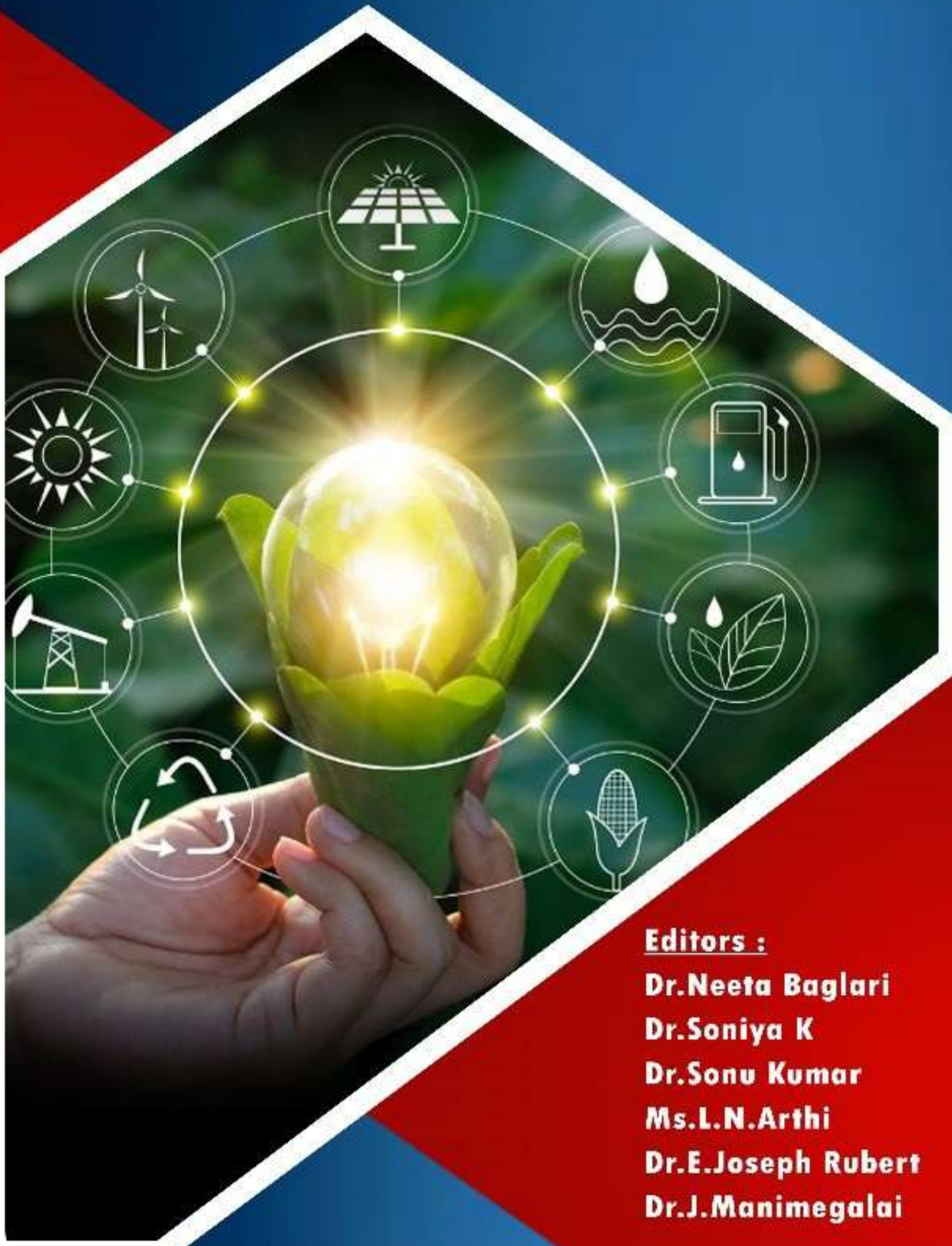
SHODHSPITIVALLEY: MULTIDISCIPLINARY RESEARCH IN TECHNOLOGICAL INNOVATION FOR SUSTAINABLE DEVELOPMENT



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PERFACE

The pursuit of sustainable development has become a global priority as societies face mounting challenges posed by climate change, resource depletion, and environmental degradation. In this context, technological innovation plays a pivotal role in addressing these pressing issues while fostering economic growth, social well-being, and environmental sustainability. The integration of multidisciplinary research across various fields has opened new frontiers for developing innovative solutions that balance technological advancement with sustainability objectives. This book, *Multidisciplinary Research in Technological Innovation for Sustainable Development*, brings together diverse scholarly contributions that explore the intersection of technology, innovation, and sustainability across multiple domains. The increasing demand for sustainable solutions calls for collaborative research efforts that transcend traditional disciplinary boundaries. This book serves as a platform for researchers, academicians, and professionals from various fields, including engineering, environmental science, information technology, social sciences, and management, to present their novel ideas and findings. The chapters featured in this book address a wide array of topics such as renewable energy systems, smart infrastructure, green technologies, digital transformation, circular economy models, and sustainable business practices. By integrating these diverse areas of study, the book highlights the importance of interdisciplinary approaches in shaping a more sustainable future. One of the key objectives of this publication is to emphasize the role of technological innovation as a driving force for achieving the United Nations Sustainable Development Goals (SDGs). Innovations in renewable energy, waste management, smart cities, and digital technologies have the potential to significantly reduce environmental impacts while enhancing the quality of life for communities worldwide. The collaborative efforts presented in this book demonstrate how technology can be harnessed to create sustainable solutions that address both environmental and socio-economic challenges. Furthermore, this book acknowledges that the path to sustainable development is not solely dependent on technological advancements but also requires sound policy frameworks, community participation, and ethical considerations. The interdisciplinary nature of the research presented herein highlights the interconnectedness of technological innovation, environmental stewardship, and social responsibility. Each chapter contributes to a broader understanding of how technological solutions can be designed, implemented, and scaled in ways that promote sustainability and inclusivity. We believe that this book will serve as a valuable resource for researchers, educators, policymakers, and industry practitioners who are dedicated to advancing technological innovation in support of sustainable development. The knowledge shared in these pages aims to inspire further research, foster collaborative partnerships, and contribute to the collective effort of building a more sustainable and resilient society. We extend our sincere gratitude to all the authors for their insightful contributions, as well as to the reviewers and editorial team for their dedication in ensuring the quality of this publication. It is our hope that this book will ignite new ideas, encourage cross-disciplinary collaboration, and pave the way for innovative solutions that contribute to a more sustainable future for generations to come.

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Modern Pedagogy Methods for Quality Learning and Teaching: Technological Innovations for Sustainable Development

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Abstract

This chapter examines modern pedagogical strategies and techniques meant to improve the quality of instruction in the digital era. Teachers now have more options and difficulties than ever before due to changes in educational paradigms and technological breakthroughs. The main areas covered in the brief include learner-centered approaches, blended and online learning, active learning, and the use of technology in the classroom. This chapter looks at how contemporary pedagogy and high-quality results interact in an effort to give educators and institutions useful guidance on how to adapt to and grow in the rapidly changing educational environment.

Keywords : Education, Modern methods, Online learning, Blended learning and Student engagement

I. Introduction

A. Background and Context of Modern Education

The environment in which teaching and learning take place has changed significantly in the modern educational landscape. The standards and demands on education have changed as a result of the emergence of the digital era, globalization, and societal changes. Compared with previous generations, students today bring a radically different mix of situations, learning styles, and technology proficiency to the classroom. The demand for contemporary pedagogical strategies that may successfully engage and empower students within this new educational paradigm has arisen as a result of this changing environment. Thus, this chapter is constructed with the framework and context of contemporary education in mind, taking into account the changing requirements and learning styles of today's students.

B. Significance of Modern Pedagogy

Contemporary pedagogy is an essential element of promoting high-quality teaching and learning, as well as a reaction to evolving educational conditions. Modern pedagogy is important because it can help close the gap between what is expected of students now and what is taught in past centuries. Modern pedagogy may serve the different needs of students, encourage engagement, and improve educational outcomes by placing a strong emphasis on active learning, digital resources, learner-centered practices, and innovation. In a time when

educational establishments aim for both excellence and pertinence, contemporary pedagogy techniques provide a way to fulfill these goals.

C. Purpose and Structure of the Chapter

This chapter's goal is to explore the complex world of contemporary pedagogy techniques and examine how they affect the caliber of instruction and learning. The study covers a wide range of topics, including learner-centered approaches, technological integration, online and blended learning strategies, and active learning tactics. Our goal in this chapter is to provide learners a thorough grasp of these techniques and how they relate to education. The chapter's organization makes sense, with each section building on the one before it. The historical background and pedagogical evolution will be examined first, laying foundations for contemporary methods. Then, we will examine each of these contemporary teaching components, emphasizing their fundamental ideas, effective uses, and merits for the educational ecosystem. This chapter's goal is to provide insight into the critical role that contemporary pedagogy plays in determining the caliber of education in our quickly evolving global society. By the time this investigation is through, we expect to have provided educators, organizations, and legislators with important insights into how these techniques might be used in the real world and how they can promote high-quality education in the contemporary age.

II. Modern Pedagogy in Context

A. Historical Evolution of Pedagogy

In order to fully understand the importance of contemporary pedagogical approaches, one must comprehend the historical development of pedagogy. Over the course of of centuries, pedagogy—the art and science of teaching—has seen some intriguing changes. Pedagogy has always changed to meet the demands and ideologies of the times, from the progressive education movement of the 20th century to traditional educational systems like the Socratic method. These historical advancements served as the basis for the contemporary pedagogical strategies that are under discussion today. Understanding this historical background enables us to track the development of educational theory and the ongoing search for more potent pedagogical approaches.

B. Key Challenges in Contemporary Education

Pedagogy must change in response to the numerous complicated difficulties that face modern education. The demand on education to educate students for a world that is changing quickly have increased due to factors including globalization, cultural diversity, and shifting employment markets. Difficult challenges include things like different learning styles, equal access to high-quality education, and the requirement for lifelong learning. Furthermore, the COVID-19 pandemic highlighted how crucial flexibility is to learning. These difficulties underline the necessity of contemporary pedagogy, which seeks to resolve these problems with creative and adaptable methods.

C. The Role of Technology in Modern Pedagogy

Modern pedagogy is completely dependent on technology, which is transforming both teaching and learning. Technology plays a wide range of roles in education, including those

of digital tools, online learning environments, and creative teaching techniques. It has made individualized learning experiences possible, increasing accessibility and interest in education. Furthermore, via the provision of interactive tools and the promotion of student participation, technology has enabled active learning. Technology is not only an additional tool in the context of modern pedagogy; rather, it is a catalyst for change that shapes how teachers present knowledge and how students interact with it. Technology integration will continue to be a pillar of contemporary pedagogy wherever we go, improving the caliber and efficacy of education in the digital era.

III. Active Learning Strategies

A. Definition and Principles of Active Learning

An important change in the way that education is approached is represented by active learning. Fundamentally, active learning is a teaching strategy that involves students in the process of learning and encourages their participation. In contrast to traditional passive learning, which engages students as information recipients, active learning involves students in discussions, critical thinking exercises, and application of what they have learned. This method is predicated on the idea that pupils learn best when they are actively engaged in the process of learning. Student participation, interaction, teamwork, and problem-solving are all pillars of active learning, and they all promote a deeper comprehension of the material.

B. Examples of Active Learning Techniques

Active learning strategies come in a variety of forms, tailored to fit specific learning objectives and contexts. Case studies, debates, simulations, peer teaching, cooperative group discussions, and problem-solving activities are a few examples. Flipped classrooms involve students watching videos or texts ahead of time to get ready for the lecture, and then during class, they participate in discussions and active learning activities. Active learning is greatly aided by technology, which provides tools like interactive simulations, online discussion boards, and clickers that provide immediate feedback. By encouraging students to actively engage in their education, these strategies all help them to develop critical thinking skills and a greater understanding of the subject material.

C. Benefits and Outcomes of Active Learning

There are several advantages and results to active learning. Active learning improves student retention, understanding, and problem-solving abilities, according to research that keeps coming back. Students who actively participate in the course material are more likely to retain and use the knowledge they have gained. Additionally, by supporting a variety of learning styles and experiences, active learning strategies foster a more inclusive learning environment. Additionally, students acquire useful abilities like critical thinking, communication, and teamwork—skills that companies are increasingly looking for. Teachers discover that active learning enhances the dynamic and satisfying nature of their instruction. Together, these advantages support the main objective of raising the standard of instruction and learning by developing more capable and engaged students.

IV. Online and Blended Learning

A. Definition and Characteristics of Online and Blended Learning

With its flexibility and adaptability, online and blended learning have emerged as popular educational modalities for today's students. E-learning, sometimes referred to as online learning, mostly occurs on digital platforms. It is distinguished by self-paced learning, synchronous or asynchronous interactions, and remote access to course resources. Conversely, blended learning incorporates both online and conventional in-person training. Blended learning's hybrid format enables a combination of in-person instruction and virtual participation. Both online and blended learning have the advantages of offering a large selection of digital resources, allowing for self-directed learning, and offering the possibility of customized learning experiences.

B. Case Studies of Successful Online and Blended Courses

Several case studies demonstrate the effectiveness of blended and online learning. To provide courses to a global audience, Harvard University and other educational institutions have embraced online platforms, therefore democratizing access to excellent learning. Furthermore, blended learning has been implemented by K–12 schools to offer pupils a customized education that blends in-person instruction with online courses. These examples show how these methods are efficient and scalable. These courses' success frequently depends on elements like well created course materials, engaging conversations, and strong support networks. They demonstrate how online and hybrid learning may meet the needs of a wide variety of students and produce excellent learning outcomes

C. Challenges and Solutions in Implementing Online and Blended Learning

There are some difficulties involved in implementing blended and online learning. It is imperative to address issues like the digital gap, guaranteeing student involvement, and upholding academic integrity. Providing all students with access to technology and the internet, training teachers in online teaching techniques, and establishing efficient proctoring and evaluation procedures in place are common solutions to these problems. It's also critical to create well-structured online courses that encourage communication and teamwork. Even though there are obstacles, they can be overcome with careful planning, financial support for technology infrastructure, and continuous assistance for teachers and students. To fully utilize the potential of online and blended learning to raise educational standards, one must be able to adjust to these difficulties and find solutions.

V. Learner-Centered Approaches

A. Shift from Teacher-Centered to Learner-Centered Education

The foundation of contemporary pedagogy has been a significant transition from teacher-centered to learner-centered education. In traditional education, teachers would frequently deliver material to students in a passive manner. Learner-centered models, on the other hand, acknowledge that students ought to take an active role in their education. The job of educators is fundamentally altered by this transition, as they now serve as mentors and

facilitators rather than just as information providers. With the learner at the center, learner-centered education customizes curriculum to meet each student's requirements and preferences. The improvement aims to provide a more inclusive and stimulating learning environment by taking into account the different backgrounds, experiences, and learning styles of students.

B. Personalized Learning and Its Impact

Personalized learning is one of the main benefits of learner-centered education, and it has an enormous effect on educational quality. Students can choose their own learning pathways, choose their own pace, and study subjects that match their objectives and areas of interest thanks to personalized learning. This method results in a greater comprehension of the subject matter in addition to increasing desire and engagement. Furthermore, individualized learning recognizes that every student learns differently and may need a variety of tools and approaches in order to achieve. Personalized learning helps students achieve better academic results and acquire crucial skills, laying the groundwork for lifelong learning. It does accomplished by meeting each student's unique needs.

C. Strategies for Fostering Learner Autonomy

One of the most important aspects of learner-centered education is encouraging autonomy among students. Students that possess learner autonomy are able to take charge of their own education. Establishing clear learning objectives, supporting self-directed learning, and offering resources for independent investigation are some tactics to support learner autonomy. Furthermore, encouraging critical thinking and problem-solving abilities helps students make well-informed choices regarding their educational path. Peer and teacher feedback systems that work well aid students in evaluating their development and making necessary strategy adjustments. By implementing these techniques, teachers can foster the growth of learner autonomy, fostering an environment in the classroom that supports self-directed and autonomous learners and, in the end, raises the normal level of instruction.

VI. Technology Integration

A. The Role of Technology in Enhancing Pedagogy

A fundamental component of contemporary pedagogy, technology integration serves purposes well beyond practicality. Technology improves pedagogy by giving teachers creative tools to interact with students, encourage teamwork, and present material in engaging ways. By providing interactive resources and adaptable learning platforms that are tailored to each student's needs, it makes individualized learning experiences possible. Technology also promotes greater inclusivity by supporting a range of learning methods and skill levels. Additionally, it improves the scope of education by enabling distant and asynchronous learning, which was especially important during the COVID-19 pandemic. Essentially, technology improves pedagogy by providing teachers with new opportunities to raise standards and encourage student achievement.

B. Tools and Platforms for Effective Teaching and Learning

Many platforms and tools have been developed to support efficient teaching and learning. Moodle and Canvas are two examples of learning management systems (LMS) that

act as central locations for communications, assessments, and course materials. Dynamic content delivery is made possible by multimedia materials, digital textbooks, and interactive whiteboards. For synchronous online learning and remote collaboration, web conferencing platforms like Zoom and Microsoft Teams are becoming indispensable. Furthermore, gamification platforms and educational applications include students in entertaining and interactive learning activities. These platforms and tools give teachers the ability to monitor student progress, change up their teaching strategies, and give insightful feedback—all of which contribute to raising the standard of instruction.

