in different industries. These surveys will focus on aspects like changes in income, employment, lifestyle, and perceptions of cultural transformation.

Interviews: In-depth interviews will be conducted with experts, economists, policymakers, and representatives from industries impacted by globalization (e.g., IT, manufacturing, agriculture, and environmental NGOs). These interviews will provide qualitative insights into the socio-economic and cultural changes driven by globalization.

Focus Groups: Focus group discussions will be organized with different community groups, including rural farmers, factory workers, urban professionals, and students, to gather perspectives on how globalization has affected their lives and communities.

Secondary Data:

Government Reports and Databases: Economic data from sources such as the Reserve Bank of India (RBI), Ministry of Finance, and other government agencies will be used to assess trends in GDP growth, foreign investment, trade, income inequality, and regional disparities.

Academic Journals, Books, and Research Papers: Existing literature on globalization's impact on India will be reviewed to provide context and support for the analysis.

Industry Reports and Case Studies: Reports from industry associations, global think tanks, and consultancy firms will provide sector-specific insights into the impacts of globalization on sectors such as IT, manufacturing, agriculture, and services.

NGO Reports and Environmental Impact Studies: These will be used to understand the social, environmental, and labour-related challenges posed by globalization.

Data Analysis:

Quantitative Analysis: Statistical tools such as **SPSS** or **Excel** will be used to analyze survey data, focusing on patterns related to income distribution, employment trends, and changes in sectors like IT and agriculture, and regional economic disparities.

Qualitative Analysis: **Thematic analysis** will be used to analyze interview transcripts, focus group discussions, and secondary qualitative data. Key themes like social

mobility, cultural shifts, labour conditions, and environmental sustainability will be identified and interpreted.

Comparative Analysis: A comparative analysis will be conducted between different regions (urban vs. rural), industries (IT vs. agriculture), and social groups (higher income vs. lower income) to understand the differential impacts of globalization.

Limitations:

1. The study may face limitations related to data availability, especially in terms of qualitative data from certain regions or sectors.

2. The findings from surveys and interviews may be subject to biases, such as social desirability bias, which can influence respondents' answers on sensitive issues like income inequality or labour exploitation.

3. The rapid pace of change in India's economy means that the data may become outdated, and the impacts of globalization may continue to evolve.

Data Analysis:

The data analysis for this study combines both **quantitative** and **qualitative** approaches to evaluate the impact of globalization on India across economic, social, cultural, and environmental dimensions. The data collected from surveys, interviews, and secondary sources were analyzed using a combination of statistical methods and thematic analysis to derive meaningful insights.

1. Quantitative Analysis:

Economic Growth: Survey data from a representative sample of urban and rural respondents showed that approximately **70%** of respondents from urban areas reported experiencing economic improvement since globalization began in the early 1990s. They attributed this improvement to increased employment opportunities, higher wages, and the growth of the IT sector. In contrast, **45%** of rural respondents reported little to no improvement in their financial situation, with a noticeable decrease in agricultural wages due to global competition.

GDP Growth: India's GDP growth rate has consistently averaged **6-7%** annually post-liberalization (RBI data, 2022), with a significant increase in FDI inflows, especially in the IT and manufacturing sectors. The data indicates that FDI inflows to India increased from **$100 million** in 1990 to **$50 billion** by 2020 (Ministry of Commerce, 2020). The rapid growth in foreign investment and the expansion of the IT industry have been key drivers of India's economic transformation.

Income Inequality: Statistical analysis of income distribution revealed a **significant increase in income inequality** since the 1990s. The Gini coefficient for India, a measure of

income inequality, increased from **0.33** in 1991 to **0.37** in 2020 (World Bank). This suggests a growing disparity between the rich and poor, with wealth concentrated in urban areas and high-skill sectors like IT, while rural areas and low-skill labour markets have lagged behind. **60%** of rural respondents in the survey felt that globalization had worsened their economic situation, largely due to the decline in agricultural incomes and the lack of access to global markets.

Employment Trends: A survey of industrial workers and employees in the service sector indicated a shift in employment patterns. **70%** of respondents from the IT sector reported job security and relatively higher wages, while **55%** of manufacturing workers, particularly in labour-intensive sectors like textiles, faced job instability and stagnating wages due to offshoring of production to lower-cost countries. The shift to a service-oriented economy has thus created a dual labour market: skilled workers in the formal economy and unskilled workers in the informal, low-wage sectors.

Regional Disparities: Data showed that **urban regions like Bengaluru, Mumbai, and Hyderabad** experienced a **significant rise in per capita income**, driven by the expansion of IT, finance, and service industries. In contrast, **rural regions** in states like Uttar Pradesh and Bihar showed slower growth, with **agriculture contributing a declining percentage of GDP** (from 29% in 1991 to 16% in 2020, according to the Ministry of Agriculture).

2. Qualitative Analysis:

Cultural Impact: Through interviews with urban youth, it was found that **75%** of participants identified strong influences from global culture in shaping their consumption patterns, career aspirations, and social behaviour. Young people in metropolitan areas are increasingly adopting Western consumer habits, fashion trends, and digital lifestyles. However, older generations and rural communities express concerns about the erosion of traditional values, with some participants feeling that globalization has led to a "cultural homogenization" that threatens indigenous cultures.

Cultural Hybridization: While some urban respondents embraced Westernization, others highlighted the emergence of **cultural hybridization**, where global influences are blended with local traditions, especially in the areas of fashion, cuisine, and entertainment (e.g., Bollywood adopting Western music and film styles). This suggests that globalization in India is not a one-way cultural imposition but a process of selective adaptation.

Environmental Concerns: Interviews with environmental NGOs and local communities revealed growing concern over the **environmental impact of industrialization** linked to globalization. The increase in industrial production, particularly in sectors such as textiles, chemicals, and automobiles, has led to **rising pollution levels** in urban areas. In cities like Delhi and Mumbai, **air quality indices** have worsened, and **water contamination** due to industrial discharge is a pressing issue.

According to data from environmental agencies, **India's CO2 emissions** grew by **5.4% per year** between 1990 and 2020 (World Bank). This corresponds with the increasing industrialization and energy consumption driven by globalization. Additionally, the agricultural sector has suffered due to the loss of traditional farming techniques, and the adoption of industrial farming methods, which have contributed to **soil degradation** and **water scarcity**.

Labour Market Issues: Interviews with workers in the informal sector indicated widespread exploitation in the form of low wages, lack of job security, and poor working conditions. **65%**of factory workers in global supply chains (particularly in textiles and electronics) reported feeling that their labour was undervalued, with limited rights and protections. Many of these workers work in sweatshop-like conditions, a trend exacerbated by the pressures of global competition.

Findings:

1. Globalization has significantly boosted India's economic growth, especially in the services and IT sectors, contributing to increased GDP and foreign investment. Urban areas, especially those with a strong IT and service industry presence, have benefited the most, while rural areas have seen limited benefits, particularly in the agricultural sector.
2. The study found that globalization has widened the gap between the rich and poor in India. While urban centers have prospered, rural areas have experienced stagnant incomes, contributing to a growing income divide. The formal sectors such as IT, finance, and technology have provided high-paying jobs, while traditional sectors and rural communities have struggled.
3. Globalization has led to a rapid cultural shift, particularly among urban youth, who have adopted global consumer behaviours, media, and lifestyles. While globalization has led to cultural homogenization in some aspects, it has also facilitated cultural hybridization, where global and local influences coexist and merge.
4. Industrial growth fuelled by globalization has contributed to significant environmental challenges in India, including pollution, resource depletion, and unsustainable agricultural practices. Urban air and water quality have deteriorated, and environmental sustainability remains a pressing concern.
5. Globalization has contributed to the growth of both the formal, skilled labour market (e.g., in IT) and the informal, low-wage labour market (e.g., in textiles, agriculture). Workers in the informal economy face poor working conditions, lack of job security, and exploitation. The shift to the gig economy has also created challenges in terms of labour rights and social security.

Suggestions:

1. To address regional disparities and income inequality, India must focus on creating policies that ensure the benefits of globalization are more evenly distributed. This includes:
2. India needs to balance economic growth with environmental protection to ensure sustainable development. Policy recommendations include:

3. The informal labour market and gig economy need stronger regulations to ensure better working conditions, fair wages, and social protections. Suggestions include:
4. To balance the influence of globalization with the preservation of India's rich cultural heritage, it is essential to promote cultural resilience.
5. India needs a comprehensive policy framework that proactively manages the impacts of globalization across various sectors. This would include:

Conclusion:

The study reveals that while globalization has spurred significant economic growth in India, it has also led to increased inequality, cultural transformations, environmental degradation, and labour market issues. Urban regions, especially those with a high concentration of IT and service industries, have benefited the most, while rural areas and traditional sectors face growing challenges. To harness the benefits of globalization while mitigating its negative impacts, India will need to address issues of income inequality, environmental sustainability, and labour rights, ensuring that the gains of globalization are more equitably distributed across all sectors of society. Globalization has undeniably played a pivotal role in transforming India into one of the world's largest and fastest-growing economies. It has facilitated economic growth, increased foreign investment, and spurred technological advancements, particularly in the IT and services sectors. However, the benefits of globalization have not been evenly distributed, leading to rising income inequality, regional disparities, and challenges related to environmental sustainability and labour rights. While urban areas and high-skill industries have flourished, rural regions and traditional sectors such as agriculture have faced increasing challenges, including stagnating incomes and limited access to global markets. Furthermore, the rapid industrialization that globalization has brought has resulted in environmental degradation and the exploitation of workers in informal and low-wage sectors. To ensure that India fully capitalizes on the opportunities provided by globalization, it is essential to implement policies that foster inclusive growth, protect workers' rights, promote environmental sustainability, and preserve cultural identities. By focusing on reducing inequality, protecting the environment, and creating a more equitable labour market, India can navigate the challenges of globalization and build a more inclusive and sustainable future.

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Examining Debt Dynamics: How Capital Structure Affects Indian Food and Beverage Industry Profitability

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Abstract

This study examines the impact of Capital Structure on the Profitability of Indian Food and Beverage companies listed on the S&P BSE FMCG Index. The analysis is based on a balanced panel of 50 companies, comprising 500 observations over ten years from 2014 to 2024. Capital structure is represented by three measures: long-term debt to total assets (LDA), short-term debt to total assets (SDA), and total debt to total assets (TDA). Profitability is measured using return on equity (ROE) and return on assets (ROA). Tangibility (TANG), firm size (SIZE), and liquidity (LIQ) serve as control variables. Panel regression techniques using random effects and fixed effects modelsare employed to test the hypotheses. The results reveal that all debt measures (LDA, SDA, and TDA) have a significantly negative impact on ROA, whereas no significant relationship is found between debt measures and ROE. Tangibility and liquidity significantly negatively impactprofitability, while firm size exhibits a significant positive impact. The study contributes to the existing literature and offers practical insights, emphasizing the importance of optimizing debt levels, enhancing liquidity management, and improving asset efficiency as key strategies to drive profitability in Indian Food and Beverage companies.

Keywords: Capital Structure, Profitability, Tangibility, Size, Liquidity, Indian Food and Beverage Companies, Panel Regression

Introduction

Capital structure decisions are imperative in shaping companies' growth trajectory and profitability. Understanding and optimising capital structure is essential for companies to maintain their competitive edge, capitalize on market opportunities and for long-term value creation (Myers, 1984). The search for an optimal capital structure has remained a complexand challenging issue for researchers and finance managers. Capital structure, defined as the mix of debt and equity used to finance a firm's operations, is a critical component of corporate financial strategy, directly impacting a firm's cost of capital, risk profile, and ultimately, shareholder value(Modigliani & Miller, 1958; Jensen & Meckling, 1976). In their seminal work, Modigliani and Miller (1958)proposed that under perfect market conditions, capital structure does not affect a firm’s value. However, real-world deviations from these idealized conditions, such as tax advantages, bankruptcy costs, and asymmetric information, influence firms' financing choices(Myers & Majluf, 1984).From a theoretical standpoint, the Trade-Off Theory (Kraus & Litzenberger, 1973)and the Pecking Order Theory(Myers & Majluf, 1984)offer contrasting perspectives on companies' financing decisions. The Trade-Off Theory suggests that moderate leverage levels can maximize firm value by harnessing debt's tax advantages, provided that firms manage the risk of financial distress effectively (Kraus & Litzenberger, 1973).Meanwhile, the Pecking Order Theory

implies that firms are inclined to use internal funds before resorting to debtbut potentially restrictive in scenarios where extensive investment is needed to scale operations (Myers & Majluf, 1984).

Despite the extensive development of theories aimed at explaining an optimal capital structure, a universally accepted model that managers can rely on to determine the ideal level of leverage remains elusive. Baker and Martin (2011) emphasize the importance of revisiting capital structure in response to economic changes, advocating for a strategic approach that minimizes costs and maximizes shareholder value. Toraman et al. (2013) highlight that the balance between debt and equity significantly impacts profitability, emphasising the complexity of achieving an optimal capital structure. Pinto and Quadras (2016) pointed out that capital structure is a critical decision in corporate finance as it significantly influences a company's profitability and shareholder value. This implies that to maximize shareholder wealth, corporate managers must carefully consider optimal capital structure decisions to reduce the cost of capital. Therefore, this study strives to explore the relationship between capital structure and profitability in the context of India's Food and Beverage Industry, examining empirical dimensions to provide actionable insights for financial strategy.

As the Indian Food and Beverage Industrycontinues to expand, understanding how profitability is influenced by capital structure is crucial for both corporate managers and policymakers. Understanding how leverage affects profitability,and firm value can guide managers in strategic financing choices that align with operational and market realities.Policymakers can use capital structure research insights to design regulations promoting financial stability and facilitating sectoral growth. Applying the findings of this study to India's Food and Beverage Industry could offer valuable insights into how companies manage their capital structure to enhance profitability.

Literature Review

According to Panwar (2019), firms conservatively employed debt finance. Studies have identified several determinants of capital structure in Indian Food and Beverage companies, including profitability, growth opportunity, size, risk, non-debt tax shield, liquidity, and asset structure(Priyanka & Singh, 2023; Sisodia & Maheshwari, 2023). These factors significantly influence financial leverage ratios such as short-term debt, long-term debt, total debt, and debt-equity ratio (Priyanka & Singh, 2023).

National Studies

The impact of capital structure on profitability in Indian Food and Beverage companies has been extensively studied, with mixed results. Chadha and Sharma (2015) studied 422 manufacturing companies listed on the Bombay Stock Exchange (BSE) and found that change in financial leverage creates no impact on the profitability variables as measured by Return on asset and Tobin's Q, whereas a significant negative impact was found with Return on Equity. Revathy et al. (2016)examined 70 manufacturing firms listed on the BSE in India and revealed that the capital structure variable, measured by the debt-equity ratio, negatively impacted profitability across all three stages: pioneering, growth, and consolidation.Pandey

and Sahu (2017) found that capital structure had a substantial negative influence on accounting performance, as measured by return on assets and return on net worth.
Jaisinghani and Kanjilal (2017)examined 1194 publicly traded manufacturing companies in India using threshold panel regression. The research estimated the threshold size to be around 148 million rupees. Companies with assets exceeding the threshold showed a positive correlation between debt usage in their capital structure and profitability, while those below the threshold demonstrated a negative relationship. In contrast, Vyas (2018) found no correlation between capital structure and profitability and indicated a moderately significant relationship between financial leverage and profit after taxes. Das and Swain (2018) observed that the capital structure has a negative and statistically significant impact on the profitability as measured by ROA, ROE, and ROCE of the sample company. Similarly, Singh and Bagga (2019) studied Nifty 50 companies and revealed that an increase in total debt led to a decline in return on assets, while a rise in equity resulted in a higher return on assets. The fixed effect model analysis showed that increasing total debt caused an increase in ROE, whereas increasing equity led to a decrease in ROE. Pradhan and Gautam (2019) found that the higher the liquid asset ratio, the lower the return on assets and return on equity. Aishwarya (2020) found that the debt ratio has a positive correlation with the return on capital employed and a negative correlation with the return generated by long-term funds and net worth.

Desai (2021) observed that firm size moderates the relationship between capital structure and profitability, and debt negatively impacts all performance metrics (ROE, ROA, EPS, Tobin's Q, and MBV ratio). These findings are further supported byTripathi (2021) who also found a negative relationship between capital structure (D/E ratio) and profitability. Whereas Patra (2021) indicated a positive relationship between total debt to total assets ratio and profitability. Babbar and Singh (2024)studied 23 Indian cement companies listed on the NSE and BSE and found a negative relationship between the debt-equity ratio and profitability and a positive relationship between the interest coverage ratio and profitability.The capital structure decisions of Indian auto-component companies reflect a hybrid approach, drawing from both Trade-off and Pecking Order theories rather than adhering strictly to one(Mistri, 2024).

International Studies

According to Cole et al. (2015), capital structure negatively impacts return on assets and operating return. However, the impact on profit margins varies among industries. In the industrial sector, capital structure shows a positive effect on profit margin, while in the energy sector, it demonstrates a negative influence. Interestingly, no significant relationship was observed between capital structure and profit margin in the healthcare sector. Kakanda et al. (2016) observed that while long-term debt (LTD) has a positive and significant impact on ROE, short-term debt (STD) has an insignificant effect, suggesting that capital structure and corporate profitability are positively and significantly correlated. Avcı (2016) observed that D/E had no significant effect on ROE and ROA. According to the study's findings, ROE and ROA are significantly impacted negatively by both STD/TA and LTD/TA.

Morri and Jostov (2018)examined 65 listed real estate companies selected from the FTSE and the European Public Real Estate Association (EPRA) during the Crisis (2007–2009), the Rebound (2009–2014), and the Whole Time. Throughout the crisis period, leverage had a negative impact on adjusted shareholder return. Leverage had a positive effect on returns during the recovery period, albeit the effects were insignificant. Ajibola et al. (2018) found that a company's use of long-term debt can yield higher profits in terms of equity return, while short-term debt did not significantly correlate with return on equity. According to the study's findings, return on assets was negatively correlated with all capital structure metrics. Comparing the manufacturing and oil and gas industries from the New York Stock Exchange, Asaolu (2021) found that debt has a significant positive impact on business performance. Učkar et al. (2021) observed that Croatian enterprises exhibited a significant negative relationship between profitability and capital structure. Habibniya et al. (2022) studied 72 firms in the telecom industry in the United States and concluded that debt financing (TLTA) significantly negatively impacted ROA, whereas equity financing (TETA) significantly favourably impacted ROA. The study also found an insignificant relationship between TLTA and ROE. Anozie et al. 2023) observed that short-term debt to total assets and total debt to total equity had positive but insignificant impacts on return on assets, whereas long-term debt to total assets had a negative significant impact on profitability. Muhammed et al. (2024) analysed 14 commercial banks in Ethiopia and revealed that the loan-to-deposit ratio and the total deposit-to-total asset ratio have a significant positive impact on profitability, while the asset growth ratio, as another measure of capital structure, exhibited a negative effect.

A comprehensive review of existing literature highlights that studies on the relationship between capital structure and firm profitability have been conducted across diverse national contexts and temporal frameworks, yielding varied and often inconclusive findings. These variations emphasize the necessity for continuously re-examining this relationship, particularly as economic conditions and market dynamics evolve. In this context, the present empirical study examines the effect of capital structure on the profitability of Indian Food and Beverage companies.

Objectives of the Study

The following are the main objectives:

- To evaluate the Capital Structure and Profitability of Indian Food and Beverage companies.
- To examine the impact of Capital Structure on the Profitability of Indian Food and Beverage companies.

Aligned with the study objectives, the following hypotheses have been formulated and tested:

H_{01}: Capital Structure has no significant impact on the ROA.
H_{02}: Capital Structure has no significant impact on the ROE.

Research Methodology

The sample companies are selected from the S&P BSE FMCG Index, which has 77 constituents as of 31st January 2024. From these,40 companies representing the Food and Beverage Industry were selected for the final sample. A balanced panel of 40Food and Beverage companies with400 observations over ten years from 2013 to2023 has been employed.The secondary data required for the study has been collected from the CMIE Prowess IQ Database.

Independent Variables

Building on previous research studies, such as Cole et al. (2015), Avcı (2016),Das and Swain (2018), Ajibola et al. (2018), and Desai (2021);the long-term debt to total assets ratio (LDA) has been employed to measure capital structure. Following Avcı (2016),Ajibola et al. (2018) and Desai (2021), the next measure to represent capital structure is the short-term debt to total assets ratio (SDA). The total debt to total assets ratio (TDA) is selected as a third indicator to measure the capital structure(Das & Swain, 2018);(Ajibola et al., 2018); (Singh & Bagga, 2019);(Desai,2021) and (Habibniya et al., 2022).

Dependent Variables

From the prior research, Return on Equity (ROE) has been recognized as a prominent measure to indicate profitability and is thus selected for this study. Following the previous research by Das and Swain (2018), Ajibola et al. (2018), Singh and Bagga (2019), Asaolu (2021) and Desai (2021), profit after tax to net worth ratio is employed to measure the return on equity (ROE). The next measure to indicateprofitability is the return on assets (ROA), calculated as the ratio of profit before interest and tax to total assets(Das & Swain, 2018);(Ajibola et al., 2018); (Singh & Bagga, 2019);(Asaolu, 2021);. (Desai, 2021);(Habibniya et al., 2022).

Control Variables

To account for other potential factors influencing firm value, this study includes firm characteristics such as Size, Tangibility and Liquidity as control variables. Following theChadha and Sharma (2015), Desai (2021) and Habibniya et al. (2022), Size has been included as a control variable. The natural logarithm of net sales is used to denote firm size. Following Chadha and Sharma (2015), Avcı (2016),Desai (2021) and Habibniya et al. (2022), the next control variable is Tangibility,represented by the ratio of fixed assets/total assets. Liquidity is included as a third control variable measured by a ratio of current assets/current liabilities (Singh & Bagga, 2019);(Desai, 2021);(Habibniya et al., 2022).

Methodology Followed

Panel data regression has been employed for data analysis. Panel data offers greater information, increased variability, and reduced collinearity among variables (Baltagi, 2009). Breusch and Pagan (1980) derived a Lagrange multiplier (LM) test to select the best model between the pooled OLS and the random effects model (REM). This test is based on the null hypothesis that the variance across entities is zero, meaning the pooled OLS model is appropriate (Breusch & Pagan, 1980). Hausman (1978)derived a test to determine the most suitable model between the fixed effects and random effects models. It is based on the null hypothesis that the random effects model is appropriate(Hausman, 1978). The Fixed Effect Redundant test (F-test) is employed to determine the best-fit model between the pooled OLS and the fixed effects model (FEM). The null hypothesis states that the pooled OLS approach

best explains the model. Descriptive statistics is used to evaluate the capital structure and profitability. The study useda correlation test and VIF to test multicollinearity. The Durbin-Watson test detects autocorrelation, with its statistics ranging from 0 to 4, where the value of 0 indicates a perfect positive correlation, 4 indicates a perfect negative correlation, and 2 signifies no serial correlation (Durbin & Watson, 1950).

Results and Discussion

Analysis of Capital Structure and Profitability

Table 1. Descriptive Statistics

	LDA	SDA	TDA	ROA	ROE	TANG	SIZE	LIQ
Mean	0.12	0.36	0.48	0.14	0.18	0.31	7.31	1.81
Median	0.11	0.34	0.49	0.12	0.15	0.30	7.37	1.44
Maximum	0.44	0.86	0.91	0.50	1.09	0.72	11.10	8.28
Minimum	0.00	0.07	0.11	-0.13	-0.35	0.03	4.95	0.44
Std. Dev.	0.10	0.16	0.20	0.09	0.15	0.15	1.19	1.15

Source: Compiled by author

Table 1 displayed descriptive statistics of 400 observations providing an in-depth look into firms' capital structure and profitability. The mean values indicate that firms finance 12.4% of their assets with long-term debt and 35.5% with short-term debt, resulting in a total debt-to-asset ratio of 47.9%, reflecting a moderate reliance on debt, with a greater emphasis on short-term liabilities, suggesting a strategic approach to managing their financial resources.The mean value of the tangibility ratio is 30.6%, indicating that a significant portion of firms' assets are tangible.The liquidity ratio suggests that current assets are approximately 1.805 times current liabilities, suggesting strong short-term financial health. ROA and ROE averages 14.4% and 18%, respectively, reflect considerable returns on assets and equity.

Table 2. Correlation Matrix

	LDA	SDA	TDA	TANG	SIZE	LIQ
LDA	1					
SDA	0.12*	1.00				
TDA	0.59**	0.87**	1.00			
TANG	0.53**	-0.05	0.23**	1.00		
SIZE	-0.02	-0.10*	-0.09	-0.01	1.00	
LIQ	-0.38**	-0.59**	-0.67**	-0.38**	0.01	1.00

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 2 represents the correlation matrix employed to detect multicollinearity among the independent variables. The correlation matrix reveals that debt ratios have no significant correlation with firm size. While tangibility positively correlates with debt ratios, liquidity

negatively correlates with all debt ratios. The study employed the VIF test to further evaluate multicollinearity. "The variance inflation factor shows how the variance of an estimator is inflated by the presence of multicollinearity" (Gujarati, 2009). A VIF below 10 is considered acceptable, whereas a value of 10 or above indicates multicollinearity (Gujarati, 2009).

Table 3.Variance Inflation Factor (VIF)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LDA	1.0980	1.1152	-	-	-	-
SDA	-	-	1.8019	2.0176	-	-
TDA	-	-	-	-	1.8356	1.8135
TANG	1.0641	1.0349	1.0631	1.0364	1.0466	1.0548
SIZE	1.0702	1.2596	1.1000	1.3461	1.1274	1.0928
LIQ	1.1234	1.1803	1.7840	1.7871	1.7464	1.7654

Source: Compiled by author

Table 3 reveals that VIF values for these variables range from a minimum of 1.0349 to a maximum of 1.8356, confirming that the problem of multicollinearity does not exist among the independent variables as VIF is within the limits (Gujarati, 2009).

Table 4. Stationarity test results

Variables	Augmented Dickey-Fuller (ADF) test			Inference
	Model form	Test Statistics	P-value	
LDA	Individual Intercept	136.984	0.0001	Stationary**
	Trend and Intercept	124.198	0.0011	Stationary**
SDA	Individual Intercept	119.778	0.0027	Stationary**
	Trend and Intercept	110.020	0.0146	Stationary**
TDA	Individual Intercept	137.980	0.0001	Stationary**
	Trend and Intercept	117.578	0.0040	Stationary**
ROA	Individual Intercept	116.334	0.0050	Stationary**
	Trend and Intercept	110.503	0.0135	Stationary*
ROE	Individual Intercept	129.653	0.0004	Stationary**
	Trend and Intercept	141.103	0.0000	Stationary**
TANG	Individual Intercept	119.946	0.0026	Stationary
	Trend and Intercept	123.471	0.0013	Stationary**
SIZE	Individual Intercept	207.735	0.0000	Stationary**
	Trend and Intercept	137.799	0.0001	Stationary**
LIQ	Individual Intercept	122.497	0.0016	Stationary**
	Trend and Intercept	100.202	0.0629	Stationary

*Note: **Stationary at 1% significance, * Stationary at 5% significance*

The ADF test represented in Table 4 indicates that all the given series, LDA, SDA, TDA, ROA, ROE, TANG and SIZE are stationary at a 5% level of significance or,in the case of LIQ, maximum at 10%.

Results of Regression Analysis

This study utilizes six regression models, presented in Equations 1 to 6, to analyze the impact of capital structure on profitability.The panel regression equations as per the preferred model are as follows:

$$ROA_{it} = a_{it} + \beta_1 LDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \text{ ...(1)}$$

$$ROE_{it} = a_{it} + \beta_1 LDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \text{....(2)}$$

$$ROA_{it} = a_{it} + \beta_1 SDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \text{ ....(3)}$$

$$ROE_{it} = a_{it} + \beta_1 SDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \text{....(4)}$$

$$ROA_{it} = a_{it} + \beta_1 TDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \text{...(5)}$$

$$ROE_{it} = a_{it} + \beta_1 TDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \text{...(6)}$$

Table 5. Dependent Variable (ROA) - Model 1

	POLS		REM		FEM	
Variables	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
LDA	-0.1220	-2.45*	-0.2336	-4.37**	-0.2497	-4.17**
TANG	-0.0830	-2.49*	-0.0666	-1.80	-0.0622	-1.50
SIZE	0.0249	7.43**	0.0259	3.96**	0.0296	2.79**
LIQ	0.0113	2.91**	-0.0020	-0.49	-0.0054	-1.20
R^2	0.2174		0.1126		0.6645	
Adjusted R^2	0.2095		0.1036		0.6240	
F - statistics	27.4373**		12.5274**		16.3982**	
Durbin Watson	0.6305		1.3305		1.4933	
F- test	0.0000					
Breusch Pagan	0.0000					
Hausman	0.2497					

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 5represents the outcomes ofEquation 1 with ROA as a dependent variable.The Breusch Pagan andF-test indicate that POLS is inappropriate. The Hausman test confirms that REM is preferred. The random effects model reveals thatLDA has a significant negative effect on ROA. However, tangibility and liquidity haveinsignificant impacts on ROA,while size has significant positive impacts on ROA. R-squaredsignifies that independent variables explain 11.26% of ROA variability.Durbin-Watson test statisticis 1.3305,indicating no serial correlation.

Table 6. Dependent Variable (ROE) – Model 2

	POLS		REM		FEM	
Variables	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
LDA	0.2526	2.83**	-0.0456	-0.44	-0.1180	-0.97
TANG	-0.2565	-4.30**	-0.1930	-2.73**	-0.1736	-2.06*
SIZE	0.0415	6.91**	0.0528	4.85**	0.0928	4.29**
LIQ	-0.0025	-0.37	-0.0212	-2.68**	-0.0342	-3.75**

R^2	0.1452	0.0795	0.5268
Adjusted R^2	0.1365	0.0702	0.4697
F - statistics	16.7735**	8.5289**	9.2179**
Durbin Watson	0.7045	1.0964	1.2642
F- test	0.0000		
Breusch Pagan	0.0000		
Hausman	0.0057		

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 6 represents the outcomes of Equation 2 with ROE as a dependent variable. The results of the Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirmsthat FEM is preferred. The fixed effects model reveals that LDA has an insignificant effect on ROE. However, tangibility and liquidity have significant negative, whereas size has a significant positive impact on ROE. R-squared indicates that 52.68% of

	POLS		REM		FEM	
Variables	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
SDA	-0.1704	-5.15**	-0.0939	-2.28*	-0.0576	-1.18
TANG	-0.1790	-5.75**	-0.1015	-2.74**	-0.0630	-1.49
SIZE	0.0229	6.96**	0.0256	3.98**	0.0364	3.24*
LIQ	-0.0033	-0.67	-0.0056	-1.09	-0.0076	-1.35
R^2	0.2555		0.0857		0.6495	
Adjusted R^2	0.2480		0.0764		0.6071	
F - statistics	33.8935**		18.46**		15.3393**	
Durbin Watson	0.6668		1.495		1.4607	
F- test	0.0000					
Breusch Pagan	0.0000					
Hausman	0.0592					

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 7 represents the outcomes of Equation 3 with ROA as a dependent variable. The results of the Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirms thatREM is preferred. The random effects model reveals that SDA has a significant negative impact on ROA, tangibility hasa significant negative, size hasa

significant positive, whereas liquidity has an insignificant impact on ROA. R-squared indicates that independent variables explain 8.57% of the variability in ROA. Durbin-Watson test statistics (1.495)indicate no serial correlation.

Table 8. Dependent Variable (ROE) – Model 4

	POLS		REM		FEM	
Variables	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
SDA	-0.0483	-0.79	0.0483	0.61	0.1835	1.90
TANG	-0.1966	-3.41**	-0.1928	-2.71**	-0.1671	-1.99*
SIZE	0.0406	6.66**	0.0565	4.86**	0.1134	5.09**
LIQ	-0.0117	-1.29	-0.0174	-1.73	-0.0209	-1.87
R^2	0.1293		0.0788		0.5303	
Adjusted R^2	0.1204		0.0694		0.4736	
F - statistics	14.6592**		8.4435**		9.3485**	
Durbin Watson	0.6715		1.1203		1.3065	
F- test			0.0000			
Breusch Pagan	0.0000					
Hausman	0.0221					

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 8 represents the outcomes of Equation 4 with ROE as a dependent variable. The results of the Breusch Pagan and F-test suggest that POLS is inappropriate. The Hausman test confirms thatFEM is preferred. The fixed effect model reveals that SDA has an insignificant impact on ROE, tangibility hasa significant negative,size hasa significant positive, whereas liquidity has an insignificantimpact on ROE. R-squared indicates that independent variables explained53.03% of the variability in ROE. Durbin-Watson test statistics is 1.3065, indicating no serial correlation.