C. Digital Literacy and Digital Citizenship

It is now essential to promote digital citizenship and literacy as technological integration increases. Digital literacy include not just using digital tools but also assessing online content critically, protecting one's online identities, and utilizing technology in an ethical manner. On the other hand, responsible and polite behavior in the online community is the focus of digital citizenship. In order to teach children how to use technology safely and morally, educators are essential. By imparting these abilities and principles, students are better prepared to take use of technology's advantages and develop into responsible digital citizens. As a result, learning becomes safer and more knowledgeable online, improving the standard of instruction by equipping students to be responsible digital citizens in a world that is becoming more interconnected by every moment.

VII. Assessment and Feedback

A. Modern Assessment Methods

The focus of modern pedagogy is on moving away from traditional systems of evaluation, which mainly rely on standardized testing and summative, high-stakes exams. Rather, it promotes a wider variety of evaluation methods intended to evaluate students' ability to apply their knowledge and abilities in addition to what they already know. Authentic assessments, project-based assessments, performance assessments, and rubrics are examples of contemporary assessment techniques. As part of a performance evaluation, students must solve a real-world problem or complete a task to show off their knowledge or abilities. In project-based evaluations, students demonstrate their understanding by working together on a large-scale project. Genuine evaluations measure pupils' competencies in scenarios that replicate actual world contexts. Rubrics offer clear and uniform standards for assessing student work, facilitating impartial and constructive evaluation.

B. Formative and Summative Assessment in Modern Pedagogy

Formative and summative assessments are important, and modern education acknowledges this fact. Formative evaluations take place during the learning process and have the goal to give teachers and students continuous feedback. They are diagnostic in the sense that they assist teachers in understanding out what the pupils are learning and where they might be having difficulty. Peer evaluations, class discussions, quizzes, and polls are examples of formative assessments. Contrarily, summative assessments are usually evaluations given at the conclusion of a unit or course. They usually hold greater weight when it comes to grading and are intended to gauge overall learning. Major projects, research

papers, and final exams are examples of summative assessments. In order to both demonstrate students' general understanding and competency at the end of an instructional session and to ensure that they receive timely feedback to improve their learning process, modern pedagogy combines formative and summative assessments.

C. Providing Timely and Constructive Feedback

Giving prompt, helpful feedback is essential to improving the learning process in modern education. Feedback for students should be clear, insightful, and practical, emphasizing both their strengths and areas for growth. It should be sent out as soon as possible so that students can use it for their current assignments. Feedback can also come in a variety of formats, including written remarks on assignments, audio or video comments, or in-person conversations. Technology has an impact as well since it can make providing feedback more effective. Giving constructive criticism enables students to recognize their areas of strength and development, which inspires them to go deeper into the material and take charge of their education. Through the integration of contemporary methods for evaluation and feedback, educators can cultivate a more efficient and stimulating learning environment, thereby augmenting the general standard of education.

VIII. Professional Development for Educators

A. Continuous Learning for Teachers

In contemporary education, continuous development is essential to effective instruction. Teachers are aware that in order to deliver high-quality instruction, they need to be up to date on the most recent findings, innovations in technology, and pedagogy. Teachers who are driven by continuous learning update their knowledge and abilities on a regular basis, attend conferences, seminars, and workshops, and work for advanced degrees or credentials. It also includes evaluating and reflecting on oneself to find areas where one needs to improve. By demonstrating a dedication to lifelong learning, educators not merely set an example for their students but also ensures that they remain current in their industry.

B. Training and Support for Modern Pedagogy Methods

Innovative methods are frequently used in modern teaching that teachers may not have learned in their first training. Training and assistance in the use of contemporary teaching techniques are therefore crucial. Workshops and professional development programs assist instructors in becoming proficient in learner-centered approaches, technological integration, and active learning strategies. Teachers who enroll in these programs are also exposed to the most recent pedagogical research and best practices. After receiving initial training, mentorship and peer collaboration provide crucial continuous support that enables educators to share ideas and receive direction on how to effectively use these strategies.

C. Impact on Teacher Effectiveness

The effectiveness of teachers is directly impacted by professional development for educators. Teachers who engage in ongoing professional development and obtain training in contemporary pedagogy techniques enhance their ability to adjust to the changing requirements of their pupils and the educational environment. They are therefore better equipped to design dynamic and engaging learning environments, meet the varied

requirements of their students, and match their pedagogy with the objectives of contemporary education. Consequently, this results in better student outcomes since children gain from the increased efficacy of instruction provided by teachers who are dedicated to their own professional development.

IX. Quality Outcomes and Measuring Success

A. Defining Quality Learning and Teaching

In contemporary pedagogy, defining excellent instruction and learning is an essential first step. The development of critical thinking and problem-solving skills, the acquisition of knowledge and skills, and the readiness of students for difficulties they will face in the real world are all important components of quality education. Engaging, dynamic, and learner-centered experiences that enable students to become lifelong learners are hallmarks of quality learning. On the other hand, effective pedagogical methods, the creation of a welcoming and inclusive learning environment, and the ongoing pursuit of professional development are all components of quality teaching. The extent to which students are equipped for future success in their academic and professional endeavors is a common indicator of the quality of education in the modern era.

B. Metrics and Assessment for Measuring Success

A variety of metrics and assessment instruments are used to evaluate the effectiveness of high-quality teaching and learning activities. Quantitative indicators like retention rates, graduation rates, and scores on standardized tests may be among them. Peer assessments and surveys of student satisfaction are two examples of qualitative metrics that are equally crucial. Assessments, both formative and summative, are important tools for gauging student development and learning objectives. Performance evaluations, portfolios, and rubrics can all offer comprehensive insights into how effectively students are achieving learning goals. The focus on continuous improvement in contemporary pedagogy entails continuing, flexible assessment and data-driven decision-making to raise educational standards.

C. Case Studies of Institutions with Exemplary Quality Outcomes

Case studies of educational institutions with excellent quality outcomes are very helpful in developing a deeper knowledge of what effective teaching and learning actually look like. These establishments serve as examples of how excellent teaching combined with a dedication to excellence may produce remarkable outcomes. Case studies can highlight colleges with strong graduation rates and a track record of placing alumni in successful jobs. They may also showcase K–12 institutions that have effectively incorporated technology and learner-centered strategies to establish more captivating and productive learning environments. Furthermore, looking at global examples of educational systems that routinely rank highly in terms of innovation and student achievement might provide insights into effective practices in contemporary pedagogy.

Conclusion

In conclusion up, the review of contemporary pedagogy techniques for excellent instruction and learning highlights a number of important results and ideas for teachers. Learner-centered approaches, technology integration, online and blended learning, active

learning strategies, and learner-centered approaches have the ability to empower and engage students in ways that were previously imaginable. It is imperative that educators engage in ongoing professional development to promote a culture of lifelong learning. Effective modern pedagogy also relies on adopting a learner-centered approach and giving timely, constructive feedback. It is essential to plan for potential challenges as we consider issues like closing the digital gap and sustaining participation in digital environments. However, there is certainly evidence that contemporary pedagogy improves education quality. As a result, there's an imperative to action for educators as well as entities to adopt these strategies, adjust to shifting paradigms in education, and get learners ready for the opportunities and difficulties of the contemporary world. By doing this, we can realize the full potential of education, giving students the best learning opportunities and equipping them with the skills they need to prosper in a society that is dynamic and constantly changing.

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Decoding Memes: A Contagious Digital Content

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Abstract

The emergence of memes as a potent communication tool in the digital age has had a profound impact on contemporary culture. Social, political, and cultural trends are reflected in memes, which are usually funny pictures, videos, or text that are quickly circulated. In order to understand how memes work as a type of digital information that spreads both within and outside of social media platforms, this chapter examines the phenomena of memes. In order to explore how memes generate meaning and impact collective behaviour, the chapter applies concepts from semiotics, communication theory, and viral marketing. Since memes can be readily copied and modified and frequently capitalise on current affairs, popular culture, or common experiences, they are contagious. Through the creation, sharing, or remixing of content, memes allow people to engage in a communal conversation, fostering a feeling of identity and community. The function of memes in the spread of information is also covered in this chapter, emphasising how they may be used as a platform for political, social, or ideological statements in addition to being a source of pleasure. Through the prism of digital culture, it investigates how memes subvert established media outlets, democratise content production, and challenge conventional modes of communication. Furthermore, the chapter discusses the ethical difficulties underlying memes, such as the distribution of content that is contentious or divisive, copyright violation, and disinformation. In the end, the chapter offers a thorough grasp of memes as a crucial component of digital culture, highlighting their function in forming online communities and influencing current events. Memes' viral proliferation serves as an example of how quickly digital communication is changing and emphasises the significance of user-generated content in a linked, digital society.

Index Terms: Memes, Digital Culture, Viral Content, Social Media, Semiotics, Communication Theory, Digital Communication

1.Introduction to the History of Mimesis to Internet Memes

The word *mimesis,* which has its roots in Ancient Greek philosophy, basically means *imitation* or *representation,* especially when it comes to literature, art, and human behaviour. The idea of mimesis has had a significant impact on our understanding of representation, meaning, and cultural production since its inception in the writings of Plato and Aristotle, where it was used to characterise the process by which art mimics life. It has since developed in contemporary semiotics and media theory. We follow the history of mimesis in this part, from its origins in classical philosophy to its current expression in digital culture, which leads to the emergence of internet memes.

1.1. Classical Foundations of Mimesis: *Mimesis* played a major role in philosophical debates about representation and art in ancient Greece. In his *Republic*, Plato expressed cynicism about mimesis, contending that the way art imitated reality was only a shadow of ideal objects' true shapes, distorting reality. In contrast, Aristotle presented a more complex

perspective in his *Poetics*, arguing that mimesis is a necessary tool for comprehending and interacting with human experiences rather than merely a replication of reality. Aristotle believed that the audience feels catharsis through the portrayal of human deeds in tragic drama, and that this catharsis was largely due to the act of imitation.

1.2. Mimesis in Literature and Art: *Mimesis* has spread throughout history, from the fields of philosophy to the visual arts and literature. Mimetic theory was used to investigate how human life is imitated in literature, both in terms of social conventions and character behaviour. By employing mimesis techniques to depict the natural world with unparalleled accuracy, Renaissance artists such as Michelangelo and Leonardo da Vinci aimed to produce realistic depictions of the human body. In the 19th century, authors such as Marcel Proust and James Joyce offered a more contemporary and abstract interpretation of imitation and representation by portraying fragmented, subjective experiences, challenging conventional ways of mimesis.

1.3. The Rise of Modern Media and the Evolution of Mimesis: The function of *mimesis* started to change with the introduction of photography, film, and later television. In contrast to text-based forms of representation, visual media emerged as the main tool for reflecting human existence. Cinema, particularly in the 20th century, emerged as a leading medium for mimetic representation, using increasingly advanced technologies to depict reality. Mimesis was used by filmmakers such as Orson Welles and Alfred Hitchcock to create intricate stories that challenged the distinctions between illusion and reality, rather than just as a means of imitation.

1.4. The Birth of Internet Memes: The technique and experience of mimesis underwent a dramatic change in the digital age, which led to the emergence of online *memes*. The idea of mimesis, which is the copying or alteration of pre-existing cultural artefacts, is closely related to the modern meme. A viral cycle of imitation is created when internet *memes*—which are frequently marked by humour, satire, and commentary—are swiftly modified, remixed, and disseminated throughout social media platforms. Memes are democratic and participatory, in contrast to traditional forms of art or media; anybody can make, share, or alter a meme, so participating in the act of mimetic creation.

One of the most common kinds of digital mimesis nowadays is memes. They exemplify the fundamental elements of mimesis—imitation, replication, and the collaborative reworking of cultural narratives—through this quick spread and change. Internet memes frequently use humour and irony to both reflect and impact public debate, drawing on common experiences or cultural allusions. Memes provide a means for people to remark on, question, and influence social institutions and cultural norms in addition to being imitations of reality. The lines separating authorship, context, and meaning are continually shifting in this dynamic, decentralised form of mimetic expression.

1.5. From Classical Mimesis to Digital Memes: From its classical origins to its digital development, mimesis's history reveals a change in the way imitation functions in society. Internet memes have democratised mimetic techniques, making them available to a worldwide audience, whereas older forms of mimesis were frequently associated with high art and elite intellectual conversation. Memes are able to develop and spread at an

exceptionally high rate thanks to the internet's quick information sharing and viral trends. They provide insight into the collective psychology of online communities by acting as both reflections of and responses to modern society. Consequently, the online meme is an extension of the mimetic tradition, albeit one that has been tailored to the distinct opportunities and difficulties of the digital realm. Memes are a synthesis of history, technology, and culture, and they are a crucial component of the changing terrain of digital communication and social interaction, from the philosophical arguments about imitation in antiquity to the viral dissemination of digital material. The history of mimesis to online memes is examined, demonstrating how imitation—once limited to classical philosophy and traditional art—has developed into a viral digital phenomenon that profoundly influences and reflects modern culture.

The Theoretical Framework of Memes

Several interdisciplinary frameworks are used in the study of memes, especially in the context of digital culture, in order to comprehend their formation, dissemination, and social effects. In his 1976 book *The Selfish Gene*, British evolutionary biologist Richard Dawkins proposed the idea of memetics, which is central to meme theory. The term *meme* was created by Dawkins to refer to an idea, behaviour, or fashion that replicates and spreads throughout a civilisation. Building on this fundamental concept, the theoretical framework of memes combines ideas from digital media studies, evolutionary biology, semiotics, and communication theory to explain how memes operate as viral units of culture and communication in the digital age.

2.1. Memetics: The Evolution of Ideas: *Memetics* offers a biological and evolutionary foundation for comprehending the propagation of *memes*. Dawkins claims that memes multiply, mutate, and evolve in a manner akin to that of genes. Memes are spread from person to person through cultural transmission, much like genetic material is spread through reproduction. Memes undergo numerous iterations throughout time, with each replication being susceptible to *mutations* or changes that may make them more appealing or pertinent to new audiences. According to this theory, selection forces drive meme transmission, with the most *fit* memes—those that most appeal to people or fit in with contemporary cultural contexts—having a higher chance of being shared and going viral. According to Dawkins' memetic theory, memes can be viewed as *cultural replicators*, copying ideas, practices, or behaviours and changing over time to increase their chances of surviving in the collective mind. This evolutionary paradigm is consistent with the infectious nature of online memes, which flourish in an increasingly linked digital world because they are simple to spread, modify, and remix.

2.2. Semiotics and the Significance of Memes: Semiotics, the study of signs and symbols, provides an essential theoretical lens for understanding how meaning is constructed and communicated through memes. A *sign* in semiotic theory is made up of two parts: *the signifier*, which is the form or representation, and *the signified*, which is the idea or meaning that underlies it. Memes frequently combine text, images, and cultural allusions to create intricate symbols that are deciphered by context and common knowledge. According to this concept, a meme serves as a symbol that uses encoding and decoding to convey meaning.

Only people who possess the necessary cultural knowledge may comprehend the particular cultural or social significance that the visual image or word (signifier) invokes. The well-known *Distracted Boyfriend* meme, for instance, is based on the particular image of a man staring at another lady while his girlfriend disapproves, signifying a typical social situation of distraction and temptation. Even while the image is straightforward, it gains depth when paired with a message that addresses current topics like infidelity, materialism, or social conventions. In order to convey complex ideas quickly, memes frequently use preexisting symbols and preconceptions that are easy to comprehend and interpret. This semiotic method demonstrates how memes are powerful platforms for expressing political, social, and ideological commentary in addition to being entertaining content.

2.3. Communication Theory: Memes as a New Form of Social Interaction: Additional understanding of how memes influence online discussions and group discourse can be gained from communication theory. The sender-message-receiver paradigm, in which communications were sent linearly from one entity to another, was the main emphasis of communication models in the past. However, this top-down communication system is challenged by the emergence of memes, which bring more decentralised, participatory forms of contact. Memes enable peer-to-peer communication in a networked society, enabling people to produce and consume material. A feeling of collective identity is fostered among participants through the frequent sharing, remixing, and repurposing of memes. Memes' participatory aspect also fits with *User-Generated Content* (UGC) theories, which highlight how media and communication have become more accessible to all. Memes serve as the main medium for the ongoing cycle of content creation and consumption that is made possible by the internet, especially through sites like Reddit, Twitter, and Instagram. Furthermore, networked communication can be used to understand memes, which proliferate quickly through linked online communities. This is similar to the idea of viral communication, when content reaches a wider and more varied audience by spreading rapidly over the internet. The propensity of *memes* to go viral is a reflection of how social structures and traditional media no longer limit communication; rather, social networks and user participation enable it to flow freely across digital platforms.

2.4. Digital Media Studies: The Role of Platforms and Algorithms: An important context for comprehending the technological infrastructure supporting meme culture is provided by studies of digital media. Social media sites, online discussion boards, and digital tools for content production and dissemination are all part of the particular digital environment in which internet memes are found. The algorithms that decide what content is available on these sites, for example, have an impact on how memes spread. For instance, the algorithms that social media platforms like Facebook, Twitter, and TikTok use are made to give preference to content that receives a lot of likes, shares, and comments. Memes may swiftly reach enormous audiences since they are well optimised for these platforms due to their hilarious, relevant, and easily shareable character. By encouraging viral material, algorithms contribute to the propagation of memes and make them more contagious in online environments. Furthermore, when talking about memes, it is impossible to overlook the influence of platform cultures. The rules and practices for making and disseminating memes vary depending on the social media site. For instance, user-driven discussion and vote

processes on Reddit frequently generate memes, whereas challenges and trends that users can join on TikTok frequently influence memes. These platform-specific factors alter the form, meaning, and impact of memes by changing how they are produced, modified, and shared.

2.5. Cultural and Ideological Critique: Memes as Political and Social Commentary: Memes are becoming more and more popular as platforms for social and political expression as well as cultural and intellectual analysis. A comprehension of memes' function in questioning authority, disseminating political ideas, and challenging social norms is part of their theoretical framework. In movements like *#BlackLivesMatter*, *#MeToo*, and political demonstrations, memes have played a crucial role as a platform for protest and unity. Memes have the ability to challenge power systems, undermine the narratives of the mainstream media, and provide voice to under-represented groups. Memes are frequently a powerful technique for influencing public opinion because of the way they oversimplify and exaggerate complicated topics, as demonstrated by grassroots movements and political campaigns. Memes are powerful tools for ideological expression because of their capacity to swiftly communicate emotional truths, paradoxes, or inconsistencies in modern society, which enables them to captivate audiences on a visceral level.

Memes are explained by a comprehensive theoretical framework that draws from a variety of disciplines to explain their nature, dissemination, and cultural relevance. By combining ideas from digital media studies, evolutionary biology, semiotics, and communication theory, we may better grasp how memes serve as potent social commentary, cultural communication, and identity-formation tools in addition to being viral content. In a world where people are becoming more interconnected, memes are a distinctive and dynamic kind of digital expression that continues to influence how people communicate, exchange ideas, and create meaning.

Types of Memes

Memes are ever-changing reflections of comedy, society trends, and internet culture. They give people an easy way to express their feelings, ideas, and humour. Each sort of meme offers a different way for people to interact in the digital age, and they differ in their target audience, format, and purpose. Memes, whether for amusement or societal criticism, are becoming a crucial component of online communication. Memes can be grouped according to their *Focus* and *Nature*, among other criteria. A summary of how memes fall into these two groups is provided below:

3.1. Memes by Focus: These memes refer to the main theme or concept of the memes. The types of memes by *Focus* are as follows:

3.1.1. Crossover Memes: *The Crossover Memes* combine two or more different franchises or cultural allusions to produce amusing and frequently surprising combinations. They make use of pop cultural moments or the familiarity of several fandoms. A meme that combines *Star Wars* characters with a meme format such as *This is fine*, for instance, might produce humorous or sarcastic commentary regarding the current status of the *Star Wars* universe.

3.1.2. Dank Memes: *Dank memes* tend to be cryptic or nonsensical, humorous, gloomy, or purposefully low-effort. Additionally, they might be purposefully terrible, tongue-in-cheek

embracing offensive humour or online culture. *The SpongeBob Imitating the Old Man* meme, for instance, features SpongeBob posing as an elderly man and is frequently utilised for sardonic comedy or caustic comments.

3.1.3. Dark-humour Memes: *Dark Humour Memes* are humorous takes on subjects like death, disease, tragedy, or social taboos that are generally seen as morbid, sensitive, or taboo. Shock value, irony, and absurdity are frequently used by these memes to mock weighty or awkward topics. Although they may be amusing to some, they can also be contentious and offensive to those who believe the subjects are unsuitable for humour. Most people who appreciate humour that pushes boundaries or satirically examines the darker facets of life will find dark-humour memes appealing.

3.1.4. Deep Fried Memes: *Deep Fried Memes* are purposefully over-edited photos featuring distorted audio, hazy images, or exaggerated colours. The effect, which is frequently employed for ridiculous or surreal humour, gives the meme a disorganised, ostentatious look. For instance, a meme that features a badly compressed image with distorted text or audio and is frequently connected to absurd or illogical subjects for humorous effect.

3.1.5. Gendered Memes: Memes that emphasise or play with gender-related issues are known as *Gendered Memes*. They frequently draw attention to the roles, expectations, and preconceptions that come with being male, female, or non-binary. Whether supporting or contradicting mainstream perceptions of gender, these memes can humorously highlight prevalent gender conventions, experiences, or behaviours. They frequently use comedy, exaggeration, or irony to challenge how gender is portrayed in culture, celebrate gender identities, or reflect societal beliefs.

3.1.6. Hashtag Memes: *Hashtag Memes* are memes centred around hashtags, in which users link their material to a trend or issue that is going viral by using a particular hashtag. On social media sites like Instagram and Twitter, hashtag memes are frequently spotted. Examples of hashtags that become popular memes are *#ThrowbackThursday* and *#NoMakeup*, when users share material without makeup or post throwback images, respectively.

3.1.7. Nostalgic Memes: *Nostalgic Memes* have reference or evoke memories of the past, often with a sense of longing or humour about older pop culture, technology, or experiences. For example, Memes about childhood cartoons or outdated technology like floppy disks or dial-up internet.

3.1.8. Political Memes: *Political Memes* are memes frequently satirize or comment on current affairs and policy while interacting with political people, movements, or ideologies. Memes that include political figures and have amusing captions, such those about US presidents, elections, or international politics, are one example.

3.1.9. Pop-Culture Memes: *Pop-Culture Memes* are memes that focus on viral phenomena, movies, TV series, celebrities, or music. Memes that reference well-known events or include well-known people are two examples. *Distracted Boyfriend*, for instance, uses a scene to symbolise someone who is preoccupied with a recent fad.

3.1.10. Relatable Memes: *Relatable Memes* are memes that appeal to a wide range of people by highlighting common experiences or emotions. For instance, memes pertaining to relationships, work-related difficulties, or everyday irritations.

3.1.11. Religious Memes: *Religious Memes* are those that refer to, discuss, or parody religious topics, personalities, customs, or beliefs. From amusing or playful interpretations of religious ideas to more sombre contemplations of faith and spirituality, these memes can cover a wide spectrum. In order to either support or contradict the views of various religious organisations, they frequently employ religious symbols, quotations, or tales. Religious memes can be used to spread religious messages or spark debate on religious issues, but some are made for amusement.

3.1.12. Revenge Memes: *Revenge Memes* are comical representations of the idea of getting even or retaliating against someone, usually in a light-hearted or exaggerated way. The circumstances depicted in these memes usually involve people getting even with others in inventive, outrageous, or humorous ways. They frequently employ humour to examine issues of justice, retaliation, or payback, sometimes in a way that emphasises the ridiculousness or innocuousness of seeking revenge. They may also be based on real-life events, societal contexts, or imaginary settings.

3.1.13. Social Commentary Memes: *Social Commentary Memes* are used to comment or voice thoughts about social, political, or cultural topics. They frequently make a point or offer a critique by using irony or comedy. *The Last Week Tonight with John Oliver Meme,* for instance, repurposes a speech or a clip from the show to make political statements.

3.2. Memes by Nature: This is a reference to the meme's approach, tone, or style. *Memes by Nature* come in the following varieties:

3.2.1. Image Macros: *Image Macros*, one of the most popular kinds of memes, combine a picture or piece of art with a caption. The text is typically positioned at the top or bottom of the picture, and for emphasis, it is frequently bolded and capitalised. For instance, *The Distracted Boyfriend Meme*, which typically features amusing text that symbolises priorities or diversions, shows a man staring at another lady while his partner expresses disapproval.

3.2.2. Meme Challenges: Users create their own variations of a mission or topic for a *Meme Challenge*, which is frequently shared on social media. These tasks could be humorous, imaginative, or intended to encourage particular pursuits. For instance, *The Icy Bucket Challenge*, in which participants douse themselves in icy water to increase awareness of *Amyotrophic Lateral Sclerosis* (ALS).

3.2.3. Meme Stencils: Templates with fixed elements, including text blocks, characters, or captions, are called *Meme Stencils*. These are frequently employed for narrative-driven memes or recurrent joke series. Take the *Two Buttons Meme*, for instance, in which a character must make a tough decision between two possibilities.

3.2.4. Meme Templates: An existing image, video, or format that has been modified or captioned by others is called a *Meme Template*. These templates are flexible since they may be altered and reused. *The Expanding Brain Meme Template*, for instance, represents various

levels of intelligence or awareness by depicting various stages of brain growth with progressively more ridiculous imagery.

3.2.5. Narrative Memes: *Narrative Memes* use a series of pictures or text to tell a tale. They might have a predetermined structure or punchline at the end, and they might be longer than other memes. For instance, *The Mocking SpongeBob Meme* mocks someone's speech by using alternating capitalization.

3.2.6. Normic Memes: Memes that play with the idea of normalcy or what is seen conventional or socially acceptable are known as *Normative Memes.* These memes frequently make fun of or exaggerate commonplace, everyday occurrences, stereotypes, or actions that are generally accepted as typical in society. A common source of humour in Normic Memes is the subversion or highlighting of the ridiculousness of everyday, normalised objects, or the presentation of something that is so ridiculously normal that it is ironic. A Normic meme, for instance, can draw attention to a cliché or a usual attitude in a way that exaggerates it, demonstrating how certain *normal* behaviours or thoughts can be amusing or inappropriate in particular situations. They frequently examine the idea of what is considered normal in today's culture, reflecting a form of social criticism.

3.2.7. Reaction Memes: The *Reaction Memes* are intended to express feelings or reactions to certain situations. They make use of TV show or movie screenshots and face expressions. *The Surprised Pikachu Meme*, for instance, uses a startled Pikachu to convey how it feels about an unexpected result.

3.2.8. Sarcastic Memes: The *Sarcastic Memes* frequently make fun of everyday occurrences or social conventions by using irony, sarcasm, or exaggerated comments to convey a joke or point. For instance, a meme that mockingly extols failure or errors with exaggerated admiration, such as *I am such a genius!*

3.2.9. Satirical Memes: *Satirical Memes* are memes that criticize or critique social, political, or cultural topics through humour, exaggeration, or irony. For instance, memes that highlight absurdity by making fun of contemporary political personalities or social phenomena.

3.2.10. Sound Memes: *Sound Memes* are a subset of memes that use audio to express comedy, criticism, or reactions. Usually, this audio takes the shape of brief sound snippets, music, or sound effects. These sound clips are frequently shared on Twitter, YouTube, and TikTok and are frequently looped or modified for comedic effect. They can include remixes or parodies of well-known songs, lines from movies, or online trends, as well as viral audio snippets. The audio is the primary component that makes sound memes identifiable and humorous, even though they are frequently combined with graphics.

3.2.11 Text Memes: In the *Text Memes*, all of the content used is text, whether it be dialogue, jokes, or short stories. They are more accessible because they do not require any pictures or videos. As an illustration, consider *The Dad Jokes Meme*, which uses cheesy, pun-based comedy and is frequently shared on social media as brief text postings.

3.2.12. Viral Video Memes: *Viral Video Memes* are brief video snippets that either have funny text, music, or sound effects added to them or are funny in and of themselves. They are occasionally made from moments from TV series and movies or viral videos. One of the

earliest instances of viral video memes is *The Charlie Bit Me Video*, in which a newborn bites his brother's finger.

3.2.13. Voice Memes: *Voice Memes* are a subset of memes that mostly feature audio recordings of people speaking, frequently with their voices manipulated or amplified for humorous effect. Voiceovers, impressions, or scripted statements that are funny, ridiculous, or relatable are examples of these. *Voice memes*, which might include imitating accents, well-known quotations, or humorous circumstances using one's voice, are frequently posted on social media sites like Instagram, Twitter, and TikTok. To heighten the hilarity, they experiment with tempo, tone, and delivery.

3.2.14. Wade Memes: Wade Wilson, popularly known as *Deadpool* in the Marvel Comics universe, is frequently featured in *Wade Memes*, a particular kind of meme. Deadpool's irreverent humour, breaking the fourth wall, and propensity for sardonic, self-aware, or ridiculous remarks are often exploited by these memes. With amusing or relatable comments that embrace chaos, dark humour, or unexpected circumstances, *Wade memes* frequently feature phrases or imagery from the *Deadpool* films or comics. They might also make allusions to popular culture, online fads, or meme formats, using Wade Wilson's persona to heighten the humour.

3.2.15. Wholesome Memes: These memes emphasise encouragement, positivism, or feel-good stuff in general. Instead of humour or sarcasm, they are meant to offer warmth or kindness. For example, A picture of a cute animal with an uplifting message like *You are doing great!* or *Keep going, you are awesome!*

We may better understand how memes perform a variety of functions, from amusement to social criticism, and how they appeal to particular groups based on themes or tones by classifying them into categories like *Focus* and *Nature*.

Ethical and Social Implications of Memes

As a digital communication tool, *memes* are now ingrained in contemporary culture. Usually, they are amusing, visually appealing content such as texts, videos, or photographs, that go viral online. Even though *memes* are frequently regarded as amusing, they have a number of moral dilemmas and societal ramifications. Here are a few important things to think about:

4.1. The Positive Impact on Mental Health: *Memes* can benefit mental health in a number of ways, despite their light-hearted nature. They can be effective instruments for fostering relationships, relieving stress, and even fostering personal development if utilised carefully and appropriately. The following are a few ways memes can improve mental health:

4.1.1.Stress Relief and Humour as Coping Mechanism:

- ***Laughter and Endorphins:*** Memes frequently inject humour into commonplace circumstances, enabling people to laugh at the difficulties of life. Endorphins, the body's natural feel-good chemicals, are released when you laugh, and they can lift your spirits and lower stress levels. Memes that are humorous might act as an emotional reset and provide a respite from pessimistic thinking.

- ***Escaping Overwhelming Situations:*** Memes might offer a little reprieve for those who are struggling with nervousness or difficult life situations. Memes enable people to take a step back and see their issues in a more humorous and approachable manner by making fun of challenging circumstances or sharing similar experiences.

4.1.2. Community and Shared Experiences:

- ***Feeling of Belonging:*** Memes can foster a sense of belonging by allowing individuals to share relatable experiences with others. Many memes highlight common struggles—be it work stress, relationship dynamics, or everyday challenges—that people can laugh at together. This shared experience creates a sense of connection, reducing feelings of isolation.
- ***Supportive Communities:*** Meme cultures frequently emerge around certain identities or interests, such as fandoms, LGBTQ+ issues, or mental health awareness. People can find comfort in knowing that others go through similar feelings or circumstances in these encouraging and motivating environments.

4.1.3. Expression of Emotions:

- ***Venting Through Humour:*** People can express their feelings in a safe and controllable way with memes. Memes regarding anxiety, despair, or existential ideas, for instance, give people a place to talk about challenging emotions without feeling overpowered. This kind of self-expression can be empowering, providing a means of expressing feelings without facing them head-on.
- ***Emotional Release:*** People can unleash bottled-up emotions by posting or sharing a meme that encapsulates a sensation, such as delight or frustration. Memes' short, easily absorbed format provides an instant emotional release, and their frequently amusing tone helps keep people from becoming overly overwhelmed by their feelings.

4.1.4. Mental Health Awareness and Education:

- ***De-stigmatizing Mental Health:*** Memes that discuss mental health concerns, such anxiety, depression, or therapy, can aid in de-stigmatizing these subjects. They can help make discussions about mental health seem less taboo and more approachable. After coming across a meme that speaks to them, people who might have otherwise been embarrassed to talk about their difficulties may feel more at ease asking for assistance or sharing their stories.
- ***Raising Awareness:*** In an approachable and palatable way, memes can raise knowledge of coping mechanisms, self-care advice, and mental health services. These messages can swiftly reach a large audience, benefiting those who might not otherwise look for more conventional mental health information.

4.1.5. Positive Reinforcement and Affirmation:

- ***Encouragement and Affirmations:*** A lot of memes convey messages of self-compassion, encouragement, or optimism. Self-esteem can be somewhat but significantly increased by memes that contain inspirational sayings, affirmations, or messages about loving oneself. They serve as a reminder to people to look after their own mental health, unwind, and be kind to themselves.

- ***Validation of Emotions:*** A kind of affirmation can be obtained from memes that depict personal hardships. It can reassure people that they are not alone in their feelings when they see a meme that expresses what they are experiencing. One may feel less pressured to hide or perform their actual emotions as a result of this realization.

4.1.6. Creative Expression:

- ***Self-Expression and Humour as Therapy:*** Making memes is a common way for people to express themselves or even as a kind of self-therapy. Making a meme may be a fun and creative way for people to process their feelings or ideas. For some, it's a means of using humour to reframe unpleasant circumstances, making suffering or adversity seem silly.
- ***Finding Creative Outlets:*** Making and sharing memes can be a helpful way for people who are having mental health issues to express themselves. It can be an easy and enjoyable method to transform feelings, ideas, and life events into a creative endeavour that can also be therapeutic.