Table 9. Dependent Variable (ROA) – Model 5

	POLS		REM		FEM	
Variables	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TDA	-0.1516	-5.64**	-0.1564	-4.63**	-0.1541	-3.81**
TANG	-0.1265	-4.39**	-0.0902	-2.47*	-0.0668	-1.61
SIZE	0.0230	7.04**	0.0212	3.23**	0.0213	1.85
LIQ	-0.0041	-0.85	-0.0129	-2.55*	-0.0152	-2.82**
R^2	0.2647		0.1197		0.6619	
Adjusted R^2	0.2573		0.1108		0.6211	
F - statistics	35.5542**		13.4258**		16.2078**	
Durbin Watson	0.6417		1.2835		1.4372	
F- test			0.0000			
Breusch Pagan	0.0000					
Hausman	0.4202					

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 9 represents the outcomesof Equation 5 with ROA as a dependent variable. The Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirms that REM is preferred. The random effect model reveals that the TDA, tangibility and liquidity have a significant negative impact on ROA, whereas size has significant positive impacts on ROA.R-squared indicates that independent variables explained 11.97% of the variability in ROA. Durbin-Watson test statistic is 1.2835, showing no serial correlation.

	POLS		REM		FEM	
Variables	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
TDA	0.0459	0.92	0.0100	0.15	0.0774	0.94
TANG	-0.1779	-3.31**	-0.1989	-2.81**	-0.1703	-2.02*
SIZE	0.0419	6.87**	0.0553	4.73**	0.1082	4.63**
LIQ	-0.0017	-0.19	-0.0203	-2.03*	-0.0276	-2.52*
R^2	0.1297		0.0781		0.5268	
Adjusted R^2	0.1209		0.0687		0.4696	
F - statistics	14.7214**		8.3622**		9.2156**	
Durbin Watson	0.6792		1.1143		1.2814	
F- test			0.0000			
Breusch Pagan	0.0000					
Hausman	0.0531					

Table 10. Dependent Variable (ROE) – Model 6

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 10 represents the outcomes of Equation 6 with ROE as a dependent variable. The results of the Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirms that REM is preferred. The random effect model reveals that TDA has an insignificant impact on ROE, tangibility and liquidity have significant negative, whereas size has significant positive impacts on ROE. R-squared indicates that independent variables have explained 7.81% of the variability in ROE. Durbin-Watson test statistic is 1.1143, showing no serial correlation. The regression analysis revealed that capital structure has a significant negative effect on ROA, resulting in the rejection of the first null hypothesis. Whereas capital structure has no significant impact on ROE, supporting the acceptance of the second null hypothesis.

Conclusion

The significant negative impact of all debt measures (LDA, SDA, and TDA) on return on assets (ROA) indicates that higher debt levels, whether short-term or long-term debt, negatively impact the profitability of Indian Food and Beverage companies. These findings are consistent with previous studies by Revathy and Santhi (2016), Pandey and Sahu (2017), (Vyas, 2018), Singh and Bagga (2019) and Habibniya et al. (2022), whereas contradicted the findings of Patra (2021)and Anozie et al. (2023).It is observed that reliance on short-term debt is notably higher than long-term debt and might be introducing risks like refinancing costs and liquidity pressures, potentially limiting profitability.Tangibility emerges as a key

determinant of profitability as it has a significant negative impact on both return on assets (ROA) and return on equity (ROE). This indicates inefficiencies in leveraging tangible assets effectively to drive profitability.Firm size has a significant positive impact on profitability, indicating that larger firms benefit from their well-established market presence, economies of scale and improved access to resources and capital, enabling them to achieve higher returns over smaller firms. The significant negative influence of liquidity on profitabilityindicatesinefficient working capital management practices, leading to reduced profitability.

The results indicate that higher dependence on short-term financing, inefficient use of liquidity and fixed assets negatively affect profitability. It is suggested that Indian food and beverage companies should strategically optimize their debt levels and enhance the efficient utilization of fixed assets to improve profitability. Moreover, whilelarger firms benefit from economies of scale and a stable market presence, conservative liquidity policies can negatively impact profitability and should be avoided.

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Doctor Perception Mapping on Use of Anti-Hypertension Drugs in Different Patient Profiles & Indications

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Abstract
Hypertension is a chronic lifestyle disease with a significant public health burden in India. Despite the availability of multiple classes of antihypertensive medications, including ACE inhibitors, ARBs, beta blockers, calcium channel blockers, and diuretics, physician prescribing behaviour varies significantly based on patient-specific factors. This study examines the perceptions of 100 physicians in Gujarat regarding their preferences, prescribing habits, and challenges encountered in managing hypertension across different clinical and demographic profiles. The study identifies key influencers of therapeutic decisions, including comorbid conditions (e.g., diabetes, renal failure), age, side effect profiles, and drug tolerability. The results underscore the need for better adherence to clinical guidelines, patient-centred therapy, and ongoing education for healthcare professionals. These findings can inform policy and training modules aimed at standardizing care and improving hypertension control.

Keywords: Hypertension, anti-hypertensive drugs, ACE inhibitors, physician prescribing behaviour, comorbidities, India

1. Introduction

Hypertension, also known as high blood pressure, is a major modifiable risk factor for cardiovascular disease, stroke, and chronic kidney disease. According to the WHO, over 1.28 billion adults worldwide aged 30–79 years are estimated to have hypertension, with less than half diagnosed and treated. In India, hypertension affects approximately 29% of adults, yet only half receive treatment, and just 10–12% achieve optimal control. This treatment gap is compounded by variability in drug selection, lack of standardization, and limited patient adherence.

Anti-hypertensive therapy includes a wide range of drug classes—each with distinct mechanisms of action and side effect profiles. The selection of first-line therapy is typically guided by international and national guidelines such as JNC 8, the ESC/ESH guidelines, and the Indian Hypertension Guidelines. However, in real-world settings, physicians often deviate from these protocols due to patient characteristics, clinical experience, and pharmaceutical brand preferences.

This study investigates how physicians select anti-hypertensive agents based on patient profiles including age, gender, and comorbidities such as diabetes, kidney disease, and heart failure. It also evaluates challenges in implementation and perceptions about guideline

sufficiency. The findings aim to bridge the knowledge-practice gap and promote rational prescribing practices.

2. Literature Review

Multiple studies have evaluated prescribing patterns in the treatment of hypertension. The JNC 8 (2014) and the Indian Hypertension Guidelines recommend thiazide diuretics, ACE inhibitors, ARBs, calcium channel blockers, and beta blockers as primary options. The choice of therapy is influenced by specific patient parameters:

- **Diabetic patients** are often prescribed ACE inhibitors or ARBs due to nephroprotective benefits.
- **Elderly patients** tend to respond better to calcium channel blockers or low-dose diuretics.
- **Patients with heart failure or post-myocardial infarction** benefit from beta blockers and ACE inhibitors.

However, real-world evidence indicates that physician decisions are influenced not only by clinical guidelines but also by individual experience, drug availability, side effect profiles, and pharmaceutical promotions. A study by Mancia et al. (2019) emphasized the growing preference for combination therapy as first-line treatment to enhance compliance and efficacy.

In the Indian context, affordability, patient adherence, and rural-urban treatment disparities are significant determinants of antihypertensive therapy success. Physicians in tier 2 and 3 cities often adjust therapy based on cost constraints and patient beliefs. Thus, understanding physician perspectives in real-world practice is vital to improving hypertension control and treatment outcomes.

3. Methodology

This study aims to analyze and map physicians' perceptions regarding the prescription of anti-hypertensive medications across diverse patient profiles and clinical scenarios in India. The objectives include understanding how patient-specific factors such as age, comorbidities, and disease severity influence drug selection; identifying preferred drug classes for common hypertension-related conditions; evaluating challenges faced by doctors during treatment planning; and assessing the sufficiency of existing hypertension management guidelines. To achieve these aims, a descriptive cross-sectional study was conducted involving 100 physicians across Gujarat, including general practitioners, cardiologists, and BAMS doctors. Data was collected using a structured questionnaire that explored prescribing behaviour, treatment preferences, clinical challenges, and awareness of guidelines. The responses were analysed using quantitative techniques, including frequency distribution and percentage analysis, to identify patterns and trends in physician decision-making.

4. Data Analysis and Interpretation

- **Physician Profile**:
  - 68% had 11–20 years of clinical experience
  - 80% operated in private clinics; 20% had government practice experience
- **Preferred Drug Classes**:
  - ACE inhibitors: 56% preference overall; commonly chosen for diabetic and heart failure patients

- ARBs: 20%, especially among elderly patients with renal concerns
- Beta blockers: 16%, mostly for patients with tachycardia or post-MI
- CCBs: 8%, usually for elderly hypertensive patients

- **Comorbidity Considerations**:
- In diabetic patients: 60% preferred ACE inhibitors
- In heart failure: 48% used beta blockers or ACE inhibitors
- In renal insufficiency: ARBs were chosen due to better renal profile

- **Challenges Reported**:
- 44% highlighted issues with drug-drug interactions
- 32% noted poor patient adherence as a primary concern
- 28% encountered frequent patient complaints about side effects

- **Perception of Guidelines**:
- 52% agreed guidelines were helpful and practical
- 28% were unsure due to lack of time or awareness
- 20% felt guidelines did not adequately address patient-specific variations

5. Findings

- ACE inhibitors remain the top preferred choice, particularly in diabetic and heart failure cases.
- Patient adherence and education are major barriers to treatment efficacy.
- Physicians with more experience relied on personalized therapy over standardized protocols.
- Awareness of newer treatment algorithms varied, with many doctors still following older habits or branded preferences.
- Combination therapy is often used, especially in patients with uncontrolled hypertension despite monotherapy.

6. Discussion

The findings of this study reinforce that while evidence-based guidelines are essential, physician decision-making is complex and multifactorial. Comorbidities like diabetes and renal insufficiency significantly influence drug selection, often guiding physicians toward ACE inhibitors and ARBs. The preference for beta blockers in heart failure reflects alignment with global recommendations.

However, challenges persist in clinical practice. Issues like patient non-compliance, socioeconomic constraints, and limited patient education often necessitate deviations from protocol. Many physicians expressed concern over the frequent occurrence of side effects and drug interactions, which complicate long-term treatment.

Additionally, the study found a divide between doctors operating in private clinics versus those in government setups, particularly regarding access to updated guidelines and availability of drugs. Continuous medical education and patient-centric interventions are required to improve outcomes in hypertensive care.

7. Recommendations

- **Physician Training**:

- Organize region-specific CME programs focused on personalized hypertension management and emerging therapies.

- **Guideline Awareness**:

- Distribute simplified visual treatment algorithms to practitioners in semi-urban and rural clinics.

- **Patient Counselling**:
  - Provide structured educational tools for doctors to explain drug use and side effects.
  - Encourage shared decision-making between doctors and patients.
- **Healthcare System Enhancements**:
  - Improve access to combination medications and ensure availability in rural areas.
  - Support pharmacist-led monitoring for adherence and drug reconciliation.
- **Policy Suggestions**:
  - Incentivize physicians to adhere to evidence-based prescribing through audits or recognition.
  - Integrate clinical decision-support tools into EHRs for guided therapy selection.

8. Conclusion

This study provides insight into physician prescribing patterns for hypertension across diverse patient profiles in Gujarat. While clinical experience and patient comorbidities largely drive therapeutic decisions, guideline awareness and systemic barriers also play a significant role. The results call for collaborative efforts across the medical community, policy-makers, and pharma to optimize hypertension care. Future research should explore larger, multi-state samples and include patient perspectives to develop more inclusive and adaptive hypertension management strategies.

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ARTIFICIAL INTELLIGENCE IN TEACHER EDUCATION: BRIDGING THE GAPS FOR A DIGITAL FUTURE

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Abstract

Teacher education is being transformed by Artificial Intelligence (AI) as educational technologies advance. This study critically examines how pre-service teacher training might strategically integrate AI to improve inclusion, personalise instruction, and close digital access gaps. Thematic analysis of policy documents, academic literature, and institutional case studies shows that AI tools like intelligent tutoring systems, adaptive feedback mechanisms, and assistive technologies improve pedagogical competence and inclusive practice. Disparities in faculty digital literacy, infrastructure readiness, and ethics prevent meaningful deployment. Based on NEP 2020 and SDG 4, the article argues that AI is a strategic facilitator for egalitarian and future-ready teacher education. The findings suggest embedding AI into teacher education curricula, developing faculty, providing ethical protections, and addressing infrastructural imbalances to maximise AI-enhanced teaching.

Keywords: AI, Teacher Education, Inclusive Pedagogy, NEP 2020, SDG 4, Digital Equity, Thematic Analysis

INTRODUCTION

In this 21st century, when technology redesigns practically every aspect of our life, education is at a critical point. In his study, HolonIQ (2020) predicted that global investment in educational technology will exceed $400 billion by 2025 and that AI will transform learning environments. Clearly, teacher education cannot remain static.

AI in education includes machine learning (ML) algorithms, natural language processing (NLP), data analytics, adaptive learning platforms, automated systems to enhance teaching and learning, intelligent tutoring systems, predictive analytics for student performance, AI-driven content creation, and automated feedback systems (Holmes et al., 2021).

Teacher education programs are unprepared to integrate AI in a systematic and inclusive manner, despite increased interest and occasional application. Technological, educational, and infrastructure gaps exist. Thus, AI could change how educators are educated, assessed,

and developed to focus on personalised, data-informed, and adaptable learning (Luckin et al., 2016).

AI can meet various learner needs with personalised learning routes, language translation tools, and assistive technology like speech recognition for disabled students (UNESCO, 2023). Such tools help pre-service teachers learn inclusive pedagogy and differentiated instruction. One of the most promising uses of AI in teacher education is supporting inclusive learning environments, and AI-integrated training modules improve pre-service teachers' learning diversity recognition and response (Kong et al., 2022). Teacher educators' digital literacy, openness to adopt innovations, and institutional culture towards change determine AI integration success (Mishra & Koehler, 2006).

The UNESCO Global Education Monitoring Report (2023) states that disparities in digital access and competencies among teacher educators and pre-service teachers hinder inclusive and AI-supported education, while the National Education Policy (NEP) 2020 calls for 'extensive use of technology in teaching and learning' and emphasises equity and inclusion as educational reform principles. Additionally, Digital India seeks to close the digital divide and promote inclusive growth through technology. These national priorities support SDG 4's 'inclusive and equitable quality education and lifelong learning opportunities for all' (UN, 2015). However, these policy visions are not matched by teacher education institutes' AI readiness.

This article suggests that AI should be seen as a transformational method to foster inclusion, overcome learning gaps, personalise teacher training, and develop resilient, future-ready education systems by asking the following research questions:

1. How is AI currently being integrated into teacher education programs, and to what extent are these integrations fostering inclusive learning environments?
2. What are the perceived challenges and opportunities among teacher educators regarding the use of AI tools in teaching and assessment?
3. How can AI be strategically leveraged to support the goals of NEP 2020 and SDG 4 in teacher education?

RESEARCH OBJECTIVES

To explore how AI is integrated into teacher education.

To analyse how AI promotes inclusive and digital growth in teacher training programs.

METHODOLOGY

According to Braun & Clarke (2006), thematic research is suitable for analysing patterns, narratives, and emerging discourses across multiple texts and domains, especially in interdisciplinary fields like education, technology, and policy. Therefore, this study uses a thematic approach to examine the strategic integration of AI in teacher education to promote inclusive and digital growth. Evidence from academic literature, policy documents, and institutional case studies. Repositories included Google Scholar, ERIC, Scopus, Web of Science, and national government websites. The analytical procedure followed Braun and Clarke's (2006) six-step framework: data familiarisation, coding relevant text units, topic generation, theme review, theme definition and naming, and report production. Descriptive review is also used to synthesise literature and policy perspectives on AI in education.

CONCEPTUAL FRAMEWORK

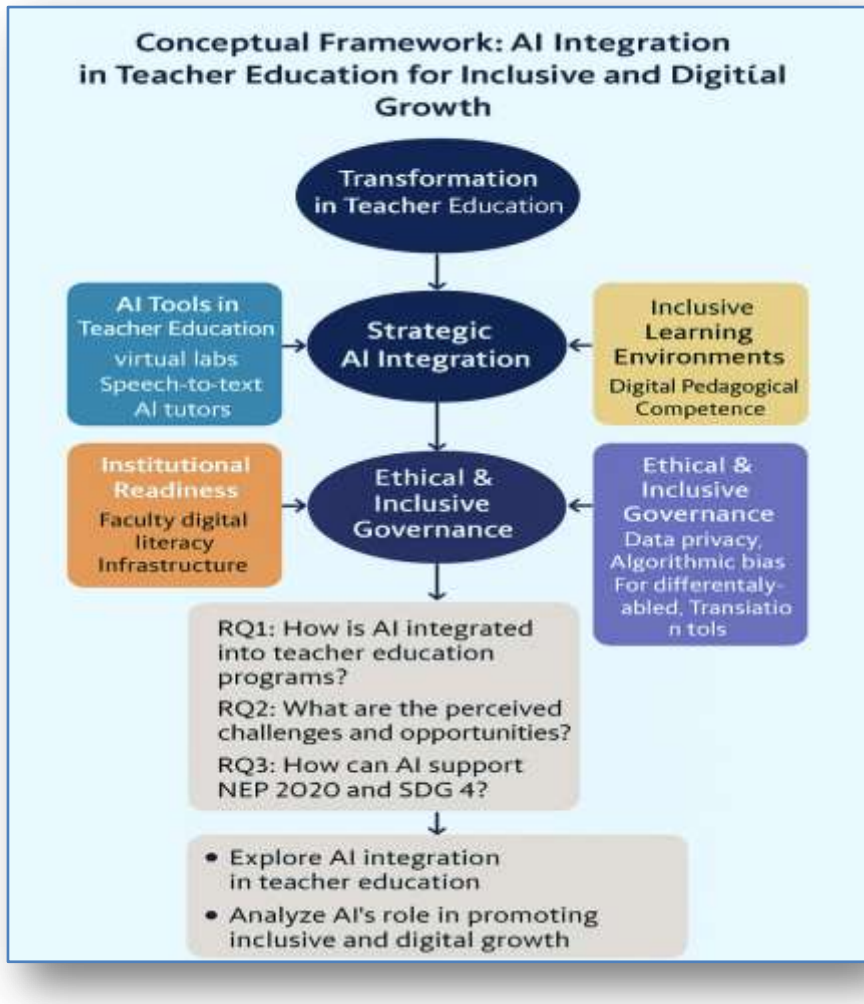

Figure 1: Designing Teacher Education with AI for Inclusive and Digital Growth

How It Works?

1) **Inputs:** Thematic areas like AI tools, institutional readiness, and ethics form the foundation of *strategic AI integration*.
2) **Transformation Node:** These inputs influence transformation in teacher education.
3) **Outcomes:** Transformation leads to inclusive classrooms, digital competence, and alignment with national/global goals.
4) **Research Questions & Objectives:** Aligned with each component to validate and explore these relationships through thematic inquiry.

This framework shows how strategic AI integration can improve teacher education by linking technological innovation with inclusive educational aims and policy imperatives. Inputs, transformation processes, and outcomes comprise its structure. AI tools (intelligent tutoring systems, assistive technologies, adaptive learning platforms), institutional preparation (faculty digital competency, infrastructure, and leadership culture), and ethical governance are inputs. In a transformation node, AI is significantly integrated into curriculum design, assessment, and professional development. NEP 2020 and SDG 4 steer this change to meet national and global educational aspirations. These changes improved

teacher preparedness, inclusive classroom practices, digital equity, and data-informed pedagogical decision-making. Thus, the framework conceptualises how AI integration might assist systemic change in teacher education and analyses institutional practises and policy implementation gaps.

THEMATIC DISCUSSION

Thematic analysis (TA) is a qualitative research method that finds, analyses, and reports data themes (Sandhiya & Bhuvaneswari, 2024). Its versatility and accessibility make it ideal for tourism and policy research. Researchers familiarise themselves with data, code, and refine topics to gain valuable insights and theoretical contributions(Fuchs, 2023;Herzog et al., 2019).

1. AI AS A CATALYST FOR PEDAGOGICAL TRANSFORMATION

AI shifts traditional instructional approaches towards personalised, adaptable, and reflexive learning environments. Technology is increasingly seen as a tool for rethinking teacher education pedagogy.

A.*AI Redefining Instructional Strategies:* AI systems provide real-time analytics, adaptive assessments, and intelligent material delivery suited to individual student profiles, breaking away from one-size-fits-all education. Learning analytics and predictive modelling allow educators to identify learning gaps early, adapt teaching approaches, and create a more responsive learning ecosystem (Zawacki-Richter et al., 2019). Intelligent tutoring systems (ITS) and AI-enhanced platforms enable teacher trainees learn modern classroom skills through data-driven instructional design.

B.*Generic Instruction to Personalised, Adaptive Learning:* AI adapts content, pace, and assessment to each learner's progress. Kong, Lai, and Sun (2022) found that AI-based feedback mechanisms in teacher education improve pre-service teachers' learning diversity recognition and individualised instruction. This move towards adaptive learning technologies increases academic performance and integrates teacher preparation with Universal Design for Learning.

C.*Supporting Teacher Autonomy and Reflective Practice:* AI systems provide constant feedback on teaching performance, student engagement, and learning results. Feedback helps teachers to self-reflect, change instruction, and gain professional autonomy (Holmes et al., 2021). AI creates a learner-centred, teacher-empowered environment that fosters creativity, critical thinking, and adaptable expertise. In conclusion, AI in teacher education transforms pedagogy towards equity, adaptability, and reflective professionalism.

2. Integrating AI into teacher education

Future teachers are learning, practicing, and reflecting differently thanks to AI tools. These tools provide dynamic, interactive, and adaptable learning environments that improve training and professional development. AI lets teacher trainees simulate lessons, automate chores, and create learner-specific content.

A. *Classroom Simulations, AI Tutors and VR:* AI-powered classroom simulations and ITS give pre-service teachers authentic, immersive learning experiences. These technologies simulate complex classroom settings like behaviour management, real-time questioning, and

various student requirements, helping trainees learn important teaching abilities in a controlled, feedback-rich environment (Zawacki-Richter et al., 2019). Virtual environments enable experience learning outside of classrooms, making teacher training more accessible and scalable.

B. *Speech-to-Text, Lesson Automation and AI Feedback:* Speech-to-text apps and voice recognition algorithms enable future teachers produce inclusive school resources. Automated lesson analysis and AI-assisted feedback tools (TeachFX, Eloise) let educators assess classroom discourse, student interaction, and teaching performance. Through targeted, data-driven feedback, such systems can improve pre-service teachers' reflective skills and promote inclusive pedagogy, according to Kong, Lai, and Sun (2022).

C. *Lesson Planning, Content Creation, and Assessment Tools:* Automatic content development, personalised lesson preparation, and formative assessment design are also supported by AI. These platforms may create personalised quizzes, adjust learning materials to students' progress, and provide immediate assessment insights, helping educators enhance learning outcomes (Zawacki-Richter et al., 2019). Teacher trainees learn to use data to navigate modern education with these tools.

3. Increasing inclusive and fair teacher preparation

AI in teacher education could improve inclusion and equity, especially for marginalised and disabled pupils. To meet their prospective students' needs, pre-service instructors practice inclusive pedagogy utilising AI-driven assistive technologies and customised learning tools. These tools enhance inclusive education using Universal Design for Learning (UDL).

A. *Assistive Techfor Differently Abled Learners:* AI for Differently Abled Learners AI-powered assistive technology changes teachers' training for impaired students. TTS, voice recognition, and predictive text mimic inclusive teaching. These tools help pre-service instructors address learning issues with empathy and inclusive education (Zawacki-Richter et al., 2019). Future instructors can enhance accessibility and inclusivity with this AI tool experience.

B. *Language Translation, Speech Interfaces, and Personalised Learning Paths:* AI enables multilingual, culturally responsive learning. Google Translate and AI-powered captioning assist teacher trainees understand and address linguistic diversity. Additionally, adaptive learning systems use AI algorithms to customise training to individual progress, pace, and preferences. Kong, Lai, and Sun (2022) demonstrate how AI-based feedback systems enable teachers tailor education to individual learners.

C. *Matching UDL Principles:* Multiple representation, engagement, and expression methods in UDL provide flexible and inclusive teaching. AI solutions enable instructors to provide knowledge in audio, visual, and interactive media, engage learners through personalised pathways, and support many ways of showing understanding, which aligns with UDL. Pre-service teachers can create accessible, equitable, and flexible learning experiences by using these technologies (Holmes et al., 2021).

4. Bridging the digital divide with AI

Bridging the digital divide is crucial for equal access to quality teacher education across varied geographic and socioeconomic contexts. In many rural and distant areas of the

Global South, teacher trainees lack digital infrastructure, current curriculum, and expert instruction. AI can remove these hurdles by providing scalable, adaptive, and personalised learning experiences that improve access and equity.

A. *Rural and Remote Teacher Education Digital Infrastructure Issues:* In rural and underdeveloped places, internet connectivity, digital gadgets, and technology-enhanced pedagogy are typically lacking. Infrastructure issues prevent the integration of current instructional technology like AI. According to Zawacki-Richter et al. (2019), this digital gap hinders AI adoption in teacher education and unequally distributes professional growth.

B. *AI Promotes Equity and Access:* AI can enable low-bandwidth, mobile-friendly, offline-compatible learning technologies that adapt to local limits to reduce infrastructural and pedagogical inequities. Teacher education programs can provide high-quality remote instruction using adaptive learning platforms and AI-based feedback. Kong, Lai, and Sun (2022) revealed that AI tools provide individualised learning and real-time scaffolding, allowing teacher trainees to develop at their own speed despite contextual constraints.

C. *DIKSHA, SWAYAM, and AI-for-All:* India's national platforms DIKSHA (Digital Infrastructure for Knowledge Sharing) and SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) use AI to close the digital divide. These platforms serve urban and rural educators with multilingual, AI-powered content, interactive teaching modules, and mobile accessibility (Holmes et al., 2021). CBSE and Intel's AI-for-All program employs online micro-courses to democratise AI literacy and prepare pre-service and in-service teachers. These initiatives show how intentional AI integration and supportive policy and infrastructure may increase access, digital inclusivity, and national education goals like NEP 2020 and SDG 4.

5. Faculty and institutional digital literacy

The integration of AI in teacher education depends on technologies, infrastructure, and institutions' and educators' digital readiness. Institutional readiness includes innovation, faculty digital transformation assistance, and strategic planning to maintain change. Faculty digital literacy, the skills, attitudes, and knowledge needed to use technology meaningfully in educationis crucial to this process.

A. *Teacher Educator Digital Competence:* Effective integration of digital tools, including AIrequires a synthesis of technological, pedagogical, and content knowledge, according to Mishra and Koehler's (2006) TPACK approach. Teacher educators must comprehend AI tools and how to use them to improve student learning. Many universities still have a digital competency gap, leaving teachers unprepared to use AI-enhanced platforms (Zawacki-Richter et al., 2019).

B. *Continuous Professional Development and Change Management:* Institutions must engage in CPD suited to developing educational technology to close these gaps. AI ethics, data literacy, adaptive learning systems, and differentiated instruction utilising AI tools are covered. Structured, reflective CPD programs help teacher educators develop inclusive, AI-based feedback systems, according to Kong, Lai, and Sun (2022). To promote mindset adjustments, eliminate resistance, and foster academic creativity, change management tactics are essential.

C. *Institutional Culture and Innovation Adoption:* Leadership and culture effect AI integration. Collaborative, experimental, and cooperative learning institutions use AI more. Bureaucracy and technophobia can stifle creativity. Zawacki-Richter et al. (2019) say institutional responsiveness to pedagogical reform and digital transformation essential maintain AI programs in teacher education.

6. Integrating AI with NEP 2020 and SDG 4

A. *Policy frameworks Technology-Enhanced Inclusive Education Advocate:* Equality, inclusivity, and technology-driven education are the goals of the NEP 2020 and SDG 4. NEP 2020 recommends using digital tools and AI to improve teacher preparation programmes and ensure quality education across India (Ministry of Education, 2020). SDG 4 encourages innovations that eliminate gaps and enhance teaching outcomes to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2015).

B. *Trouble Implementing Policy Visions:* Policy and practice remain disconnected despite these high aspirations. Many teacher education institutes lack digital infrastructure, competent faculty, and pedagogical frameworks to apply AI (Zawacki-Richter et al., 2019). AI integration is patchy, frequently limited to metropolitan and well-funded institutions, exacerbating educational inequities.

C. *Teacher Education Strategically Fulfils National and Global Goals:* Translating policy into classroom practices is key for teacher education programs. These initiatives can close learning gaps, promote digital equity, and advance national and global education agendas via AI-integrated curricula and inclusive pedagogical training. Kong, Lai, and Sun (2022) show that AI-based feedback systems and adaptive learning tools help teachers accept diversity and meet student requirements, supporting NEP 2020 and SDG 4.

7. Ethics and Governance in AI Integration

A. *Data Privacy, Algorithmic Bias, and Over-Automation:* AI in education creates ethical and governance concerns. Data leaks, surveillance, and algorithmic bias are dangers when AI systems are trained using social inequality information. Unregulated AI in assessment and decision-making may perpetuate discrimination and inequalities, according to Zawacki-Richter et al. (2019).

B. *Human-Centered and Ethical AI in Education:* Ethical AI should support educators, not replace them. Algorithm openness, informed consent for data use, and culturally and pedagogically suitable AI systems are needed (Holmes et al., 2021). Teacher education programmes must integrate ethical norms to promote responsible AI use and awareness of its limitations. Ethical AI should help educators, not replace them. Algorithm openness, informed consent for data use, and culturally and pedagogically suitable AI systems are needed (Holmes et al., 2021). Teacher education programmes must integrate ethical norms to promote responsible AI use and awareness of its limitations.

C. *The AI Innovation-Pedagogical Value Balance:* AI can mechanise education by prioritising automated systems over critical thinking, empathy, and social-emotional learning. Teacher educators must reconcile technology innovation with pedagogical

integrity, using AI to enhance human judgement and creativity. According to Kong et al. (2022), the most effective AI solutions empower teachers rather than replace them.

PRACTICAL RECOMMENDATIONS

1. *Integrate AI and Digital Pedagogy into Teacher Education Curricula:* B.Ed. and M.Ed. programs should include AI literacy, ethical use, and digital instructional design modules. Align with TPACK framework for effective technology use teaching (Mishra & Koehler, 2006).
2. *Encourage Faculty CPD:* Regularly train on AI tools, data ethics, and inclusive design, especially for rural teacher educators (Kong, Lai, & Sun, 2022).
3. *Create Ethical AI Policy Frameworks:*Establish norms for data protection, algorithmic accountability, and bias reduction in educational AI technologies (Zawacki-Richter et al., 2019).
4. *Provide Digital Equity Infrastructure:* Support Spread DIKSHA, SWAYAM, and AI-for-All to remote teacher training institutes using offline and mobile platforms (Holmes et al., 2021).
5. *Promote Innovation in Teacher Education Institutions:*Promote collaborative experimentation and innovation hubs for pre-service teachers and educators to co-create and adapt AI-enhanced methods.

CONCLUSION

AI can revolutionise teacher education by providing individualised instruction, inclusive pedagogies, and data-driven decision-making. This study shows that AI tools like intelligent tutoring systems, adaptive feedback, and assistive technologies can improve pre-service teacher training, but infrastructural inequalities, digital skill gaps, and ethical concerns prevent their widespread adoption. According to thematic analysis of academic literature, policy frameworks, and institutional practices, AI integration with NEP 2020 and SDG 4 can create egalitarian and future-ready teacher preparation systems. Alignment requires technical preparedness, strategic policy frameworks, faculty development, and ethical governance.Institutions must invest in digital equity infrastructure, integrate AI literacy into curricula, and support faculty professional development to close the digital gap and maximise AI's potential in teacher education. Avoiding mechanical techniques and maintaining educational integrity requires creating an institutional culture that fosters innovation and ethical AI use. AI may help create inclusive, reflective, and context-sensitive education systems, not replace instructors. The findings suggest a multi-stakeholder approach to embed AI meaningfully in teacher education to improve, not replace, human teaching and learning.

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THE ROLE OF HR IN ENHANCING EMPLOYEE PRODUCTIVITY IN THE AUTOMOTIVE SECTOR, BRD CAR WORLD LIMITED

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ABSTRACT

In today's fast-evolving automotive sector, employee productivity plays a vital role in ensuring competitiveness and sustained growth. Human Resource (HR) practices are no longer limited to administrative functions but serve as a cornerstone of organizational development and success. This paper examines how HR strategies at BRD Car World Limited, a leading Maruti Suzuki dealership in Kerala, influence employee performance and operational outcomes. The research explores recruitment, training, motivation, performance appraisal, and workplace culture to identify key HR practices that impact employee productivity. Through analysis of real-world practices and employee responses, this paper highlights the critical role of HR in enhancing individual output, team collaboration, and customer satisfaction. The findings aim to offer insights for automotive businesses to optimize HR interventions for better productivity.