4.1.7. Normalization of Therapy and Self-Care:

- ***Breaking Down Barriers to Therapy:*** Memes have the power to normalise asking for professional assistance. Funny memes that make fun of therapy sessions, coping strategies, or self-care routines might inspire people to put their mental health first and see therapy as a common—even fashionable—aspect of self-improvement.
- ***Encouraging Self-Care Habits:*** Memes that encourage self-care practices, including writing, meditation, or just relaxing, might inspire individuals to take care of themselves. Those who are dealing with mental health issues may be motivated to adopt similar behaviours after witnessing others practise self-care or healthy habits.

4.1.8. Catharsis and Emotional Release:

- ***Collective Catharsis:*** *Collective Catharsis* can be provided by memes that draw attention to existential issues, common complaints, or the challenges of contemporary living. The knowledge that others go through similar feelings and difficulties can be consoling to people. People feel less alone in their struggles because to this shared release.
- ***A Humorous Outlet for Negative Emotions:*** People frequently find humour in situations that might otherwise be stressful or frustrating thanks to memes. A feeling of relief and a reduced emotional burden might result from this practice of finding humour in adversity.

4.1.9. Reducing Social Stigma:

- ***Building Tolerance and Understanding:*** Social barriers can be broken down by memes that showcase a range of voices and experiences. Memes that highlight identity, mental illness, or handicap, for instance, might foster tolerance and understanding. Memes assist lessen social stigma and foster a more accepting atmosphere for those who are struggling with mental health issues by normalising a wide range of experiences.

4.2. The Negative Impact of Memes: Despite the fact that memes have many advantages, using them can have drawbacks. Individuals, groups, and society at large may all be impacted by these possible negative effects. The following are some of the main detrimental effects of memes:

4.2.1. Reinforcement of Harmful Stereotypes:

- ***Perpetuating Bias:*** Stereotypes regarding race, gender, ethnicity, nationality, and other groups can be reinforced by memes, which frequently use simplification and exaggeration for comedic effect. Memes that make fun of someone because of their looks, attitude, or cultural customs, for instance, might help disseminate negative, one-dimensional views about particular groups.
- ***Normalization of Prejudice:*** When memes spread unchecked, they have the power to normalise negative viewpoints, trivialising important issues or making prejudices seem more acceptable. For example, by making discrimination seem amusing or socially acceptable, memes concerning racial or gender roles can legitimise it.

4.2.2. Cyberbullying and Harassment:

- ***Targeting Vulnerable Individuals:*** Cyberbullying, in which people are made fun of, ridiculed, or tormented via viral content, commonly uses memes as a technique. Because of the internet's anonymity and reach, harmful memes can spread easily and frequently cause emotional misery to their target. Serious mental health issues, such as anxiety, depression, and even suicide thoughts, can result from bullying via memes.
- ***Exploitation of Private Moments:*** Memes can occasionally be created using private photos or videos without the owners' permission. Particularly if the content is sexualised or inaccurately portrays the person, this may result in unwelcome attention, humiliation, or a privacy breach.

4.2.3. Disinformation and Misinformation:

- ***Spread of False or Misleading Information:*** Although memes are a very powerful tool for rapidly disseminating information, they may also be harmful when the material is inaccurate or deceptive. Memes have the potential to mislead audiences by oversimplifying complicated topics like political arguments or scientific facts. Memes that make false claims about current affairs, politics, or health, for instance, might aid in the dissemination of false information.
- ***Political Polarization:*** In political debate, memes are commonly employed to further particular ideas. They can be a tool for social criticism, but by demonising opposing viewpoints or oversimplifying complex subjects, they can also cause society to become more divided. if a result, there may be less opportunity for fruitful discussion and more polarisation if people only interact with information that confirms their own opinions.

4.2.4. Mental Health Impact and Emotional Distress:

- ***Promotion of Toxic Humour:*** Some forms of humour can be damaging, even though memes can be a way to relieve stress. Memes that trivialise or make fun of severe problems, such as trauma, physical impairments, or mental illness, can invalidate people's lived experiences and make it more difficult for them to feel understood or

seek treatment. People may feel ashamed of their difficulties as a result of these memes, which could further the stigma associated with mental health.

- ***Triggering Negative Emotions:*** Memes that deal with delicate subjects like social standing, body image, or personal tragedy can be upsetting for people with specific mental health issues. For instance, memes that encourage body shaming or unattainable beauty standards can have a detrimental impact on one's self-esteem and increase the risk of eating disorders or body dysmorphia.

✓ ***4.2.5. Cultural Appropriation and Insensitivity:***

- ***Disrespecting Marginalized Cultures:*** Thoughtless use of memes can lead to cultural appropriation because they frequently incorporate aspects of other cultures. This happens when elements of a culture, including language, customs, or symbols, are utilised disrespectfully or in a way that is not true to their original meaning. For instance, making fun of religious or significant iconography might be disrespectful to the culture or community from which it originates.
- ***Insensitive Humour:*** It can be disrespectful to individuals who are directly impacted when memes mock tragedies, natural disasters, or social problems. Jokes that trivialize important topics, like poverty, terrorism, or genocide, can be harmful because they downplay how severe these problems are and make those who are suffering feel ignored or denigrated.

4.2.6. Exploitation of Sensitive Topics:

- ***Trivializing Serious Issues:*** Memes that address serious topics like addiction, abuse, sadness, or death frequently trivialise real experiences. Even though comedy can occasionally be a coping mechanism, making these subjects into memes might minimize how serious these problems are and stop important dialogues or understandings from occurring.
- ***Desensitization:*** Desensitisation can result from repeated exposure to memes that minimise important issues or push divisive ideas. Individuals may grow less sympathetic or cognizant of the relevance of the subjects being ridiculed, which could result in a more indifferent attitude towards significant societal issues.

4.2.7. Privacy Violations and Consent Issues:

- ***Unconsented Use of Personal Content:*** Frequently, pictures, videos, or personal narratives are used to create memes without the participants' permission. This is especially dangerous when people's privacy is infringed upon and their photos are used to create memes that are widely disseminated without their consent. A person's reputation, profession, or personal life may be negatively impacted for some time by this.
- ***Loss of Control Over Image and Identity:*** The person who originally posted the content or the person who first appears in it loses control over how it is utilized when it gets turned into a meme. This can make people feel vulnerable, especially if the meme is changed or misrepresented in a way that is embarrassing or dangerous.

4.2.8. Normalization of Toxic Behaviour:

- ***Glorification of Harmful Actions:*** Certain memes celebrate or encourage harmful behaviours, such misogyny, violence, or drug misuse. Memes have the power to normalise undesirable behaviours and attitudes by transforming them into amusing, viral material. Memes that depict dangerous behaviours, such as binge drinking or drug use, for instance, might make these behaviours seem more socially acceptable, especially to younger audiences.
- ***Encouraging Negativity:*** Certain meme groups have the potential to create a negative and cynical society where members bond around whining, making fun of others, or dismantling social standards. This may foster an atmosphere in which unpleasant feelings, such rage or frustration, are expressed and magnified without any healthy channels.

4.2.9. Intellectual Property Issues:

- ***Loss of Creator Credit:*** The original producers of memes may not receive enough credit because they are frequently circulated extensively without giving due credit. This is especially troublesome for creators like painters, writers, and designers who depend on their intellectual property to make a living. Due to memes' tendency to spread, the original author's work is frequently misrepresented or altered without permission.
- ***Copyright Infringement:*** Memes occasionally violate intellectual property rights by using copyrighted photos, films, or other content without authorization. For creators, this can lead to moral and legal dilemmas, particularly when their work is used for profit without giving them credit.

4.2.10. Emotional Fatigue and Meme Overload:

- ***Information Overload:*** Information overload may result from the steady stream of memes, particularly during periods of political upheaval or significant world events. Constantly viewing viral content can wear people out mentally, especially if the memes are repetitious or cover serious subjects. This can contribute to burnout, stress, or a feeling of being overwhelmed.
- ***Desensitization to Important Issues:*** The public may become desensitised if significant social or political topics are frequently reduced to memes. The steady stream of memes can trivialize important subjects rather than encouraging serious conversation, which lowers people's motivation to interact with or take action on real-world issues.

Memes can be a source of self-expression, humour, and connections, but they can also have detrimental impacts on mental health, reinforce negative stereotypes, infringe on privacy, and aid in the spread of false information. These dangers emphasize the need for more accountability in the production and consumption of memes, particularly with regard to respecting others, being aware of the influence of content, and taking into account the wider societal ramifications. Promoting a more conscientious and moral attitude to the dissemination and application of memes in society is crucial as meme culture develops further.

4.3. Cultural Sensitivity and Appropriation:

4.3.1. Cultural Representation: Cultural allusions are frequently the source of memes, but when they are misused or taken out of context, they can be hurtful or offensive. For instance,

using indigenous or marginalized cultures for humorous effect may cause these cultures to become even more marginalized or misunderstood.

4.3.2. Stereotypes and Generalizations: Memes have the potential to unintentionally perpetuate negative stereotypes, particularly those pertaining to nationality, gender, ethnicity, and religion. They have the power to spread unfavourable stereotypes about particular groups of people, even when they are produced with the intention of entertaining.

4.4. Copyright and Ownership:

4.4.1. Content Ownership: It is common for memes to be circulated without giving due credit or acknowledging the rights of others. If the meme is extensively shared without attribution, the original creators may lose credit or money for their effort.

4.4.2. Exploitation: It is common for memes to be remixed, changed, and shared in ways that its original creators may not have wanted or approved of. The unapproved usage of content may raise ethical questions as a result.

4.5. Accountability and Responsibility:

4.5.1. Anonymity: Since memes are frequently disseminated anonymously or under false identities, it can be challenging to hold people accountable when they transgress moral boundaries. It is possible that those who make insensitive or dangerous memes will never face consequences for their actions.

4.5.2. Collective Responsibility: Memes are typically shared and altered by a lot of people, which causes blame to spread. It is challenging to assign blame to

4.6. Privacy and Consent:

4.6.1. Invasion of Privacy: Images, movies, or words from private people are often transformed into public content by memes without their consent. While some people may voluntarily engage in meme culture, others may feel that their privacy has been infringed upon when their picture or likeness appears in a meme, frequently without their permission or context awareness.

4.6.2. Consent and Exploitation: Sometimes people are turned into *meme celebrities* against their will, and their image is exploited in ways that might not be consistent with their beliefs or preferences. As a result, there is conflict between individual liberty and civic involvement.

4.7. Satire vs. Harmful Content:

4.7.1. Comedy as a Tool for Social Critique: Memes that provide comments on social, political, and cultural topics can be effective satirical weapons. Memes can highlight social injustices, question established power structures, and raise awareness of important issues through humour.

4.7.2. Harmful Humour: When satire trivializes important issues or makes fun of marginalized communities, it can easily cross the line into harmful content. What is meant to be hilarious can really do more harm than good by strengthening unfavourable opinions and decreasing the possibility of fruitful discussions on important subjects.

4.8. Meme Culture and Social Movements:

4.8.1. Activism: The use of memes as effective activism tools has helped disseminate ideas on gender equality, social justice, and climate change, among other issues. Because memes

are viral, they can swiftly reach a large audience, which makes them helpful for planning demonstrations or promoting change.

4.8.2. Superficial Engagement: Some detractors contend that memes can result in a shallow kind of activism. People may interact with issues in a way that feels more like a trend than sincere devotion when they use memes to show support for social causes, which can appear performative rather than substantive.

4.9. Gender and Sexuality Representation:

4.9.1. Reinforcement of Gender Norms: Certain memes still propagate negative ideas about masculinity and femininity and uphold traditional gender norms. They have the ability to simplify complicated identities into generalizations or exaggerated traits.

4.9.2. Sexualization and Objectification: The objectification of people, particularly women, may be facilitated by memes that emphasize sexualization or body image. Memes that make fun of someone's sexual orientation or appearance have the potential to reinforce negative standards of self-worth and beauty.

4.10. Digital Communities and Identity:

4.10.1. Echo Chambers and Fragmentation: Memes frequently flourish in specialised online forums where members support one another's opinions. Although this can foster a feeling of community, it also promotes the development of echo chambers that restrict exposure to different points of view. This has the potential to weaken critical thinking and increase polarisation in society.

4.10.2. Identity Formation: Additionally, memes are a way for people and organisations to create their online personas. People define themselves and their online identities as they interact with and spread particular kinds of memes. People's perceptions of themselves and other people are impacted by these personas, which can occasionally be superficial or divorced from more extensive, real-world experiences. Memes have a lot of ethical weight and can have broad societal repercussions; they are much more than just amusing online content. They can have an impact on people's mental health and general well-being, as well as reflect and shape society standards and political debate. Finding a balance between creativity and respect, humour and harm, freedom of expression and accountability is the difficult part. It will take greater awareness, sensitivity, and introspection on the part of meme producers and users to navigate these moral conundrums as meme culture develops.

The Practical Application of Memes

Memes have spread beyond social media to have innovative and useful effects on a variety of fields. Because of their relatability, humour, and viral nature, memes are being used not only as entertainment but also as marketing, communication, and educational tools. A quick overview of the various fields in which memes are used is provided below:

5.1. Marketing and Advertising:

5.1.1. Brand Engagement: Businesses utilize memes to reach younger audiences and develop viral marketing campaigns for goods and services. The relevant and hilarious quality of memes enables brands to connect with consumers more authentically, humanise themselves, and increase the shareability of their marketing.

5.1.2. Trending Topics: Brands may boost their awareness and capitalise on trends by using viral memes or current events. In order to fit in with popular culture, many firms produce meme-based material, which puts a light-hearted spin on conventional advertising.

5.2. Education:

5.2.1. Making Learning Fun: Memes are used by educators to make teachings more approachable and interesting. Memes can help students relate to the subject matter by demythologising difficult concepts or injecting fun into dry content. Memes, for example, can be used to lighten the mood surrounding challenging subjects in maths or to summarize important events in history lectures.

5.2.2. Social Media in Classrooms: Memes can be used by teachers as part of assignments or to promote debates in online classes. With the aid of memes, kids may express themselves more freely and creatively, which promotes engagement and lessens the fear associated with learning.

5.3. Politics and Activism:

5.3.1. Political Commentary: The use of memes to voice political beliefs, criticize laws, and draw attention to social issues is growing. Memes have the power to make difficult political stories understandable to a wide range of people while igniting interest and conversation.

5.3.2. Activism and Advocacy: Memes have been used by social movements to disseminate messages, rally support, and foster solidarity around issues such as gender equality, racial justice, and climate change. Urgent societal issues can be condensed into easily readable and shared formats with the aid of memes.

5.4. Psychology and Mental Health:

5.4.1. Coping Mechanism: Memes serve as a means of stress release and emotional expression. In the context of mental health, memes offer a means of emotional release and validation by enabling people to relate to their challenges. For instance, memes about sadness or anxiety could normalise discussions about mental health and lessen stigma.

5.4.2. Therapeutic Use: In order to break down emotional barriers and make therapy sessions more accessible, some therapists have begun employing memes as conversation starters, particularly with younger clients.

5.5. Entertainment and Media:

5.5.1. Movies, TV, and Music: Memes are frequently used in entertainment marketing, where they can be used as promotional content, fan tributes, or inside jokes. Memes can be used by music artists and film studios to interact with fans, advertise new releases, or generate excitement for future endeavours.

5.5.2. Fandom Culture: Memes, in which fans produce content that hilariously alludes to favourite television series, films, or personalities, are an essential component of fandoms. These memes foster groups based on common interests and foster constant communication between fans and artists.

5.6.Corporate Culture and Workplace:

5.6.1. Employee Engagement: Memes are frequently utilized in businesses to raise spirits and promote a fun, cooperative environment. Internal or office memes can be used as

icebreakers in meetings, to lighten the mood during tense situations, or to make communication more relatable.

5.6.2. Brand Voice and Internal Communication: Memes assist businesses in establishing their communication voice and tone. Memes can help keep a sense of modernity and connection with employees, whether it is through making corporate updates more entertaining or coordinating internal communication with contemporary internet trends.

5.7. Health and Public Awareness:

5.7.1. Health Education: Memes are used by public health campaigns to inform the public about vital subjects including mental health, hygiene, and vaccinations. Memes have the ability to swiftly and easily disseminate important information, particularly during emergencies like pandemics.

5.7.2. Awareness Campaigns: In order to make health hazards, safety procedures, or social issues more approachable and shareable for a wide audience, nonprofits and governmental organizations utilize memes.

5.8. Technology and Software Development:

5.8.1. Software Communication: Memes are occasionally used by developers to interact with users, particularly in online forums or tech support. Memes can disseminate updates, make fun of frequent IT issues, or streamline difficult troubleshooting procedures.

5.8.2. Coding and Programming: Memes about programming languages or typical developer problems are widespread in the computer industry. By demonstrating that others have similar problems and concerns, these memes can foster a sense of community.

5.9. Journalism and News:

5.9.1. Breaking News and Commentary: Memes are being utilised more and more in news reports to highlight particular parts of a story or to add amusement. They give journalists a more memorable and approachable method to interact with audiences and remark on happenings.

5.9.2. Shaping Public Opinion: Memes are effective means of disseminating ideas and frequently influence public perception of current affairs or contentious issues. They can help make the news more approachable by bringing a humorous element to difficult subjects, but they can provide a platform for false information.