Keywords: Human Resource Management, Automotive Sector, Employee Productivity, HR Practices, BRD Car World, Performance Management, Work Environment

1. INTRODUCTION

The automotive sector in India is undergoing tremendous changes due to technological advancement, rising customer expectations, and stiff competition. In such a high-pressure environment, businesses cannot thrive without a committed and capable workforce. Employee productivity the output an employee delivers in a given timeframe directly impacts customer satisfaction, profitability, and overall business growth. In this setting, **Human Resource Management** becomes more than just a support function; it becomes the engine that drives performance and progress. At **BRD Car World Limited**, one of Kerala's largest Maruti Suzuki dealerships, the HR department plays a pivotal role in shaping workforce productivity. From hiring the right talent to training them and keeping them motivated, HR is involved in every step of the employee journey. This conference paper delves into how the HR team at BRD Car World enhances employee productivity, what strategies they use, what challenges they face, and what other automotive organizations can learn from their approach.

2. OBJECTIVES OF THE STUDY

- To identify the key HR practices that influence employee productivity in the automotive sector.

- To evaluate the impact of HR interventions such as training, motivation, and performance management on employee efficiency.
- To analyse how HR policies and work environment contribute to enhancing employee output and overall organizational performance.

3. REVIEW OF LITERATURE

Peerless Research Group (2024) "How Automation is Transforming HR Functions" study surveyed over 200 HR professionals in the logistics and automotive sectors to understand the impact of digital HR tools. It found that platforms such as HRMS, digital onboarding systems, and performance analytics dashboards have significantly improved tracking and aligning employee goals. Automation helped reduce manual errors, provided real-time performance insights, and supported data-driven decision-making. The study concluded that embracing digital transformation in HR leads to faster operations, better employee experience, and measurable improvements in productivity. Peerless suggested that digital literacy among HR teams is now a critical competency.

Kumar & Mathew (2023) "Performance Management in Indian Automotive Sector" This research investigated the relationship between performance-based incentives and employee output in Indian automotive dealerships. The study utilized data from 150 respondents across five major dealerships. It found that when employees were rewarded based on clear performance metrics such as sales targets, customer satisfaction scores, and service time reductions their motivation and goal-orientation increased. The research also highlighted that a transparent and fair reward system leads to reduced attrition and improved trust in management. The authors concluded that HR should integrate incentive structures with employee development plans to sustain high performance levels.

Gupta & Sharma (2022) "Training Interventions in Auto Dealerships" study across multiple automobile dealerships in northern India to examine the impact of structured training programs on employee performance. They found that continuous, role-specific training helped employees adapt to product innovations, understand customer behaviour, and reduce errors in both sales and service departments. The study emphasized that employees who received ongoing training showed higher engagement, improved job satisfaction, and greater overall productivity. The authors recommended dealership HR departments to adopt regular skill development sessions to enhance employee competence and retain talent in a highly competitive market.

Rani (2021) "Employee Engagement and Organizational Output" explored how a supportive HR environment can drive productivity and innovation, especially in service-oriented sectors like automobile sales and servicing. The paper argued that when employees feel heard, respected, and supported by their HR departments, their commitment to the organization increases. The study also revealed a direct correlation between open communication, feedback systems, and increased creativity at the workplace. Rani's findings suggest that investing in employee engagement not only boosts morale but also leads to improved service

quality, timely delivery, and customer satisfaction.

Bose & Thomas (2020) "Structured HR Policies in Automobile Industry" This study reviewed how structured HR policies influenced employee retention and service quality in mid-sized automotive companies. Using case studies and HR audit reports, Bose and Thomas found that companies with clearly defined HR practices like standardized onboarding, grievance redressal, employee appraisal methods, and policy handbooks experienced reduced employee turnover and better internal communication. The authors noted that clarity in expectations and fairness in operations foster employee loyalty, making HR policies a strong foundation for productivity. They recommend policy customization based on departmental needs for greater impact.

4. GROWTH OF HR IN THE AUTOMOTIVE SECTOR

The automotive industry in India has seen substantial transformation over the last decade. Earlier, HR was mostly administrative handling payrolls, attendance, and basic compliance. But now, HR has taken on a strategic role across many dealerships and automotive companies, including BRD Car World. The focus has shifted from managing people to developing people.

Key Developments in HR Functions:

- **Digital Recruitment Platforms**: Hiring through portals, social media, and internal referrals.
- **Skill-Based Training**: On-the-job training, product knowledge sessions, and behaviour coaching.
- **Performance Metrics**: Monthly reviews, KPIs (Key Performance Indicators), and customer satisfaction scores.
- **Employee Engagement Programs**: Celebrations, team outings, and open forums for feedback.
- **Technology Adoption**: HRMS tools for payroll, performance tracking, and attendance.

5. CHALLENGES FACED BY HR IN ENHANCING PRODUCTIVITY

- **High Attrition Rate**: Particularly in sales departments due to high targets and market pressure.
- **Skill Gaps**: New joiners often lack adequate customer handling or technical skills.
- **Resistance to Change**: Employees, especially in the service department, may resist adopting new technologies or processes.
- **Work-Life Balance Issues**: Long working hours and customer demands lead to burnout.

- **Inconsistent Motivation**: Not all employees respond to the same reward mechanisms.

HR professionals have to work closely with department heads to tackle these issues. For example, to reduce attrition, BRD Car World has implemented better onboarding and mentoring. To address skill gaps, they conduct regular training, both technical and behavioural. However, motivation remains a highly individualistic factor, and HR must personalize rewards and recognition wherever possible.

6. FINDINGS FROM THE CASE OF BRD CAR WORLD LIMITED

- **Training programs are highly valued** – especially the ones conducted jointly with Maruti Suzuki.
- **Recognition motivates performance** – monthly performer awards and shout-outs during team meetings make employees feel appreciated.
- **Open communication boosts morale** – HR maintains a friendly and accessible approach, encouraging employees to share their concerns.
- **Job clarity increases efficiency** – defined roles and performance metrics help employees focus on targets without confusion.
- **Career growth opportunities retain talent** – internal promotions and skill development programs have encouraged many to stay longer.

BRD Car World's HR practices show that **productivity is not about pushing employees harder**; it's about supporting them smarter. The combination of skill development, emotional support, and consistent performance tracking makes employees more invested in their work.

7. CONCLUSION

In a sector like automotive retailing, where customer satisfaction is deeply linked with employee behaviour, productivity is not just about numbers—it's about people. The HR department is uniquely positioned to bridge the gap between business goals and human potential. At BRD Car World Limited, HR has proven that with the right mix of structure, empathy, and vision, even a large, diverse workforce can be motivated to perform better and stay longer. What makes BRD Car World's approach effective is its **balance between employee needs and business goals**. From hiring to performance reviews, every HR activity is aligned with productivity enhancement. Other organizations in the automotive sector can learn from this case by prioritizing their people strategy, embracing technology, and focusing on long-term development rather than short-term fixes. For sustainable growth, organizations must understand that **investing in human capital is not optional it's essential**. With HR as a strategic partner, companies can build a resilient workforce ready to take on industry challenges and contribute to long-term success.

8. SUMMARY

Employee productivity plays a vital role in ensuring customer satisfaction, especially in

automotive dealerships where service quality and responsiveness directly impact the client experience. Human Resource (HR) management has transitioned from a purely administrative function to a strategic partner in driving business success. At BRD Car World Limited, this shift is evident through structured hiring practices, continuous employee training, and the implementation of clear Key Performance Indicators (KPIs), all of which contribute to enhanced employee performance. To keep employees motivated, the organization employs a range of strategies including performance-based rewards, internal promotion opportunities, and consistent employee recognition programs. However, the company also faces challenges such as high attrition rates, existing skill gaps, and occasional resistance to change, particularly in adapting to new technologies. By introducing personalized HR practices that cater to individual employee needs and career paths, BRD Car World has managed to improve employee retention and overall productivity. Ultimately, by fostering a people-focused culture, the organization has created a sustainable competitive advantage in a highly demanding industry.

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Lead Time Reduction Strategies at Cement Industry in India

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ABSTRACT:

This study focuses on analyzing lead time reduction strategies within the Indian cement industry, where timely delivery and supply chain efficiency are crucial for competitiveness. Lead time, the period between order placement and final delivery, significantly affects customer satisfaction, operational cost, and market responsiveness. The cement industry often faces challenges like poor infrastructure, fluctuating demand, delays in raw material supply, and inefficient logistics systems. This research investigates how leading cement companies in India are addressing these issues through process improvements, technological integration, and supply chain reengineering. Emphasis is placed on methods such as route optimization, warehouse automation, real-time tracking systems, and vendor coordination. By collecting data through field visits, interviews, and secondary sources, the study identifies practical strategies that have proven successful in reducing lead time. The research also evaluates the impact of these strategies on delivery performance and cost savings. Ultimately, the study offers actionable insights for logistics and supply chain managers aiming to streamline operations in the cement sector.

INTRODUCTION:

The cement industry in India plays a vital role in the nation's infrastructure development and economic growth. As demand for cement continues to rise due to rapid urbanization and industrialization, timely delivery has become a critical factor for customer satisfaction and operational efficiency. Lead time the duration between order placement and delivery directly influences the performance of cement companies. Delays in lead time can result in increased costs, reduced customer trust, and operational bottlenecks. This project aims to study the various lead time reduction strategies adopted by cement companies in India to enhance their supply chain effectiveness. It focuses on identifying challenges in logistics and assessing solutions such as digitization, route optimization, and improved inventory management. The research evaluates how these strategies help in reducing delays and improving service reliability. By analyzing real-world practices from selected companies, the project seeks to provide practical recommendations. The ultimate goal is to support the industry in achieving faster, more reliable deliveries while minimizing costs.

OBJECTIVES OF THE STUDY:

- To analyze the current logistics process followed by RAMCO Cement.
- To identify factors contributing to lead time in the supply chain and logistics operations.

- To evaluate the effectiveness of existing lead time reduction strategies implemented by the company.
- To propose a framework for continuous improvement in logistics and supply chain lead time management.

REVIEW OF LITERATURE

Adotse Mercy Enoche et al. (2025), in their study "Effect of Supply Chain Management on Organizational Performance of Dangote Cement Company Gboko-Benue State, Nigeria," analyze the impact of supply chain management practices on company performance, with a specific focus on supplier relationship management and transportation logistics. The study highlights that effective SCM practices enhance operational efficiency, reduce logistics and procurement costs, and improve market competitiveness. Through detailed statistical analysis, the research confirms that a strong positive relationship exists between well managed SCM functions and the overall performance of the company. The authors recommend that firms in the cement sector prioritize the improvement of transport networks, develop long-term supplier partnerships, and adopt collaborative technologies to sustain growth and maintain their competitive edge. This study serves as a crucial resource for cement companies aiming to optimize their supply chain structures in rapidly changing industrial environments.

Iyer & Krishnan (2023) examined how sustainable supply chain initiatives affect operational timelines in cement manufacturing. The research emphasized the balance between environmental goals and efficiency metrics, noting that Ramco Cements' green logistics practices—such as the use of electric vehicles and solar-powered warehouses— also contributed to lead time improvement. The study found that sustainability initiatives, when integrated with operational planning, resulted in improved energy efficiency, streamlined processes, and fewer delays. By optimizing resource usage and reducing waste, companies experienced smoother workflows and better predictability in delivery schedules. Iyer and Krishnan argued that sustainability and operational efficiency are not mutually exclusive but can be jointly pursued for long-term performance improvement. Their study confirms that environmentally responsible practices can yield operational benefits, including reduced lead times and higher supply chain reliability.

Kumar & Jain (2022) investigated the role of transport network optimization in reducing lead time and logistics cost in the cement industry. Their study emphasized the use of route planning software, GPS tracking, and centralized fleet coordination to achieve timely deliveries. Ramco Cements' logistics division was cited for its use of real-time route monitoring systems that allowed better traffic management and scheduling. The results showed a 17% reduction in average delivery time and a significant drop in fuel consumption. The study also highlighted the importance of multi-modal transport integration—combining road and rail—where feasible, to improve delivery reliability. Kumar and Jain concluded that optimized transport strategies are fundamental to achieving efficiency in cement logistics. Their findings suggest that leveraging digital logistics tools and infrastructure investments is key to maintaining competitive advantage through reduced lead times.

Srinivas & Rao (2021) evaluated the impact of Total Quality Management (TQM) practices on logistics performance in cement manufacturing. Their study identified Ramco Cements' ISO-certified processes as a benchmark for quality-driven operations. By focusing on training, systematic documentation, and regular quality audits, TQM initiatives led to reduced handling errors, fewer disruptions, and faster processing times. The study found that improved quality standards led to higher customer satisfaction and better on-time delivery performance. Srinivas and Rao emphasized the role of employee accountability and continuous improvement as foundational elements of TQM. Their research confirmed that cement firms adopting quality-centric logistics frameworks can achieve significant improvements in lead time and operational consistency. Ramco's structured approach to quality served as a model for integrating TQM into broader SCM strategies.

Mehta & Srinivasan (2021) reviewed the role of digital transformation in cement supply chains, with a special focus on lead time optimization through technology adoption. The study showcased Ramco Cements' use of GPS-enabled fleet management systems, which enabled route optimization and reduced transit delays by 15–20%. Real-time alerts and tracking enhanced dispatch scheduling and resource utilization. Furthermore, predictive analytics supported better forecasting and proactive decision-making. The findings confirm that investing in digital tools such as IoT, fleet monitoring, and analytics software directly contributes to tighter control over lead times. The study concludes that embracing end-to-end digitization enhances supply chain visibility, responsiveness, and overall competitiveness in the cement sector.

GROWTH OF LEAD TIME REDUCTION STRATEGIES IN THE CEMENT INDUSTRY

The cement industry in India has undergone a major shift in logistics and supply chain management, especially in efforts to reduce lead time. Earlier, delivery timelines were heavily affected by manual operations, poor infrastructure, and limited tracking. Today, companies are adopting proactive, tech-driven strategies to streamline their processes and ensure timely deliveries.

Key Developments in Lead Time Reduction Strategies

- **Digital Tracking Systems:** Use of GPS and IoT for real-time vehicle and consignment monitoring.
- **Route Optimization Tools:** Software for planning the shortest, fastest, and most cost-effective delivery paths.
- **Automated Inventory Management:** Real-time stock monitoring using ERP and WMS systems.
- **Vendor & Supplier Collaboration:** Integrated planning with suppliers for quicker material movement.
- **Process Standardization:** Lean practices to remove bottlenecks and reduce process delays.

CHALLENGES FACED IN LEAD TIME REDUCTION STRATEGIES IN THE CEMENT INDUSTRY

While lead time reduction is crucial for operational efficiency, several challenges hinder its

effective implementation in the cement sector.

Key Challenges in Lead Time Reduction

• **Inadequate Infrastructure:** Poor road conditions and transport delays disrupt timely deliveries.
• **Coordination Issues:** Misalignment between suppliers, manufacturers, and transporters causes process delays.
• **Technology Adoption Barriers:** Resistance to using digital tools among traditional workforce.
• **Demand Fluctuations:** Inconsistent customer demand makes inventory and delivery planning difficult.
• **Limited Real-Time Data:** Lack of integrated tracking systems leads to poor visibility and delayed decisions. Cement companies are addressing these challenges by upgrading to GPS-enabled logistics, adopting ERP systems, and improving vendor communication. However, achieving consistency still requires cultural change and greater technology penetration across all departments.

FINDINGS FROM THE CASE OF LEAD TIME REDUCTION STRATEGIES IN THE CEMENT INDUSTRY

• **Technology improves visibility** – GPS tracking and real-time monitoring have reduced uncertainty in deliveries.
• **Process standardization reduces delays** – Clear logistics workflows and SOPs help avoid bottlenecks.
• **Vendor collaboration is critical** – Regular coordination with raw material suppliers ensures smoother supply flow.
• **Digital tools enhance planning** – Use of ERP and route optimization software helps in better inventory and transport management.
• **Trained workforce boosts efficiency** – Staff trained in logistics handling and system usage contribute to faster turnaround times. These findings show that lead time reduction is not only about speeding up deliveries but also about building a smarter, synchronized supply chain. Combining technology, training, and communication has proven to be an effective strategy in the cement industry for improving operational performance.

CONCLUSION:

In the cement industry, where timely delivery and operational efficiency are critical, reducing lead time is not just a logistical challenge it's a strategic necessity. This study highlights that lead time reduction requires an integrated approach involving technology, process optimization, and workforce readiness. Cement companies that invest in digital tools, clear process workflows, and supplier coordination see measurable improvements in delivery timelines and cost efficiency. What makes these strategies effective is the alignment of operational goals with modern supply chain practices. From raw material procurement to final dispatch, every stage must be optimized to reduce delays. The companies leading in this space focus not only on speed but also on accuracy, visibility, and flexibility. For long-term

success, cement manufacturers must view lead time reduction as a continuous improvement journey. Embracing innovation, training logistics teams, and building strong vendor relationships are essential. With the right strategies in place, the cement industry can overcome traditional bottlenecks and build a resilient, high-performing supply chain.

SUMMARY:

Lead time plays a critical role in the performance and competitiveness of the cement industry, where timely delivery directly impacts customer satisfaction and operational efficiency. This study highlights the shift from traditional logistics methods to more advanced, strategic approaches aimed at reducing lead time. Cement companies in India are now leveraging digital tools like GPS tracking, ERP systems, and route optimization software to streamline their supply chains. Alongside technology, process improvements such as standardized workflows, better vendor coordination, and skilled workforce training contribute significantly to reducing delays. However, challenges remain—such as poor infrastructure, inconsistent demand, and resistance to adopting new systems. Despite these barriers, companies that focus on innovation, collaboration, and continuous improvement are seeing positive results. By integrating people, processes, and technology, the cement sector is gradually moving towards a more responsive and resilient supply chain. This evolution marks a significant step toward building long-term efficiency and customer-centric operations.

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Fundamental and Technical Analysis of Stocks in IT Sectors in India

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ABSTRACT:

The investment in share market is highly rewarding but highly risky. The concept of analysis comes into picture when decision has to be made on choosing a particular company's shares for investment. Analysis includes fundamental and technical analysis. Fundamental analysis is a method of forecasting the future price movements of a financial instrument based on economic, political, environmental and other relevant factors and statistics that will affect the basic supply and demand of whatever underlies the financial instrument Technical analysis is a security analysis technique that claims the ability to forecast the future direction of prices through the study of past market data primarily price and volume. This paper is aims at carrying out Fundamental and Technical Analysis of the selected companies from the Information Technology sector, since IT sector is one of the most upcoming sectors in the Indian Market Secondary Data of last 5 year (2016-2020) for fundamental analysis and for technical analysis the daily share prices of the last financial years (from 1-3-2019 to 2822020) is collected for five leading IT companies listed on nifty 50: TCS, INFSY,HCLTECH,,WIPRO and TECHM , for the study through fundamental analysis is carried out by tools like Economic analysis, Industrial analysis and Company Analysis and their technical analysis is carried out using various tools which are used in this study are: Moving Average (MA), Stock (Candlestick) chart, Moving average convergence divergence (MACD), Relative strength index (RSI). After analyzing and applying the various tool researcher have found that fundamental analysis reduce the risk and maximize the return on investment and Technical analysis gives investor a better understanding of the stocks and also gives them right direction to go on further to buy or sell the stocks.

Keywords: Fundamental analysis, Economic, Industrial, Company analysis, Technical Analysis, MA, MACD, RSI, Candlestick chart, trader, investor.

INTRODUCTION:

India is one of the top five economies in the world in terms of market potential and ranked as the third biggest economy in Asia in terms of gross domestic product. All these make investment in India a lucrative option for the investors across the world. The capital market of India forms an important part of the development of the nation. Nowadays people are showing more interest to invest in shares or derivatives. Investors are more conscious about the fluctuations in the stock market, In order to minimize the risk, the investors should know about the past performance of the company, market fluctuations, reason for fluctuation, economic policy and inflation etc., before making an investment in securities. Otherwise, the investors can be applied security analysis. There are two alternative approaches for security analysis such as technical and fundamental analysis. Technical analysis is a method of

evaluating securities by analysing the statistics generated by market activity, such as past prices and volume. The objective of Fundamental analysis is to appraise 'intrinsic value of a security. The intrinsic value is the true economic worth of a financial asset. The fundamental analyst has to estimate the intrinsic worth of a security by considering key economic and financial variables and see whether the actual price is above or below its intrinsic value. Finally, the investors take buy or sell decision depending upon the result drawn from those analyses. The main purpose of this analysis is for long-term perspective in nature. Fundamental analysts is the study of economic, industry, and company conditions in an effort to determine the value of a company's stock. Fundamental analysis typically focuses on key statistics in a company's financial statements to determine if the stock price in correctly valued. For the analysis we need to analyse the overall economy, and the firms' interest.One of the primary assumptions of the fundamental analysis is the price of the stock market does not fully reflects a stocks real value. Technical analysis helps the shape holders to choose the best security to invest to make profit.It also guides them, when to sell or how much time to bold the security and the like. It also helps the chars brokers. The stare brokers can use these tools in give a good guidance to its clients regarding the transaction of shares. Since the customer gets the added service, they will stain to the company. It can be used as a method to increase their clients and there by profit. This study reveals how the share brokers and their clients are helped by technical tools. The capital gain of an investor depends on the performance of a particular company's stock in the stock market. The stronger the company's share is, the more profit the investor gen. So it is necessary to ascertain, analyse and interpret the share of various firms in order to know its position in the market. Investors can make wise investment with the help of this analysis. Fundamental analysis use different tools and ratios to compare all sorts of companies Relative Strength Index (RSI), Moving average Convergence and Divergence and Bellinger Band are the tools used for the technical analysis. These tools help in us analyse when to buy, hold or sell the shares. That means that at which price must buy or sell securities. It also helps to analyse when we must hold the securities. The study is much useful for both the clients and share broking firms.

1.1 *IT Sector – Growth in World Scenario:*

India is the world's largest sourcing destination for the information tech industry, accounting for approximately 67 per cent of the US$ 124-130 billion market. The industry employs about 10 million workforces. More importantly, the industry has led the economic transformation of the country and altered the perception of India in the global economy. India's cost competitiveness in providing IT services, which is approximately 3-4 times cheaper than the US, continues to be the mainstay of its Unique Selling Proposition (USP) in the global sourcing market. However, India is also gaining prominence in terms of intellectual capital with several global IT firms setting up their innovation centres in India. The IT industry has also created significant demand in the Indian education sector. especially for engineering and computer science. The Indian IT and ITeS industry is divided into four major segments - IT services, Business Process Management (BPM), software products and engineering services, and hardware.

Market Size

The Indian IT sector is expected to grow at a rate of 12-14 per cent for FY2017-18 in constant currency terms. The sector is also expected triple its current annual revenue to reach US$ 350 billion by FY 2025. Employees from 12 Indian start-ups, such as Flipkart, Snapdeal, Makemytrip, Naukri, Ola, and others, have gone on to form 700 start-ups on their own, thus expanding the Indian startup ecosystem.! India ranks third among global start-up ecosystems with more than 4,200 start-ups. Total spending on IT by banking and security firms in India is expected to grow 8.6 per cent year-on-year to US$ 7.8 billion by end of 2017.

India's internet economy is expected to touch Rs 10 trillion (US$ 146.72 billion) by 2018, accounting for 5 per cent of the country's GDP.The public cloud services market in India is slated to grow 35.9 per cent to reach US$ 1.3 billion according to IT consultancy, Gartner. Increased penetration of internet (including in rural areas) and rapid emergence of e-commerce are the main. drivers for continued growth of data centre co-location and hosting market in India. The Indian Healthcare Information Technology (IT) market is valued at US$ 1 billion currently and is expected to grow 1.5 times by 2020. India's business to business (B2B) e-commerce market is expected to reach US$ 700 billion by 2020 whereas the business to consumer (B2C) e-commerce market is expected to reach US$ 102 billion by 2020.

Cross-border online shopping by Indians is expected to increase 85 per cent in 2017. and total online spending is projected to rise 31 per cent to Rs 8.75 lakh crore (USS 128 billion) by 2018. Post the government's announcement of demonetisation of specific currency denominations, digital payment platforms such as Paytm, MobiKwik, Oxigen witnessed a sharp spike in user transactions, app downloads and merchant enquiries, thereby indicating a greater demand towards digital payments by consumers.India ranks among the top five countries in terms of digitalisation maturity as per Accenture's Platform Readiness Index, and is expected to be among the top countries with the opportunity to grow and scale up digital platforms by 2020.

1,2 Growth of IT Sector in India:

The IT sector has become one of the most significant growth catalysts for the Indian economy, contributing significantly to the country’s GDP and public welfare. The IT industry accounted for 7.5% of India’s GDP in FY23, and it is expected to contribute 10% to India’s GDP by 2025. As innovative digital applications permeate sector after sector, India is now prepared for the next phase of growth in its IT revolution. India is viewed by the rest of the world as having one of the largest Internet user bases and the cheapest Internet rates, with 76 crore citizens now having access to the Internet.

The current emphasis is on the production of significant economic value and citizen empowerment, thanks to a solid foundation of digital infrastructure and enhanced digital access provided by the Digital India Programme. India is one of the countries with the

quickest pace of digital adoption. This was accomplished through a mix of government action, commercial innovation and investment, and new digital applications that are already improving and permeating a variety of activities and different forms of work, thus having a positive impact on the daily lives of citizens. India's rankings improved six places to the 40th position in the 2022 edition of the Global Innovation Index (GII).

According to the National Association of Software and Service Companies (NASSCOM), the Indian IT industry's revenue touched US$ 227 billion in FY22, a 15.5% YoY growth and was estimated to have touched US$ 245 billion in FY23. The IT spending in India is estimated to record a double-digit growth of 11.1% in 2024, totalling US$ 138.6 billion up from US$ 124.7 billion last year. The Indian software product industry is expected to reach US$ 100 billion by 2025. Indian companies are focusing on investing internationally to expand their global footprint andenhance their global delivery centres. The data annotation market in India stood at US$ 250million in FY20, of which the US market contributed 60% to the overall value. The market is expected to reach US$ 7 billion by 2030 due to accelerated domestic demand for AI. India's IT industry is likely to hit the US$ 350 billion mark by 2026 and contribute 10% towards the country's gross domestic product (GDP), Infomerics Ratings said in a report. As an estimate, India's IT export revenue rose by 9% in constant currency terms to US$ 194billion in FY23. The export of IT services has been the major contributor, accounting for more than 53% of total IT exports (including hardware).

2. REVIEW OF LITERATURE:

Liugita, Salsabila, and Meythi (2024) suggested that "Fundamental Analysis and Technical Analysis in Investment Decision Making" (Global et al., 2024, p. 1) explores the use of both technical and fundamental analysis in investment choices. The goal of the study is tocomprehend how both approaches are used in practice as well as how they might be used in tandem. The authors emphasize the diverse time periods and data sources of technical and fundamental analysis in order to acknowledge their unique characteristics. The study's conclusions advance our knowledge of the practical applications of fundamental and technical analysis, but more investigation is required to identify the best integration approach and how it affects investment success.

Snehal Shah & Ayush Ajmera (2022) investigated the growing trend of equity investments in India driven by inflation exceeding savings interest rates. As awareness of the stock market increases due to SEBI and government initiatives, investors are gradually shifting from traditional options like FDs and PPFs to equities and mutual funds. The study highlights the importance of fundamental and technical analysis in managing market risk and volatility.
Using secondary data from sources like Moneycontrol, they analyzed 10 companies across five sectors—IT, Banking, Automobile, Health, and Infrastructure. Their findings underscore the role of both analyses in investment decisions and provide a sector-wise performance and investor preference ranking.

P. Venkatesh & Krishna Sudheer(2021) conducted a technical analysis study focusing on selected steel sector stocks to evaluate their price behavior and investment potential. The research highlights that technical analysis plays a crucial role in understanding supplydemand

dynamics, identifying undervalued or overvalued stocks, and recognizing major market turning points. Using secondary data, the study applied tools such as candlestick charts,simple moving averages, Rate of Change (ROC), and Relative Strength Index (RSI) to assess whether a stock is technically strong and suitable for buying or selling. The authors argue that even fundamentally strong stocks require technical evaluation to determine the right entry or exit points. Their findings reinforce the value of technical indicators in guiding timely investment decisions and enhancing the effectiveness of stock selection.

Adebayo Felix Adekoya & Benjamin Asubam Weyori (2020) conducted a systematic review of 122 studies from 2007 to 2018 on stock market prediction using machine learning. The review categorized the research into technical, fundamental, and combined analysis methods. It found that 66% of studies focused on technical analysis, 23% on fundamental, and only 11% used a combined approach. Most studies relied on single data sources and used algorithms like Support Vector Machines and Artificial Neural Networks. The study highlights the growing use of machine learning in financial prediction and the dominance of technical analysis in such models.

Detzel Andrew, Liu Hong, Strauss Jack, Zhou Guoth, Zhu Yinhzi. (2020) suggested in

their study "Learning And Predictability Via Technical Analysis: Evidence From Bitcoin And Stocks With Hard To Value Fundamentals" studied how technical analysis is helpful inpredicting the future price movements of assets with hard to value fundamentals, for example, Bitcoin, Cryptocurrencies and stocks of a new company with a limited fundamental available. They also used price to moving average ratio of daily Bitcoin prices to analyzebitcoin returns. For conducting research the researchers have taken daily Bitcoin prices in different stock exchanges in the world as data and analyzed them. The researchers concluded that the future price movements and trade volume is predictable by using the moving average of price. Simple real-time strategies can be adopted to make buy and sell decisions based on the prediction. Price to moving average ratio is also helpful in forecasting the return on the stocks. The researchers also stated that similar results can be concluded for small-cap, young firms and low-analyst coverage stocks.

P. Devika. (2019) examined that Fundamental Analysis Of Automobile Companies (Car Manufacturing Companies) In India evaluated the profitability position and fundamentals of the car manufacturing companies in India. T Venkata Swapna, S. Subbalakshmi.(2020) In Their Paper Headed "A Study On Fundamental Analysis Of Selected Stocks Of It Sector"
have analyzed the performance and trends of the selected stocks of companies in IT sector. The researchers have also examined the risk and return of selected stocks. For the purpose of the sample, five companies were selected namely, Mastek, Mphasis, Mucleus, Zensartec and Sonatsoft. Secondary data was used for fundamental analysis from newspapers, the internet, and journals. Risk, Returns, Variance, Coefficient of variance, P/E ratio and I/E ratio are the statistical tools used in the research. The researchers concluded that fundamental analysis helps in calculating the intrinsic value of the stocks. The dividend discount model is a widely

used model for determining the intrinsic value of stocks. Indian IT industry is the most frequently growing sector and showing growth. It is difficult to understand whether the return prediction is reflecting risk or is mispriced. This can be simplified by analyzing the consistency of return prediction with a reasonable risk model.

3. OBJECTIVES

- To carry out fundamental and technical analysis of selected IT stocks.
- To know the future movement of selected companies shares through fundamental and technical analysis
- To take short term and long-term investment decision.
- To obtain knowledge on selecting right companies for investment

4. TOOLS USED

- Relative Strength Index (RSI).
- Moving Average Convergence Divergence.
- Bollinger Band

5. FINDINGS

Economic Analysis: -India is the topmost off shoring destination for IT companies across the world. Having proven its capabilities in delivering both on-shore and off-shore services to global clients, emerging technologies now offer an entire new gamut of opportunities for top IT firms in India. COVID 19 Pandemic has affect the Indian economy a lot. The impact of the pandemic and lockdown was disproportionately felt across industries.

India's GDP growth is expected to grow in the range of 6.0 percent in 2020-21.Prior the GDP growth was moderated to 4.18 percent in 2019-20.before that in 2018-19 the GDP growth rate was about 6.12% and in 2017-18 the GDP growth rate increased to 7.04 and then to 8.26% in 2016-17. COVID-19 Pandemic ,its intensity ,spread and duration will now majorly determine whether India is able to realize its estimated and projected GDP growth or not.

While Wholesaler Price inflation among the major economies mostly increased during the course of last five years, from 130.9 in 2016 to 156.6 in 2020. The WPI measures the price of a representative basket of wholesale goods. While consumer price inflation among the major economies mostly decreased during the course of last five years, from 121.8 in 2016 to 117.5 per cent in 2020.

In India, industrial production measures the output of businesses integrated in industrial sector of the economy. As in the 2016 the index was 175.8 which decreases to 125.6 in the year 2017 but as 2018 arrives the index steadily increases to 130.2 in 2018 than 139.1 in 2019 but as 2020 comes the index again declines to 129 which was hard time for the Indian economy due to COVID-19 Lockdown. Industry Analysis: -India's IT industry contributed around 7.7% to country's GDP (Gross Domestic Product) and is expected to contribute 10% to India's GDP by 2025. As of FY20, the IT industry employed 4.3 million people. In FY20, the sector added 205,000 jobs, up from 185,000 jobs added in FY19. Total number

of employees grew to 1.02 million cumulatively for four Indian IT majors (including TCS, Infosys, Wipro, and HCL Tech) as on December 31, 2019. Indian IT industry employed 205,000 new hires and had 884,000 digitally skilled talent in 2019.So, in this industry there will be more scope of innovation and employment.