5.10. Science and Technology:

5.10.1. Simplifying Complex Ideas: Memes can assist the scientific community in simplifying complex ideas into easily understood visual formats. This increases public access to research and facilitates the compelling communication of concepts like climate change, emerging technology, or intricate biological processes.

5.10.2. Community Building: Through the use of humour to dissolve barriers between professionals, memes help to build communities of scientists, researchers, and enthusiasts who connect over common interests and viewpoints.

Conclusion

We have examined the complex phenomena of memes in this chapter, revealing their dual nature as a source of entertainment and culture. Memes are now more than simply a passing online fad; they are an essential component of our contemporary communication environment

due to their ability to influence social, political, and private discussions as well as their viral spread across digital platforms. Memes use humour, relatability, and simplicity to simplify difficult concepts, elicit strong feelings, and create a feeling of community among a wide range of viewers. Memes have shown themselves to be effective means of communication, introspection, and transformation, whether they are used as instruments for social criticism, coping strategies for mental health, or imaginative outlets for self-expression. Memes are cultural artefacts that reflect and influence the values, struggles, and humour of our time; they are not only passing moments of humour. We must acknowledge their ability to influence, bring people together, and drive them apart as we unravel their complexity and comprehend their changing place in the dynamic digital ecology. In this era of perpetual connectivity, memes are more than just material; they are woven into the very fabric of contemporary communication, understanding, and interpersonal relationships.

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A Global Health Threat of Unsafe Food – Causes, Consequences and Solutions

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Abstract

Unsafe food is a major global health risk, leading to millions of cases of foodborne illnesses each year. This paper examines the causes of unsafe food, the consequences it has on human health, and the measures needed to prevent and mitigate its impact. By identifying the underlying factors that contribute to food safety risks, exploring the global burden of foodborne diseases, and discussing current solutions and challenges, this research paper offers a comprehensive view of the ongoing issue of unsafe food and its significant public health and economic impacts.

Keywords: Unsafe food, foodborne illnesses, food safety, global health, prevention, public health

Introduction

Food safety is a universal issue which means the assurance that food is admissible for human consumption. Food safety is used as a scientific discipline which outlines handling, preparation, and storage of food in ways that avert any food-borne illness. The hazards that make food unsafe to eat rise from bad agricultural practices, poor maintenance and hygiene in food environment, scanty preventive controls in food unit operations, misuse of supplements and chemicals, frequent recurrence of infected inputs and inappropriate storage and handling (Anonymous2021a).The Global Health Organization (WHO) estimates that unsafe food causes more than 600 million cases of foodborne diseases annually, leading to 420,000 deaths.

Food safety concerns restrict trade in global agri- food markets. As public entities and regulatory agencies impose compliance with minimum quality standards in domestic and international trade flows of fresh and processed food and beverages, NTMs, including SPS measures, can have trade and welfare effects. Thus, while several studies show that strict food standards can have a negative impact on exports, mainly for middle- and low- income countries. (Rabadan *et al* 2020). Rising incomes, increased urbanization and literacy, and a population highly tuned to international trends fueled by information technology boom are driving increased consumer priority to food quality and safety. However, a number of policy, regulatory, infrastructural and institutional obstacles need to be overcome in order to improve food safety systems to meet domestic and export requirements (Deininger 2007). Through increased attention to the spread and adoption of 'good practices' in the supply of agricultural and food products, there may be spillovers into domestic food safety systems, to the benefit of the local population and domestic producers. Thus, the associated costs of compliance may be at least partially offset by an array of benefits, both foreseen and unforeseen, from the

enhancement of food safety management capacity. (Henson S and Jaffee S 2008). Rather than degrading the competitiveness of developing countries, therefore, the enhancement of capacity to meet stricter food safety standards can potentially create new forms of competitive advantage. While there will almost inevitably be losers as well as gainers, this view suggests that the process of standards compliance can conceivably provide the basis for more sustainable and profitable agricultural and food exports in the long term. (Henson S and Jaffee S, 2008).

The young, the elderly and the sick are particularly vulnerable. If food supplies are unsecured, population shifts to less healthy diets and consume more "unsafe foods" e in which chemical, microbiological and other hazards pose health risks, that in turn costs higher healthcare expenditure and drains national wealth. In light of recurrent food contamination incidents, food safety in the 21st century should expand beyond improving nutritional profile, transparency of ingredients and regulations of unhealthy foods to include regular monitoring, surveillance and enforcement of food products in furtherance of the general public well-being and prevention of foodborne illnesses. For up to date information, the Center for Science in the Public Interest provides comprehensive tracking and documentation of foodborne illness outbreaks since 1997 (Fung F *et al* 2018).

Causes of Unsafe Food

Unsafe food can be contaminated in several ways. The primary factors contributing to unsafe food include:

A Microbial Contamination Microbial contamination is one of the leading causes of foodborne illnesses. Most foodborne diseases are caused by viruses, although bacterial agents are to blame for hospitalisations and foodborne infection-related deaths. The diseases are produced by either toxin from the disease-causing microorganism and vary from mild gastroenteritis to neurologic, hepatic, and renal disorders. The most common cause of serious and deadly foodborne diseases is foodborne bacterial agents. Pathogens such as bacteria (e.g., Salmonella, Escherichia coli), viruses (e.g., Norovirus), and parasites (e.g., Giardia) can contaminate food at various stages, from production to consumption. Improper handling, insufficient cooking, and cross-contamination during preparation or storage increase the likelihood of contamination.

B Chemical Contamination Food may also be unsafe due to chemical contamination, which can arise from the use of pesticides, heavy metals (e.g., mercury, lead), industrial chemicals, or additives in food processing. The ingestion of harmful chemicals can lead to both acute poisoning and long-term health effects, including cancer, neurological damage, and reproductive issues.

C Physical Contamination Physical contamination occurs when foreign objects such as glass, metal, or plastic get into food during processing or preparation. While less common than microbial or chemical contamination, it can still result in injuries, choking hazards, and contamination of the food product.

D Poor Food Handling and Hygiene Practices Poor hygiene practices by food handlers are a critical factor in the transmission of pathogens. Lack of proper sanitation in food preparation areas, inadequate handwashing, and improper storage of food products all

contribute to foodborne illnesses. In addition, the handling of food in unsanitary conditions can lead to cross-contamination, especially when raw and cooked foods are stored or prepared in the same area.

E Inadequate Food Regulations In many parts of the world, particularly in developing countries, food safety regulations are weak or inadequately enforced. This lack of regulation and oversight often leads to unsafe food entering the market, with food producers cutting corners to reduce costs or increase production. Without proper regulatory frameworks, food safety risks are significantly increased.

3. Consequences of Unsafe Food

Unsafe food has wide-ranging impacts on human health, the economy, and global development. These consequences include:

A Health Impacts Foodborne diseases can have serious health consequences, ranging from mild gastrointestinal discomfort to severe conditions such as organ failure and death. Children, the elderly, pregnant women, and individuals with weakened immune systems are particularly vulnerable to foodborne illnesses. The long-term health effects of chemical contamination can include chronic diseases such as cancer, kidney damage, and developmental disorders.

B Economic Burden The economic impact of unsafe food is substantial. The cost of healthcare for treating foodborne illnesses, as well as the loss of productivity due to illness or death, can be significant. In addition, food safety issues may harm the economy by reducing the productivity of the agricultural sector, lowering food export standards, and damaging the reputation of food industries.

C Social and Developmental Consequences Unsafe food can also contribute to wider social issues, particularly in developing countries. Foodborne illnesses can exacerbate poverty, as affected individuals may be unable to work or care for their families. Food insecurity is often linked to unsafe food practices, which can reduce access to adequate nutrition and further hinder development.

Global Efforts to Combat Unsafe Food

To address the widespread issue of unsafe food, international organizations, national governments, and food industry stakeholders have developed various strategies and programs. Food safety measures mean the adoption of good manufacturing practices, hazard analysis and critical control point and such other practices as may be specified by regulation, for the food business (Jaiswal 2009).

A World Health Organization (WHO) Guidelines The WHO has developed guidelines for food safety to reduce the risk of foodborne diseases. These guidelines include recommendations for food handling, storage, cooking, and the regulation of food production. WHO also monitors foodborne disease outbreaks and provides technical assistance to countries in need of improved food safety systems.

The agreement on the application of Sanitary and Phytosanitary Measures entered into force with the establishment of World Trade Organization on 1 January 1995. It concentrates the

application of food safety and animal and plant health regulations. (APEDA,2020). The SPS Agreement encourages governments to establish national SPS measures consistent with international standards, guidelines and recommendations. The WTO itself does not develop such standards. However, most of the WTO's member governments (132 at the date of drafting) participate in the development of these standards in the other international bodies. The standards are developed by leading scientists in the field and government experts on health protection.

Following group of subject matter specialized/ technical experts are propped (WTO,2022)

1. Maximum Residue Limits (MRL)
   (a) Plants and its processed products
   (b) Animals and its processed products
2. Health risk issue
   (a) Animals (zoonotic disease)
   (b) Plants

B Codex Alimentarius Commission The Codex Alimentarius, established by the WHO and the Food and Agriculture Organization (FAO), sets international food safety standards and provides a framework for food safety laws worldwide. The Commission aims to ensure that food is safe and of high quality for consumers, promoting fair practices in food trade.

C National Food Safety Regulations In many countries, national regulatory bodies such as the U.S. Food and Drug Administration (FDA) and the European Food Safety Authority (EFSA) establish food safety standards, conduct inspections, and ensure compliance with safety protocols in the food industry. These organizations regulate the use of pesticides, food additives, and contaminants to safeguard public health.

The influence of food safety standards on agricultural products trade has traditionally generated great interest among policy makers. Since the creation of the World Trade Organization (WTO) in 1995, tariff- based policy barriers have lost ground to other commercial obstacles, namely, nontariff measures (NTMs). Following WTO rules, countries adopt regulations under the sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT) agreements to protect human, animal, and plant health as well as the environment, wildlife, and human safety. (Rabadan *et al* 2020). Although SPS measures are not implemented to restrict trade, in the practice they can impede the entry of imports into a country. However, the effect of NTMs on trade is not always clear, and generalizations should be avoided (Beghin *et al* 2012).

D Education and Public Awareness Educational initiatives aimed at raising awareness about food safety practices are key to reducing unsafe food consumption. Campaigns focused on food hygiene, proper cooking techniques, and the importance of sanitation can help mitigate foodborne diseases. Additionally, educating farmers and food producers on safe handling and storage practices can reduce the risk of contamination.

Challenges and Solutions

Despite global efforts, the challenges in ensuring food safety remain significant. These challenges include:

- **Globalization of the Food Supply Chain:** The international trade of food products introduces new risks due to varying food safety standards in different countries.
- **Climate Change:** Changing environmental conditions, such as rising temperatures, can impact food safety by influencing the growth of foodborne pathogens and the safety of water sources used in food production.
- **Lack of Resources in Developing Countries:** Many countries with limited resources struggle to implement and enforce food safety regulations effectively.

To address these challenges, innovative solutions such as enhanced food traceability, the use of technology to monitor food safety, and stronger international cooperation are needed. Additionally, increasing public and private investment in food safety infrastructure and research will help improve food safety standards worldwide.

Conclusion

Unsafe food remains a critical global issue, with profound impacts on public health, the economy, and social development. By understanding the causes of unsafe food and the consequences it entails, policymakers, the food industry, and consumers can work together to ensure safer food systems. Strengthening regulations, improving food safety education, and embracing technology are essential steps toward mitigating the risks associated with unsafe food and promoting global health.

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Artificial Intelligence and Law New Trends and Techniques

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Abstract

First of all what is Artificial Intelligence and What is Law ? In normal we can say that A law is a Set of Rules which is governed by sovereign and it's breach leads to the sentence. While on the other hand Artificial Intelligence (AI) leverages computers and machines to mimic the problem solving and decision making capacities of the human kind. Basically there are mainly six kinds of Artificial intelligence. 1. Reactive Machines which has no memory and only task specific , means if you make input, delivers same output. 2. Limited memory Machines which has limited memory. 3. Theory of Mind 4. Self –Awareness 5. ANI 6. AGI 7. ASI. We are simply living in the golden era of AI and ideas that seemed like science .AI's best example is Alexia. Elon Musk has announced the Grok as an Artificially Intelligence Chat bot. The usage and Popularity of AI is increasing day by day. AI is used in every sector or we can say it has commanded or evolve every sector. It's use make tremendous contribution in the field of E- commerce like personalized shopping , fraud protection , in education personalized learning, voice assistants, creating smart contents, in lifestyle autonomous vehicles, spam filters, facial recognition, also trends in navigation, robotics, inhuman resource, in health care, agriculture, gaming, automobiles, AI in Social media like Instagram, Facebook, Twitter etc, AI in marketing Chat boat , in finance , in astronomy , in data security and also in law for precedent, Citation etc.

Key Words: Artificial Intelligence (AI), Sovereign, tremendous, Law, leverages.

Review of Literature :

1. **Dennehy, 2020** : AI has a history much longer than a is commonly understood, in field from science, philosophy ranging.
2. **Russel and Norgiv,2020** : AI has gone through many peaks and through since its early inception in the 1950's usually referred to as AI "Summers and Winters."
3. **Minsky, 1958 :** Intelligence usually means, " The ability to solve hard problems ."
4. **Allen,1998 : Bhatnagar et al., 2018; Brachman, 2006 Hearst & Hirsh, 2000; Nilson 2009 :** Despite the length of time the field has existed, there is still no commonly accepted definition.

A literature Review's quality is dependent on the rigor of the search process.

Objectives of Research :

1. To study the trends of AI in Law.
2. To study the issues in application of AI.
3. To study the contribution are provided by AI in study of Law.
4. To study the contribution of AI in every field.
5. To study the legal business value of AI.
6. To study future research issues for AI.

Hypothesis :

1. AI is the most advantageous tool in legal field as well every field.
2. AI's psychological impact on the more use of services of robots both on an individual and society level.

Introduction :

At present AI trends and techniques are used by every country day by day. Even people use AI for daily routine work like Alexa and any commanded gazets. We use chat bots and many more equipments for our routine. Even in the modern time many movies introduce the intelligency of robots like Robot and Teri baato mein uljha jiya movies. AI has expanded it's field like Law and many more fields.

Trends in Artificial Intelligence (AI) in Law :

1. **Cyber Security :** Cyber Security with data becoming more precious than ever before, there is no shortage of cyber criminals out there looking for new ways.
2. **Natural Language Processing (NLP) :** NLP Technology has emeged as a powerhouse for dealing with vast volumes or huge amounts of data.
   AI – powered systems can streanline legal research, contract-analysis, due-intelligence and document review, significantly reducing the time and effort required. NLP for legal documents, predictive analytics for case outcomes.
3. **Chat bot :** Modern chat bots are typically online and use generative artificial intelligence systems that are capable of maintaining a conversation with a user in natural language and simulating the way a human would behave as a conversational partner, such chatbots are after use deep learning and natural learning processing, but simpler chatbots have existed for decades.
4. **Open Source AI :** Building large language models and other powerful generative AI systems is an expensive process that requires enormous amounts of compute and data using open source model enables developers to build on top of other's work.

Issues in application of AI :

Title	Research agenda description	Future research issues.
1. AI Definition	Lack of consensus around the definition of AI	Is comparing AI to humans intelligence the most effective way of advancing AI research? How can a first principles approach be used to define definition of AI?
2. Resurgence of Interest	Over focus on the technology and performance aspect of AI.	What are the Societal and personal impacts of AI in recent advancement ?

		What can researchers and regulators do to keep up with the speed of these advances?
3. Machine learning	Increase in use of machine learning as amethodology amongst researchers	How can researchers measure the effectiveness of their machine learning approaches ?
4. Expert systems	Movefrom "Classical" to more hybrid / modern /mixed knowledge base.	Is the change to a more hybrid knowledge base of experts systems more, effective than "Classical" style?
5. Robotics	Effects of extended use of advanced service robots on people in still relatively undeveloped	What are the impact of the use of a service robots on people, both these they are working alongside them ? What are the long terms psychological impacts on the increased use of service robots, both on an individual and societal level?
6. Natural Language Processing	Chat bots and intelligent agents have their great advancements in recent years, while the effects of these advancements still need to be studied.	How can we quantify the value of more advanced chat bots and intelligent agents?
7. Machine vision	Machine vision seems to be logging in advances compared to strides made in other AI functions.	How can the recent advances in AI and hardware further improve the use of machine vision?

Future trends of AI in legal business :

1. Increased Automation
2. NLP
3. Cyber Security
4. Use of Chat bots
5. Augmented intelligence

6. Predictive analytics
7. E-discovery

Utilization of AI in Law field :

AI is generally used in law field as under following criteria.

- Perception
- Learning
- Reasoning
- Problem solving
- Language understanding.

AI is supposed to think and act like humans, yet do it a hundred times faster and more efficiently. When you put your face identification for your lock-screen, but every time it recognizes you though you have new haircut, new glasses or when you just woke up? That's only because of AI algorithums that alalyze and match your face features.

NLP : AI algorithums also review contracts and exact key clauses, to quick research for legal documents status & precedents.