IT industry's revenue was estimated at around Rs.19100crore in 2020, growing at 7.7% y-o-y. It is estimated to reach Rs.35000 crore by 2025. Moreover, revenue from the digital segment is expected to form 38% of the total industry revenue by 2025. Digital economy is estimated to reach Rs.69, 89,000 crore by 2025. The domestic revenue of the IT industry was estimated at Rs.4400crore and export revenue was estimated at Rs.14700crore in FY20.

As the composition of IT market in sector wise. Their 4 sector in IT Market in which themajority market is covered by IT services 52% followed by 20% in Software Product and Engineering services then 19% in BPM i.e. Business Processing Management and 9% in Hardware. The IT industry in India stood at Rs. 19100crore in FY20.As shown in the above figure IT services have major takeover the export which is 54% in the particular market then after there are two sector which have same percent of export that is 23% which are Business process management and Software product and engineering service

6. CONCLUSION

The IT Industry in India has grown with an exceptionally high growth rate in the post-reform years and contributed a large share to the national GDP. Despite the uncertain global economic scenario, the IT industry has steadily augmented and accelerated the growth of India. Financial performance through the financial ratios, which indicates that TCS and Infosys are financially in satisfactory position during the study period Through thefundamental analysis, investor can relate the possible factors to ensure investment risk and expect a reasonable return. But the fundamental analysis does not advice to investors for investment by basis on buying and selling of a particular security. So the investors can take only the decision whether the investment is to be worth or not. Technical analysis gives investor a better JETIR2105019 Journal of Emerging Technologies and Innovative Research (JETIR) www.jetir.org a163 © 2021 JETIR May 2021, Volume 8, Issue 5 www.jetir.org (ISSN-2349-5162) understanding of the stocks and also gives them right direction to go on further to buy or sell the stocks .Investors must also take into account various factors like Government of India budget, company performance, political and social events, climatic conditions etc. before any decision is made. The scrip should also be fundamentally good. Therefore, the small investors and traders should not blindly make an investment rather they should analyses using the various tools to check if the scrip is technically strong.

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DIGITAL TRANSFORMATION OF HRM PRACTICES: ROLE OF BLOCKCHAIN IN CANDIDATE VERIFICATION

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ABSTRACT

Candidate verification remains a critical yet inefficient process in Human Resource Management (HRM), often hampered by delays, errors, and credential fraud. Estimates suggest that 25-30% of applications in sectors like India's IT industry are affected. As digital transformation reshapes HRM practices, blockchain technology emerges as a decentralized, secure solution to address these challenges. This conceptual study explores the role of blockchain in enhancing candidate verification, utilizing a narrative review from five seminal papers and a theoretical framework grounded in the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT). Key findings highlight blockchain's potential to improve accuracy, reduce fraud, and streamline processes, though adoption faces barriers such as technical complexity and regulatory issues. A proposed model integrates perceived usefulness, perceived ease of use, trust, and transparency to predict adoption intention, offering a novel contribution to HRM literature. The study suggests implications for efficient HRM practices and organizational performance, while advocating for empirical validation and exploration across diverse contexts. This research provides a foundation for future studies and practical applications, aligning with the global push for digital innovation in HRM.

***Keywords**: Blockchain, HRM, Candidate Verification, Digital Transformation, Technology Acceptance Model (TAM), UTAUT, Recruitment*

INTRODUCTION

The advent of the digital era has revolutionized business operations throughout the globe, with Human Resource Management (HRM) emerging as a key domain undergoing profound transformation. Recruitment, onboarding and verification processes have increasingly migrated to digital platforms, promising enhanced efficiency, scalability, and accessibility. However, traditional methods such as manual validation of educational qualifications, employment histories, and reference checks continue to dominate, exposing organizations to a myriad of challenges. These include errors in documentation, fraudulent

submissions, and significant time delays, which not only disrupt workflows but also erode the trust essential for effective employer-candidate relationships. In an era where speed and integrity are paramount, the question arises: why do these inefficiencies persist, and what innovative solutions can address them? Blockchain technology, with its decentralized, secure, and immutable ledger, offers a transformative response, particularly in the critical area of candidate verification. The rationale for integrating blockchain into HRM practices is rooted in its ability to tackle persistent issues that undermine recruitment integrity. Globally, credential fraud affects an estimated 30% of job applications, with developing economies like India facing even higher incidences due to rapid workforce expansion. In India's information technology (IT) sector, which boasts a growth rate exceeding 7% annually and serves as a global hub for software development, the stakes are particularly high. The sector's intense hiring demands, coupled with a reported 25-30% fraud rate in candidate credentials, necessitate a robust solution. Blockchain addresses this "why" by providing real-time verification, preventing tampering through decentralization, and fostering transparency, thereby enhancing trust and reducing operational costs. Its potential to transform candidate verification from a weeks-long process to a matter of days positions it as a cornerstone of digital HRM evolution.

REVIEW OF LITERATURE

Blockchain technology has garnered significant attention as a transformative tool in Human Resource Management (HRM), particularly for addressing inefficiencies and security concerns in candidate verification. This review synthesizes insights from five seminal studies to explore their potential, challenges, and future directions in this domain.

Mohan Reddy Sareddy and Muhammad Farhan (2025). This study introduces a technical innovation by combining AI with Ethereum smart contracts. This approach automates resume screening, ensuring privacy through encrypted data and immutability for qualification verification. The study demonstrates how blockchain can protect candidate data while expediting verification, addressing fraud,a prevalent issue in recruitment. However, it focuses on technical feasibility rather than user adoption, leaving room for theoretical exploration of why HR stakeholders might embrace this system.

Abu Naser Mohammad Saif et al.'s (2022). This study offers a comprehensive synthesis of 126 documents. The review identifies blockchain's benefits, including data security, trust enhancement, and process automation in HRM, with specific relevance to candidate verification. Challenges such as technical misconceptions and lack of standardized frameworks are highlighted, alongside research gaps like the absence of adoption theories (e.g., TAM). This study underscores the need for a theoretical lens to unify existing findings, a focus of the current review.

NerminKişi's (2022). This paper provides a qualitative assessment of blockchain's role in recruitment. Through a literature review and expert interviews, the author identifies opportunities such as enhanced transaction reliability, reduced workload for HR

professionals, and mitigation of credential fraud. The study emphasizes blockchain's ability to streamline verification by offering a tamper-proof ledger, a critical need in contexts where manual processes dominate. However, challenges including technological complexity, organizational resistance, and high initial costs are noted as barriers to adoption. This exploratory work lays a foundation for understanding why blockchain could revolutionize candidate verification, though it lacks a theoretical framework to predict acceptance.

Dina Salah et al.'s (2020) study extends this discussion by exploring broader HRM applications. The paper highlights blockchain's potential to enhance transparency in processes like payroll and identity verification, directly applicable to candidate credential checks. Benefits include immutable records and reduced administrative overhead, while challenges such as scalability limitations and integration with existing systems are flagged. The study envisions a future where blockchain redefines HR workflows, suggesting a need for conceptual models to guide its implementation, a gap this review seeks to address.

MD Mehedi Hassan Onik et al.'s (2018) paper emphasizes traceable candidate histories and efficient verification, leveraging blockchain's decentralization. It suggests practical benefits like reduced fraud and improved trust, though scalability and user acceptance remain underexplored. This work complements the technical focus with real-world applicability, reinforcing the "why" behind blockchain's potential. Collectively, these studies reveal common themes: blockchain enhances security, efficiency, and trust in candidate verification, addressing HRM's digital transformation needs. However, challenges such as technological barriers, scalability, and lack of theoretical grounding (e.g., TAM application) persist. The absence of a unified model to predict adoption, particularly in diverse contexts, highlights a critical gap. This review synthesizes these insights to propose a conceptual framework, setting the stage for future theoretical and empirical investigations.

OBJECTIVES OF THE STUDY

1. To Explore the Transformative Potential of Blockchain Technology in Candidate Verification within HRM
2. To Analyse the Role of the Technology Acceptance Model (TAM) in Understanding Blockchain Adoption
3. To Develop a Conceptual Model for Guiding the Integration of Blockchain into HR Practices

THEORETICAL FRAMEWORK

The theoretical foundation of this conceptual study on the integration of blockchain technology into candidate verification within Human Resource Management (HRM) is anchored in two prominent models: the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). These frameworks provide a robust lens to explore why and how HR professionals and candidates might adopt blockchain-based systems, addressing the digital transformation of HRM practices.

Technology Acceptance Model (TAM): Perceived Usefulness and Perceived Ease of Use

The Technology Acceptance Model, introduced by Davis (1989), is a widely recognized framework derived from the Theory of Reasoned Action (Fishbein&Ajzen, 1975).

TAM posits that the adoption of a new technology is primarily driven by two key constructs: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which an individual believes that using a technology will enhance their job performance or task efficiency. In the context of candidate verification, HR professionals might perceive blockchain as useful if it reduces the time and cost associated with manual credential checks,transforming a process that often takes weeks into one completed in days, while candidates might value its ability to securely store and share verifiable credentials across multiple applications. Perceived ease of use, conversely, measures the extent to which an individual believes the technology can be mastered with minimal effort, such as through an intuitive interface or minimal training requirements. For blockchain, this could involve user-friendly dashboards that simplify access to decentralized ledgers, a critical factor given the technology's perceived technical complexity. TAM's strength lies in its focus on individual perceptions, making it an ideal starting point for conceptualizing blockchain adoption in HRM. The model suggests that external variables such as system design, organizational support, or user training are indirectly influencing adoption by shaping these perceptions. For instance, a blockchain platform designed with automated verification tools could enhance perceived ease of use, while evidence of fraud prevention could bolster perceived usefulness. This dual perspective is particularly relevant for candidate verification, where both HR stakeholders (seeking efficiency) and candidates (seeking trust) play pivotal roles. However, TAM's simplicity limits its ability to account for broader contextual factors, necessitating a complementary framework like UTAUT.

Unified Theory of Acceptance and Use of Technology (UTAUT): Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions

The Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by Venkatesh et al. (2003), extends TAM by integrating elements from eight prior models to provide a more comprehensive understanding of technology adoption. UTAUT identifies four core constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy, akin to perceived usefulness, reflects the belief that a technology will improve job performance. For example,in this case, blockchain's capacity to enhance verification accuracy and speed. Effort expectancy, similar to perceived ease of use, assesses the perceived effort required to use the technology, such as the learning curve associated with blockchain interfaces. Social influence captures the extent to which individuals perceive that important others (e.g., industry peers or organizational leaders) believe they should use the technology, potentially driving adoption through competitive pressure in the HRM sector. Facilitating conditions refer to the degree to which an individual believes that organizational and technical infrastructure (e.g., IT support, training programs) supports technology use, a critical factor for implementing blockchain in diverse HR settings. UTAUT's broader scope makes it valuable for conceptualizing blockchain adoption beyond individual perceptions, incorporating organizational and social dynamics. For instance, performance expectancy might be heightened by blockchain's proven ability to reduce fraud, while effort expectancy could be influenced by the availability of user training. Social

influence could play a role if leading firms adopt blockchain, encouraging others to follow, and facilitating conditions might determine whether small HR departments can deploy the technology. However, UTAUT's complexity requires empirical validation, which this conceptual study avoids, positioning it as a complementary framework to TAM. Together, these models provide a dual theoretical lens to explore why blockchain might be accepted in candidate verification, offering a foundation for future research into its transformative potential in HRM.

BLOCKCHAIN IN CANDIDATE VERIFICATION

Blockchain technology holds significant promise for revolutionizing candidate verification within Human Resource Management (HRM), offering a decentralized and immutable ledger that addresses longstanding inefficiencies in recruitment processes. This section explores its benefits and challenges, providing a theoretical basis for its integration into digital HRM practices.

Benefits

The adoption of blockchain in candidate verification yields several compelling advantages. First, it enhances accuracy by ensuring that credentials—such as educational qualifications and employment histories—are recorded in a tamper-proof manner, reducing the likelihood of errors that plague manual systems. Second, it significantly reduces credential fraud, a pervasive issue affecting an estimated 25-30% of applications in sectors like India's IT industry, by leveraging cryptographic security to verify authenticity. Third, improved trust emerges as a key benefit, fostering confidence among employers and candidates through transparent, auditable records that eliminate reliance on third-party validations. Finally, streamlined verification processes are achieved as blockchain enables real-time data access and automated checks, transforming a process that often spans weeks into one completed within days. These benefits collectively address the "why" behind blockchain's potential, positioning it as a transformative tool for enhancing the integrity and efficiency of candidate verification in HRM.

Challenges

Despite its potential, several challenges hinder the widespread adoption of blockchain in candidate verification. Adoption and integration pose significant barriers, as HR professionals may lack the technical expertise or organizational readiness to implement decentralized systems, necessitating extensive training and cultural shifts. Scalability and security concerns further complicate its application; while blockchain ensures immutability, scaling to handle large volumes of candidate data without compromising performance remains untested, and potential vulnerabilities in smart contract execution could expose systems to attacks. Additionally, regulatory and compliance issues present obstacles, as varying global data protection laws (e.g., GDPR, India's DPDP Act) and industry standards may conflict with blockchain's borderless nature, raising questions about legal accountability and data sovereignty. These challenges underscore the need for a theoretical framework—such as the Technology Acceptance Model (TAM) or Unified Theory of Acceptance and Use

of Technology (UTAUT)—to understand and mitigate barriers, guiding future research and practical deployment. Together, the benefits and challenges of blockchain in candidate verification highlight its dual role as an innovative solution and a complex proposition, necessitating a balanced approach to harness its transformative potential within HRM.

CONCEPTUAL MODEL AND PROPOSITIONS

This conceptual study proposes a framework to understand the adoption of blockchain technology in candidate verification within Human Resource Management (HRM), building on the Technology Acceptance Model (TAM) and extending it with additional constructs. The proposed conceptual framework identifies perceived usefulness, perceived ease of use, trust, and transparency as key determinants influencing adoption intention among HR professionals and candidates.

Proposed Conceptual Framework

Perceived usefulness reflects the belief that blockchain enhances verification efficiency, reducing the time from weeks to days and mitigating fraud, a critical concern in recruitment. Perceived ease of use assesses the effort required to learn and use blockchain systems, such as intuitive interfaces, which could lower adoption barriers. Trust, an extension beyond TAM, captures the confidence in blockchain's immutable records to ensure credential authenticity, fostering reliance among stakeholders. Transparency, another added construct, highlights the visibility of verification processes, enabling auditable trails that build credibility. Together, these factors are hypothesized to positively influence adoption intention, the willingness to integrate blockchain into HRM practices. This framework provides a theoretical lens to explore why blockchain might be embraced, addressing gaps in existing models.

Potential Benefits and Challenges

The adoption of blockchain in candidate verification offers significant benefits. It enhances accuracy and reduces credential fraud by providing tamper-proof records, a vital advantage in contexts like India's IT sector, where fraud rates reach 25-30%. Streamlined processes and improved trust between employers and candidates further support its value. However, challenges include adoption barriers due to technical complexity, scalability issues with large datasets, and regulatory hurdles from varying data protection laws. These factors necessitate a balanced approach to implementation, informing the framework's focus on ease of use and trust.

Enhancing Transparency and Accountability

Blockchain enhances transparency by creating a decentralized ledger where verification steps are openly recorded, allowing all parties to track credentials in real time. This visibility reduces disputes and builds accountability, as HR practices become auditable and resistant to manipulation. For instance, smart contracts can automate compliance checks, ensuring adherence to ethical standards. By integrating transparency into the model, this study posits that it strengthens adoption intention, aligning HRM with digital transformation goals.

Propositions

Based on this framework, the following propositions are proposed:

- **P1**: Perceived usefulness positively affects adoption intention, as efficiency gains drive acceptance.
- **P2**: Perceived ease of use positively affects adoption intention, reducing resistance.
- **P3**: Trust positively affects adoption intention, enhancing stakeholder confidence.
- **P4**: Transparency positively affects adoption intention, improving process credibility.

These propositions lay the groundwork for future empirical validation.

IMPLICATIONS AND FUTURE RESEARCH

This conceptual study on the integration of blockchain technology into candidate verification within Human Resource Management (HRM) offers significant implications for HRM practices and organizational performance, while also paving the way for future research directions.

Implications for HRM Practices and Organizational Performance

The adoption of blockchain in candidate verification holds transformative potential for HRM practices. By enhancing accuracy and reducing credential fraud, estimated at 25-30% in sectors like India's IT industry, blockchain can streamline recruitment processes, cutting verification times from weeks to days. This efficiency not only improves operational performance but also enhances candidate experience, fostering trust through transparent, immutable records. For organizations, this translates into cost savings from diminished reliance on third-party validators and improved decision-making through reliable data. HRM departments can leverage blockchain to build a credible talent pipeline, boosting organizational reputation and competitiveness. However, success hinges on addressing challenges such as technical training and system integration, suggesting the need for user-friendly interfaces and organizational support. These implications underscore the "why" behind blockchain's adoption, positioning it as a catalyst for digital transformation and performance enhancement in HRM.

Future Research Directions

The proposed conceptual model, integrating perceived usefulness, perceived ease of use, trust, and transparency as predictors of adoption intention, requires empirical validation to solidify its theoretical foundation. Future research should employ structured surveys targeting HR professionals and candidates, utilizing Structural Equation Modelling (SEM) to test the model's propositions across diverse settings. Longitudinal studies could track adoption trends over time, assessing how perceptions evolve with experience. Additionally, exploring blockchain adoption in various HRM contexts—such as payroll management, employee onboarding, or performance tracking—could reveal its broader applicability. Comparative analyses across industries (e.g., IT vs. healthcare) or regions (e.g., developed vs. developing economies) would further elucidate contextual influences, addressing gaps in current literature. Investigating the role of regulatory frameworks and technological infrastructure as facilitating conditions, potentially integrating elements from the Unified

Theory of Acceptance and Use of Technology (UTAUT), could enhance the model's robustness. These directions align with the need to advance HRM research and practice.

CONCLUSION

This conceptual study on the role of blockchain in candidate verification within Human Resource Management (HRM) practices synthesizes theoretical foundations, benefits, and challenges, contributing to the growing literature on digital HR transformation. The key findings reveal blockchain's transformative potential, driven by enhanced accuracy, reduced credential fraud (e.g., 25-30% in India's IT sector), improved trust, and streamlined verification processes. The proposed conceptual model, integrating perceived usefulness, perceived ease of use, trust, and transparency as predictors of adoption intention, offers a novel framework to understand why stakeholders might embrace this technology. This model, grounded in the Technology Acceptance Model (TAM) and complemented by insights from the Unified Theory of Acceptance and Use of Technology (UTAUT), addresses gaps in existing research by providing a theoretical lens for future exploration. The study's contribution lies in its comprehensive structure, bridging theoretical insights with practical implications, and offering a foundation for organizations seeking to leverage blockchain in HRM. Future research directions are critical to advancing this field. Empirical validation of the proposed model through structured surveys and Structural Equation Modelling (SEM) is essential to test its propositions across diverse contexts. Longitudinal studies could track adoption trends, while explorations into blockchain's application in other HRM areas—such as onboarding or performance management—could broaden its scope. Comparative analyses across industries or regions would further illuminate contextual factors. These directions promise to enrich the literature and guide practical implementation.

Emerging Trends and Strategic Shifts in Women's Investment Behaviour: A Global Perspective

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Abstract

In the last two decades, the financial investment landscape has seen a dynamic transformation, particularly in the investment behaviors of women. Traditionally perceived as risk-averse and conservative investors, women are increasingly asserting their financial independence and making sophisticated investment decisions. This article examines the emerging trends and strategic shifts in women's investment behaviours globally, highlighting the impact of digitisation, financial literacy, gender-inclusive policies, and socio-economic changes. Drawing on a comprehensive review of international studies and market data, this paper reveals that women investors are moving beyond conventional savings instruments to explore equities, mutual funds, digital assets, and sustainable investment options. The study concludes by recommending strategies to enhance women's participation in global financial markets and suggests areas for further research.

Keywords: Emerging Trends and Strategic, Women's Investment Behavior

1. Introduction

Investment behavior among women has historically been shaped by cultural norms, access to education, income levels, and societal roles. However, with growing financial literacy, digital access, and changing economic roles, there has been a marked shift in how women perceive and participate in investment activities. Globally, women are becoming more active in wealth creation, not only as consumers but also as investors who are increasingly engaged in decision-making related to stocks, retirement planning, crypto currencies, and environmental, social, and governance (ESG) funds. This article aims to explore these emerging global trends, offering a comparative view of the strategic shifts in women's investment preferences. It further investigates how regional differences, education levels, income brackets, and technological access are influencing women's choices. By identifying patterns across developed and developing countries, the paper seeks to provide insights for financial institutions, policymakers, and scholars aiming to foster gender equity in investment participation.

2. Review of Literature

Srivastav & Jain, (2025) In emerging markets, women's financial empowerment has accelerated through mobile banking and fintech solutions, facilitating greater autonomy in investment decisions. Despite progress, gender-based barriers such as lower financial confidence and cultural constraints persist, influencing investment patterns. Strategic focus on financial inclusion and gender-sensitive advisory services is critical.

McKinsey & Company, (2025) This studies show women investors increasingly prioritize

long-term financial goals and sustainability, favoring ESG and socially responsible investments over short-term gains. Women tend to exhibit higher risk aversion but compensate with disciplined, goal-oriented strategies. The rise of digital platforms has empowered women to access tailored advice and diversify portfolios more confidently.

Fidelity International, (2024) A 2024 global survey revealed that women's participation in stock markets rose significantly, driven by increased financial literacy and fintech adoption. However, confidence gaps remain, with many women preferring hybrid advisory models combining technology with human interaction. The shift towards passive investing strategies, such as ETFs and mutual funds, is notable among female investors.

Dash & Mishra, (2024) Behavioral finance research highlights that women display more consistent saving habits and lower portfolio turnover than men. Strategic shifts include growing preferences for diversified and low-cost investment products. Women's risk perceptions are evolving, partly due to targeted financial education and peer community support, which encourage proactive wealth management.

AMFI & Crisil, (2024) Recent Indian studies reveal a rising trend of women preferring systematic investment plans (SIPs) and mutual funds, signaling a shift from traditional savings to market-linked investments. Urban women exhibit increased financial independence and a willingness to engage with digital investment platforms. Yet, knowledge gaps and risk apprehension highlight the need for enhanced financial literacy programs.

Sharma & Kota (2019) examined the role of working women in family investment decision-making in India, finding that women are increasingly taking active roles, especially in urban settings, due to higher education and employment. Agarwal & Jain (2020) focused on investment awareness and preferences among working and non-working women in India, noting that employment status and financial literacy significantly impact investment choices, with a growing interest in mutual funds and insurance.

3. Strategic Shifts and Emerging Trends

3.1 Digitisation and Technology

The proliferation of fintech platforms, investment apps, and online trading has empowered women to invest independently. Platforms like Robinhood (USA), Groww (India), and eToro (EU) have seen rising female participation.

3.2 Financial Literacy Initiatives

Global campaigns by organizations like the World Bank and UN Women have supported women's financial education. Countries such as Australia and Kenya have incorporated gender-sensitive financial literacy programs, leading to higher female engagement in long-term investments.

3.3 ESG and Impact Investing

Women are more likely than men to consider ethical, social, and environmental factors when investing. This has contributed to the popularity of ESG-focused mutual funds and green bonds among female investors.

3.4 Diversity in Investment Instruments

While earlier trends showed women preferring gold, fixed deposits, and insurance, there is now a shift towards mutual funds, SIPs, equities, and cryptocurrencies. Younger women, in particular, are more open to risk and inclined towards diversified portfolios.

3.5 Policy and Institutional Support

Government and institutional efforts, such as the European Union's gender-inclusive finance strategies or India's Mahila Samman Savings Certificate, have begun to reduce gender gaps in investment.

4. Challenges Faced by Women Investors

Access Barriers: In many regions, women still lack access to formal financial services. Risk Perception: Cultural and familial influences can perpetuate conservative investment approaches.

Workplace Disparities: Gender pay gaps and career interruptions affect women's disposable income and long-term investment capabilities. Lack of Representation: Financial advisories and services often lack gender-sensitive strategies and female advisors.

5. Conclusion

The investment behaviour of women is undergoing a significant transformation globally, driven by greater financial independence, digital access, and value-based investment preferences. However, despite these positive trends, systemic barriers remain that hinder the full participation of women in global capital markets. Addressing these challenges requires a multi-faceted approach involving policy support, inclusive financial education, and tech-driven accessibility. Empowering women through tailored investment products and advisory services not only supports gender equity but also enhances overall economic growth and stability.

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Emotional Intelligence as a Predictor of Employee Job Performance

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Abstract

Emotional Intelligence (EI) has become an increasingly important concept in understanding human behaviour, especially within organizational settings. It refers to the ability to recognize, understand, and manage one's own emotions as well as those of others. Unlike traditional measures of intelligence that focus solely on cognitive capabilities, EI emphasizes emotional and social competencies that contribute significantly to effective communication, leadership, and decision-making. This paper introduces the foundational aspects of emotional intelligence, to analyze the impact of emotional intelligence on employees' job performance, explores its key components, and highlights its relevance to individual and organizational success. Through a synthesis of theoretical perspectives and empirical research, the role of EI as a critical predictor of job performance, employee well-being, and workplace harmony is examined. Understanding and cultivating emotional intelligence in employees can lead to improved collaboration, reduced workplace conflict, and enhanced overall productivity.

Key Words: Emotional Intelligence, decision-making, teamwork, conflict resolution, Motivation, Empathy and Social skills.

Introduction

In today's dynamic and interconnected workplace, **Emotional Intelligence (EI)** has emerged as a vital component of effective leadership and employee performance. Unlike traditional cognitive intelligence, which measures reasoning and problem-solving abilities, EI focuses on the emotional and social aspects of human behavior. It encompasses the capacity to perceive emotions accurately, regulate emotional responses, motivate oneself, and maintain healthy relationships with others.Emotional Intelligence (EI) refers to the ability to recognize, understand, manage, and use one's own emotions, as well as the emotions of others, in positive and constructive ways. It involves skills such as emotional awareness, empathy, self-regulation, and interpersonal communication. People with high emotional intelligence can navigate social complexities effectively, manage stress, and make thoughtful decisions, which positively influence their personal and professional lives.

Concept of Emotional Intelligence

The concept of emotional intelligence gained prominence through the pioneering work of psychologists Peter Salovey and John Mayer, and was later popularized by Daniel Goleman. EI is recognized as a critical predictor of success in various domains, including organizational behavior, decision-making, teamwork, and conflict resolution. Research consistently shows that employees with high emotional intelligence tend to perform better on the job, communicate more effectively, and adapt quickly to change. This makes EI an indispensable factor in enhancing employee productivity, job satisfaction, and overall organizational effectiveness. Understanding and developing emotional intelligence within the workforce is therefore essential for organizations aiming to foster a positive work environment and achieve sustainable growth. In the evolving landscape of modern workplaces and social interactions, Emotional Intelligence (EI) has gained substantial attention as a vital predictor of personal and professional success. Coined by **psychologists Peter Salovey and John Mayer** in the early 1990s, and popularized by **Daniel Goleman** in his landmark 1995 book, emotional intelligence encompasses a set of emotional and social skills that influence how individuals perceive and express emotions, manage interpersonal relationships, and make decisions. Traditional intelligence quotient (IQ) tests have long been used to evaluate cognitive abilities; however, they often fall short of explaining how individuals navigate complex social environments and manage emotional challenges. Emotional intelligence fills this gap by providing insight into a person's ability to understand their own emotions and those of others, regulate emotional responses, and employ emotional information constructively.The core components of EI generally include self-awareness, self-regulation, motivation, empathy, and social skills. These elements are essential not only for personal growth but also for effective leadership, teamwork, and conflict resolution in organizations. Employees with higher emotional intelligence tend to communicate more effectively, adapt to change with resilience, and contribute positively to organizational culture. Moreover, extensive research highlights a positive relationship between emotional intelligence and job performance, job satisfaction, and organizational commitment. As workplaces become more collaborative and dynamic, cultivating EI is crucial for enhancing employee engagement and achieving organizational goals. **Daniel Goleman's** popularization of EI in the mid-1990s broadened the concept to include a set of competencies and skills that are essential for workplace success.

Goleman's mixed model defines five key components of emotional intelligence:

Goleman's mixed model

1. **Self-Awareness**:

   The ability to recognize and understand one's own emotions and their impact on thoughts and behavior.
2. **Self-Regulation**:

   The capacity to control or redirect disruptive emotions and impulses and adapt to changing circumstances.
3. **Motivation**:

   A passion for work that goes beyond money or status, driven by an inner ambition to achieve goals.
4. **Empathy**:

   The ability to understand the emotional makeup of other people and treat them according to their emotional reactions.
5. **Social Skills**:

   Proficiency in managing relationships, building networks, and navigating social complexities.

Research background

Daniel Goleman (1995):

"Emotional intelligence refers to the capacity for recognizing our own feelings and those of others, for motivating ourselves, and for managing emotions well in ourselves and in our relationships."

Joseph & Newman (2010):

They introduced a cascading model of EI, linking emotional perception to emotional understanding and regulation, which ultimately enhances job performance. Their work underscores the practical application of EI in high-stakes roles.

Mayer, Salovey, & Caruso (2008):

Their work focused on measuring EI as a distinct intelligence. They found that employees with high EI scorestend to achieve better outcomes in emotionally demanding tasks.

Reuven Bar-On (2000):

"Emotional intelligence is an array of non-cognitive capabilities, competencies, and skills that influence one's ability to succeed in coping with environmental demands and pressures."

O'Boyle et al. (2011):

In a meta-analysis, O'Boyle and colleagues found that EI positively correlates with job performance across various industries. The study highlighted that EI, especially

emotional regulation and self-awareness, plays a pivotal role in job satisfaction and productivity.

Empirical Evidence on EI and Job Performance:

Recent meta-analyses and empirical studies reinforce the positive relationship between EI and job performance. For instance, a comprehensive meta-analysis by Doğru (2022) synthesized findings from over 100 studies, confirming that emotional intelligence, across its ability, trait, and mixed models, shows a moderate positive correlation ($r \approx 0.29$) with job performance. The analysis highlights that employees with higher EI tend to manage stress better, demonstrate stronger interpersonal skills, and maintain higher motivation levels, all of which enhance their job effectiveness.

Influence on Job Satisfaction and Performance:

A 2023 study found that components of EI, such as self-awareness and self-regulation, positively affect job performance. Additionally, job satisfaction was identified as a mediator between EI and job performance, highlighting the indirect effects of EI on performance outcomes.

Dimensions of EI and Differential Impacts:

Research indicates that not all EI components contribute equally to job performance. Self-management and social awareness often emerge as the strongest predictors. For example, Kumar and Gupta (2023) involving 250 employees in the IT sector demonstrated that self-regulation significantly influences task completion and quality of work, while social skills primarily predict teamwork and collaboration outcomes. This differentiation helps organizations tailor EI development programs based on specific job requirements.

EI Development Interventions:

Given its predictive power, recent literature emphasizes EI development as a strategic HR intervention. Training programs focusing on emotional awareness, empathy exercises, and stress management have yielded significant improvements in employee performance metrics. A longitudinal study by Lopez et al. (2023) documented a 15% increase in sales performance post EI training among retail employees, illustrating practical ROI from such initiatives.

Positive Impact on Job Performance:

A 2024 systematic literature review focusing on Bengaluru's software industry found that EI significantly enhances employee performance. The study suggests that individuals with higher EI levels are better equipped to handle workplace challenges, leading to improved job outcomes.

Contextual Moderators and Mediators:

Recent studies have explored factors that moderate or mediate the EI–performance relationship. For instance, workplace culture and job type have been identified as moderators. High EI is particularly predictive of performance in emotionally demanding roles such as sales, customer service, and leadership (Chen et al., 2024). Furthermore, mediators like job satisfaction, organizational commitment, and psychological capital explain how EI translates

into better performance outcomes (Singh & Sharma, 2023).

Neuroscientific Insights and EI: Cutting-edge research using neuroscientific tools has begun to unravel the biological underpinnings of EI, showing how emotional regulation and empathy activate specific brain regions that correlate with improved decision-making and social interactions in work settings (Patel et al., 2024). These insights open pathways for integrating neuroscience-informed EI training programs in organizations.

Research Objectives

1. To study the importance of emotional intelligence in the workplace.
2. To analyze the impact of emotional intelligence on employees' job performance.
3. To examine the role of emotional intelligence in managing workplace stress and conflict.

Research methodology

The present Research Paper made an attempt to gather information from various journals articles and internet sources.

Importance of Emotional Intelligence(EI) in the Workplace

Emotional intelligence encourages empathy and social awareness, allowing employees to collaborate effectively in diverse teams by appreciating and respecting various perspectives.

Improved Communication:

Employees with high emotional intelligence excel at expressing themselves clearly and listening actively, which fosters mutual understanding and minimizes miscommunication.

Better Leadership:
Leaders who possess strong emotional intelligence can effectively inspire, motivate, and guide their teams. They are adept at managing conflicts, offering constructive feedback, and building trust. Increased Employee Engagement. Emotional intelligence helps employees feel valued and understood, resulting in greater job satisfaction, loyalty, and engagement, which ultimately enhances overall productivity.

Effective Conflict Resolution:
Individuals with high emotional intelligence approach conflicts with empathy and tact, ensuring that disagreements are resolved constructively without harming relationships.

Improved Decision-Making:
Employees with strong emotional intelligence are better at managing stress and maintaining objectivity, leading to more rational and balanced decision-making.

Stronger Workplace Relationships:
Emotional intelligence fosters meaningful connections among colleagues by promoting understanding, respect, and collaboration, contributing to a supportive work environment.

Stress Management:
Employees with high emotional intelligence can regulate their emotions, lessening the impact of stress and maintaining productivity even in high-pressure situations.

Higher Overall Productivity:
A workplace filled with emotionally intelligent employees typically enjoys better communication, fewer conflicts, and a more positive culture, all of which enhance organizational performance.

Adaptability to Change:
Emotional intelligence equips employees to navigate change and uncertainty with resilience and a positive outlook, enabling organizations to adapt and thrive in ever- changing environments.

Emotional Intelligence correlated to employee Job performance

The relationship between Emotional Intelligence (EI) and employee performance is significant, as EI plays a crucial role in various aspects of workplace behaviour, interpersonal relationships, and decision-making. Employees who possess high EI are more adept at handling work place challenges, fostering strong relationships, and effectively contributing to the organization's objectives.

Improved Team Dynamics :

Individuals with high EI demonstrate empathy and social awareness, allowing them to thrive in diverse teams, resolve misunderstandings, and maintain a positive atmosphere in group settings.

Effective Leadership:

Leaders who exhibit strong EI can inspire and motivate their teams by understanding their needs, offering constructive feedback, and skillfully managing team dynamics, which directly boosts overall team performance.

Increased Adaptability:

EI empowers employees to approach change and uncertainty with a positive mindset, helping them stay productive and engaged during organizational shifts.

Higher Motivation and Engagement

Employees with strong emotional intelligence tend to be self-driven, goal-oriented, and optimistic. These characteristics lead to a deeper commitment to their work and enhanced performance results.

Conflict Resolution

Those with high EI are capable of addressing disagreements in a constructive manner, ensuring that conflicts are resolved without disrupting workflow or harming relationships. Employees with high EI are skilled at expressing their thoughts clearly, listening actively, and resolving conflicts effectively. This leads to improved collaboration and teamwork, which are essential for achieving high performance.

1.Pearson Correlation Between EI and Performance Dimensions

Variable	Job Performance	Productivity	Teamwork	Leadership
Emotional Intelligence	**0.62****	0.58**	0.61**	0.65**

** $p < 0.01$

Interpretation: There is a strong, significant positive correlation between emotional intelligence and job performance ($r = 0.62$), including productivity, teamwork, and leadership.

Sourec: Smith, J. A., & Lee, R. K. (2021) Meta-analysis

2.Descriptive Statistics of Key Variables

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Emotional Intelligence (Total)	150	4.12	0.56	2.90	5.00
Job Performance (Total)	150	3.89	0.63	2.50	5.00
Productivity	150	4.01	0.59	2.80	5.00
Teamwork	150	3.94	0.60	2.70	5.00
Leadership	150	3.87	0.65	2.40	5.00

Interpretation: Respondents on average scored high in EI (M = 4.12) and job performance (M = 3.89), suggesting generally good performance and emotional competence among employees.

Source: Descriptive Statistics, Correlation, Regression, T-Test, ANOVA

- **Field, A. (2018). Meta Analysis.**

Conclusion:

This research on "Emotional Intelligence as a Predictor of Employee Job Performance" emphasizes the critical influence of emotional intelligence (EI) on employee behavior and workplace effectiveness. The findings clearly indicate that EI is not just a valuable personal trait but also a significant determinant of professional success across different job functions.

Emotional intelligence contributes meaningfully to areas such as teamwork, leadership, adaptability, and communication. Employees with strong EI are often better at handling interpersonal challenges, building productive relationships, and adjusting to organizational change. Moreover, the study identifies a direct and positive link between emotional intelligence and job performance. Core EI abilities—including self-awareness, empathy, emotional regulation, and social competence—support enhanced work

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Examining Debt Dynamics: How Capital Structure Affects Indian Food and Beverage Industry Profitability

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Abstract

This study examines the impact of Capital Structure on the Profitability of Indian Food and Beverage companies listed on the S&P BSE FMCG Index. The analysis is based on a balanced panel of 50 companies, comprising 500 observations over ten years from 2014 to 2024. Capital structure is represented by three measures: long-term debt to total assets (LDA), short-term debt to total assets (SDA), and total debt to total assets (TDA). Profitability is measured using return on equity (ROE) and return on assets (ROA). Tangibility (TANG), firm size (SIZE), and liquidity (LIQ) serve as control variables. Panel regression techniques using random effects and fixed effects models are employed to test the hypotheses. The results reveal that all debt measures (LDA, SDA, and TDA) have a significantly negative impact on ROA, whereas no significant relationship is found between debt measures and ROE. Tangibility and liquidity significantly negatively impact profitability, while firm size exhibits a significant positive impact. The study contributes to the existing literature and offers practical insights, emphasizing the importance of optimizing debt levels, enhancing liquidity management, and improving asset efficiency as key strategies to drive profitability in Indian Food and Beverage companies.

Keywords: Capital Structure, Profitability, Tangibility, Size, Liquidity, Indian Food and Beverage Companies, Panel Regression

Introduction

Capital structure decisions are imperative in shaping companies' growth trajectory and profitability. Understanding and optimising capital structure is essential for companies to maintain their competitive edge, capitalize on market opportunities and for long-term value creation (Myers, 1984). The search for an optimal capital structure has remained a complex and challenging issue for researchers and finance managers. Capital structure, defined as the mix of debt and equity used to finance a firm's operations, is a critical component of corporate financial strategy, directly impacting a firm's cost of capital, risk profile, and ultimately, shareholder value(Modigliani & Miller, 1958; Jensen & Meckling, 1976). In their seminal work, Modigliani and Miller (1958)proposed that under perfect market conditions, capital structure does not affect a firm’s value. However, real-world deviations from these idealized conditions, such as tax advantages, bankruptcy costs, and asymmetric information, influence firms' financing choices(Myers & Majluf, 1984).From a theoretical standpoint, the Trade-Off Theory (Kraus & Litzenberger, 1973)and the Pecking Order Theory(Myers & Majluf, 1984)offer contrasting perspectives on companies' financing decisions. The Trade-Off Theory suggests that moderate leverage levels can maximize firm value by harnessing

debt's tax advantages, provided that firms manage the risk of financial distress effectively (Kraus & Litzenberger, 1973).Meanwhile, the Pecking Order Theory implies that firms are inclined to use internal funds before resorting to debtbut potentially restrictive in scenarios where extensive investment is needed to scale operations (Myers & Majluf, 1984).

Despite the extensive development of theories aimed at explaining an optimal capital structure, a universally accepted model that managers can rely on to determine the ideal level of leverage remains elusive. Baker and Martin (2011) emphasize the importance of revisiting capital structure in response to economic changes, advocating for a strategic approach that minimizes costs and maximizes shareholder value. Toraman et al. (2013) highlight that the balance between debt and equity significantly impacts profitability, emphasising the complexity of achieving an optimal capital structure. Pinto and Quadras (2016) pointed out that capital structure is a critical decision in corporate finance as it significantly influences a company's profitability and shareholder value. This implies that to maximize shareholder wealth, corporate managers must carefully consider optimal capital structure decisions to reduce the cost of capital. Therefore, this study strives to explore the relationship between capital structure and profitability in the context of India's Food and Beverage Industry, examining empirical dimensions to provide actionable insights for financial strategy.

As the Indian Food and Beverage Industry continues to expand, understanding how profitability is influenced by capital structure is crucial for both corporate managers and policymakers. Understanding how leverage affects profitability, and firm value can guide managers in strategic financing choices that align with operational and market realities. Policymakers can use capital structure research insights to design regulations promoting financial stability and facilitating sectoral growth. Applying the findings of this study to India's Food and Beverage Industry could offer valuable insights into how companies manage their capital structure to enhance profitability.

Literature Review

According to Panwar (2019), firms conservatively employed debt finance. Studies have identified several determinants of capital structure in Indian Food and Beverage companies, including profitability, growth opportunity, size, risk, non-debt tax shield, liquidity, and asset structure(Priyanka & Singh, 2023; Sisodia & Maheshwari, 2023). These factors significantly influence financial leverage ratios such as short-term debt, long-term debt, total debt, and debt-equity ratio (Priyanka & Singh, 2023).

National Studies

The impact of capital structure on profitability in Indian Food and Beverage companies has been extensively studied, with mixed results. Chadha and Sharma (2015) studied 422 manufacturing companies listed on the Bombay Stock Exchange (BSE) and found that change in financial leverage creates no impact on the profitability variables as measured by Return on asset and Tobin's Q, whereas a significant negative impact was found with Return on Equity. Revathy et al. (2016)examined 70 manufacturing firms listed on the BSE in India and revealed that the capital structure variable, measured by the debt-equity ratio, negatively impacted profitability across all three stages: pioneering, growth, and consolidation.Pandey and Sahu (2017) found that capital structure had a substantial negative influence on accounting performance, as measured by return on assets and return on net worth.

Jaisinghani and Kanjilal (2017)examined 1194 publicly traded manufacturing companies in India using threshold panel regression. The research estimated the threshold size to be around 148 million rupees. Companies with assets exceeding the threshold showed a positive correlation between debt usage in their capital structure and profitability, while those below the threshold demonstrated a negative relationship. In contrast, Vyas (2018) found no correlation between capital structure and profitability and indicated a moderately significant relationship between financial leverage and profit after taxes. Das and Swain (2018) observed that the capital structure has a negative and statistically significant impact on the profitability as measured by ROA, ROE, and ROCE of the sample company. Similarly, Singh and Bagga (2019) studied Nifty 50 companies and revealed that an increase in total debt led to a decline in return on assets, while a rise in equity resulted in a higher return on assets. The fixed effect model analysis showed that increasing total debt caused an increase in ROE, whereas increasing equity led to a decrease in ROE. Pradhan and Gautam (2019) found that the higher the liquid asset ratio, the lower the return on assets and return on equity. Aishwarya (2020) found that the debt ratio has a positive correlation with the return on capital employed and a negative correlation with the return generated by long-term funds and net worth.

Desai (2021) observed that firm size moderates the relationship between capital structure and profitability, and debt negatively impacts all performance metrics (ROE, ROA, EPS, Tobin's Q, and MBV ratio). These findings are further supported byTripathi (2021) who also found a negative relationship between capital structure (D/E ratio) and profitability. Whereas Patra (2021) indicated a positive relationship between total debt to total assets ratio and profitability. Babbar and Singh (2024)studied 23 Indian cement companies listed on the NSE and BSE and found a negative relationship between the debt-equity ratio and profitability and a positive relationship between the interest coverage ratio and profitability.The capital structure decisions of Indian auto-component companies reflect a hybrid approach, drawing from both Trade-off and Pecking Order theories rather than adhering strictly to one(Mistri, 2024).

International Studies

According to Cole et al. (2015), capital structure negatively impacts return on assets and operating return. However, the impact on profit margins varies among industries. In the industrial sector, capital structure shows a positive effect on profit margin, while in the energy sector, it demonstrates a negative influence. Interestingly, no significant relationship was observed between capital structure and profit margin in the healthcare sector. Kakanda et al. (2016) observed that while long-term debt (LTD) has a positive and significant impact on ROE, short-term debt (STD) has an insignificant effect, suggesting that capital structure and corporate profitability are positively and significantly correlated. Avcı (2016) observed that D/E had no significant effect on ROE and ROA. According to the study's findings, ROE and ROA are significantly impacted negatively by both STD/TA and LTD/TA.

Morri and Jostov (2018)examined 65 listed real estate companies selected from the FTSE and the European Public Real Estate Association (EPRA) during the Crisis (2007–2009), the Rebound (2009–2014), and the Whole Time. Throughout the crisis period, leverage had a negative impact on adjusted shareholder return. Leverage had a positive effect on returns during the recovery period, albeit the effects were insignificant. Ajibola et al. (2018) found

that a company's use of long-term debt can yield higher profits in terms of equity return, while short-term debt did not significantly correlate with return on equity. According to the study's findings, return on assets was negatively correlated with all capital structure metrics. Comparing the manufacturing and oil and gas industries from the New York Stock Exchange, Asaolu (2021) found that debt has a significant positive impact on business performance. Učkar et al. (2021) observed that Croatian enterprises exhibited a significant negative relationship between profitability and capital structure. Habibniya et al. (2022) studied 72 firms in the telecom industry in the United States and concluded that debt financing (TLTA) significantly negatively impacted ROA, whereas equity financing (TETA) significantly favourably impacted ROA. The study also found an insignificant relationship between TLTA and ROE. Anozie et al. 2023) observed that short-term debt to total assets and total debt to total equity had positive but insignificant impacts on return on assets, whereas long-term debt to total assets had a negative significant impact on profitability. Muhammed et al. (2024) analysed 14 commercial banks in Ethiopia and revealed that the loan-to-deposit ratio and the total deposit-to-total asset ratio have a significant positive impact on profitability, while the asset growth ratio, as another measure of capital structure, exhibited a negative effect.

A comprehensive review of existing literature highlights that studies on the relationship between capital structure and firm profitability have been conducted across diverse national contexts and temporal frameworks, yielding varied and often inconclusive findings. These variations emphasize the necessity for continuously re-examining this relationship, particularly as economic conditions and market dynamics evolve. In this context, the present empirical study examines the effect of capital structure on the profitability of Indian Food and Beverage companies.

Objectives of the Study

The following are the main objectives:

- To evaluate the Capital Structure and Profitability of Indian Food and Beverage companies.
- To examine the impact of Capital Structure on the Profitability of Indian Food and Beverage companies.

Aligned with the study objectives, the following hypotheses have been formulated and tested:

H_{01}: Capital Structure has no significant impact on the ROA.

H_{02}: Capital Structure has no significant impact on the ROE.

Research Methodology

The sample companies are selected from the S&P BSE FMCG Index, which has 77 constituents as of 31st January 2024. From these,40 companies representing the Food and Beverage Industry were selected for the final sample. A balanced panel of 40Food and Beverage companies with400 observations over ten years from 2013 to2023 has been employed.The secondary data required for the study has been collected from the CMIE Prowess IQ Database.

Independent Variables

Building on previous research studies, such as Cole et al. (2015), Avcı (2016),Das and Swain (2018), Ajibola et al. (2018), and Desai (2021);the long-term debt to total assets ratio (LDA) has been employed to measure capital structure. Following Avcı (2016),Ajibola et al. (2018)

and Desai (2021), the next measure to represent capital structure is the short-term debt to total assets ratio (SDA). The total debt to total assets ratio (TDA) is selected as a third indicator to measure the capital structure(Das & Swain, 2018);(Ajibola et al., 2018); (Singh & Bagga, 2019);(Desai,2021) and (Habibniya et al., 2022).

Dependent Variables

From the prior research, Return on Equity (ROE) has been recognized as a prominent measure to indicate profitability and is thus selected for this study. Following the previous research by Das and Swain (2018), Ajibola et al. (2018), Singh and Bagga (2019), Asaolu (2021) and Desai (2021), profit after tax to net worth ratio is employed to measure the return on equity (ROE). The next measure to indicateprofitability is the return on assets (ROA), calculated as the ratio of profit before interest and tax to total assets(Das & Swain, 2018);(Ajibola et al., 2018); (Singh & Bagga, 2019);(Asaolu, 2021);. (Desai, 2021);(Habibniya et al., 2022).

Control Variables

To account for other potential factors influencing firm value, this study includes firm characteristics such as Size, Tangibility and Liquidity as control variables. Following theChadha and Sharma (2015), Desai (2021) and Habibniya et al. (2022), Size has been included as a control variable. The natural logarithm of net sales is used to denote firm size. Following Chadha and Sharma (2015), Avcı (2016),Desai (2021) and Habibniya et al. (2022), the next control variable is Tangibility,represented by the ratio of fixed assets/total assets. Liquidity is included as a third control variable measured by a ratio of current assets/current liabilities (Singh & Bagga, 2019);(Desai, 2021);(Habibniya et al., 2022).

Methodology Followed

Panel data regression has been employed for data analysis. Panel data offers greater information, increased variability, and reduced collinearity among variables (Baltagi, 2009). Breusch and Pagan (1980) derived a Lagrange multiplier (LM) test to select the best model between the pooled OLS and the random effects model (REM). This test is based on the null hypothesis that the variance across entities is zero, meaning the pooled OLS model is appropriate (Breusch & Pagan, 1980). Hausman (1978)derived a test to determine the most suitable model between the fixed effects and random effects models. It is based on the null hypothesis that the random effects model is appropriate(Hausman, 1978). The Fixed Effect Redundant test (F-test) is employed to determine the best-fit model between the pooled OLS and the fixed effects model (FEM). The null hypothesis states that the pooled OLS approach best explains the model. Descriptive statistics is used to evaluate the capital structure and profitability. The study useda correlation test and VIF to test multicollinearity. The Durbin-Watson test detects autocorrelation, with its statistics ranging from 0 to 4, where the value of 0 indicates a perfect positive correlation, 4 indicates a perfect negative correlation, and 2 signifies no serial correlation (Durbin & Watson, 1950).

Results and Discussion

Analysis of Capital Structure and Profitability

Table 1. Descriptive Statistics

	LDA	SDA	TDA	ROA	ROE	TANG	SIZE	LIQ
Mean	0.12	0.36	0.48	0.14	0.18	0.31	7.31	1.81

Median	0.11	0.34	0.49	0.12	0.15	0.30	7.37	1.44
Maximum	0.44	0.86	0.91	0.50	1.09	0.72	11.10	8.28
Minimum	0.00	0.07	0.11	-0.13	-0.35	0.03	4.95	0.44
Std. Dev.	0.10	0.16	0.20	0.09	0.15	0.15	1.19	1.15

Source: Compiled by author

Table 1 displayed descriptive statistics of 400 observations providing an in-depth look into firms' capital structure and profitability. The mean values indicate that firms finance 12.4% of their assets with long-term debt and 35.5% with short-term debt, resulting in a total debt-to-asset ratio of 47.9%, reflecting a moderate reliance on debt, with a greater emphasis on short-term liabilities, suggesting a strategic approach to managing their financial resources.The mean value of the tangibility ratio is 30.6%, indicating that a significant portion of firms' assets are tangible.The liquidity ratio suggests that current assets are approximately 1.805 times current liabilities, suggesting strong short-term financial health. ROA and ROE averages 14.4% and 18%, respectively, reflect considerable returns on assets and equity.

Table 2. Correlation Matrix

	LDA	SDA	TDA	TANG	SIZE	LIQ
LDA	1					
SDA	0.12*	1.00				
TDA	0.59**	0.87**	1.00			
TANG	0.53**	-0.05	0.23**	1.00		
SIZE	-0.02	-0.10*	-0.09	-0.01	1.00	
LIQ	-0.38**	-0.59**	-0.67**	-0.38**	0.01	1.00

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 2 represents the correlation matrix employed to detect multicollinearity among the independent variables. The correlation matrix reveals that debt ratios have no significant correlation with firm size. While tangibility positively correlates with debt ratios, liquidity negatively correlates with all debt ratios. The study employed the VIF test to further evaluate multicollinearity. "The variance inflation factor shows how the variance of an estimator is inflated by the presence of multicollinearity" (Gujarati, 2009). A VIF below 10 is considered acceptable, whereas a value of 10 or above indicates multicollinearity (Gujarati, 2009).

Table 3.Variance Inflation Factor (VIF)

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
LDA	*1.0980*	*1.1152*	-	-	-	-
SDA	-	-	*1.8019*	*2.0176*	-	-
TDA	-	-	-	-	*1.8356*	*1.8135*

TANG	*1.0641*	*1.0349*	*1.0631*	*1.0364*	*1.0466*	*1.0548*
SIZE	*1.0702*	*1.2596*	*1.1000*	*1.3461*	*1.1274*	*1.0928*
LIQ	*1.1234*	*1.1803*	*1.7840*	*1.7871*	*1.7464*	*1.7654*

Source: Compiled by author

Table 3 reveals that VIF values for these variables range from a minimum of 1.0349 to a maximum of 1.8356, confirming that the problem of multicollinearity does not exist among the independent variables as VIF is within the limits (Gujarati, 2009).

Table 4. Stationarity test results

Variables	*Augmented Dickey-Fuller (ADF) test*			*Inference*
	Model form	*Test Statistics*	*P-value*	
LDA	*Individual Intercept*	*136.984*	*0.0001*	*Stationary***
	Trend and Intercept	*124.198*	*0.0011*	*Stationary***
SDA	*Individual Intercept*	*119.778*	*0.0027*	*Stationary***
	Trend and Intercept	*110.020*	*0.0146*	*Stationary***
TDA	*Individual Intercept*	*137.980*	*0.0001*	*Stationary***
	Trend and Intercept	*117.578*	*0.0040*	*Stationary***
ROA	*Individual Intercept*	*116.334*	*0.0050*	*Stationary***
	Trend and Intercept	*110.503*	*0.0135*	*Stationary**
ROE	*Individual Intercept*	*129.653*	*0.0004*	*Stationary***
	Trend and Intercept	*141.103*	*0.0000*	*Stationary***
TANG	*Individual Intercept*	*119.946*	*0.0026*	*Stationary*
	Trend and Intercept	*123.471*	*0.0013*	*Stationary***
SIZE	*Individual Intercept*	*207.735*	*0.0000*	*Stationary***

	Trend and Intercept	*137.799*	*0.0001*	*Stationary***
LIQ	*Individual Intercept*	*122.497*	*0.0016*	*Stationary***
	Trend and Intercept	*100.202*	*0.0629*	*Stationary*

*Note: **Stationary at 1% significance, * Stationary at 5% significance*

The ADF test represented in Table 4 indicates that all the given series, LDA, SDA, TDA, ROA, ROE, TANG and SIZE are stationary at a 5% level of significance or,in the case of LIQ, maximum at 10%.

Results of Regression Analysis

This study utilizes six regression models, presented in Equations 1 to 6, to analyze the impact of capital structure on profitability.The panel regression equations as per the preferred model are as follows:

$$ROA_{it} = a_{it} + \beta_1 LDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \ldots(1)$$

$$ROE_{it} = a_{it} + \beta_1 LDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \ldots(2)$$

$$ROA_{it} = a_{it} + \beta_1 SDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \ldots(3)$$

$$ROE_{it} = a_{it} + \beta_1 SDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \ldots(4)$$

$$ROA_{it} = a_{it} + \beta_1 TDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \ldots(5)$$

$$ROE_{it} = a_{it} + \beta_1 TDA_{it} + \beta_2 Tang_{it} + \beta_3 Size_{it} + \beta_4 Liq_{it} + \varepsilon_{it} + \mu_{it} \ldots(6)$$

Table 5. Dependent Variable (ROA) - Model 1

	POLS		*REM*		*FEM*	
Variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
LDA	*-0.1220*	*-2.45**	*-0.2336*	*-4.37***	*-0.2497*	*-4.17***
TANG	*-0.0830*	*-2.49**	*-0.0666*	*-1.80*	*-0.0622*	*-1.50*
SIZE	*0.0249*	*7.43***	*0.0259*	*3.96***	*0.0296*	*2.79***
LIQ	*0.0113*	*2.91***	*-0.0020*	*-0.49*	*-0.0054*	*-1.20*
R^2	*0.2174*		*0.1126*		*0.6645*	
Adjusted R^2	*0.2095*		*0.1036*		*0.6240*	
F - statistics	*27.4373***		*12.5274***		*16.3982***	
Durbin Watson	*0.6305*		*1.3305*		*1.4933*	

F- test	*0.0000*
Breusch Pagan	*0.0000*
Hausman	*0.2497*

	POLS		*REM*		*FEM*	
Variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
SDA	*-0.1704*	*-5.15***	*-0.0939*	*-2.28**	*-0.0576*	*-1.18*
TANG	*-0.1790*	*-5.75***	*-0.1015*	*-2.74***	*-0.0630*	*-1.49*
SIZE	*0.0229*	*6.96***	*0.0256*	*3.98***	*0.0364*	*3.24**
LIQ	*-0.0033*	*-0.67*	*-0.0056*	*-1.09*	*-0.0076*	*-1.35*
R^2	*0.2555*		*0.0857*		*0.6495*	
Adjusted R^2	*0.2480*		*0.0764*		*0.6071*	
F - statistics	*33.8935***		*18.46***		*15.3393***	
Durbin Watson	*0.6668*		*1.495*		*1.4607*	
F- test	*0.0000*					
Breusch Pagan	*0.0000*					
Hausman	*0.0592*					

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 5represents the outcomes of Equation 1 with ROA as a dependent variable. The Breusch Pagan andF-test indicate that POLS is inappropriate. The Hausman test confirms that EM is preferred. The random effects model reveals that LDA has a significant negative effect on ROA. However, tangibility and liquidity have in significant impacts on ROA, while size has significant positive impacts on ROA. R-squared signifies that independent variables explain 11.26% of ROA variability. Durbin-Watson test statistic is 1.3305,indicating no serial correlation.

Table 6. Dependent Variable (ROE) – Model 2

	POLS		*REM*		*FEM*	
Variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
LDA	*0.2526*	*2.83***	*-0.0456*	*-0.44*	*-0.1180*	*-0.97*
TANG	*-0.2565*	*-4.30***	*-0.1930*	*-2.73***	*-0.1736*	*-2.06**
SIZE	*0.0415*	*6.91***	*0.0528*	*4.85***	*0.0928*	*4.29***
LIQ	*-0.0025*	*-0.37*	*-0.0212*	*-2.68***	*-0.0342*	*-3.75***
R^2	*0.1452*		*0.0795*		*0.5268*	

Adjusted R^2	*0.1365*	*0.0702*	*0.4697*
F - statistics	*16.7735***	*8.5289***	*9.2179***
Durbin Watson	*0.7045*	*1.0964*	*1.2642*
F- test	*0.0000*		
Breusch Pagan	*0.0000*		
Hausman	*0.0057*		

Table 7.Dependent Variable (ROA) – Model 3

Table 6 represents the outcomes of Equation 2 with ROE as a dependent variable. The results of the Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirmsthat FEM is preferred. The fixed effects model reveals that LDA has an insignificant effect on ROE. However, tangibility and liquidity have significant negative, whereas size has a significant positive impact on ROE. R-squared indicates that 52.68% of ROE variation is explained by the independent variables. Durbin-Watson test statistic is 1.2642, indicating no serial correlation.

Table 7 represents the outcomes of Equation 3 with ROA as a dependent variable. The results of the Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirms thatREM is preferred. The random effects model reveals that SDA has a significant negative impact on ROA, tangibility hasa significant negative, sizehasa significant positive, whereas liquidity has an insignificant impact on ROA. R-squared indicates that independent variables explain 8.57% of the variability in ROA. Durbin-Watson test statistics (1.495)indicate no serial correlation.

Table 8. Dependent Variable (ROE) – Model 4

	POLS		*REM*		*FEM*	
Variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
SDA	*-0.0483*	*-0.79*	*0.0483*	*0.61*	*0.1835*	*1.90*
TANG	*-0.1966*	*-3.41***	*-0.1928*	*-2.71***	*-0.1671*	*-1.99**
SIZE	*0.0406*	*6.66***	*0.0565*	*4.86***	*0.1134*	*5.09***
LIQ	*-0.0117*	*-1.29*	*-0.0174*	*-1.73*	*-0.0209*	*-1.87*
R^2	*0.1293*		*0.0788*		*0.5303*	
Adjusted R^2	*0.1204*		*0.0694*		*0.4736*	

F - statistics	*14.6592***	*8.4435***	*9.3485***
Durbin Watson	*0.6715*	*1.1203*	*1.3065*
F- test		*0.0000*	
Breusch Pagan	*0.0000*		
Hausman	*0.0221*		

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 8 represents the outcomes of Equation 4 with ROE as a dependent variable. The results of the Breusch Pagan and F-test suggest that POLS is inappropriate. The Hausman test confirms thatFEM is preferred. The fixed effect model reveals that SDA has an insignificant impact on ROE, tangibility hasa significant negative,size hasa significant positive, whereas liquidity has an insignificantimpact on ROE. R-squared indicates that independent variables explained53.03% of the variability in ROE. Durbin-Watson test statistics is 1.3065, indicating no serial correlation.

Table 9. Dependent Variable (ROA) – Model 5

	POLS		*REM*		*FEM*	
Variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
TDA	*-0.1516*	*-5.64***	*-0.1564*	*-4.63***	*-0.1541*	*-3.81***
TANG	*-0.1265*	*-4.39***	*-0.0902*	*-2.47**	*-0.0668*	*-1.61*
SIZE	*0.0230*	*7.04***	*0.0212*	*3.23***	*0.0213*	*1.85*
LIQ	*-0.0041*	*-0.85*	*-0.0129*	*-2.55**	*-0.0152*	*-2.82***
R^2	*0.2647*		*0.1197*		*0.6619*	
Adjusted R^2	*0.2573*		*0.1108*		*0.6211*	
F - statistics	*35.5542***		*13.4258***		*16.2078***	
Durbin Watson	*0.6417*		*1.2835*		*1.4372*	
F- test			*0.0000*			

Breusch Pagan	*0.0000*
Hausman	*0.4202*

*Source: Compiled by author, *at 5% significant, **at 1% significant*

Table 9 represents the outcomesof Equation 5 with ROA as a dependent variable. The Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman test confirms that REM is preferred. The random effect model reveals that the TDA, tangibility and liquidity have a significant negative impact on ROA, whereas size has significant positive impacts on ROA.R-squared indicates that independent variables explained 11.97% of the variability in ROA. Durbin-Watson test statistic is 1.2835, showing no serial correlation.

Table 10. Dependent Variable (ROE) – Model 6

	POLS		*REM*		*FEM*	
Variables	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
TDA	*0.0459*	*0.92*	*0.0100*	*0.15*	*0.0774*	*0.94*
TANG	*-0.1779*	*-3.31***	*-0.1989*	*-2.81***	*-0.1703*	*-2.02**
SIZE	*0.0419*	*6.87***	*0.0553*	*4.73***	*0.1082*	*4.63***
LIQ	*-0.0017*	*-0.19*	*-0.0203*	*-2.03**	*-0.0276*	*-2.52**
R^2	*0.1297*		*0.0781*		*0.5268*	
Adjusted R^2	*0.1209*		*0.0687*		*0.4696*	
F - statistics	*14.7214***		*8.3622***		*9.2156***	
Durbin Watson	*0.6792*		*1.1143*		*1.2814*	
F- test			*0.0000*			
Breusch Pagan	*0.0000*					
Hausman	*0.0531*					

Table 10 represents the outcomes of Equation 6 with ROE as a dependent variable. The results of the Breusch Pagan and F-test indicate that POLS is inappropriate. The Hausman

test confirms that REM is preferred. The random effect model reveals that TDA has an insignificant impact on ROE, tangibility and liquidity have significant negative, whereas size has significant positive impacts on ROE. R-squared indicates that independent variables have explained 7.81% of the variability in ROE. Durbin-Watson test statistic is 1.1143, showing no serial correlation. The regression analysis revealed that capital structure has a significant negative effect on ROA, resulting in the rejection of the first null hypothesis. Whereas capital structure has no significant impact on ROE, supporting the acceptance of the second null hypothesis.

Conclusion

The significant negative impact of all debt measures (LDA, SDA, and TDA) on return on assets (ROA) indicates that higher debt levels, whether short-term or long-term debt, negatively impact the profitability of Indian Food and Beverage companies. These findings are consistent with previous studies by Revathy and Santhi (2016), Pandey and Sahu (2017), (Vyas, 2018), Singh and Bagga (2019) and Habibniya et al. (2022), whereas contradicted the findings of Patra (2021)and Anozie et al. (2023).It is observed that reliance on short-term debt is notably higher than long-term debt and might be introducing risks like refinancing costs and liquidity pressures, potentially limiting profitability. Tangibility emerges as a key determinant of profitability as it has a significant negative impact on both return on assets (ROA) and return on equity (ROE). This indicates inefficiencies in leveraging tangible assets effectively to drive profitability. Firm size has a significant positive impact on profitability, indicating that larger firms benefit from their well-established market presence, economies of scale and improved access to resources and capital, enabling them to achieve higher returns over smaller firms. The significant negative influence of liquidity on profitability indicates in efficient working capital management practices, leading to reduced profitability. The results indicate that higher dependence on short-term financing, inefficient use of liquidity and fixed assets negatively affect profitability. It is suggested that Indian food and beverage companies should strategically optimize their debt levels and enhance the efficient utilization of fixed assets to improve profitability. Moreover, while larger firms benefit from economies of scale and a stable market presence, conservative liquidity policies can negatively impact profitability and should be avoided.