Benefits of Artificial Intelligence in law :

AI in law firms has proven to be a golden ticket to increased productivity, improved decision-making, and higher competitiveness in the industry . Many legal professioalist utilize AI in their law firms.AI helps legal firms to research many case law ideal dealing in perspective to winning the case. But somewhat it is cursed too for non productivity and non use of brain leads to chaos to their remembarance power decreased. Many law writings including chat Gpt which misleads non creativity for framing sentences. Older judges or advocates has learnt many things and they make it in application but now a days AI more use make a law field aspirants handicapped. So, the researcher tries to achieve pros and cons section in this paper.

- Increased productivity
- Improved access to justice
- A better client –centered experience.

What are Pros and Cons of AI in the practice of Law ?

Pros : **1.** Efficiency and time savings.

2. Enhanced legal research
3.Improved document Review
4.Predictive analysis
5.Cost reduction
6.Enhance due diligence
7.Review contract quickly.
8.24/7 availability

Cons :
Job Displacement

Lack of Human Judgement
Bias in Algorithums
Security Concerns
Complerity and cost of Implementation
Ethical and legal challenges
Resistance to change.

Conclusion

It increases deep learning process, machine learning. This research Artificial ntelligence (AI) is transforming the legal industry, bringing both opportunities and challenges. AI-powered tools streamline legal research, contract analysis, and case prediction, improving efficiency and accuracy. Emerging trends, such as predictive analytics, natural language processing, and blockchain integration, are reshaping legal practices, enabling faster decision-making and reducing costs. However, ethical concerns, data privacy risks, and the potential for biased AI decisions remain significant challenges. Legal professionals must adapt by embracing AI while ensuring compliance with regulations and ethical guidelines. Ultimately, the fusion of AI and law presents a promising future, balancing innovation with responsibility to uphold justice and fairness. One notable trend is the evaluation of AI's competency in legal tasks. For instance, Link laters, a prominent law firm, has developed the Links AI English law benchmark to test large language models' ability to answer complex legal questions. While AI models have shown improvement, experts emphasize that AI should not replace human supervision due to occasional inaccuracies and lack of nuanced understanding.

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List of Abbreviation :

AI= Artificial Intelligence
NLP = Natural Language Processing

Cultural Boundaries and Feminine Identity: Exploring Marginalization in Bharati Mukherjee's *Wife*

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Abstract

Post-colonial women writers often face a dual challenge as they navigate the complexities of indigenous culture and feminism. These writers must confront the legitimacy of feminine discourse in patriarchal societies while also carving out a "space" for their narratives within the broader context of feminism. Bharati Mukherjee, in her novel Wife, explores this dilemma through the protagonist, Dimple, whose experience of marginalization is a direct result of the cultural and ideological forces that shape feminine identity. Mukherjee critically examines how cultural expectations and societal norms confine women's identities, especially in immigrant contexts. Dimple, the novel's heroine, mistakenly equates the social circle of Indian immigrants in America with a genuine "cultural experience," which limits her ability to engage with the wider American society and restricts her growth. This misguided view prevents her from experiencing life beyond the constraints of her immediate ethnic community, thereby shaping a distorted perception of her place within American culture. Despite her initial inability to step beyond her cultural moorings, Dimple's experiences reveal the nuanced ways in which the clash between her inherited cultural values and the American social order informs her understanding of identity, autonomy, and agency. Through Wife, Mukherjee underscores the tensions faced by immigrant women, positioning the novel as a critical exploration of cultural displacement and the complex process of self-definition within the intersections of patriarchy, cultural expectation, and feminism.

INTRODUCTION

Among the immigrant women novelists of the 1990s in America, Bharati Mukherjee's prolific works have garnered significant global attention. Known for her use of social realism, Mukherjee stands out among her contemporaries in her adept portrayal of the complex issues faced by immigrant women from India. Among her novels, *Wife* is particularly notable for its deep psychological exploration of the protagonist and its undeniable technical brilliance. On the surface, the novel appears to tell the straightforward story of Amit and Dimple, a newly married Bengali couple who immigrate to the United States. However, beneath the surface, Dimple's character is revealed to harbor complex, dark impulses. Her latent sadomasochistic tendencies are exacerbated by the violence-prone and individualistic nature of American society, ultimately leading to the tragic act of her killing her own husband. Mukherjee's narrative goes beyond the story of an immigrant couple, delving into the profound psychological unraveling of Dimple, who is torn between her cultural heritage and the foreignness of American society. Through Dimple's psyche, the novel explores themes of alienation, violence, identity, and the clash of cultures, making *Wife* a significant and powerful work in post-colonial literature.

SUFFERINGS OF LIFE

In the novel Wife, Bharati Mukherjee presents Dimple Das Gupta, a compliant and obedient

daughter from a middle-class Bengali household. She perceives her life before marriage as merely a "dress rehearsal" for the authentic existence she anticipates will commence with her marriage.Dimple, deeply influenced by idealized images of marriage gleaned from Indian films, magazines, and advice columns, fantasizes that marriage will provide her freedom—freedom defined by an idyllic lifestyle of cocktail parties and charity dinners. However, her unrealistic notions of marriage are bound by cultural expectations and the narrow confines of her upper-middle-class upbringing. Dimple oscillates between fear and fantasy, obsessing over her physical appearance, particularly her “Sitar-shaped body” and "rudimentary breasts," which further underscore her feelings of inadequacy and confusion. Her understanding of marriage is shaped by vague, external influences rather than genuine emotional or relational depth. Dimple's increasing discontent with her own powerlessness in the face of the shifting cultural dynamics within post-colonial India leads her to a state of profound psychological unrest. She turns to “The Doctrine of Passive Resistance” as a method of coping, hoping to use domestic passivity to gain affection from her future husband, whom she views as her only hope for adult freedom. Eventually, Dimple finds a matrimonial match in Amit Basu, an ideal candidate for her emigration to the United States. Their marriage is arranged through the typical route of matrimonial advertisements in ethnic newspapers and magazines—emphasizing her passive, obedient role as a daughter and prospective wife. Described as “Discreet and Virgin,” Dimple’s life remains defined by her subordination to male authority, leaving her to wait for the real life she believes marriage will bring. Through Dimple’s journey, Mukherjee explores themes of alienation, cultural displacement, and the emotional fragmentation faced by immigrant women, highlighting the psychological toll of cultural expectations and societal constraints on feminine identity.

Dimple’s growing sense of alienation and displacement, as well as her struggle with identity in a foreign environment. Her dissatisfaction with Amit, her husband, is evident when she critiques his choice of location for an outing—an example of her desire for something different, something that would align more with her own needs or desires. This discontent highlights the disconnection she feels not only from her immediate surroundings but also from the people in her life, including her husband.The "subterranean streak of violence" in Dimple’s character points to the intense emotional turmoil she experiences. Her violent response to her pregnancy, symbolized by her forceful physical actions to rid herself of it, reveals how deeply troubled she is. The "unnatural" enjoyment of vomiting and her attempts to expel the pregnancy as though it were a “vile thing” suggests a deep conflict between her emotional state and her physical reality. Dimple seems to be in a desperate state of mind, attempting to exert control over something as uncontrollable as her own body and its changes.Her physical actions, such as skipping rope until she collapses, are symbolic of her attempts to escape, to shed her past life, and to resist the societal expectations placed on her. The abortion, as an act of self-determination and an extreme form of agency, is yet another expression of her need to control her circumstances, even if it means resorting to drastic measures. The violent nature of these actions—physically demanding and emotionally intense—reflects the depth of her internal chaos.Dimple’s sense of identity in America is influenced by her marginalization, which is compounded by the presence of other Indian and Bengali immigrants. While she is in a foreign land, she feels both estranged from her old life

and out of place in her new one. The idea of "Americanized Bengalis" and the reversal of roles, as presented in Mukherjee's *Wife*, challenges the notion of belonging, identity, and cultural assimilation. Dimple's experience in America seems more about surviving in a social vacuum, where her connections are superficial and mediated by the media, rather than any sense of true community.The scene at dinner, where Dimple observes Jyothi and Amit discussing topics like love and death, symbolizes her disconnection from her new life. She views such conversations as something foreign, something she has never experienced in the same way before. The dinner, and later the party at Columbia University, further emphasize her outsider status—while the other characters seem to navigate their new lives with a sense of ease or understanding, Dimple remains on the periphery, unsure and unsettled.The offer of a job and the discussion with Vinod Khanna reveal another layer of Dimple's alienation. She is seen as "fresh and Un-Americanized," a label that places her in contrast with those who have assimilated into American life. However, her recognition that Mullick—whom she deems more "American" than the Americans themselves—represents a shift in her understanding of identity. It is a recognition of the complexity of cultural assimilation and the ways in which identity can be shaped by external forces and personal experiences.

Dimple's interactions with Milt Glassery seem to further complicate her feelings of marginalization and identity. The fact that she is trying to navigate a new life in a foreign culture, while still grappling with the tension between her past and her present, underscores the central theme of alienation in the novel. This analysis beautifully captures the depth of Dimple's emotional and psychological struggle in *Wife*. The use of her name, "Dimple," as a symbol of subtle yet significant inner turmoil is quite striking. The name, while small and seemingly insignificant, acts as a powerful metaphor for the internal dissatisfaction and emotional disconnection Dimple feels. It reflects the way something small can grow into a larger issue, subtly influencing her every action and reaction, causing her to resent the world around her.Her emotional detachment from her pregnancy, which she sees as "unfinished business," reveals how she views life not as something to embrace but as a series of obstacles to overcome. The pregnancy represents an anchor to her past, keeping her tethered to a life she wishes to escape, rather than something to celebrate or nurture. In her mind, it is an interruption of her desires for independence and reinvention, showing how deeply her identity is tied to the notion of freedom and self-determination. This perception of the pregnancy as a burden underscores her disconnection from the natural cycle of life and growth, a theme that resonates throughout the novel as she grapples with what it means to be an individual in a world that seems to demand conformity.Dimple's rejection of her new name can also be seen as an expression of her rejection of the role and expectations placed on her by others. Names, especially in the context of marriage and new roles, carry heavy significance in shaping identity, and Dimple's distaste for hers suggests her discomfort with the identity she's expected to assume in her new life. It's not just about a name, but about her broader struggle to find a sense of belonging and self-acceptance in a life that feels foreign to her.The symbolism of the lace doilies is particularly poignant. The doilies, often associated with traditional domesticity, represent the very structure and routine that Dimple finds stifling. They are emblematic of the life she feels trapped in—a life of conforming to societal and familial expectations. Her desire to return to her room in Rash Behari Avenue, a place

that might have once felt limiting, now symbolizes a lost sense of security and familiarity. The juxtaposition of Dimple's longing for her old life—one she once criticized—shows the complexity of her emotions, as well as her deep sense of dislocation and the human tendency to romanticize what is no longer within reach. This inner conflict is central to Dimple's character, and it highlights the tension between the desire to escape one's past and the unrelenting pull of that past, especially in a foreign environment where she feels both physically and emotionally uprooted. Her dissatisfaction with the present, combined with the inability to fully embrace the future, creates a sense of stagnation, and this internal struggle drives much of her actions and decisions throughout the novel.

Dimple's increasing sense of alienation and confusion as she navigates the complexities of American society, which she perceives as both foreign and hostile. The "atmosphere of crime" that permeates her surroundings seems to dull her own emotional responses, allowing her to detach from her guilt. The murder of the elderly couple, an event that should be horrific, strangely comforts Dimple because it serves as a way for her to justify her own actions and avoid confronting her feelings of guilt toward Amit. This detachment from her own emotions, as reflected in her thoughts, highlights the emotional numbness that Dimple experiences in a world that feels increasingly disconnected from her personal identity.The line from M. Siva Rama Krishna that "this pervasive atmosphere of crime dulls the edge of her own guilt" underscores how Dimple's internal conflict is shaped by her environment. The normalization of crime in her new world creates a backdrop that makes her own moral compass feel less defined or urgent. The disorienting atmosphere of violence, fear, and moral ambiguity allows Dimple to excuse her behaviour and actions, because in this chaotic new society, her personal struggles seem insignificant or justifiable by comparison. Dimple's misunderstanding of American social norms—like her confusion at the kosher deli—is a powerful moment of cultural dissonance. She feels caught between her own cultural background and the new social codes she encounters. Her expectation of universal exchange and her recognition of "many races" in Calcutta make her initially believe she can easily navigate cultural diversity, but the sharp distinction between her previous experiences and the rigid boundaries in America disorients her. The communal divide she faces, one that's framed around religion and ethnicity in the United States, feels completely foreign to her. In Calcutta, the mixing of different religious and ethnic groups was a part of her everyday life, so the stark separation she faces in America challenges her sense of self and her assumptions about how people live together. The deli incident also highlights Dimple's struggle to find a place for herself in this new world. She wants to engage with the American society around her, but she doesn't yet have the tools to decode its complex layers of identity, race, and culture. She interprets the deli's rejection not only as an affront to her desires but also as a symbol of her broader failure to integrate into American society. She believes that her inability to navigate this cultural barrier speaks to her failure to establish a "voice" or identity in a world that feels like a series of insurmountable obstacles.This sense of not having a voice or being unable to locate a space that resonates with her identity is a recurring theme for Dimple. As she struggles to fit into American society, she also contends with the idea of belonging—where she can feel heard, understood, and validated. Her disillusionment is heightened by the realization that she cannot easily reconcile her past self with the

expectations of her new life in the United States. Her experience of cultural dislocation and her inability to express herself or understand the rules of American society create an emotional and psychological barrier that prevents her from experiencing life in a meaningful way. She is trapped between two worlds—her past in India and her present in America—and unable to bridge the gap between them. The failure to find her "space" within American culture underscores the broader theme of identity crisis and the difficulty of reconciling different parts of oneself when those parts seem irreconcilable.

Dimple's escalating emotional instability and her intense feelings of isolation and frustration. At the moment of her interview, when she ties the knot, it represents her final "maidenly accomplishment." The fact that this achievement feels like the last step in her life marks a key moment in her psyche—she is still attached to traditional ideas of accomplishment, yet the lack of real fulfilment in her life makes this a hollow victory. When Amit doesn't get a job, Dimple's view of him shifts dramatically. For her, a man without a job is not a man at all, which reflects her deep-seated beliefs about gender roles, societal expectations, and her reliance on material markers of success to validate her relationships. Dimple's thoughts of suicide, triggered by this lack of fulfilment and dissatisfaction with Amit's perceived inadequacies, underscore her emotional fragility. The overwhelming sense of disconnection she feels is compounded by her inability to communicate, which "stipples and chokes her voice." This suppression of her voice symbolizes her growing inability to express herself in her marriage and in her new life in America. The frustration of this silence erodes her mental stability, and it manifests in the vivid, nightmarish visions she has, which include thoughts of suicide and violent acts. The nightmares and visions of death point to the deep psychological conflict she's experiencing—her dissatisfaction with her life, her husband, and her inability to break free from the emotional paralysis she feels. Her recurring nightmares of violence and death are significant not only for their shocking content but also because they give insight into Dimple's subconscious desires and anxieties. The image of her walking on a beach and finding Ina Mullick, dead and wearing Dimple's sari, is both symbolic and disturbing. The beach, a place often associated with the boundary between land and water, symbolizes the liminal space in which Dimple exists—neither fully in her old life nor in her new one. The water spilling from Ina's mouth hints at the theme of drowning in emotions, feeling overwhelmed, and losing control. Ina, dressed in Dimple's sari, may represent Dimple herself—her latent desires, frustrations, and ultimately, her feelings of being trapped in her own identity. Dimple's perception of Amit as "irresponsible" reflects her growing dissatisfaction with him. She feels that he doesn't provide her with the emotional and intellectual stimulation she desires, only offering "small comforts" instead. For Dimple, these comforts are insufficient because they do not fulfill her deeper needs for fantasy, imagination, and a life of excitement. Amit's failure to be the kind of partner she envisioned—a source of both material support and emotional fulfilment—leaves her feeling bored and unfulfilled. Her need for a "fantasy life" point to her yearning for something more—something that transcends the mundane and connects her to a larger, more meaningful existence. She is looking for escape, excitement, and fulfilment, but Amit's inability to provide that leaves her frustrated and emotionally disconnected. The lack of communication between Dimple and Amit is critical in understanding her state of mind. Without the ability to express her needs or