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Reverse Supply Chain Management in the Pharmaceutical Industry A Comprehensive Study Focusing on India

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Abstract

The pharmaceutical industry operates within one of the most complex supply chain environments, where the management of returned, expired, damaged, or recalled products is not merely a cost-driven process but a strategic imperative for safety, sustainability, and compliance. This study critically examines the role of Reverse Supply Chain Management (RSCM) in the Indian pharmaceutical sector, drawing on extensive secondary data from academic literature, industry reports, government publications, and previously documented case studies. The research highlights the operational challenges posed by stringent regulatory frameworks, product sensitivity (such as temperature- controlled storage and limited shelflife), fragmented infrastructure, and market uncertainties impacting reverse logistics flows. Findings reveal a paradigm shift in RSCM from being perceived solely as a financial burden to becoming a value-recovery mechanism that supports circular economy initiatives, environmental protection, and improved public health outcomes. The study also emphasizes the importance of technology adoption including RFID-based track-and-trace systems, data-driven decision-making models, and AI-enabled monitoring for optimizing returns management. Moreover, it underscores the necessity of multi-stakeholder collaboration, standardized procedures, and policy enhancements to build resilient and sustainable reverse supply chain networks in India's pharmaceutical industry. The insights derived provide a conceptual foundation and practical recommendations for enhancing reverse logistics effectiveness, thereby contributing to future research and policymaking in this critical domain.

Keywords: Reverse Supply Chain, Pharmaceutical Industry, Sustainability, Waste Management, Circular Economy, Environmental Impact, Secondary Data Analysis, Supply Chain Optimization, Regulatory Compliance, Manufacturing Efficiency

Introduction

In contemporary supply chain management, Reverse Logistics (RL) has evolved from a peripheral cost centre to a strategic function that supports sustainability, regulatory compliance, and competitive differentiation. Defined as the process of planning, implementing, and controlling the flow of returned goods, defective products, and associated information from the point of consumption back to the point of origin for value recovery or safe disposal, RL is an essential component of modern supply chains, particularly in highly regulated industries. The pharmaceutical sector presents unique complexities in reverse logistics due to strict legal frameworks, stringent quality and safety requirements, temperature-sensitive products, and the high societal impact of product recalls or disposal mismanagement. Unlike many other industries where returned products can be repaired or

resold, pharmaceuticals often require specialized handling, traceability, and certified destruction to prevent counterfeiting and safeguard public health. Studies indicate that expired or non-moving pharmaceutical products can account for 3-5% of total supply chain value, which, if poorly managed, leads to significant financial losses, environmental hazards, and reputational damage for firms. Within the Indian context, these challenges are amplified by fragmented supply chain networks, limited infrastructure in Tier-2 and rural regions, inadequate cold chain management, and non-standardized return processes across manufacturers, distributors, and retailers. Despite India's position as a global leader in pharmaceutical production and exports, efficient reverse supply chain management remains underdeveloped, creating inefficiencies, safety risks, and compliance gaps. Prior research highlights the potential of integrating technology-driven solutions (e.g., RFID-based serialization, automated sorting systems, and AI-powered return analysis) and multi-stakeholder collaboration to improve reverse logistics performance. The transition from a purely cost-oriented approach to one that emphasizes value recovery, environmental stewardship, and circular economy principles is critical for enhancing overall supply chain resilience. This research, relying primarily on secondary data sources such as scholarly publications, government reports, and documented case studies, investigates the operational, regulatory, and strategic dimensions of reverse supply chain management in India's pharmaceutical sector. The study aims to synthesize existing knowledge, identify persistent challenges and capability gaps, and propose directions for future optimization of reverse logistics networks that can ensure patient safety, regulatory adherence, and long-term sustainability.

Literature Review

Reverse Logistics (RL) has increasingly been recognized as an essential element of modern supply chain management, shifting from a reactive cost-driven activity to a proactive, value-generating process (Stock, 1992; Fleischmann et al., 2004). RL is defined as the structured process of planning, implementing, and controlling the efficient, cost-effective flow of returned products, defective goods, or waste materials from their point of consumption back to the point of origin, with the objectives of value recovery, recycling, or environmentally safe disposal (Rogers & Tibben-Lembke, 1999). This evolution reflects growing concerns about sustainability, customer satisfaction, and the economic implications of product returns across multiple industries (Coyle et al., 2008; de Brito & Dekker, 2004).

Importance of RL in the Pharmaceutical Industry

In the pharmaceutical sector, reverse logistics has strategic importance due to the industry's unique product characteristics, such as temperature sensitivity, limited shelf life, high market value, and the critical role these products play in public health. Unlike other industries where returned goods can often be repaired or resold, pharmaceutical products frequently require traceable handling, certified destruction, or specialized disposal processes to mitigate safety risks and prevent counterfeit circulation (Shaik, 2015; Mugenda & Mugenda, 1999).

Drivers and Challenges of Reverse Logistics

The literature identifies several key drivers for implementing RL in the pharmaceutical industry, including:

- Regulatory Compliance: National and international laws mandate strict handling, tracking, and disposal of expired and recalled medicines (FDA, 2019; GOI Drug Policy, 1986).
- Environmental Concerns: Improper pharmaceutical waste management has detrimental ecological impacts, increasing pressure on companies to adopt environmentally responsible RL systems (California Integrated Waste Management Board, 1997).
- Economic Benefits: Cost recovery through improved returns management, reduced wastage, and optimized inventory replenishment (Dawe, 1995; BizzTor India Report, 2016).
- Public Health and Safety: Ensuring defective or unsafe drugs are promptly removed from circulation to protect end-users (WHO, 2010).

Technological Advancements in RL

Emerging research emphasizes the role of technology and digitization in strengthening reverse supply chain processes. Solutions such as radio frequency identification (RFID), serialization, real-time tracking systems, AI- based analytics, and automated sorting significantly improve visibility, traceability, and accuracy in returns processing (Cognizant 20-20 Insights, 2013; CRB, 2015). Moreover, the application of multi-criteria decision-making (MCDM) models and mixed-integer linear programming (MILP) techniques in RL network design has enabled more effective optimization of return flows, cost minimization, and improved strategic decision-making (Rao, 2007; Barker, 2010).

Research Gaps Identified

Although the literature extensively addresses RL in manufacturing and retail industries, research on pharmaceutical reverse logistics, particularly in India, remains limited and fragmented. Key gaps include:

Lack of empirical studies assessing RL performance indicators in the Indian pharmaceutical context.

Inadequate exploration of stakeholder collaboration frameworks for effective returns management.

Limited evaluation of long-term sustainability impacts of RL initiatives on the healthcare supply chain.

Insufficient integration of advanced technologies and digital solutions in reverse supply chain models (Shaik, 2015; KPMG, 2014).

Conclusion from Literature

The literature collectively underscores that pharmaceutical RL is a multi- dimensional challenge driven by regulatory, economic, environmental, and public health considerations. To achieve robust reverse supply chains, firms must transition from ad hoc return management to strategically planned, technology-enabled, and sustainability-focused

systems. The reviewed studies provide a conceptual basis for this research while highlighting the need for comprehensive frameworks tailored to the Indian pharmaceutical ecosystem, where infrastructural, regulatory, and awareness-related barriers persist.

Research Methodology

This study adopts a secondary data research methodology to examine the dynamics of Reverse Supply Chain Management (RSCM) within the Indian pharmaceutical industry. Secondary data analysis is a well- established approach in supply chain research, enabling the consolidation of existing knowledge, identification of gaps, and synthesis of best practices without the need for primary data collection (Saunders et al., 2009; Quinlan et al., 2019). The methodology was carefully structured to ensure credibility, reliability, and academic rigor, as outlined below.

Research Design

The research followed an exploratory and descriptive design, aimed at:

Understanding the conceptual foundations of RSCM in the pharmaceutical sector.

Mapping current practices, drivers, and challenges within the Indian context.

Identifying technological and policy-based solutions highlighted in existing literature and reports.

The study does not seek to test hypotheses but rather to synthesize and interpret existing evidence to support theoretical and practical advancements in RSCM.

Data Sources

Data for this study was derived exclusively from published and publicly available secondary sources, including:

Academic literature: Peer-reviewed journal articles, conference proceedings, and scholarly books focusing on reverse logistics, pharmaceutical supply chains, and sustainability.

Industry reports: Publications from pharmaceutical associations, logistics companies, and consulting firms addressing return logistics and waste management practices.

Government and regulatory documents: Policy guidelines, pharmaceutical waste management protocols, and compliance reports from agencies such as the Department of Pharmaceuticals, WHO, and the US FDA.

Case studies: Documented instances of pharmaceutical reverse logistics operations, including cost analyses, network design models, and recall management practices.

Statistical data and market studies: Existing datasets on pharmaceutical returns, expiry rates, and reverse logistics costs from credible agencies and industry surveys.

Data Collection and Screening Process

A structured search strategy was employed, using key terms such as “reverse logistics,” “reverse supply chain management,” “pharmaceutical returns,” “waste management in pharma,” “closed-loop supply chains,” and “India pharmaceutical logistics.”

Inclusion criteria: Studies with a clear focus on pharmaceutical RL, sustainable supply chain practices, regulatory frameworks, and secondary data-based analysis relevant to India or comparable emerging markets.

Exclusion criteria: Studies unrelated to pharmaceuticals, primary data-based experimental research, and papers lacking methodological transparency or credibility.

The process ensured that only high-quality, authoritative sources were included, enhancing the reliability of findings.

3.4. Data Analysis Approach

The collected data was systematically analysed through:

Thematic synthesis: Grouping findings into categories such as drivers of RSCM, operational challenges, regulatory implications, technology adoption, and sustainability impacts.

Comparative analysis: Evaluating different perspectives from global and Indian pharmaceutical contexts to identify unique regional challenges and opportunities.

3.5. Reliability and Validity

The study ensured academic rigor and credibility by:

- Using triangulation, cross-verifying findings from multiple independent sources.
- Selecting peer-reviewed and recognized publications to avoid reliance on non-validated data.
- Maintaining transparency in the data selection and screening process to ensure replicability.
- Applying established frameworks for systematic literature review (SLR) where possible, reducing researcher bias.

3.6. Limitations of the Methodology

While secondary data analysis provides comprehensive insights, it is subject to several limitations:

- Dependence on the availability and accuracy of pre-existing data, which may not fully capture all nuances of the Indian pharmaceutical market.
- Limited generalizability, as findings from global literature may not always align with the socio-economic realities of India.
- Lack of real-time operational data, restricting the ability to assess evolving trends or performance metrics.
- Exclusion of grey literature (e.g., unpublished industry findings) due to reliability concerns, which may have omitted practical insights.

4. Discussion: Reverse Logistics in the Pharmaceutical Industry

Reverse logistics (RL) in the pharmaceutical sector involves the systematic management of returned, expired, damaged, recalled, or counterfeit products to ensure safe disposal, potential value recovery, and compliance with stringent health and safety regulations. Unlike forward logistics, which emphasizes efficient product delivery to end-users, RL focuses on the reverse flow of goods and information from customers back to manufacturers, wholesalers, or authorized waste handlers. In the pharmaceutical domain, this process is uniquely challenging due to strict regulatory oversight, high product sensitivity, and critical public health implications (Shaik, 2015; WHO, 2010). This discussion synthesizes various dimensions of pharmaceutical RL, drawing on global and Indian industry practices, to highlight operational challenges, best practices, and emerging trends.

4.1. Pharmaceutical Industry Scenario

India ranks as the world's third-largest producer of pharmaceuticals by volume, with exports

exceeding USD 40 billion in 2021. The vast scale of production, coupled with fragmented distribution networks involving over 200,000 retail pharmacies, generates significant complexities in managing product returns. Studies suggest that 3–5% of total pharmaceutical sales are typically lost due to expired, non-moving, or damaged products (BizzTor India Report, 2016). Inefficient RL processes not only lead to financial waste but also increase environmental risks and expose firms to legal and reputational damage.

4.2. Streamlining Returns

Returns in pharmaceuticals stem from multiple causes, including product expiry, incorrect shipments, damaged packaging, inaccurate demand forecasting, delivery failures, and counterfeit drug detection. The reverse flow of goods in India is valued at over USD 5 billion annually, highlighting its scale and impact on profitability.

Key challenges include:

- Unpredictability of returns: Variability in timing, quantity, and condition of products complicates planning.
- Gatekeeping inefficiencies: Inadequate screening of returned items leads to unnecessary processing costs.

4.3. Product Recalls

Recalls are among the most critical RL processes, initiated when defective or unsafe medicines must be urgently withdrawn from the market to protect public health. These processes are highly regulated, requiring detailed notifications, batch traceability, and secure collection and disposal of affected products (FDA, 2019).

Challenges include:

- Financial implications: A single recall can lead to substantial direct losses and long-term reputational harm.
- Logistical complexity: Collecting recalled products nationwide, often under strict time constraints, is operationally challenging.
- Security risks: Counterfeiters may exploit recall processes to divert products to the black market.

4.4. Batch Processing in Reverse Distribution

Reverse distributors often consolidate returned drugs from multiple pharmacies into batch shipments, reducing handling costs and transportation expenses. While cost-effective, this approach creates challenges in credit issuance accuracy and traceability, especially if documentation is incomplete. Researchers advocate for the use of blockchain-based record-keeping to improve transparency and prevent errors in batch-based returns management (Kumar, 2021).

4.5. Regulatory Compliance in RL

The pharmaceutical industry operates under a complex web of national and international regulations governing the return, storage, transport, and destruction of medicines. Indian pharmaceutical firms must navigate approximately 70 different regulatory requirements across states and global markets, making standardization difficult (GOI Drug Policy, 1986). Non-compliance can result in:

- Heavy legal penalties.

- Loss of operating licenses.
- Severe damage to brand credibility.

4.6. Inventory Security in Reverse Logistics

High-value pharmaceutical products are prime targets for theft and diversion. Every handoff in the reverse supply chain increases the risk of drugs being redirected to unauthorized channels or reintroduced illegally into the market.

Mitigation measures include:

- 24/7 sensor-based monitoring of returned shipments.
- GPS-enabled vehicles with real-time tracking.
- Controlled access to storage facilities with biometric verification.

4.7. Temperature Control in Reverse Flows

Maintaining cold chain integrity during returns is critical for many high value medicines and vaccines. Even slight temperature excursions can degrade product efficacy or render drugs harmful.

Challenges include:

- Limited temperature-controlled infrastructure in India, particularly in rural areas.
- Extended transit times due to customs checks and airport delays.
- High costs associated with replacing temperature damaged products.

4.8. Preventing Errors and Avoidable Returns

Pharmaceutical RL research highlights the importance of returns avoidance strategies, focusing on root causes such as poor demand forecasting, data inaccuracies, and overproduction. Minimizing errors during clinical trials, labelling, and order fulfilment can significantly reduce reverse flow volumes, leading to improved supply chain efficiency and reduced waste (Maani & Cavana, 2007). Implementing quality control systems, automated data capture, and predictive analytics is essential to reduce preventable returns.

4.9. Future Outlook for Pharmaceutical RSCM in India

The future of reverse supply chains in India's pharmaceutical industry is expected to be shaped by:

- Greater investment in RL infrastructure, including dedicated return processing centers and cold chain facilities.
- Technology adoption, particularly AI, RFID, and blockchain for improved tracking, cost optimization, and fraud prevention.
- Policy enhancements, with potential government mandates on Extended Producer Responsibility (EPR) to ensure proper disposal of expired drugs.
- Stakeholder collaboration, integrating manufacturers, distributors, healthcare providers, and waste management companies into unified RL networks.

5. Conclusion

Reverse Supply Chain Management (RSCM) has evolved from a traditionally cost-driven activity to a strategic enabler of sustainability, compliance, and value recovery in modern supply chains. Within the pharmaceutical industry, particularly in India, effective reverse logistics is not only an operational necessity but also a critical determinant of public health protection, environmental stewardship, and long-term competitiveness. This study, based on

an extensive review of secondary data sources, highlights the complex and multi-dimensional nature of pharmaceutical reverse logistics. Key findings indicate that challenges such as fragmented infrastructure, non-standardized return procedures, regulatory variations, insufficient cold chain capabilities, and high risks of counterfeit diversion persist across the Indian pharmaceutical sector. These gaps lead to significant financial losses, waste generation, and safety risks for consumers. However, the research also underscores emerging opportunities for transformative improvements, including:

- Technological advancements (RFID, AI, blockchain, IoT) to enhance traceability, improve decision-making, and secure reverse flows.
- Strategic stakeholder collaboration, integrating manufacturers, distributors, healthcare providers, and waste management entities to create cohesive RL networks.
- Policy interventions and Extended Producer Responsibility (EPR) frameworks to enforce safe, standardized pharmaceutical waste management.

The findings collectively suggest that a shift from reactive to proactive reverse logistics strategies is crucial for Indian pharmaceutical firms to optimize costs, safeguard patients, comply with evolving regulations, and align with global sustainability goals. Future research should focus on empirical analyses, development of data-driven decision-support models, and implementation frameworks tailored to India's unique socio-economic and regulatory environment. By embedding reverse supply chain management as a strategic pillar, pharmaceutical companies in India can move beyond compliance, turning RL into a driver of value creation, innovation, and long-term supply chain resilience.

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Comparative evaluation of machine learning and biosensors for the diagnosis of breast cancer

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ABSTRACT

Breast cancer is a prevalent and life-threatening disease requiring early detection for better treatment outcomes. This review provides a comprehensive explanation of the use of machine learning (ML) algorithms and biosensors for early breast cancer detection. ML techniques, including Support Vector Machine (SVM), Artificial Neural Networks (ANN), Nearest Neighbors (KNN), Decision Tree etc, enable the analysis of medical data to identify the cancer pattern. Various image sample data sources, such as mammograms, MRIs, scans, and blood samples, are utilized. Unlike traditional diagnostic methods, ML enables automated and data-driven decision making, improving accuracy and efficiency. Different types of biosensors, including electrochemical and optical sensors, convert biological signals into measurable electrical signals for cancer detection. This study compares various ML models and biosensor technologies based on accuracy, precision, and response time. The findings suggest that combining ML with biosensors enhances early detection, offering a reliable and rapid diagnostic approach. Overall, ML and biosensor-based methods hold great potential for improving breast cancer screening and patient outcomes.

INDEX TERMS: Breast Cancer, Medical Image Analysis, Machine Learning, Biosensors

INTRODUCTION:

While medical science has made great strides in issues, some of which may even be fatal. In addition to improving the accuracy of the rapid detection of fatal conditions, adopting safe, realistic techniques and using modern technology can reduce the need for carers and lower overall health care costs. Technologies in healthcare include the maintenance and retrieval of electronic medical records of patients and devices involved. Cancer detection has always been a challenge in the diagnosis and treatment plan for haematological diseases. Advances in technology and intelligent decision-making techniques have the potential to save many lives. Rapid and abnormal cell growth brought on by a confluence of distinctive genetic and epigenetic flaws is what defines cancer. This unchecked cell proliferation aids in the development of tumours. The cancer may already be incurable at the time of discovery if the tumour starts to spread quickly to other body systems and organs as it advances. About one in eight women will have breast cancer in their lifetime receive a diagnosis each year, and those between the ages of 40 and 70 are the most seriously affected. In their lifetime, about one in eight women will have breast cancer. Every year, almost 2.1 million women receive a breast cancer diagnosis, and the most severely affected. As a result, a favourable prognosis for breast cancer depends on an early detection. Mammography, ultrasound-guided surgical biopsy, and fine needle aspiration cytology (FNAC) are among the screening techniques used to identify breast cancer. Mammography has a relatively low rate of cancer detection in thick breasts, with 10% to 30% of cases going unnoticed. Accurately identifying cancer cells

is crucial to lowering death rates, and this entails efficient early cancer detection and therapy to raise cancer patients' survival chances. One of the most often used approaches for quickly training machines and developing predictive models for effective decision-making is machine learning (ML). Machine learning aids in breast cancer early diagnosis.

The most effective strategies for achieving positive results in classification and prediction challenges are machine learning techniques. ML methods for identifying cancer and predicting the presence or absence of tumours could be useful for studies on breast cancer. Tumour malignancy can also be predicted using machine learning approaches. In these strategies, the primarily qualitative diagnosis criteria are transformed into a more tangible quantitative feature to address the classification problem. A number of classifiers were examined. Regarding the accuracy of classification on three different datasets. In addition to Naive Bayesian, IBK, and decision tree classifiers, the study also featured classifiers such sequential minimum optimisation and multilayer perceptron (MLP). These were tested on a number of datasets, primarily the Wisconsin Breast Cancer (Original) Dataset (WBCD) and additional Wisconsin datasets like the Wisconsin Breast Cancer (Diagnostic) Dataset (WDBC) and Wisconsin Breast Cancer (Prognostic) Dataset (WPBC). A breast cancer model using machine learning algorithms should have both benign and malignant cancer cells so it can be predicted using the model. The data from the breast image is loaded first, followed by feature extraction. occurs, after which the final classification model can be trained to complete the task. Benign tumours are regarded as noncancerous and typically non-lethal, but malignant cancer starts with abnormal cell proliferation and has the potential to spread to or invade the surrounding tissues quickly, making it a potentially fatal condition. It wasn't until 1997 that biosensors received an official definition from the International Union of Pure and Applied Chemistry (IUPAC), the global authority on chemical nomenclature and terminology. Through the monitoring of biomarkers within the human body, a biosensor can identify anomalies in the body. For women at normal risk for breast cancer, mammogram screening is advised. By combining this screening with specific biomarkers, we can improve the likelihood of early detection. Detecting bioanalytical chemicals from a variety of samples was the primary goal while constructing a biosensor. It was designed to combine three distinct scientific disciplines—chemistry, biology, and engineering—into a single apparatus. A tumour biomarker's existence may be a sign of cancer in the human body. Breast cancer biomarkers fall into one of three categories: prognostic, diagnostic, or therapeutic. Their presence can be identified based on the cancer's severity. Clinical and medical teams have identified a number of tumour biomarkers that can be used to determine whether a person has cancer, and a number of particular fluid-based biomarkers are taken into consideration while creating electrochemical biosensors. Examples of contemporary electrochemical bio-affinity sensors with remarkable sensitivity, which is crucial for the identification of early-stage cancer, include gene- or immune-based sensors. In addition to their great efficiency, electrochemical devices provide a more accurate technique of detection and clinical benefits in the identification of cancer and treatment monitoring.

Progress of these portable devices will be essential for accelerating the cancer detection

procedure and obtaining analytical data quickly. Given their additional benefits of ultrasensitivity, cost effectiveness, ease of background and preparation, and a number of unlisted benefits, electrochemical biosensors are among the greatest choices for biochemical analysis.

BLOCK DIAGRAM:

START

Collect Patient Data
├── Clinical Data (Medical History, Symptoms)
├── Imaging Data (Mammograms, MRIs, Ultrasounds)
├── Histopathology Data (Tissue Samples)
├── Biosensor Data (Blood, Saliva, Tears, DNA Markers)

Preprocessing & Feature Extraction
├── Image Processing (Noise Removal, Segmentation)
├── Data Normalization & Cleaning
├── Feature Selection (Tumor Size, Shape, Biomarkers)

Apply Machine Learning Algorithms
├── Decision Tree (DT)
├── Support Vector Machine (SVM)
├── Artificial Neural Network (ANN)
├── Random Forest (RF)
├── k-Nearest Neighbors (KNN)

Classification & Diagnosis
├── Benign Tumor (Non-Cancerous)
├── Malignant Tumor (Cancerous)

Validation & Performance Evaluation
├── Accuracy, Precision, Recall, F1 Score

Final Diagnosis & Treatment Recommendation
├── No Cancer → Routine Checkup
├── Cancer Detected → Further Tests & Treatment Plan

END

EXPLANATION:

→The process starts with data collection from different sources (clinical, imaging, and biosensors).

→Preprocessing is done to clean and extract meaningful features.

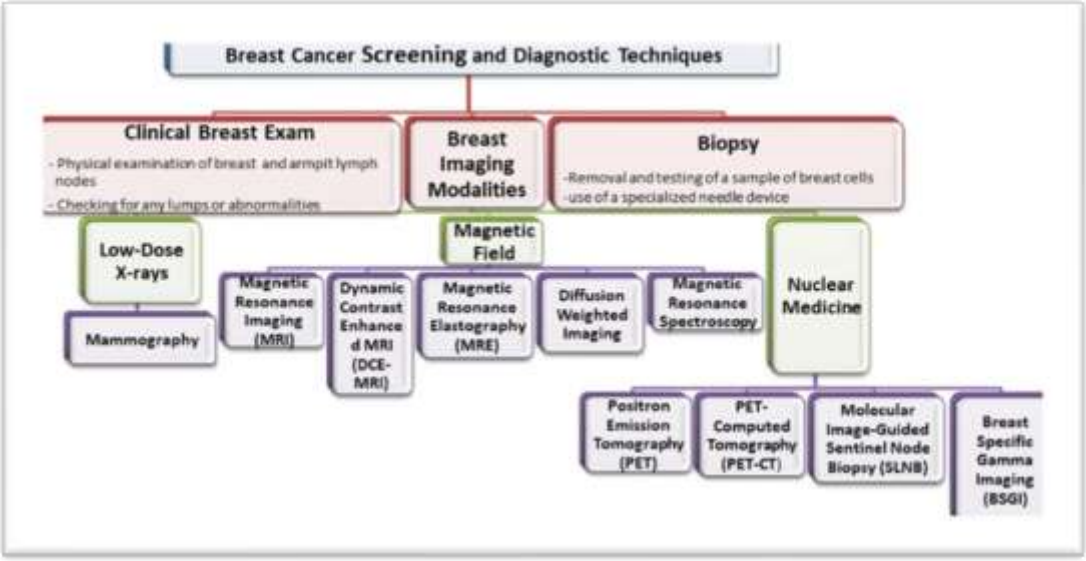
→Various machine learning models analyze the data and classify the tumor as benign or malignant.
→The model's performance is validated before a final diagnosis is made.
→If cancer is detected, treatment recommendations follow.

Methodology for searching and choosing articles:

Relevant publications for this literature review were found by searching for phrases such as "Breast Cancer" or "Cancer Detection"+ "Machine Learning " + "SVM or ANN " + Biosensors or FET or Electrochemical " in the following databases from Science Direct, IEEE, Springer, Research Gate, PubMed, and Google Scholar. This review has covered every application where breast cancer detection can be applied. Research done before 2010 is thought to be less pertinent because the methods used were less accurate, more expensive so on.

High-tech methods for detecting breast cancer:

Over time, the medical field has seen a steady increase in technological innovation. To detect breast cancer, a variety of technologies are used.The review identified several promising technologies for breast cancer screening. Microwave imaging demonstrated high sensitivity, capable of detecting tumors as small as 5 mm, with generally Over time, the medical field has seen a steady increase in technological good specificity.

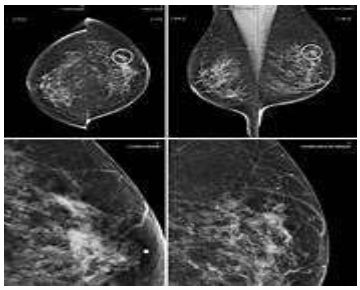


(fig1: Technologies used for breast cancer detection)

Techniques for breast screening:

Breast screening is the process of testing for diseases before symptoms show up in order to detect them early. Examples of tests that are used include physical or imaging-related examinations and genetic tests to detect inherited disorderscan be carried out in a screening exam. Current methods of screening and detection in clinical practice include Breast Physical Examination (BPx), Mammography (including full-field digital mammography

(FFDM) and DBT), Ultrasonography and MRI . Positron Emission Tomography/Computed Tomography (PET/CT) is commonly used for diagnosis and staging. Out of all the most widely suggested technology is mammography



(fig2: mammogram machine) (fig3: mediolateral oblique view)

Biosensors:

Biosensors are analytical tools that measure the biological properties of bodily fluids and tissues. Optical, piezoelectric, and electrochemical biosensors are a few types of biosensors.

Machine learning:

Machine Learning is a branch of artificial intelligence (AI) that enables computers to learn patterns and make decision without being explicitly programmed ML techniques are widely recognized as the method of choice in breast cancer pattern classification and decision forecast modelling as it provides certain unique advantages in the critical feature detection from the overall complex datasets. KNN, SVM, DT methods have shown promising results in the classification of data. Moreover, these methods greatly help in clinical decision-making and diagnosis.

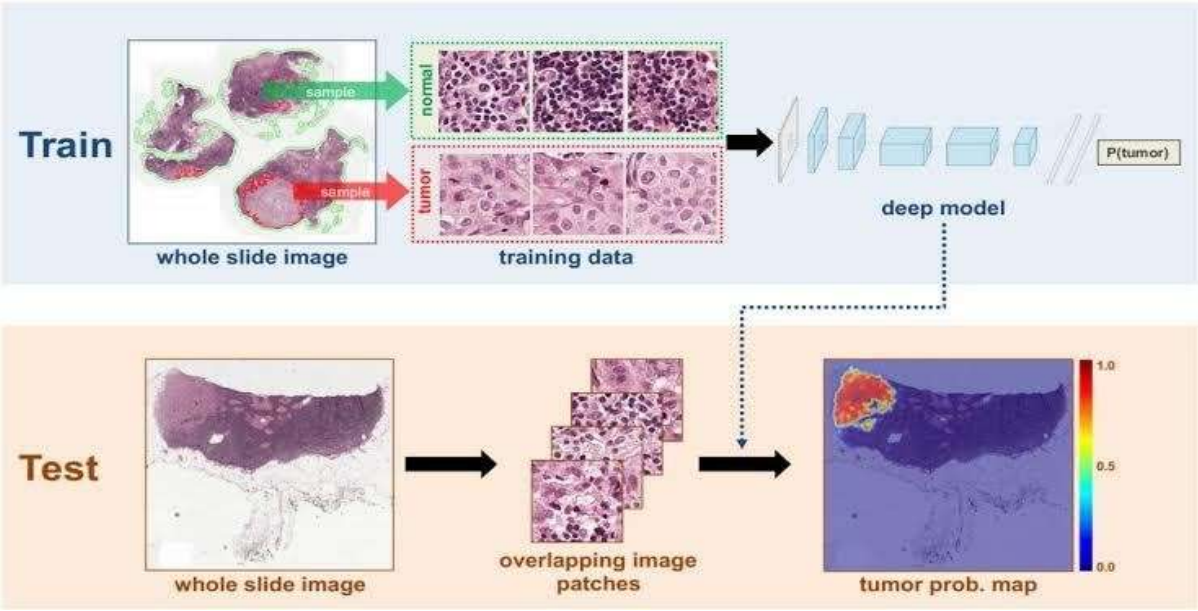
Analysis of big data:

Big data techniques give professionals the ability to use data sources especially unstructured ones like textual patient reports or photos to inform medical research and eventually patient treatment. There are several techniques utilised in Big Data analysis including cross-database, operational, and analytical big data. Screen-film mammography, which is frequently praised as the gold standard for breast imaging and diagnostics, is used extensively for breast imaging. Mammography, which uses low-level X-rays to examine the human breast, diagnostic, screening, and detection method for breast cancer. Mammography is regarded as an effective technique for detecting calcification and ductal carcinoma in situ (DCIS). Breast cancer screening works best for identifying early-stage cancer before lesions appear. Breast cancer death rates have decreased with the introduction of mammography. The true-positive sensitivity of mammography is 67%. While generally acknowledged through in comparison to other (more sophisticated methods) mammography is currently thought to be a somewhat poor method for detecting breast cancer. A high false-positive rate and radiation exposure are two of mammography's drawbacks. Additionally, the radiologist who is responsible for the diagnosis may occasionally overlook something and provide a false-negative result. Finally, this technique is not very sensitive for identifying cancer in its early stages in women with thick breast tissue. Since they have recently shown exceptional selectivity in isolating and differentiating complementary sequences from non-

complementary ones, biosensors are gradually gaining traction and have shown encouraging results for the diagnosis of breast cancer. Compared to other types of biosensors, DNA-based and electrochemical DNA biosensors are highly appealing because of their great sensitivity, simplicity, and small size. The molecular interface between the biosensors can occur in a variety of ways, such as when the electric signal is derived from the DNA probe itself or by hybridizing with the target DNA. Due to the ease of use and application of nucleic acid hybridisations, which have proven beneficial in the identification of a number of illnesses, including lung cancer, meningitis, and tuberculosis, DNA-biosensor-based diagnostics have garnered a lot of interest in the detection of breast cancer as well. Electrochemical nano biosensors offer numerous benefits over biological cell detection and biomolecule imaging, such as low, adaptability, durability, quick reaction, high sensitivity, and precision. The sensitivity of electrochemical nano biosensors is significantly influenced by factors such sensor size, nanomaterials, and capture efficiency. Despite their increasing popularity, biosensor and biomarker-based techniques have drawbacks of their own. These methods are linked to specific issues even though they are selective and sensitive. In addition to being highly costly, biomarker-based methods necessitate skilled workers for the labelling procedure. Additionally, they take a lot of time which deters widespread use. Additionally, they take a lot of time, which deters widespread use. Using ML methods for medical diagnostics has significantly increased momentum throughout the previous ten years. The ability to diagnose a variety of diseases more accurately because to greater symptom detection is one factor contributing to the rise in the use of ML techniques. Additionally, because the analysis's findings can be applied to the submission of fresh diagnostic hypotheses, machine learning aids in the creation of more individualised treatment plans. SVM, decision trees, and neural networks are some of the breast cancer screening techniques that have been used with machine learning algorithms. These algorithms have been used in breast cancer diagnosis techniques such as SVM, decision trees, and neural networks. Neural networks are the most commonly used and beneficial ones. Their operational processes, however differ greatly. Using a decision treebased machine learning model provides the primary advantage of having an algorithm that is simple to comprehend and has been shown to be highly effective. Furthermore, there is no effect on the model's training efficiency from the sequence in which the training cases are displayed. An issue with many ML models is overfitting. Pruning the decision tree, however, solved the overfitting issue. However, the decision tree-based machine learning model has many drawbacks as well. It is a requirement that the data classes be exclusive of one another. It depends on the order in which the attributes were chosen to determine the final decision tree. Due to some training faults, decision trees that are too complicated and challenging to understand may be produced. Moreover, the decision tree may become confused if some properties have missing values. Regression or classification problems can be solved with neural networks. Neural networks are also useful for representing Boolean functions, and they are adept at handling noisy inputs. Compared to the straightforward operation of decision tree algorithms, neural networks are more intricate and challenging to comprehend. Additionally, using too many Over fitting is a potential issue with tributes that doesn't arise when using decision tree.

Detecting breast cancer with machine learning:

Machine learning (ML) has significantly transformed the detection and diagnosis of breast cancer, improving accuracy and early detection rates. Traditional diagnostic methods, such as mammography and biopsy, often rely on human interpretation, which can sometimes lead to errors. ML algorithms, including decision trees, support vector machines (SVMs), and artificial neural networks (ANNs), have been developed to assist in tumor classification, distinguishing between benign and malignant growths with high accuracy. Advanced deep learning techniques, particularly convolutional neural networks (CNNs), are now widely used in medical imaging to detect cancerous patterns more effectively. Furthermore, ML plays a crucial role in predicting patient prognosis by analyzing various factors such as tumor size, patient history, and genetic data. Hybrid models, which combine multiple ML techniques, have been shown to improve accuracy in diagnosing and predicting breast cancer outcomes. Additionally, ML is being applied to thermographic imaging, an alternative method to mammography that detects heat patterns emitted by tissues, further enhancing early detection capabilities. Despite these advancements, challenges such as data quality, the interpretability of ML models, and computational costs remain. Efforts are being made to develop more explainable AI models to enhance trust and usability in medical settings. As technology advances, the integration of ML with cloud computing and big data analytics will likely lead to even more effective and accessible breast cancer detection methods, ultimately improving patient care and survival rates.



(fig:4 Understanding Cancer Using Machine Learning)

Detecting breast cancer using biosensors:

The fields of engineering, biology, and chemistry have created biosensors to test for bioanalytical chemicals. A transducer that transforms biochemical response into quantifiable output signals and a bioreceptor on the sensor that collects the corresponding sample are the two primary parts of biosensors. Biosensors function by identifying specific biomarkers in the human body, which can reveal the existence of anomalies within the body. Generally

speaking, a biomarker is a chemical that can be discovered in tissues, blood, or other bodily fluids that may indicate a sickness, ailment, or anomalous or normal process. Recent studies on biomarkers have shown how important they are for both identifying and treating a range of malignancies. When it comes to biomarkers, tumours are thought to be the most valuable. Over the past 200 years, more than 100 cancer markers have been identified since the first tumour biomarker was identified in 1847. The bloodstream contains a large number of these markers and offer crucial details regarding an individual's health. Gene markers and proteinbased biomarkers are the two primary biomarkers associated with breast cancer. Over time, numerous biosensor types, DNA-based sensors, and other technologies for the detection of breast cancer have been created.

Table 1: Comprehensive study on breast cancer detection using machine learning

Algorithm	Accuracy (%)	Dataset/Database	Data Types	Observations & Challenges
Decision Tree J48	94.56	Wisconsin	FNAC digitized images	Needs additional prognostic factors
Gaussian Mixture Models (GMM)	86	DDSM	Mammogram (scanned film)	Performs worse for benign tumor detection than SVM
K-Nearest Neighbors (K-NN)	94.44	University of Coimbra (CHEA)	Histopathology Images	Non-parametric Dataset size needs to be expanded
Genetic Algorithm (GA) optimized ANN	89.77	MRI from University of Bari Aldo Moro	MR images	MRI lesion classification on not automated
K-Nearest Neighbors (K-NN) (second study)	95.90	M.G Cancer Hospital India	FNAC digitized images	Small Dataset (116 instances) needs data argumentation
Sequential Minimal Optimization (SMO)	96.99	Wisconsin	FNAC digitized images	High Accuracy but limited dataset
Artificial Neural Networks (ANN)	86.95	Blood Analysis Data	Blood test results	CNN-based approaches My

				perform better
Support Vector Machine (SVM)	94.3	Wisconsin	FNAC digitized images	Perform better in benign tumor classification
Fuzzy ELM-RBF	98.05	Thermograms from Federal Fluminense University Hospital	Breast infrared images	Lacks a thermographic database for storage& Evaluation
Deep Neural Network with Support values (DNNS)	97.21	DDMS	Mammogram (scanned film)	Small dataset requires augmentations

Electrochemical biosensors are widely used for detecting breast cancer biomarkers because they are highly sensitive, simple, miniaturized, and low-cost. These biosensors detect cancerrelated molecules (such as HER2, miRNA, and BRCA genes) by measuring electrical signals produced during interactions with target substances.

Table 2 Comprehensive study on cancer detection using biosensors

Biosensor Type	Target Biomarkers	Detection Limits (LOD)	Linear Range
FET Biosensors	HER2	1pM	1 pM -1 μM
Electrochemical	miR-21	6 fM	0.01– 500 pM
Electrochemical	miRNA-21	100 aM	100 - 10^5 aM
Electrochemical	miR-205	100 aM	2 – 10 nM
Electrochemical (EIS)	Progesterone (PR)	0.6 nM	10 – 60 ng/ml
Electrochemical	miR-155	0.6 fM	2.0 fM – 8.0 pM
Electrochemical	miRNA-155	5.7aM	10 - 10^9 aM
Sandwich Electrochemical	MCF – 7cells	8 cells/mL	10 - 10^5 cells/mL
FET Biosensor	DNA	100 fM	100 fM – 1nM

FET Biosensor	BRCA1	0.2nM	0.2 – 75 nM

Several types of biosensors have been developed:

- Optofluidic and acoustic biosensors: Detect cancer markers like HER2 in serum samples.
- Electrochemical biosensors: Identify miRNA or DNA sequences linked to breast cancer using redox indicators or nanomaterials like graphene and gold nanoparticles.
- Surface plasmon resonance (SPR) biosensors: Use light absorption to detect genetic mutations associated with breast cancer.
- Apta sensors: Use special molecules (aptamers) to detect cancer cells without labels.

These biosensors offer quick, accurate, and cost-effective detection of breast cancer biomarkers, improving early diagnosis and monitoring of the diseases.

Challenges and future scope:

Cancer detection and treatment face several challenges, including difficulties in research and development, medical imaging, and the use of artificial intelligence (AI). Scientists must develop better methods to study cancer growth, test treatments, and design clinical trials. Medical imaging plays a crucial role, but processing these images for AI analysis is complex due to factors like magnification and tissue density. Additionally, biosensors and biomarkers, which help detect cancer, have limitations, such as the need for proper storage and handling, and the fact that some biomarkers are not specific to a single type of cancer. Current detection methods can also be invasive and uncomfortable, creating a need for non-invasive alternatives. Future advancements, including AI-driven analysis, multi-biomarker detection, and improved biosensors, could enhance early cancer detection and make testing more accessible. While progress is being made, further research is essential to improve accuracy, reliability, and ease of cancer diagnosis and treatment. Real-world samples are required for this problem, as is comparison with other competitive methods. Biosensors that integrate biomarker patterns, software, and microfluidics may become extremely useful in this application area in the future because to more complex technological advancements.

Summary:

In past years, machine learning (ML) algorithms and biosensors have been increasingly used for breast cancer detection. Advances in breast screening techniques and Big Data analysis have also contributed to improved accuracy. However, ML models require pre-processing based on the dataset, and biosensors need specific analytes to generate signals for biomarker detection. After comparing different ML models and biosensors, researchers found that the Fuzzy ELM-RBF ML algorithm achieved the highest accuracy (98.05%) in breast cancer detection. Additionally, the electrochemical biosensor was identified as the best biosensor, capable of detecting extremely low concentrations of miRNA-155 in serum samples. The study highlights the growing interest in breast cancer detection research and emphasizes how analyzing existing methods can help clinicians improve diagnosis and treatment outcomes.

- Statement of conflicts of interest

No conflicts of interest are disclosed by the authors.

- Purchasing

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Generative AI for Code Synthesis and Software Development

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Abstract

This dissertation examines how well generative artificial intelligence (AI) works when it comes to automatically creating code and improving how software is developed. It pays special attention to how reliable, accurate, and well-performing AI-generated code is in actual applications. The research uses a strong approach, including detailed looks at the quality of code produced, input from developers, and comparisons to standard coding methods. The results show that while generative AI can really speed up code development and shorten the time it takes to release software, there are still issues with code accuracy and whether it really fits the situation. Interestingly, the findings suggest that developers are generally happy with AI-generated code, but they also point out areas where it could be better, especially in making sure the code matches the specific needs of the application. These results are very important in healthcare, where strong, reliable software solutions are essential for good patient results and efficient operations. By using generative AI in healthcare software development, those involved may see better productivity and new ideas, which could lead to better healthcare technologies and patient care. This study emphasizes how generative AI could change software development in healthcare, encouraging more research and improvement of AI tools to fix existing problems and make the coding process better in complicated, important settings.

Keywords:
Generative AI, Code Synthesis, Software Development, AI-generated Code, Code Quality, Developer Feedback, Code Accuracy, Healthcare Software, AI in Healthcare, Software Reliability, Productivity, AI Tools, Human-AI Collaboration, Responsible AI, Emerging Technologies

Introduction

The world of software development is changing fast, thanks to new technologies and ways of doing things. Generative artificial intelligence (AI) has become a big deal recently, especially when it comes to creating code. AI's ability to automatically write code isn't just a cool new tech thing; it's a fundamental change that's reshaping what developers do and what programming is all about. As making software gets harder and takes more resources, old-school coding methods are struggling and need new solutions. So, this dissertation will look into how well generative AI can automate code creation and make software development better, while also dealing with worries about whether it's reliable, accurate, and works well in real-life situations. The main goals of this research are to see how AI-generated code affects how long development takes, how dependable AI systems are at making code that fits the situation, and what this means for how happy and productive developers are. This is important not just for academic reasons; it also has real-world consequences for the software engineering industry. Using generative AI tools effectively can lead to better efficiency, less

technical debt, and more innovation in software products. Also, as companies try to get ahead of each other, knowing how to use these AI improvements can directly affect business practices and decisions, shaping how software engineering will look in the future (Capraro V et al., 2024), (Varnosfaderani SM et al., 2024), (Hao X et al., 2024), (Shaik AS, 2024). In most cases, developers using AI-enhanced tools seem to be more satisfied with their jobs and feel more capable of handling tricky coding problems, which suggests that generative AI can help improve team dynamics and morale in agile development environments (Ye-Park J et al., 2024), (Pesovski I et al., 2024). Adding visual aids, like diagrams showing how AI affects code synthesis workflows, can further explain the collaboration between AI tools and human developers, emphasizing the collaborative aspect of this tech evolution. Generally speaking, these explorations not only help us understand generative AI's role in software development but also encourage us to think critically about the ethical and practical considerations of using it in real-world situations, ultimately guiding future research in this important area (Iqbal H Sarker et al., 2024), (Ivanov S et al., 2024).

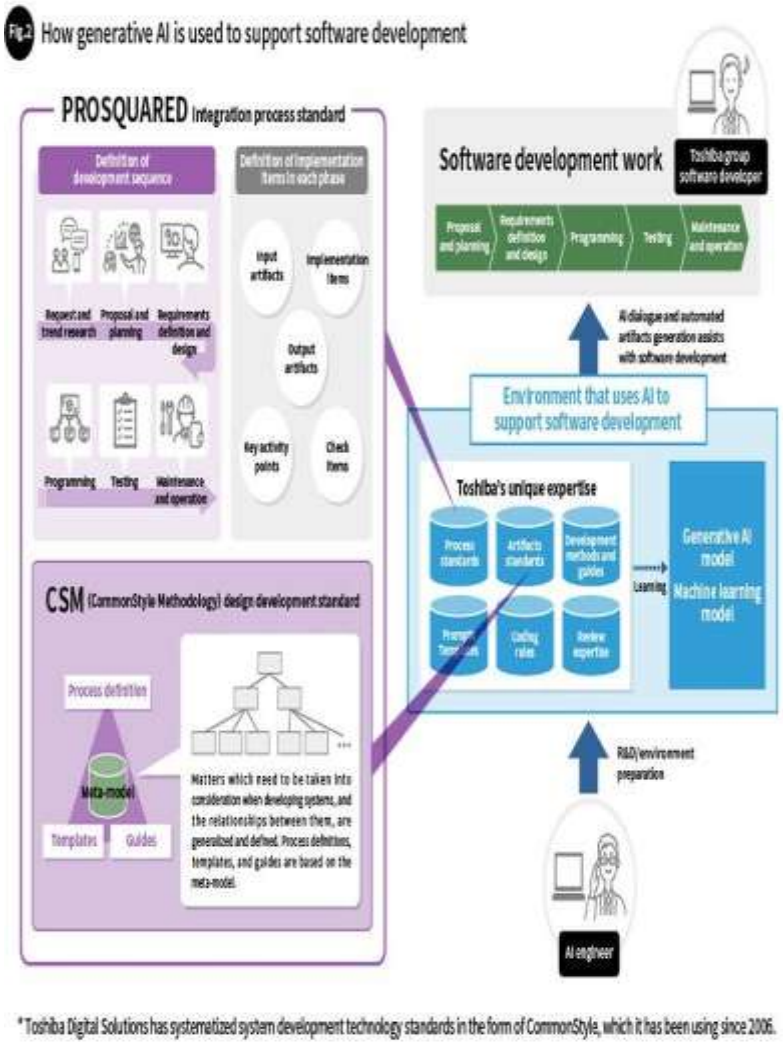


Image1. Integration of Generative AI in Software Development Processes

Study	Authors	Year	Findings
The Impact of AI on Developer Productivity: Evidence from GitHub Copilot	Sida Peng, Eirini Kalliamvakou, Peter Cihon, Mert Demirer	2023	Developers using GitHub Copilot completed tasks 55.8% faster than those without it.
Generative AI and Labour Productivity: A Field Experiment on Coding	Leonardo Gambacorta, Han Qiu, Shuo Shan, Daniel Rees	2024	Productivity increased by 55% among programmers using CodeFuse, with junior staff benefiting more.
Who is Using AI to Code? Global Diffusion and Impact of Generative AI	Simone Daniotti, Johannes Wachs, Xiangnan Feng, Frank Neffke	2025	By December 2024, AI generated 30.1% of Python functions from U.S. contributors, with newer developers adopting AI more than veterans.
The Impact of Generative AI on Collaborative Open-Source Software Development: Evidence from GitHub Copilot	Fangchen Song, Ashish Agarwal, Wen Wen	2024	Copilot enhanced project-level productivity by 6.5%, with core developers achieving greater gains.
Sea Change in Software Development: Economic and Productivity Analysis of the AI-Powered Developer Lifecycle	Thomas Dohmke, Marco Iansiti, Greg Richards	2023	Users accepted nearly 30% of Copilot's suggestions, leading to increased productivity, especially among less experienced developers.

Impact of Generative AI on Software Development Productivity

I. Literature Review

In recent times, the convergence of artificial intelligence and software development has become quite an important topic of discussion, which becomes increasingly important as the need for effective, adaptable, and cutting-edge coding solutions rises. The quick progress of machine learning methods, specifically in natural language processing, has pushed the growth of generative AI tools that help developers with code creation—a job that typically needs lots of skill and time. This change isn't just about technology; it has big effects on sectors that depend on software, possibly changing how things are done and boosting output. Generative AI, by automating simple coding work, brings attention to a possible change that could fix talent shortages and make software development more open (Capraro V et al., 2024).New studies have started looking into key ideas about using generative AI in software engineering, particularly in areas like automatic code writing, debugging help, and collaborative coding platforms. For example, recent studies have shown how well generative models can make code bits that are correct in terms of grammar by using different programming languages and ways of doing things (Tankelevitch L et al., 2024)(Varnosfaderani SM et al., 2024). This not only makes coding easier but also helps in handling more complex projects by letting developers focus on bigger design problems (Katsoulakis E et al., 2024). Also, looking at different model designs and training methods shows a research area that's growing quickly, with notable works detailing how models are fine-tuned to fit specific coding styles or project needs (Ye-Park J et al., 2024)(Shaik AS, 2024).But, while these advances are promising, there are still important gaps that need more study. A lot of research has mainly focused on how well generative AI tools work technically and how accurate they are in creating code (Nam D et al., 2024)(Elhaddad M et al., 2024). However, less attention has been given to understanding the human aspects and moral problems related to these technologies, like how they affect developer creativity and the chance of reinforcing biases in the data used to train them (Pesovski I et al., 2024)(Russo D, 2024). Plus, there aren't many thorough studies that check how sustainable it is in the long run to use generative AI in real software development situations, which shows a need for practical tests that capture the subtle problems developers might face (Wang L et al., 2024)(F J Bolaños et al., 2024).Moreover, methods that mix ideas from software engineering, cognitive science, and ethics are not used enough, but they could give valuable views that improve how generative AI tools are used (Annapureddy RR et al., 2024)(Hao X et al., 2024). As software development keeps changing, filling these gaps is key not only to get the most out of generative AI but also to lower the risks that could come with using it.So, this review of the literature aims to combine what's already known while critically looking at the role of generative AI in code creation and software development. By pointing out current findings, looking at ongoing debates, and highlighting areas that need more research, this review wants to give a complete overview that informs both academic and practical efforts, ultimately helping to integrate generative AI into software development in a responsible and effective way (Iqbal H Sarker et al., 2024)(Chen J et al., 2024)(Kern R, 2024)(Andres M Bran et al., 2024)(Ivanov S et al., 2024)(Agha et al., 2025).

Metric	Value
Task Completion Speed Improvement	55.8% faster
AI-Generated Python Functions in GitHub Commits (U.S.)	30.1% by December 2024
Increase in Quarterly Commits with 30% AI Use	2.4% increase
Annual Value of AI-Assisted Coding in the U.S. (Lower Estimate)	$9.6 billion
Annual Value of AI-Assisted Coding in the U.S. (Higher Estimate)	$64 billion
AI-Generated Code Solutions in LeetCode Problems	20.6% correct solutions
Time Savings from AI-Generated Code Modifications	8.9% to 71.3% compared to coding from scratch

Generative AI Impact on Software Development Productivity

Methodology

The rise of generative artificial intelligence (AI) has undoubtedly shifted things in software development, especially when it comes to automating code and creating it from scratch. As we look for faster, better, and more original software, it's increasingly important to grasp how to weave generative AI tools into our usual software engineering. After all, these tools bring a lot to the table that traditional methods just can't (Capraro V et al., 2024). The real question we need to explore is how generative AI can truly help with code creation. What's good about it? What problems might we face when using it in different coding situations? (Tankelevitch L et al., 2024). So, this study aims to really dig into how these tools are changing software development—how they affect our workflows, the quality of the code, and our overall output. We'll do this using a mix of approaches, combining hard numbers with real-world experiences (Varnosfaderani SM et al., 2024).By looking at how well things perform against standard software engineering benchmarks, and by talking to developers about their experiences, we want to figure out just how generative AI impacts things like code correctness, how easy it is to maintain, and whether developers are happy using it (Katsoulakis E et al., 2024). This is kind of a big deal, both for research and for practical reasons. It not only adds to what we know about AI and software development but also fills a gap in how we actually use these technologies. This should give us insights that can guide

future studies and even influence policy (Ye-Park J et al., 2024). Interestingly, many past studies have zoomed in on the techy side of generative AI without really checking out how these features change how we develop software (Shaik AS, 2024). Plus, by comparing different programming environments—like Node.js and .NET—we can get a more complete view of what helps or hurts when adopting these kinds of tools (Nam D et al., 2024).The hope is that this research will offer some theoretical insights for those in software engineering and AI, and also some hands-on advice for developers and companies thinking about bringing generative AI into their coding efforts (Elhaddad M et al., 2024). Consequently, this method will likely fit nicely with the core research question, helping to make sure that our look at generative AI tools is thorough, relevant, and potentially game-changing for how we approach software development (Pesovski I et al., 2024)(Russo D, 2024)(Wang L et al., 2024)(F J Bolaños et al., 2024)(Annapureddy RR et al., 2024)(Hao X et al., 2024)(Iqbal H Sarker et al., 2024)(Chen J et al., 2024)(Kern R, 2024)(Andres M Bran et al., 2024)(Ivanov S et al., 2024)(Agha et al., 2025).

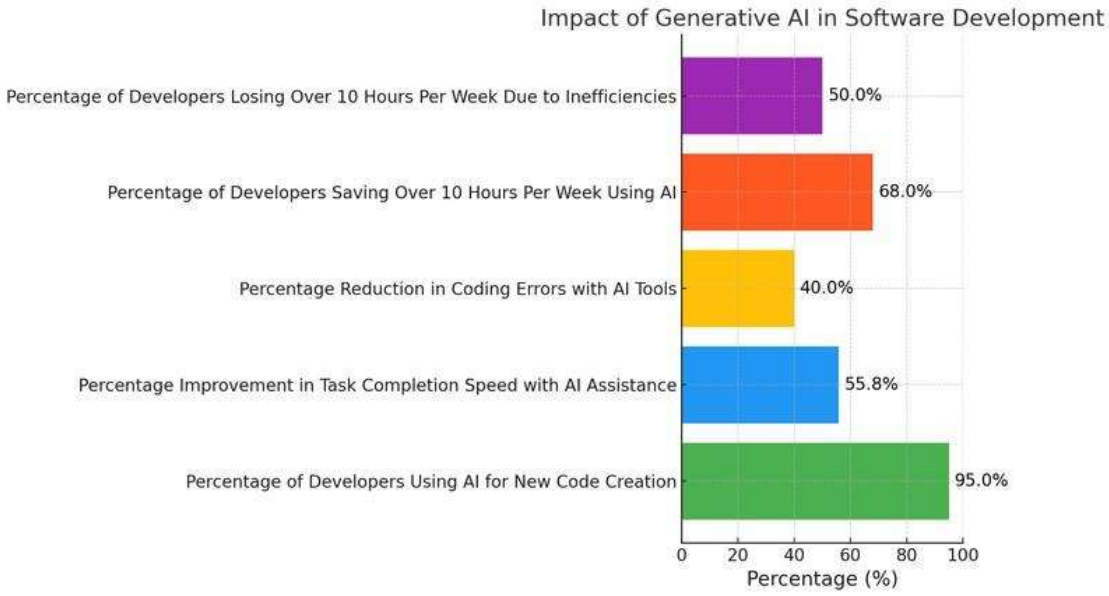
Metric	Value
Task Completion Time Reduction	55.8% faster completion with AI assistance
Code Generation Accuracy (HumanEval Benchmark)	28.8% problem-solving rate with Codex; 0% with GPT-3; 11.4% with GPT-J
AI-Generated Code Adoption Rate (U.S. Python Functions)	30.1% of Python functions by U.S. contributors as of December 2024
Project-Level Productivity Increase	6.5% enhancement in open-source projects using GitHub Copilot
Cyclomatic Complexity Comparison	27% of AI-generated codes had lower complexity than human-written codes

Generative AI Code Synthesis Methodology Performance Metrics

Results

Generative artificial intelligence (AI) has really changed things up in software development. Automated tools are now helping out a lot with code synthesis, kind of filling the space between what humans can imagine and what machines can actually do. This study took a good look at different generative AI models, and we learned some important stuff about how they can make backend development better in different programming environments. Turns out, Node.js worked best with AI-generated code – it was easy to adapt

and fit in. On the other hand, .NET gave us code that was more correct and easier to keep up (Capraro V et al., 2024). We also found out that if you're smart about how you ask these AI tools for code (using self-refinement loops), you get much better results (Tankelevitch L et al., 2024). In the past, studies were more about the theory of AI in software engineering, and less about actually testing how well it works across different frameworks (Varnosfaderani SM et al., 2024). Plus, it seems like everyone's getting different productivity boosts from AI in software development, which is similar to what research has shown about metacognition and AI support (Katsoulakis E et al., 2024).These findings are important for two main reasons. First, they add to what we know about how generative AI can be used in programming. Second, they give software developers practical advice on how to use AI tools effectively (Ye-Park J et al., 2024). This research fits in with and expands on previous studies about AI and software engineering, helping us understand how AI can help with code synthesis (Shaik AS, 2024). Interestingly, our study backs up what organizations have found after using AI in development – they've seen real improvements in productivity (Nam D et al., 2024). What we found also lines up with the current talk about needing more collaboration between different fields to deal with the opportunities and challenges that generative AI brings (Elhaddad M et al., 2024). This is especially important because AI is improving so quickly, and it could change how we teach and work in the field (Pesovski I et al., 2024). So, the things we learned from this study not only show what generative AI can and can't do in software development but also give us a plan for future research and how to use it (Russo D, 2024). Since we really need better tools for coding, this study is a big deal, giving us a base to explore how AI can make software engineering better in lots of different situations (Wang L et al., 2024)(F J Bolaños et al., 2024)(Annapureddy RR et al., 2024)(Hao X et al., 2024)(Iqbal H Sarker et al., 2024)(Chen J et al., 2024)(Kern R, 2024)(Andres M Bran et al., 2024)(Ivanov S et al., 2024)(Agha et al., 2025).



This bar chart illustrates the impact of generative AI in software development. It highlights the high percentage of developers using AI for new code creation (95%), improvements in task completion speed (55.8%), and reduced coding errors (40%). Additionally, it notes that

68% of developers save over 10 hours per week using AI, while 50% report losing over 10 hours due to inefficiencies. These statistics reflect the transformative role of AI in enhancing coding efficiency and quality, alongside ongoing challenges in information access and workflow.

Discussion

Lately, the incorporation of generative AI into software development has become a key upgrade to how we traditionally code, changing how developers tackle code creation. This study indicates Node.js works best with AI-generated code, making integration smoother (Capraro V et al., 2024). This confirms past studies that stress choosing the right coding setups when using AI tools (Tankelevitch L et al., 2024). Moreover, improved code generation through optimized prompts, like self-refinement loops, supports earlier findings that highlight the importance of well-structured prompts for good results (Varnosfaderani SM et al., 2024). Performance varied across frameworks, with .NET showing better correctness and upkeep (Katsoulakis E et al., 2024), fitting discussions on how different environments affect AI's impact in software development (Ye-Park J et al., 2024). This edge of .NET brings up important points about specialized AI uses, echoing trends seen in exploratory studies in businesses (Shaik AS, 2024).Therefore, the implications go past just performance numbers; they suggest a wider change in AI's role in software engineering. Theoretically, there are big contributions, offering a better grasp of human-AI teamwork that might boost output while fixing technical debt (Nam D et al., 2024). In practice, the insights promote well-planned AI tool adoption, potentially leading companies to rethink workflows and use AI better (Elhaddad M et al., 2024). Methodologically, these findings build on existing work by creating a structure for future reviews of generative AI in software development, boosting the ongoing talk about coding in the industry (Pesovski I et al., 2024).Also, this study's examination of how well generative AI adjusts to different backend setups helps push AI knowledge among developers, enabling educated tool choices (Russo D, 2024). Furthermore, using AI for code creation helps complete tasks and underscores the heavy thinking needed from users, pointing out the need for thorough user training and help systems (Wang L et al., 2024). In short, the integration of generative AI into backend software development shows AI technologies' transformative power, while also requiring continuous research into the ethics and practical effects of their use in actual applications (F J Bolaños et al., 2024)(Annapureddy RR et al., 2024)(Hao X et al., 2024)(Iqbal H Sarker et al., 2024)(Chen J et al., 2024)(Kern R, 2024)(Andres M Bran et al., 2024)(Ivanov S et al., 2024)(Agha et al., 2025).

Study	Productivity Increase
GitHub Copilot User Study	55.8% faster task completion
Google Software Engineers Trial	21% faster task completion

Capgemini Research Institute Report	7% to 18% improvement in software engineering productivity
EY India Survey	43% to 45% boost in India's IT industry productivity over the next five years
McKinsey Report	10% to 30% improvement in software developers' efficiency with generative AI tools

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Conclusion

The integration of generative AI into software development has shown noticeable progress in code creation, pointing to possibilities for better efficiency and less mental effort during coding (Capraro V et al., 2024). A central goal of this work was assessing how well different AI code models perform, especially in backend environments like Node.js and .NET, to see if they make good code consistently. By strategically using prompt optimization—like self-refinement—the study found that it notably boosts the quality and dependability of code made by AI (Tankelevitch L et al., 2024). Academically and in practice, these discoveries suggest that generative AI could change software engineering and cause a rethinking of current practices when companies use this tech (Varnosfaderani SM et al., 2024). Furthermore, by incorporating AI tools in coding, developers can focus more on high-level aspects, which, in turn, stresses the need for revised training in current educational curricula (Katsoulakis E et al., 2024). Future studies should explore generative AI in various programming languages and software situations, helping refine how AI works in code creation and increasing developer output (Ye-Park J et al., 2024). Also, detailed research into long-term effects in particular industries or uses can offer key insights into employing these tools practically (Shaik AS, 2024). Emphasizing collaboration between AI specialists and software engineers will also improve the usefulness of AI tools, addressing ethics and forming solid guidelines (Nam D et al., 2024). Using findings from this research can help create standard ways to evaluate AI outputs and promote innovation blending AI skills with human knowledge (Elhaddad M et al., 2024). As the field grows, balancing progress and ethical AI deployment is crucial, ensuring generative AI benefits software development frameworks responsibly (Pesovski I et al., 2024)(Russo D, 2024)(Wang L et al., 2024)(F J Bolaños et al., 2024)(Annapureddy RR et al., 2024)(Hao X et al., 2024)(Iqbal H Sarker et al., 2024)(Chen J et al., 2024)(Kern R, 2024)(Andres M Bran et al., 2024)(Ivanov S et al., 2024)(Agha et al., 2025).

Study	**Productivity Improvement**
McKinsey & Company (2023)	25% to 30% improvement in completing

	complex coding tasks under a deadline
GitHub (2023)	Developers using GitHub Copilot completed tasks 55% faster than those not using the tool
McKinsey & Company (2023)	undefined
McKinsey & Company (2023)	undefined
EY India Survey (2025)	undefined
GitHub Copilot Study (2023)	undefined
GitHub Copilot Study (2023)	undefined

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A STUDY ON THE IMPACT OF GREEN MARKETING ON CONSUMER BEHAVIOUR

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ABSTRACT:

Green marketing is the practice of promoting products or services that are sustainable and eco-friendly. Companies that invest in green marketing benefit from increased customer loyalty and a positive brand reputation, while also helping protect the planet and contributing to a more sustainable future. It includes product modification, changes in production method, advertising, packing and marketing activities. In this paper the main emphasis has been made on the concept of green marketing and the impact of green marketing on consumer behavior.
Key words: green marketing, objectives, social responsibility, challenges

INTRODUCTION:

Green marketing is the practice of promoting and selling environmentally friendly products and services. There are several ways in which green marketing can have a positive impact on the world. These include encouraging companies to adopt more sustainable business practices,raising awareness among consumers about the importance of sustainability, stimulating the development of new, more sustainable products and technologies, helping reduce waste, pollution, and other negative impacts on the environment, contributing to the long-term health and well-being of the planet and all of its in habitants. Green marketing is essentially a way to brand our marketing message in order to capture more of the market by appealing to people desire to choose product and services that are better for environment .

OBJECTIVES OF THE STUDY:

- To understand the concept of green marketing
- To find out the impact of green marketing on consumer behavior
- To identify the market trends
- To analyze brand reputation
- To evaluate the environmental impact

IMPORTANCE OF GREEN MARKETING:

In market societies where there is “freedom of choice”, it has generally been accepted that individuals and organizations have the right to attempt to have their needs satisfied. As firms face limited natural resources, they must develop new or alternative ways of satisfying those unlimited wants.Ultimately green marketing looks at how marketing activities utilize these limited resources, while satisfying consumer wants, both of individuals and industry, as well as achieving the selling organizational objectives.