frustrations, Dimple becomes increasingly isolated. Her thoughts of violence, both toward herself and her husband, are symbolic of her inner turmoil and the desire for an outlet to release the overwhelming frustration and pain she feels. In many ways, her dreams and nightmares are her only means of confronting the anger and powerlessness that have built up inside her.This disintegration of Dimple's sensibility, her frustration with the reality of her life, and her violent, dark visions all point to her desperate struggle with her identity, her marriage, and her place in the world. Her longing for a "fantasy life" reflects her deep dissatisfaction with the life she's been given and her yearning for something more meaningful, creative, and emotionally fulfilling. The deepening emotional and psychological chasm between Dimple and Amit, as well as the increasing disintegration of Dimple's sense of self. Amit's failure to nourish her fantasies and engage with her emotional and psychological needs exacerbates her feelings of isolation and alienation. In Dimple's mind, Amit doesn't just fail to meet her needs—he fails to fit into her world entirely. The comparison of Amit to Jyothi, someone who could have been an equally acceptable match in Dimple's mind, underscores how Dimple views her marriage as a matter of chance rather than fate or deep connection. She doesn't seem to see Amit as the person who truly complements her, but rather as someone who simply happened to be her husband because of circumstances. The intense disconnection Dimple feels from Amit and her dissatisfaction with marriage as an institution are expressed in the vivid image of "sleeping bodies as corpses." This metaphor is not just about a dislike of Amit; it reflects her broader sense of numbness and alienation from the world around her. The image of corpses suggests death, decay, and lifelessness—states that resonate with Dimple's growing despair. Her perception of marriage as something that has "betrayed" her reveals her disillusionment with the very idea of commitment and partnership, as it has failed to deliver the excitement, fulfilment, and glamour she once imagined. The marriage, like her life, has become a hollow shell, an institution that has robbed her of the "glittery things" she once dreamed of. Dimple's desire to abandon old friendships further highlights her growing sense of isolation and disconnection from anything that once provided meaning or connection. When she says there is "nothing to describe and nothing to preserve," it suggests that she feels life has lost its vibrancy and significance. Her relationships, memories, and even her sense of self are beginning to feel empty and irrelevant, further feeding her internal alienation. The image of Dimple feeling estranged from her own body—"curiously alien to her"—is one of the most striking moments of the text. It indicates a deep psychological fragmentation, where Dimple's sense of self has become unmoored from her physical form. The body, once a site of self-expression and agency, has turned into a source of hatred and malice. This disconnection from her body mirrors her disconnection from the world and from others, and it heightens the sense of internal conflict and self-loathing that drives her violent impulses. Dimple's increasing detachment from her environment is also represented by the apartment, which has become a symbol of psychological decay. The apartment's "corrosion" mirrors the breakdown of Dimple's sense of identity and her mental state. The disintegration of the physical space reflects the fragmentation of her internal world. The television, which she describes as a "diabolical trap," becomes a symbol of her entrapment in a cycle of passive consumption and emotional stagnation. Instead of providing her with a window to escape or connect with the outside world, the television becomes a form of incarceration—an endless loop of images that

prevent her from escaping her own despair. It's no longer a means of entertainment or escape, but an object of torment, highlighting Dimple's sense of being trapped in her own life and mind.The imagery of "too many images of corrosion within the apartment" emphasizes the overwhelming sense of decay and destruction that permeates Dimple's life. Her physical environment mirrors her inner emotional landscape—both are filled with a sense of irreversible degradation. The apartment, once possibly a place of comfort or familiarity, has become an outward manifestation of the disintegration of Dimple's psyche, reinforcing the idea that she is living in a state of mental and emotional breakdown. Dimple's alienation, both from her own self and from the world around her, reaches a breaking point. The thoughts of murder—her desire to hurt and even kill Amit—are the manifestation of her inner turmoil and rage. The disconnection between her fantasies and her reality, her inability to communicate her needs or find fulfilment, and her increasing sense of estrangement all contribute to her volatile emotional state.

Dimple finds comfort in the company of Ina, Leni, and Milt Glasses during her times of distress. Unfortunately, Ina and Leni fail to provide the support she needs. As a result, her attraction to Milk Glasses only exacerbates her feelings of loneliness and hopelessness. She grapples with a significant breach of her gendered Indian cultural norms: "She was in a worse state than ever, more isolated, further distanced from Amit and her Indian community, left only with borrowed facades, akin to a shadow devoid of emotions." Cut off from the world around her and disenchanted with Amit, who, unable to find stable employment, resorts to washing dishes, Dimple reflects: "Life ought to have been kinder to her, should have balanced its equations differently so that she was not left with an illusion." Dimple contemplates various methods of ending her life. She considers igniting a synthetic sari, placing her head in an oven, cutting her wrist with shattered glass in a sink filled with boiling dishwater, starving herself, or falling onto a bread knife while envisioning the resurgence of Japanese Samurai. While waiting for the train on the platform, she reflects on the urns for her husband's ashes, questioning, "Should he meet an untimely end?" and wonders, "What becomes of the fragments of bone and tissue that are scanned but not fully consumed?" This line of reasoning begins to border on madness, culminating in her resolution to "Kill Amit and conceal his body in the freezer." She approached him quietly and chose her preferred location, just beneath the hairline, where the mole had become larger and darker. With her right hand, she lifted the knife and drove it into the magical circle once, twice, seven times.

Dimple's act of murdering Amit signifies her ultimate triumph in realizing her masochistic inclinations. Through this act, she has reshaped society into a mechanism of punishment. Her spiral into insanity can be seen as both an affirmation and a repudiation of her identity as a victim of cultural dislocation and patriarchal constructs. Bharathi Mukherjee, a keenly observant yet empathetic immigrant within American society, has garnered acclaim for her distinctive insights on expatriation, perceiving it as a metaphysical state of exile and a driving force for attitudinal change in both minority and majority communities. The motif of diasporic aspirations is prevalent throughout her literary oeuvre, yet her exploration of this theme appears more assured and expansive following her move to America, effectively capturing the complex emotions tied to expatriation—nostalgia, frustration, and hope—more so than during her period in Canada, which was characterized by uncertainty and despair.

Dimple, the protagonist in "Wife," is depicted as an exceptionally immature young woman who is perpetually engrossed in fantasies about marriage, convinced that it will grant her both freedom and love. After a lengthy period of suffering and anticipation, she eventually weds Amit Kumar Basu. Bharathi Mukherjee delves into Dimple's intricate world, marked by a juxtaposition of daydreams and nightmares, effectively illustrating her troubled mental state through a series of striking and grotesque images. In his article “Immigrant Lives: Protagonists in Bharathi Mukherjee’s The Tiger’s Daughter & Wife,” F.A. Inamdar contends that the novel's cover, which implies themes of passivity and submissiveness in Dimple, represents a significant thematic error.Dimple is portrayed throughout the narrative as a symbol of freedom and defiance, exhibiting an uninhibited emotional expression. In stark contrast, Amit Basu is depicted as a victim, both in India and New York, representing the struggles of an innocent, duty-bound husband caught in the turmoil of his wife's neuroses. Inamdar suggests that Dimple ultimately remains a restless spirit, unable to fully belong to either location. Additionally, Brahma Dutta Sharma and Susheel Kumar Sharma, in their collaborative article “The Contribution of Women to the Development of the Indian English Novel,” highlight that Mukherjee’s work, especially in "Wife," explores the difficulties of adaptation faced by Indians living in the West. Dimple's understanding of her identity and her feelings of marginalization significantly influence her responses to her new environment, which is primarily populated by fellow Indians, particularly Bengalis. Mukherjee's "Wife" illustrates how the experiences of Indians, including those Bengalis who have assimilated into American culture, reflect "the experience of being abroad," revealing a shift in ideological viewpoints. Dimple has never imagined a hopeful future; her parents are depicted as one-dimensional characters. Her surroundings lack the enriching sounds and colors of nature, instead being shaped by the vibrant romance portrayed in advertisements and magazine stories. Although she is an immigrant in America, she does not feel nostalgic for her homeland. The sole source of excitement in her life is the news from Calcutta about her friend Prixie's romantic escapades. Christine Gomez, in the article "The Ongoing Quest of Bharathi Mukherjee’s from Expatriation to Immigration," posits that Dimple exemplifies the expatriate experience of feeling dislocated in both her original culture and the new one. The theme of expatriation is not only woven throughout the narrative but also acts as a metaphor for deep-seated alienation, including existential disconnection. Expatriation encapsulates a complex emotional and psychological condition marked by a wistful longing for the past, often represented by the ancestral home, the pain of exile and homelessness, the struggle to assert one's identity in an unwelcoming new setting, a perceived moral or cultural superiority over the host country, and a rejection of the identity imposed by that setting.

Expatriates frequently create a protective barrier to safeguard themselves from cultural clashes and the antagonism they face in their new environment. This idea is vividly depicted in the novel, where the cage serves as a pivotal symbol. It signifies a life that, although comfortable, is also restrictive, representing isolation and a rejection of genuine freedom. Notably, Dimple's act of killing her husband follows her viewing of a television program that prominently featured a birdcage. Dimple’s interpretation of Sita’s submissiveness, self-sacrifice, and sense of obligation acts as a complex symbol. She strives to rise above the traditional expectations imposed on wives, longing for independence and affection within the

confines of marriage. This quest gives rise to a range of emotions, including indignation, sorrow, resentment, irritability, malice, and unproductive anger. Torn between two distinct cultures, Dimple longs for an imagined third space. Living in her social isolation, she reflects the experiences of many Americans who feel disillusioned by the promises of fulfillment perpetuated by the media, often turning to the violent solutions suggested by their environment. In her essay "Psychotic Violence of Dimple in Wife," Prasanna Sri Sathupati contends that Dimple is neither passive nor compliant; instead, she represents freedom and rebellion throughout the story. In contrast, Amit Basu emerges as a victim, both in India and New York. His murder epitomizes the tragic outcome of a devoted husband who succumbs to the psychological distress instigated by his wife.

CONCLUSION

Dimple's subservience in *Wife* serves as a tragic reflection of the cultural and ideological constraints placed on her. In a society that expects women to defer to male authority—whether in the form of her father or husband—Dimple is systematically denied the opportunity to cultivate a sense of self that is independent of those around her. The societal expectation that she must conform to others' judgments of her emotions and behaviours stifles her ability to explore and assert her own desires. This sense of being subjugated to external authority leaves her incapable of acting as an agent of change in her own life, as she has been conditioned to defer to the perspectives of the men around her.This dynamic is exacerbated by Dimple's inability to justify or validate her feelings. She has been taught to suppress her emotions and to view her desires through the lens of her cultural and familial obligations. Her feelings are not hers to explore, and so when Dimple is reduced or dismissed by Milt Glasser—another figure of authority who reinforces her sense of powerlessness—her isolation deepens. She is pushed further into despair, unable to see a way out of the suffocating structures around her. In this sense, her inability to act on her own behalf or find meaning in her experiences is tied to the pervasive gendered norms that limit her autonomy and self-expression. Dimple's resistance to these structures reaches a breaking point when she commits the ultimate betrayal in the eyes of her culture: the murder of her husband. This violent act can be viewed as her attempt to break free from the oppressive forces that have shaped her existence. As Gayatri Spivak notes, the ability to "explain" or understand oneself and the world is a fundamental aspect of agency. Dimple's inability to explain or justify her actions within the frameworks of cultural norms or reason leaves her in a state of madness. This lack of a coherent, rational self-image is what makes her act of violence so incomprehensible, both to herself and to others. She has no words or context that would allow her to explain her feelings, and as such, her act of violence becomes the ultimate expression of her psychological and emotional disintegration. Michel Foucault's analysis of madness in *Madness and Civilization* offers a useful framework for understanding Dimple's violent breakdown. Foucault argues that madness, at its core, is an experience of rupture a disconnection from both oneself and society. He speaks of the "zero point" of madness as a state in which an individual's sense of self is fundamentally divided, and the experience of this division becomes the defining characteristic of their condition. In Dimple's case, the culmination of her mental dissolution can be seen in her violent act against Amit. Her delusions, her sense of alienation, and her confusion about her reality reflect a state of

madness that arises from a profound sense of disjunction—both from her cultural roots and from the alien culture in which she finds herself.

The vision of Amit's head transposed onto the television set is a powerful symbol of this disjunction. The television, which has become a symbol of entrapment and mental decay for Dimple, now becomes the site of her ultimate act of violence. Amit's head on the television screen signals the merging of Dimple's internal breakdown with the external, disorienting world she inhabits. This transposition of bodies and images is an expression of the collapse of boundaries between self and other, reality and illusion. It reflects Foucault's concept of the "culmination of the void"—the point at which the self-disintegrates into a fragmented, unrecognizable form, and any attempt to make sense of the world becomes futile. Dimple's madness is a direct result of her resistance to the oppressive male ideology that governs her life, as well as her disconnection from the alien culture she finds herself in. Her rejection of both her own and a foreign culture—the inability to reconcile her internal self with the external world—leads to her violent act. This act, rather than being a rational response, is an expression of her deepest anguish and desire, emotions that lie beyond the reach of reason or logic. In her delirium, Dimple is driven to violence not by a coherent, purposeful plan, but by an overwhelming sense of rupture and dissolution. The act itself is the culmination of her deep psychological distress and her inability to find meaning or agency in a world that has constrained her at every turn.In this way, Bharathi Mukherjee's *Wife* reveals the devastating impact of cultural and gendered oppression on a woman's psyche. Dimple's violent act is not a mere breakdown, but a profound expression of her struggle to assert her identity in a world that denies her the agency to do so. Her act of violence serves as both a tragic culmination of her inner turmoil and a symbolic rejection of the oppressive forces that have shaped her existence.

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Overheated Systems are creating New Cybersecurity Vulnerabilities that need to be Addressed in a Changing Climate

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Abstract

As global temperatures rise due to climate change, the increasing frequency of heatwaves is directly impacting the performance and security of digital infrastructures. Overheated systems, such as servers and data centres, are becoming more susceptible to failures, overheating, and physical damage, which in turn create new vulnerabilities within cybersecurity frameworks. These vulnerabilities can lead to data breaches, system downtimes, and potential exploitation by malicious actors. This shift calls for urgent attention to adapting cybersecurity strategies, including improved cooling mechanisms, environmental monitoring, and disaster recovery plans, to mitigate the risks posed by a warmer world. By addressing these emerging threats, organizations can ensure the resilience and security of their digital assets amidst a changing climate.

Keywords: Overheated systems, Cyber security, vulnerabilities, Climate change, Rising temperatures, Digital infrastructure

1. Introduction:

As global temperatures continue to rise due to climate change, the digital infrastructure that supports modern society is facing unprecedented challenges. One of the most pressing concerns is the impact of overheating on the systems that power our data centres, networks, and critical technologies. These overheating issues not only threaten the physical health of hardware but also introduce new vulnerabilities into cybersecurity frameworks. As systems become more prone to failure or malfunction in hotter environments, the risk of data breaches, unauthorized access, and system outages increases significantly. Cybersecurity must evolve to address the unique challenges posed by a warming world. The rise in environmental temperatures is not only a problem for physical infrastructure but also presents new entry points for cyber attackers. The intersection of climate change and cybersecurity requires a comprehensive approach, including improved cooling solutions, enhanced

monitoring of environmental conditions, and proactive measures to strengthen digital resilience.

2. Overheated Systems:

As global temperatures rise, the impact on physical systems, especially in the realm of cybersecurity, becomes more pronounced. Overheated systems—primarily servers, data centres, and critical infrastructure—are increasingly vulnerable to a range of issues that not only disrupt operations but also expose digital assets to significant security risks.

In a typical data centre, where countless servers and computing devices work around the clock, maintaining optimal temperature levels is essential for preventing hardware failure. However, as climate change leads to higher average temperatures, cooling systems that once ensured optimal performance may become less effective. This issue is particularly acute in regions experiencing frequent or prolonged heatwaves, where the external environment further stresses cooling mechanisms, leading to potential overheating of servers.

The consequences of overheated systems are far-reaching. At the most basic level, excessive heat can cause hardware to malfunction or fail, resulting in critical service disruptions. But beyond physical damage, overheating can increase the likelihood of data corruption, loss, or unauthorized access. Cyber attackers may exploit vulnerabilities caused by system instability or downtime, leveraging these weaknesses to infiltrate networks and cause breaches.

3. Cybersecurity Vulnerabilities:

Cybersecurity vulnerabilities refer to weaknesses in a system, application, or network that can be exploited by malicious actors to gain unauthorized access, disrupt services, or compromise sensitive data. These vulnerabilities are often the result of flawed design, poor configurations, outdated software, or unforeseen environmental factors. As the digital world grows and evolves, so too do the methods and sophistication of cyberattacks. The rise in global temperatures and the increasing frequency of environmental changes add a new layer of complexity to this landscape, introducing additional vulnerabilities that need to be addressed. Overheated systems also present challenges in terms of network resilience and redundancy. A failure in one part of a network due to overheating can have a domino effect, compromising interconnected systems or even entire networks. This increased risk of cascading failures could make cyberattacks more impactful, as attackers might gain access to critical systems that control essential services like energy grids, transportation systems, or communication networks. These vulnerabilities are not confined to the physical infrastructure alone. Software vulnerabilities can also be exacerbated by temperature-induced stress. For example, poorly optimized software may crash or behave unpredictably under heat stress, potentially allowing attackers to exploit the instability or inject malicious code into a system. Moreover, with a rise in remote work and the proliferation of Internet of Things (IoT) devices, systems exposed to higher temperatures in non-controlled environments (e.g., edge devices, smart infrastructure) are becoming more prone to exploitation.

4. Climate Change and Its Impact on Cybersecurity:

Climate change refers to long-term changes in temperature, weather patterns, and other environmental conditions on Earth, primarily driven by human activities such as the burning

of fossil fuels, deforestation, and industrial processes. These changes are contributing to an increase in the frequency and intensity of extreme weather events, such as heatwaves, storms, flooding, and wildfires, which are having profound impacts on both the natural environment and human society.