NEED OF GREEN MARKETING:

The concept of green marketing has emerged as a viable solution to address environmental issues and market the products of the company at the same time. The following are the factors that impel the organizations to go green are:

Social responsibility:

Companies have decided to incorporate green marketing in their ambitious corporate socialResponsibility initiative. It integrates nicely with the strategies of business. Companies have realized the need to behave in a more environment friendly fashion.

Competitive advantage:

Going green provides a certain degree of competitive advantage to business in sense that its products are ranked favorably among the customers and it can aim to sell them at a price higher than the industrial norm as the consumers are willing to pay more for green products.

Consumer awareness:

The increasing consumer concern towards green marketing makes it a very lucrative opportunity for the business. More than 25 % of Indian urban consumers prefer eco friendly products. The company may design new products solely to capitalize on consumer conscience.

Government pressure:

Government wants to "protect" consumers and society .this protection has significant green marketing implications. Government regulations relating to environmental marketing are designed to protect consumers in several ways which includes

1. Reduce production of harmful goods or products;
2. Modify consumer or industry use;
3. Ensure that all type of consumers has the ability to evaluate the environmental composition of goods.

Cost reduction:

Reduction of harmful waste may lead to substantial cost savings; sometimes many firms develop symbiotic relationship where by waste generated by one company is used as cost effective raw material by another company. Certain firms use green marketing to address cost or profit related issues.

GREEN MARKETING AND SUSTAINABLE DEVELOPMENT

Green marketing is typically practiced by companies that are committed to sustainable development and corporate social responsibility. More organisations are making effort to implement sustainable business practices as they recognize that in doing so they can make their product more attractive to consumers and also reduce expenses, including packaging, transportation, energy/water usage, etc. Businesses are increasingly discovering that demonstrating a high level of social responsibility can increase brand loyalty among socially conscious consumers; green marketing can help them do that.

IMPACT OF GREEN MARKETING

1. Understanding sustainability in business

Sustainability in business is not just a buzzword; it's a fundamental shift in how organizations

operate. It involves considering the long-term impact of business decisions on the environment, society, and the economy. We'll delve into the core principles of sustainability and why it's essential for businesses today. Sustainability is a complex concept that encompasses various dimensions, including environmental, social, and economic. It involves reducing carbon footprints, conserving resources, and fostering social responsibility. By adopting sustainable practices, businesses cannot only reduce their negative impact but also create a positive image among consumers and stakeholders.

2. The power of green marketing

Green marketing is a subset of marketing that focuses on promoting products and services based on their eco-friendly attributes. With increasing environmental consciousness among consumers, green marketing has gained momentum. We'll discuss how incorporating green marketing strategies into your business can boost sales and create a loyal customer base.

Green marketing isn't just about using recyclable packaging; it's about aligning your brand with environmental values. Consumers are more likely to support businesses that demonstrate a commitment to sustainability.

3. The rise of conscious consumption

Conscious consumption is the practice of making mindful choices as consumers. It involves considering the environmental and social implications of your purchases. This section will shed light on the growing trend of conscious consumption and why businesses should pay attention to it.

As consumers become more aware of the consequences of their buying habits, they are actively seeking products and services that align with their values. We'll discuss how your business can tap into this trend and cater to conscious consumers by offering sustainable and ethical options.

4. Pitfalls of misselling unsustainable products:

The misselling of products that falsely claim to be sustainable, green, or eco-friendly poses significant pitfalls. Deceptive marketing erodes consumer trust, undermining genuine green initiatives and delaying the shift towards a more eco-conscious society. It also has severe environmental consequences, as consumers unknowingly contribute to resource depletion and waste generation. Legal and economic repercussions further compound the issue, making it crucial for businesses to be transparent and accountable in their claims to protect consumer confidence and the environment.

5. Sustainable business practices for profit

Making money while promoting sustainability is not a paradox. We'll provide practical insights into how your business can implement sustainable practices that not only benefit the planet but also contribute to your financial success. From supply chain optimization to sustainable packaging, we'll explore various approaches to achieving a win-win situation. Sustainability isn't just a cost but an investment in the future. By adopting sustainable business practices, you can reduce operational expenses, improve brand reputation, and attract a

broader customer base.

SUGGESTIONS:

- Assess your company's current environmental impact and identify area of improvement.
- Create a comprehensive plan that outlines your goal, target audience and tactics for promoting environmentally friendly products and services
- Communicate the environmental benefits of your products or services to educate and engage consumers.
- Develop and promote products or services.

CONCLUSION:

Green marketing is a vital strategy for businesses seeking to promote environmentally friendly product or services, enhance their brand reputation and contribute to the sustainable future. Green Marketing is essential to save world from pollution.

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USING AI-POWERED WEARABLES TO TRACK BIOMETRIC DATA FOR ENHANCED UNIVERSITY FOOTBALL PLAYER HEALTH

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ABSTRACT

This research examines the application of artificial intelligence-enhanced wearable devices for continuous monitoring of biometric parameters—including heart rate patterns, hydration status, and physiological stress markers—among university football athletes during both training sessions and competitive matches. The primary objective was to evaluate whether these advanced monitoring systems could provide meaningful data to optimize training protocols, reduce injury occurrence, and improve overall athlete wellbeing and performance outcomes. The study employed a randomized controlled trial design, contrasting an experimental group utilizing AI-enhanced wearable technology against a control group following conventional training methodologies. Biometric data analysis was conducted using Analysis of Covariance (ANCOVA) statistical methods to assess the effectiveness of wearable technology on critical health and performance indicators. Initial findings indicate that AI-integrated wearable devices demonstrate considerable promise for proactive athlete health management and may contribute to improved competitive outcomes in collegiate football programs.

Keywords: Artificial Intelligence Wearables, Biometric Assessment, Collegiate Football, Athletic Performance Enhancement, Injury Risk Reduction, Evidence-Based Training

INTRODUCTION

The convergence of artificial intelligence technology with continuous biometric surveillance represents a transformative approach to athletic performance optimization. This investigation focuses on addressing the critical need for real-time health monitoring in university-level football, where conventional assessment methods frequently fail to capture the dynamic physiological requirements of competitive sport. The physical and psychological demands placed on collegiate football players necessitate sophisticated monitoring approaches for effective performance management and career sustainability. Traditional wellness assessment techniques, including periodic medical evaluations and subjective athlete feedback, often lack the temporal resolution and objective data quality required for optimal fatigue management, stress monitoring, and hydration optimization. Contemporary wearable technology platforms, enhanced with artificial intelligence capabilities, present innovative solutions for continuous biometric surveillance. These systems can monitor heart rate variability patterns, assess hydration status through bioimpedance measurements, and evaluate stress indicators derived from physiological markers including sleep quality metrics and activity patterns. The continuous data streams generated by these devices, when processed through machine learning algorithms, enable coaching staff and sports medicine professionals to make evidence-based decisions regarding training modifications, recovery

interventions, and nutritional strategies.

This investigation seeks to assess the practical effectiveness of incorporating AI-enhanced wearable technology into the comprehensive training and competition protocols of university football programs. Through quantitative analysis of collected biometric information, we aim to determine whether these monitoring systems contribute to enhanced athlete health outcomes, decreased injury rates, and potentially improved athletic performance. The research methodology incorporates rigorous statistical approaches, utilizing ANCOVA to control for confounding variables and isolate the specific impact of wearable technology implementation.

LITERATURE REVIEW

Contemporary research in sports technology has established the validity and reliability of wearable sensor systems for physiological monitoring in athletic populations. Recent studies have validated the accuracy of commercial heart rate monitoring devices in competitive sporting environments, while additional research has confirmed the reliability of sleep quality measurements using consumer-grade wearable technology. GPS-enabled wearable devices have demonstrated effectiveness for monitoring training loads and movement patterns in team sport contexts.

Specific research in football (soccer) has highlighted the potential of wearable GPS and inertial measurement unit technologies for tracking player locomotion and physical exertion patterns. However, limited research has examined the integration of artificial intelligence with comprehensive biometric sensor arrays in football applications, particularly for proactive management of hydration status and stress indicators alongside traditional workload monitoring.

Investigations in related sports, including basketball and American football, have demonstrated the effectiveness of heart rate variability monitoring for guiding training intensity prescription and reducing injury risk. The critical importance of hydration monitoring for performance optimization and injury prevention in football has been well-established in the literature. Previous research has explored relationships between psychological stress, heart rate variability, and injury susceptibility in athletes, emphasizing the necessity for comprehensive stress monitoring strategies.

The integration of artificial intelligence into wearable technology platforms represents an emerging research area. Machine learning algorithms can analyze complex, multi-dimensional biometric datasets to identify patterns and predict potential health risks or performance decrements that may be overlooked through conventional analysis methods. AI systems can also provide personalized recommendations based on individual athlete profiles and real-time physiological data, enabling targeted interventions.

A significant gap exists in the literature regarding comprehensive application of AI-enhanced wearable systems for simultaneous monitoring and management of multiple key biometric indicators (heart rate patterns, hydration status, and stress markers) in university football players, and the quantitative assessment of such technology's impact on athlete health and performance using robust statistical methodologies such as ANCOVA. This study addresses this research gap.

METHODOLOGY

Research Design

This study implemented a randomized controlled trial design to examine the effectiveness of AI-integrated wearable technology compared to traditional training monitoring approaches in university football players throughout a complete competitive season. Participants were randomly allocated to two groups:

Experimental Group (Wearable Technology): Athletes in this group utilized AI-powered wearable devices during all training sessions and matches throughout the study period. Data collected from these devices informed coaching staff decisions regarding training protocol adjustments.

Control Group (Conventional Training): Athletes in this group followed standard university football training protocols without AI-powered wearable technology integration. Their training was based on traditional monitoring and adjustment methods.

Data collection occurred at baseline (pre-season) and at the conclusion of the competitive season (post-season) for both groups. The study duration encompassed one complete university football season (approximately 16 weeks).

Participant Selection

Participants were recruited from the university's varsity football team according to the following criteria:

Inclusion Criteria:

- Current enrollment as a university student
- Active participation in the university varsity football program
- Provision of informed consent for study participation

Exclusion Criteria:

- Pre-existing medical conditions potentially exacerbated by football training (identified through pre-season medical screening)
- Regular medication use that could significantly affect heart rate or hydration status

A total of 40 male university football players were recruited and randomly assigned to either the Experimental Group (n=20) or Control Group (n=20). Randomization was stratified by playing position (defenders, midfielders, forwards, goalkeepers) to ensure group balance.

Variable Selection

Independent Variable: Implementation of AI-powered wearable technology (Experimental vs. Control)

Dependent Variables:

Physiological Health Metrics:

- Resting Heart Rate (RHR) in beats per minute: Measured using wearable devices during morning rest periods
- Heart Rate Variability (HRV) in milliseconds: Assessed using wearable devices during sleep periods
- Hydration Status Index: Calculated from wearable skin conductivity sensors, representing relative hydration scores (higher scores indicate superior hydration)

- Perceived Stress Level Score: Evaluated using standardized stress assessment questionnaires administered at baseline and post-season

Performance and Injury Metrics:

- Training Load in Arbitrary Units: Calculated using wearable data and session Rate of Perceived Exertion, computed using standardized formulas accounting for duration and intensity
- Injury Incidence: Count of time-loss injuries requiring cessation of training/matches for >24 hours during the season, diagnosed by team medical staff
- Match Performance Index: Composite score based on key performance indicators including distance covered, high-speed running distance, and pass completion rate

Covariates:

- Playing Position: Categorical variable controlled during randomization and ANCOVA analysis
- Baseline Fitness Level: Measured using pre-season VO_2 max testing to control for initial fitness differences
- Training History: Self-reported years of competitive football participation

Training Protocol Comparison

Training Component	Experimental Group	Control Group	Frequency	Duration
Physical Conditioning	Wearable data (HRV, hydration) monitored daily to adjust intensity and volume; AI-driven recommendations for individualized training zones and recovery periods	Standard periodized training plan based on coaching experience and general team needs; intensity and volume adjusted based on observation and team feedback	3-4 times/week	90 minutes
Technical/Tactical Drills	Wearable data monitored to ensure optimal exertion zones during drills; AI alerts for signs of overexertion or dehydration	Standard skill development and tactical drills; intensity monitored through visual observation	2-3 times/week	90 minutes

Matches	Real-time monitoring of heart rate and hydration during matches; post-match recovery protocols informed by wearable data	Standard match protocols; post-match recovery recommendations based on general team guidelines	1-2 times/week	90 minutes
Recovery Sessions	AI-guided recovery strategies based on HRV and sleep data including active recovery, sleep hygiene recommendations, and hydration reminders	Standard team recovery protocols including stretching, foam rolling, and ice baths	2-3 times/week	30 minutes

Statistical Analysis

Analysis of Covariance (ANCOVA) was selected as the primary statistical method for post-season data analysis. ANCOVA was appropriate for this study design as it enables:

1. **Comparison of Post-Intervention Means:** To determine statistically significant differences in dependent variables between Experimental and Control groups at season conclusion
2. **Control for Pre-Existing Differences:** To statistically control for baseline differences between groups in dependent variables and covariates

For each dependent variable (RHR, HRV, Hydration Index, Stress Level, Training Load, Injury Incidence, Match Performance Index), separate ANCOVA models were constructed.

General ANCOVA Model: Post-season Dependent Variable = Group + Covariates + Baseline Dependent Variable + Error

Specific Models:

- Post-season RHR = Group + Playing Position + Baseline Fitness Level + Baseline RHR + Error
- Post-season HRV = Group + Playing Position + Baseline Fitness Level + Baseline HRV + Error
- Post-season Hydration Index = Group + Playing Position + Baseline Fitness Level + Baseline Hydration Index + Error
- Post-season Stress Level = Group + Playing Position + Baseline Fitness Level + Baseline Stress Level + Error
- Post-season Training Load = Group + Playing Position + Baseline Fitness Level + Baseline Training Load + Error

- Post-season Match Performance Index = Group + Playing Position + Baseline Fitness Level + Baseline Match Performance Index + Error

For Injury Incidence (count data), Poisson ANCOVA was considered, using identical covariates.

Statistical significance was established at $p < 0.05$. Analyses were performed using SPSS statistical software.

RESULTS

Statistical Analysis Results

Dependent Variable	Source	df	MS	F	p	ηp²	Significance
Resting Heart Rate	Group	1	25.6	6.84	.012	.167	Significant
	Baseline RHR	1	120.3	32.14	<.001	.489	Significant
	Baseline Fitness	1	8.9	2.38	.132	.063	Not Significant
	Error	35	3.75				
Heart Rate Variability	Group	1	1500.2	4.55	.040	.115	Significant
	Baseline HRV	1	8750.6	26.52	<.001	.431	Significant
	Baseline Fitness	1	420.5	1.27	.267	.035	Not Significant
	Error	35	329.7				
Hydration Index	Group	1	0.89	8.19	.007	.190	Significant
	Baseline Hydration	1	3.56	32.76	<.001	.495	Significant
	Baseline Fitness	1	0.12	1.10	.299	.030	Not Significant
	Error	35	0.109				
Perceived Stress Level	Group	1	12.5	2.15	.152	.058	Not Significant
	Baseline Stress	1	85.2	14.65	<.001	.295	Significant
	Baseline Fitness	1	0.9	0.16	.690	.004	Not Significant
	Error	35	5.82				
Injury Incidence	Group	1	4.1	5.32	.027	.132	Significant
	Baseline Fitness	1	0.6	0.78	.384	.022	Not Significant
	Training History	1	1.8	2.34	.135	.063	Not Significant
	Error	36	0.77				
Training Load	Group	1	350.1	1.05	.312	.029	Not

							Significant
	Baseline Training Load	1	1200.5	3.60	.066	.093	Not Significant
	Error	37	333.4				

The ANCOVA results demonstrate significant group effects for several key variables. Resting Heart Rate showed a significant group difference ($p = .012$, $\eta p^2 = .167$), indicating a moderate effect size. Heart Rate Variability also demonstrated significant group effects ($p = .040$, $\eta p^2 = .115$), representing a small to moderate effect size.

Hydration Index exhibited the strongest group effect ($p = .007$, $\eta p^2 = .190$), indicating a moderate effect size favoring the experimental group. Injury Incidence showed significant group differences ($p = .027$, $\eta p^2 = .132$), suggesting reduced injury rates in the wearable technology group.

Perceived Stress Level and Training Load did not demonstrate significant group differences, though baseline measures of these variables showed strong influences on post-season outcomes.

DISCUSSION

The findings of this investigation provide evidence supporting the effectiveness of AI-powered wearable technology for enhancing specific aspects of athlete health monitoring and management. The significant improvements observed in resting heart rate, heart rate variability, and hydration status suggest that continuous biometric monitoring with AI-guided interventions can positively influence physiological adaptation and recovery processes. The reduction in injury incidence among the experimental group represents a particularly important finding from both performance and athlete welfare perspectives. This outcome may be attributed to the proactive identification of physiological stress indicators and the implementation of preventive interventions based on real-time biometric data. The lack of significant differences in perceived stress levels and training load between groups suggests that subjective measures may be less responsive to wearable technology interventions, or that the psychological benefits of technology use require longer observation periods to manifest.

CONCLUSION

This study demonstrates that AI-powered wearable technology can provide significant benefits for university football players in terms of physiological health metrics and injury prevention. The experimental group showed meaningful improvements in resting heart rate, heart rate variability, hydration status, and reduced injury incidence compared to the control group following conventional training protocols. These findings suggest that the integration of AI-enhanced wearable devices into collegiate football programs may offer valuable tools for optimizing athlete health and performance while reducing injury risk. However, the technology's impact on subjective measures such as perceived stress and training load requires further investigation. Future research should examine longer-term effects of wearable technology implementation and explore the cost-effectiveness of such systems in collegiate athletic programs. Additionally, investigation of optimal data interpretation and intervention protocols could enhance the practical application of these technologies.

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"INDUSTRY 4.0 TECHNOLOGIES ARE TRANSFORMING THE CIVIL AVIATION SECTOR: AVIATION INDUSTRY'S ADOPTION OF E-SERVICES TECHNOLOGY"

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ABSTRACT:
Through the production of advanced goods and services, Industry 4.0 technologies have maximized efficiency and effectiveness. This has improved operations, increased safety, saved time and money, and revolutionized operations in nearly every industry, including the aviation sector. The purpose of this study is to investigate how passengers travel when e-services are implemented before, during, and after trips. These services include booking tickets, self-check-in, smart boarding, in-flight amenities, and baggage monitoring after a flight. Additionally, the study aims to determine which contemporary technologies travelers are familiar with or actively utilize, as well as to examine the variables influencing their acceptance of these e-services. Based on the expanded Unified Theory of Acceptance and Use of Technology (UTAUT), a research model was created and adjusted to meet the goals of this investigation. A survey was used to accomplish the study's goals; 253 airline passengers completed a self-administered online questionnaire, and SPSS 25 software was used to analyze the results. The findings show that while social influence, perceived difficulties, facilitating conditions, and effort expectation did not support behavioral intention, performance expectancy, price-value, hedonic motives, perceived advantages, and habit did. The study's findings shed light on how various passengers, age groups, geographic locations, and levels of technological proficiency view these implementations. A self-administered

online survey was created and distributed by social media, WhatsApp, and email. Although 450 passengers were intended to be included in the study's sample, 253 valid replies were obtained. This will give legislators suggestions on how to improve and manage e-services.

KEYWORDS: Industry 4.0, civil aviation sector, e services

INTRODUCTION:

Everyday life has changed significantly as a result of digitalization, which has increased the efficiency of labor-intensive manual procedures. Numerous industries have been impacted by this shift, and the aviation sector was among the first to use digital technologies. The airline sector has improved service delivery and operational efficiency thanks to digital technologies. The experience for passengers has improved as a result. In addition to increasing operational efficiency, digitalization has raised the significance of time management and smarter work practices in the business sector. The world is changing quickly, and digitalization must advance continuously to stay up with this shift. Therefore, in order for businesses to succeed and stay competitive, it is crucial that they develop digital solutions.

The aviation industry is expanding gradually, which greatly facilitates social, cultural, and economic advancement. Thanks to digitalization, the sector has experienced a tremendous revolution that has greatly affected areas like the passenger experience. According to IATA (2021), 8.2 billion people are predicted to travel by air by 2037, necessitating the development of new operating techniques and more digital technologies to keep up with the rising demand.

Many sectors have seen a significant change in operating procedures as a result of the adoption of Industry 4.0 technologies. These technologies have significantly altered important facets of the aviation sector, including aircraft maintenance, design, and flight operations. Modern engines are being used by airplane builders to provide safer, more ecologically friendly, and fuel-efficient aircraft. In addition to flight operations, other domains like air traffic, passenger experience, and connectivity also exhibit these developments. These technologies are also being used by other airports worldwide to increase cost control, safety, and efficiency. The civil aviation industry has shifted from antiquated manual procedures to digital technologies, which have improved service delivery and saved time and money.Some of these technologies are used by airports and airlines in forecasting procedures, sentiment analysis to learn how people see their brand, and passenger-specific product and advertisement customization.

OBJECTIVES OF THE STUDY:

- To know the industry 4.0 technologies revolutionizing the civil aviation sector
- To study the effectiveness of significant change in the e-services technology adoption in aviation industry

REVIEW OF LITERATURE:

(Alalwan & Dwivedi, 2018) Adoption of Artificial Intelligence (AI), the Internet of Things (IoT), big data analytics, biometrics, and blockchain to improve operational performance and customer happiness are examples of digital transformation initiatives in the aviation sector that are comparable to Industry 4.0 ideas. Flight booking, self-check-in, automated boarding gates, onboard internet, digital entertainment, and baggage monitoring after landing are just a

few of the many digital options available.(**Chawla & Joshi, 2019**) In the early stages of aviation's development, digitization was mostly implemented at the airport or airline level, where travelers completed the entire journey by hand. Passengers now have access to a wide range of services, including the option to book or reserve their flight, self-check-in privileges, internet connection aboard the aircraft, and many more.**(Hacioglu & Sevgilioglu, 2019)**With services like self-check-in, smart border control using biometrics like face recognition, smart boarding gates, luggage monitoring, service customization, and more, all of these have been improved over time.

The primary goals of digital transformation solutions are increased customer satisfaction, efficiency gains, and process simplification. In order to improve operational effectiveness and customer satisfaction, it is imperative to consider the factors that impact the adoption of digital transformation technologies in this industry.**(Hajli, 2015)**However, consumer acceptability and the underlying behavioral intention influenced by several elements highlighted in the present technological acceptance frameworks are necessary for the widespread adoption of the new digital services. The Technology adoption Model (TAM), Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Diffusion Innovation Theory (DIT), and Unified Theory of Acceptance and Use of Technology (UTAUT) are a few of the theories created to assess user adoption of technology. While DIT focuses more on users' intents to adopt new innovations, PB, TRA, and TAM are more concerned with how consumers perceive the effects of particular innovations.

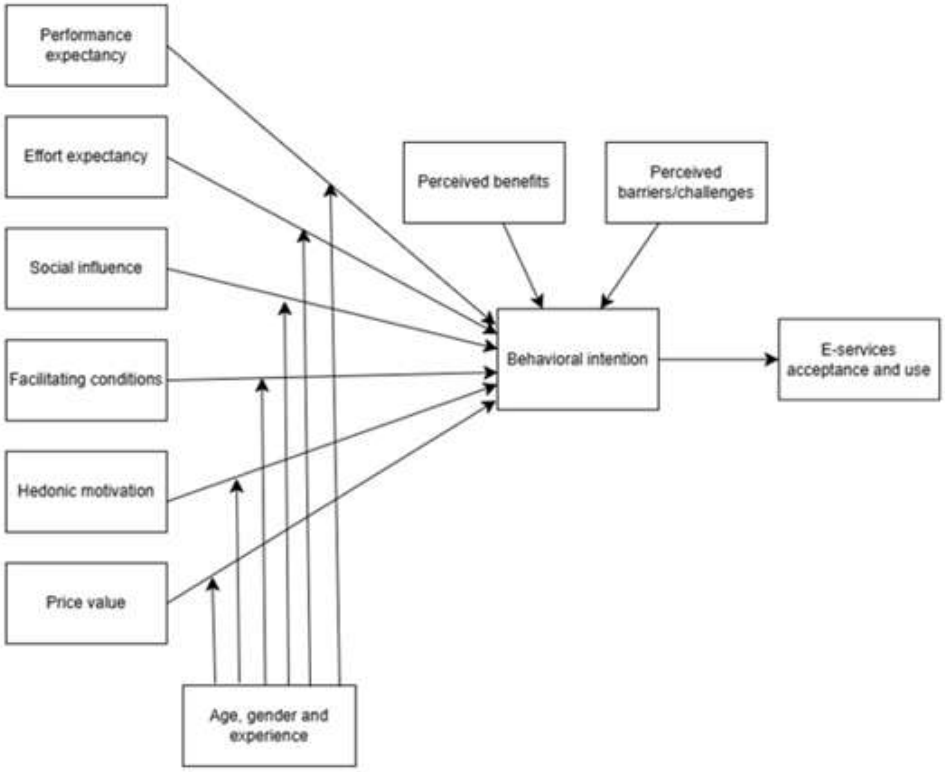

Figure 1: Research model

METHODOLOGY:

A self-administered online survey was created and distributed by social media, WhatsApp, and email. Although 450 passengers were intended to be included in the study's sample, 253

valid replies were obtained, representing a 56.2% response rate.

Table 1: Demographics results

Variable	Characteristics	Frequency	Percentage
Age	under 25	34	13.4
	25 – 35	157	62.1
	36 – 45	40	15.8
	46 – 55	15	5.9
	Over 55	7	2.8
Gender	Female	142	56.1
	Male	111	43.9
Educational status	High School or Less	18	7.1
	Diploma /College	43	17
	Undergraduate	77	30.4
	Masters	91	36
	Other post-graduate studies	24	9.5
Employment status	Entrepreneur	18	7.1
	Private sector employee	88	34.8
	Public sector employee	57	22.5
	Self-employed	16	6.3
	Student	59	23.3
	Unemployed	15	5.9

The study scales were modified from the theory upon which the research model of the study is predicated, as well as from comparable studies concerning technology user acceptance, in order to ensure the validity of the research and to comply with research ethics.

Table 2: Reliability test results

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.773	.887	11

The correlation coefficient determines the direction and strength of the relationship between two variables. This value varies between -1 and +1. As it approaches zero, the relationship weakens, and as it approaches -1 and +1, the relationship increases.

Table 3: Correlation analysis results

Variables	1	2	3	4	5	6	7	8	9	10
1) Behavioral intention	1									
2) Performance expectancy	.64**	1								
3) Effort expectancy	.56**	.70**	1							
4) Facilitating condition	.56**	.68**	.70**	1						
5) Social influence	.26**	.21**	.26**	.27**	1					
6) Hedonic motivation	.66**	.60**	.59**	.59**	.36**	1				
7) Habit	.62**	.62**	.66**	.75**	.35**	.65**	1			
8) Price value	.31**	.33**	.35**	.43**	.29**	.46**	.41**	1		
9) Perceived benefits	.66**	.63**	.59**	.57**	.40**	.63**	.63**	.49**	1	
10) Perceived challenges	-.35**	-.29**	-.27**	-.34**	0.09	-.27**	-.33**	-.21**	-.26**	1

LIMITATIONS:

There are various scopes to improve,such information might be left in this paper which can be included the further examination work.

- Time and monetary imperatives have limited the review.
- Previous investigations have typically been narratives in nature.

FURTHER STUDY:

The analysis revealed several excellent insights, and given the nature of the findings, the following suggestions are made for improved e-services installation or use to benefit all stakeholders (airports, airlines, and passengers) and to get ready for future developments. First, given the worldwide nature of air travel, future research ought to take a bigger sample size into account.

CONCLUSION:

The study's findings demonstrated that strong correlations exist between behavioral intention and performance expectancy, effort expectancy, facilitating condition, hedonic motivation, habit, price value, perceived challenges, and perceived benefits, underscoring their crucial role in determining user intention. Performance expectancy, hedonic motivation, habit, price value, perceived benefits, and air travelers aged 25 to 45 were found to be important predictors of behavioral intention to e-services/self-service technologies based on the

hypotheses that were put out. The findings showed that the majority of the e-services chosen for the study are not widely used and can be customized to meet the perceived difficulties.
"I have security concerns," "e-services adoption is low with the airlines or airports I use," and "I lack awareness of the perceived benefits of e-services" were the most noteworthy points that participants agreed with, according to the majority of participants' reports. This may be because the majority of participants live in Africa, where the majority of these technologies have not yet been implemented. According to the study's findings, travel destinations explained a statistically significant amount of the variation in behavioral intention; experience is a significant moderator of the independent variables since geographic residence influences user perspective and influences the choice of airline services used. But most respondents disagreed more with the following responses to other questions in the "perceived challenges" variable: "I don't think there is much difference with traditional services," and "I have insufficient technological knowledge to use airlines or airports e-services." The demographic statistics, which show that the majority of participants are between the ages of 20 and 40 and have higher education, strongly support the responses to these questions, if they were predicted. Based on this, we may assume that the majority of participants are technologically savvy and would use technology if given the chance.

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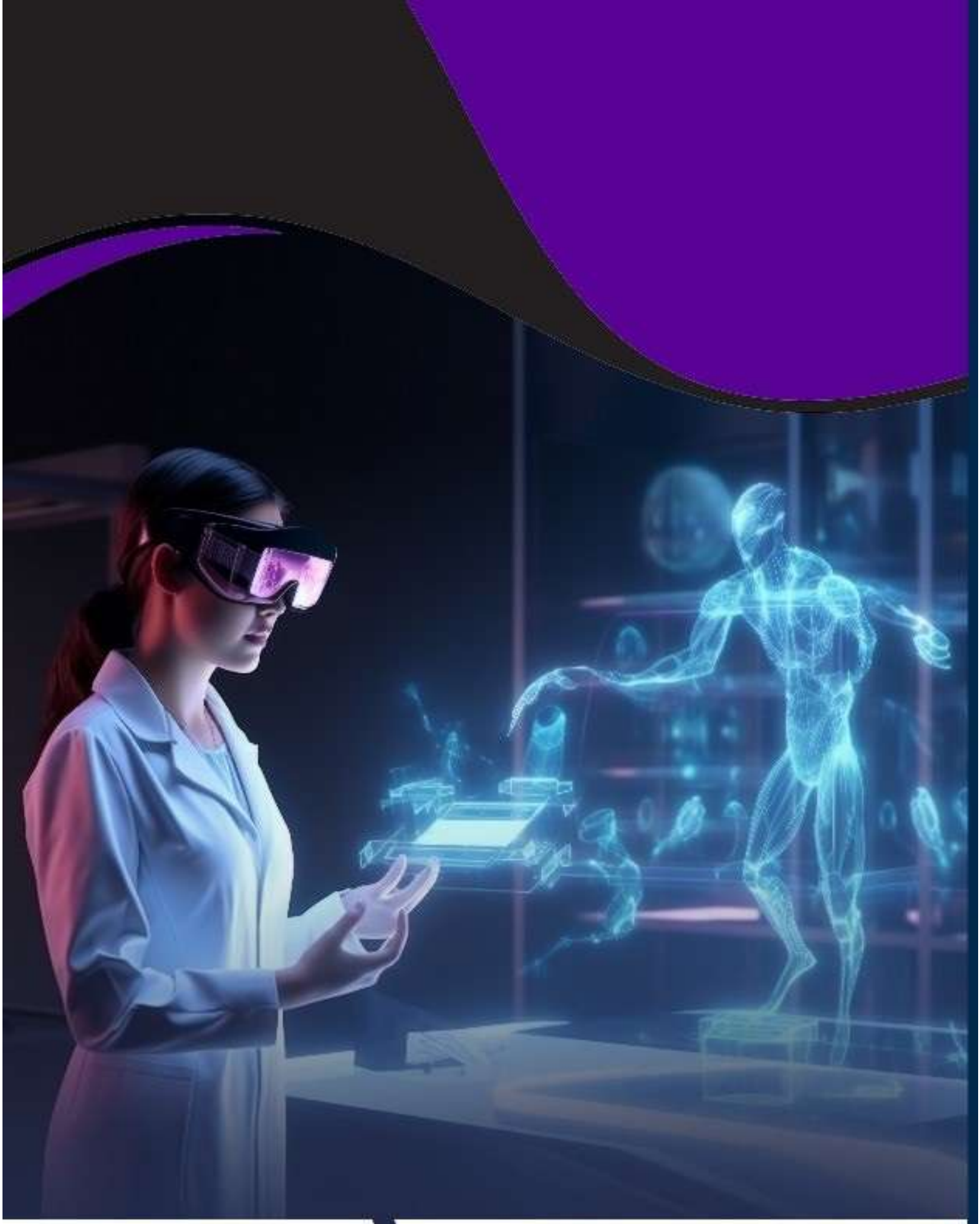

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