Cybersecurity, climate change presents both direct and indirect risks to digital infrastructures and security systems. While the physical and environmental consequences of climate change—such as rising sea levels or extreme weather events—are more immediately apparent, its impact on the digital world is equally significant and often overlooked. Here are a few key ways in which climate change intersects with cybersecurity:

4.1. Temperature Increases and Hardware Vulnerabilities:

As global temperatures rise, overheating of physical systems becomes an increasing concern. Data centres, server farms, and critical infrastructure may experience higher operational temperatures, which can lead to hardware failures, data corruption, or system outages. These issues expose organizations to cybersecurity risks, as overheating can degrade system performance and create new attack vectors.

4.2. Increased Frequency of Extreme Weather Events:

Climate change is causing more frequent and severe extreme weather events, including hurricanes, floods, and wildfires. These events can damage physical infrastructure, including data centres, communication networks, and power grids. Cybersecurity systems that depend on the availability of these infrastructures may become vulnerable during natural disasters.

4.3. Emerging Cyber Threats Targeting Climate Data:

As the effects of climate change become more pronounced, governments, organizations, and research institutions are increasingly collecting and sharing climate-related data. This data is critical for informing climate policies, disaster response plans, and scientific research.

4.4. Impact on Supply Chains and Infrastructure Resilience:

Climate change can affect the resilience of global supply chains and critical infrastructure. For example, extreme weather may disrupt transportation networks, impacting the timely delivery of essential hardware, software, or cybersecurity tools. In addition, supply chains for critical infrastructure components, such as semiconductor chips or cooling systems, may be interrupted due to climate-related disruptions. As cybersecurity relies on a stable and secure supply of resources and tools, these disruptions can lead to vulnerabilities in both the physical and digital realms.

4.5. Emerging Cybersecurity Challenges in Remote and Distributed Environments:

As climate change continues to shape how people live and work, there is an increasing shift toward remote and distributed work environments. In areas where extreme weather is common, employees may rely on cloud-based services, remote access tools, and IoT devices to stay connected. These environments, while offering flexibility, also introduce new vulnerabilities that can be exploited by cybercriminals.

4.6. Environmental Security and Sustainability:

In response to climate change, there is a growing emphasis on integrating sustainability into business practices, including cybersecurity strategies. Organizations are adopting green IT initiatives, such as reducing energy consumption, optimizing resource use, and adopting renewable energy sources for their digital infrastructures.

4.7. Disaster Recovery and Business Continuity Planning:

The increased frequency of climate-induced disasters calls for enhanced disaster recovery and business continuity planning. Organizations must not only prepare for traditional cyberattacks but also for the possibility of climate-related disruptions. Securing critical systems, developing contingency plans for natural disasters, and ensuring data redundancy are crucial steps to mitigate the impact of climate change on organizational cybersecurity. Adapting business continuity strategies to include climate-related risks will become an essential part of long-term cybersecurity planning.

5. Rising Temperatures and Their Impact on Cybersecurity:

Rising temperatures due to climate change present a multifaceted challenge to the security of digital infrastructures and systems. The increasing global temperature is not just an environmental concern; it is becoming a critical factor influencing the performance, integrity, and security of hardware, data centres, and critical digital infrastructures. As temperatures continue to rise, it is essential to understand how this environmental shift impacts cybersecurity and what measures must be taken to mitigate the associated risks.

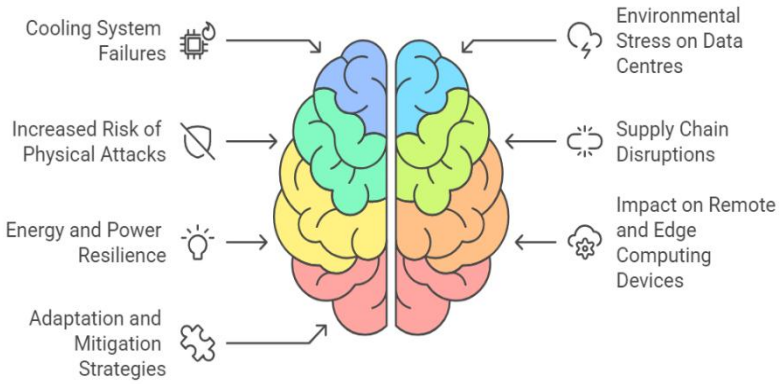

Fig 5.1 – Challenges in Hardware and System Stability

5.1. Hardware Degradation and System Instability:

One of the most direct consequences of rising temperatures is the degradation of hardware. Servers, storage devices, and networking equipment are designed to operate within a specific temperature range. When these devices overheat, they can experience performance degradation, malfunctions, or even complete system failures. For example, overheating can cause **data corruption**, **disk failures**, or **CPU throttling**, which can disrupt the normal operation of critical systems and compromise data integrity. If these system failures are not properly managed, they can create security vulnerabilities that attackers may exploit.

5.2. Cooling System Failures:

Data centres and server farms are equipped with cooling systems to regulate temperature and prevent overheating. However, as external temperatures rise due to climate change, these cooling systems can become less effective. In some regions, air conditioning and refrigeration systems may struggle to maintain appropriate temperatures inside these facilities. Without proper cooling, systems may overheat, and the risk of hardware failure increases. This not only affects system performance but can also leave the systems vulnerable to data breaches and cyberattacks. For instance, during overheating events, security monitoring tools may fail or become less responsive, increasing the chances of undetected malicious activity.

5.3. Environmental Stress on Data Centres:

The demand on data centres to stay operational during extreme temperature events places additional strain on physical security systems and operational reliability. High temperatures can compromise backup power systems, such as generators and uninterruptible power supplies (UPS), which are designed to ensure data centres remain operational during power outages. If these backup systems fail due to environmental factors, it could lead to downtime or the loss of critical data, making these systems more vulnerable to cyberattacks. Cybercriminals may take advantage of this downtime to exploit weaknesses, gain unauthorized access, or install malicious software on compromised systems.

5.4. Increased Risk of Physical Attacks:

As temperatures rise, organizations may look for cheaper, less efficient solutions to maintain operational temperatures in their data centres and infrastructure, which could lead to greater vulnerabilities. For example, a poorly maintained cooling system or less secure facility may make it easier for attackers to gain physical access to critical systems. Physical access, combined with environmental stressors like extreme heat, may lead to unauthorized tampering with hardware, security devices, or backup systems.

5.5. Supply Chain Disruptions:

Rising temperatures and extreme weather events caused by climate change can also disrupt supply chains for critical IT infrastructure components. The manufacturing and distribution of servers, cooling equipment, and networking hardware may be delayed due to heatwaves, wildfires, or transportation issues. Supply chain disruptions can prevent organizations from obtaining necessary resources to replace or upgrade their cybersecurity infrastructure. This may result in using outdated or less secure equipment, exposing systems to potential vulnerabilities.

5.6. Energy and Power Resilience:

As temperatures increase, the demand for energy, particularly for cooling and air conditioning systems, also rises. In areas where energy resources are strained, power outages or instability in the electrical grid can have a cascading effect on IT infrastructure. Data centres and critical facilities may experience power cuts, affecting their ability to maintain operational continuity. Cybersecurity systems that rely on consistent power to monitor threats, authenticate users, and defend against attacks may become less effective during these interruptions, leaving organizations exposed to both natural and cyber threats.

5.7. Impact on Remote and Edge Computing Devices:

The proliferation of remote and edge computing devices, such as IoT sensors, smart city infrastructure, and autonomous systems, introduces new vulnerabilities when exposed to rising temperatures. These devices often operate in environments that are not as well-regulated as traditional data centres, making them susceptible to heat damage or failure. Overheated edge devices can compromise the data they collect, corrupt transmissions, or provide exploitable entry points for cyberattacks, especially in environments where monitoring and maintenance are limited.

5.8. Adaptation and Mitigation Strategies:

To address the cybersecurity challenges posed by rising temperatures, organizations must implement a combination of technological, operational, and strategic measures:

- **Improved cooling systems**: Employ advanced cooling solutions like liquid cooling or AI-powered dynamic thermal management to keep systems within optimal temperature ranges.
- **Infrastructure redundancy**: Build geographically dispersed systems to prevent single points of failure and ensure continuity during temperature-induced disruptions.
- **Environmental monitoring**: Use temperature and environmental sensors to track conditions in real-time, allowing early identification of potential overheating risks.
- **Disaster recovery planning**: Ensure that backup systems, such as cloud storage and off-site data centres, are protected from extreme weather and temperature fluctuations.
- **Resilient software and firmware**: Implement adaptive software that can function under higher temperatures, ensuring data integrity and security even when hardware is stressed.

6. Digital Infrastructure and Its Importance in Cybersecurity:

Digital infrastructure refers to the foundational technologies that enable the operation, management, and communication of digital systems and services. It includes hardware, software, networks, data centres, and cloud platforms that power the vast array of online services, applications, and systems used by businesses, governments, and individuals. As the digital landscape continues to expand, so does the complexity and interconnectivity of digital infrastructures, making them both essential and vulnerable to cybersecurity threats. With the increasing impact of climate change and rising temperatures, the stability and security of digital infrastructure are increasingly at risk. In particular, digital infrastructure is becoming more susceptible to overheating, physical damage from extreme weather events, and environmental stressors, which create new security vulnerabilities that need to be addressed.

6.1. Components of Digital Infrastructure:

Digital infrastructure is a vast network that includes various components that support data storage, transmission, and processing. Key components include:

- **Data Centres:** Physical facilities that house servers, storage devices, and networking equipment. Data centres are responsible for storing vast amounts of data and supporting critical services, such as cloud computing and enterprise applications.
- **Networks:** A web of interconnected devices, servers, and communication systems that facilitate the transmission of data across the internet. Networks enable connectivity and communication between devices, businesses, and individuals.
- **Servers and Cloud Platforms:** Servers are physical or virtual systems that process and store data. Cloud platforms allow businesses and individuals to access computing resources remotely, without having to maintain on-site hardware.
- **End-User Devices and IoT Devices:** These devices—such as computers, smartphones, smart home devices, and industrial sensors—connect to the broader digital infrastructure and contribute to the flow of data.
- **Cybersecurity Systems:** These are specialized tools and protocols designed to protect digital infrastructures from unauthorized access, attacks, and data breaches. They include firewalls, encryption, intrusion detection systems (IDS), and antivirus software.

6.2. Risks to Digital Infrastructure Due to Rising Temperatures:

Rising temperatures due to climate change pose significant risks to digital infrastructure in a variety of ways:

- **Hardware Degradation and Failure:** Servers and other hardware components within data centres are designed to operate within specific temperature ranges. When temperatures exceed these limits, the risk of hardware failure increases, which can lead to system downtime, data loss, or compromised security.
- **Cooling System Failures:** As external temperatures rise, cooling systems—whether air conditioning or liquid cooling—become less effective. Poorly cooled data centres and server rooms are more prone to overheating, which can disrupt services, degrade system performance, and expose systems to cyber vulnerabilities.
- **Power Outages:** The increased demand for electricity due to rising temperatures can place strain on power grids, leading to potential outages. Power disruptions can cripple digital infrastructure, rendering cybersecurity systems inoperable and leaving critical systems exposed to attacks.
- **Extreme Weather Events:** Climate change is causing more frequent and severe weather events like heatwaves, storms, floods, and wildfires. These events can physically damage digital infrastructure, such as power lines, network cables, and data centres, causing service interruptions and creating new opportunities for cybercriminals to exploit weaknesses in compromised systems.

- **Data Centre Locations and Environmental Stress:** Many data centres are located in regions where the external climate is extreme or where natural disasters are common. These areas may face challenges in maintaining stable and secure operations, making them more vulnerable to both physical and cyberattacks.

6.3. The Interdependence of Digital Infrastructure and Cybersecurity:

Digital infrastructure and cybersecurity are intrinsically linked. The security of digital infrastructure depends on the proper functioning and resilience of the underlying hardware, software, and networks. Any disruption to digital infrastructure—whether through environmental factors or cyberattacks—can have cascading effects on an organization's ability to maintain security.

- **System Downtime:** Disruptions caused by overheating, extreme weather, or hardware failure can result in system downtime, during which cybersecurity systems may not be able to monitor or defend against cyberattacks. This creates opportunities for malicious actors to infiltrate systems undetected.
- **Exploitation of Vulnerabilities:** Overheated systems or damaged digital infrastructure may exhibit abnormal behaviour, such as slower performance, errors, or failure to authenticate users. Cybercriminals can exploit these weaknesses to gain unauthorized access to networks or manipulate systems.
- **Data Integrity Risks:** Physical damage to digital infrastructure can lead to the loss or corruption of critical data. If data is compromised or lost, it can undermine an organization's ability to operate securely, exposing sensitive information to theft or misuse.

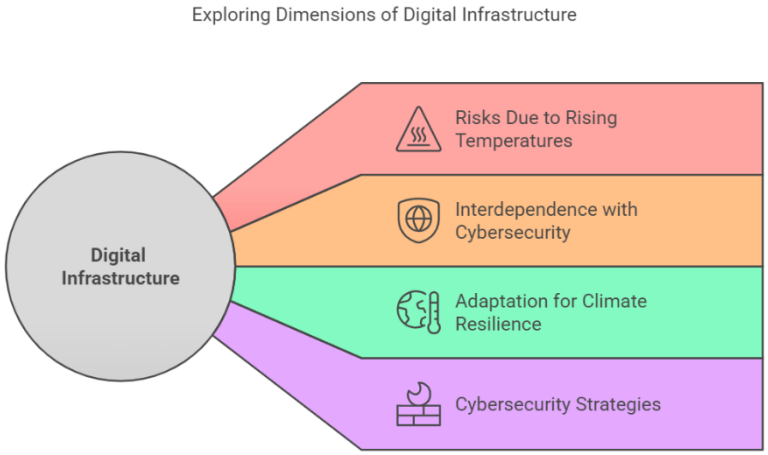

Fig: 6 – Exploring Dimensions of Digital Infrastructure

6.4. Adapting Digital Infrastructure for Climate Resilience:

To ensure that digital infrastructure remains secure and resilient in the face of rising temperatures and other climate-related challenges, organizations must adopt forward-thinking strategies to enhance the robustness of their systems:

- **Implementing Advanced Cooling Solutions:** Organizations can invest in energy-efficient cooling technologies, such as liquid cooling or natural cooling techniques, which are more effective in managing the temperature of critical infrastructure and reducing the risk of overheating.
- **Geographic Diversification:** To mitigate the risk of localized environmental disruptions, organizations should consider spreading their digital infrastructure across geographically diverse locations. This ensures redundancy and resilience in the event of a climate-related disaster in a specific region.
- **Building Disaster-Resilient Infrastructure:** Data centres and critical infrastructure should be built with resilience in mind, including features such as fire-resistant materials, flood barriers, and backup power sources to minimize damage from extreme weather events.
- **Implementing Environmental Monitoring:** Real-time monitoring of temperature, humidity, and other environmental conditions within data centres and critical facilities allows for early detection of potential overheating issues or equipment malfunctions. This proactive approach can prevent costly downtime and mitigate the risks of security breaches.
- **Cloud Computing and Edge Networks:** Leveraging cloud infrastructure and edge **computing** can reduce the reliance on centralized data centres, which are vulnerable to temperature-related risks. These technologies distribute computational resources across multiple locations, ensuring continuity even if one facility is impacted by environmental factors.

6.5. Cybersecurity Strategies for Protecting Digital Infrastructure:

To protect digital infrastructure from the cybersecurity threats exacerbated by rising temperatures, organizations should integrate climate-related risks into their cybersecurity strategy:

- **Climate-Resilient Cybersecurity Tools:** Deploy cybersecurity tools and practices that account for environmental factors, such as adaptive security measures that remain effective under fluctuating system performance or physical stress conditions.
- **Business Continuity Planning:** Integrate climate resilience into business continuity and disaster recovery plans, ensuring that data, systems, and networks can recover quickly after a climate-related event. This includes having off-site backups, cloud storage solutions, and rapid-response teams in place.

Conclusion:

The increasing global temperatures driven by climate change present significant challenges to the cybersecurity of digital infrastructures. As systems and data centres are pushed beyond their operational limits due to overheating, new vulnerabilities are emerging, making them more susceptible to both physical and cyber threats. The direct consequences of overheating, including hardware degradation, system failures, and cooling inefficiencies, create critical

gaps in security defences, potentially compromising data integrity, availability, and system reliability. In this evolving climate, cybersecurity must not only address traditional threats but also adapt to the environmental risks brought on by rising temperatures. The integration of climate-resilient solutions, such as advanced cooling technologies, robust disaster recovery plans, and geographically diversified infrastructure, is essential to ensure the continued protection of digital assets. Additionally, the development of adaptive cybersecurity tools that can withstand environmental stressors will play a crucial role in mitigating risks. As the climate continues to change, the intersection of environmental conditions and cybersecurity will require ongoing attention and innovation. It is imperative for organizations to recognize that maintaining cybersecurity in the face of a warming world requires a comprehensive approach that incorporates both technological advancements and strategic planning for climate resilience. By doing so, organizations can better protect their infrastructure, minimize disruptions, and remain secure in an increasingly volatile environmental landscape.

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A Social Evaluation of the Quality of Life Model with Particular Attention to the Academicians in the Research Area

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ABSTRACT

Quality of work life" refers to giving an employee's whole attention as a person rather than his or her task. "quality of work life" has recently gained immense popularity. It primarily talks about how an employer can ensure the overall health of a worker instead of merely concentrating on work-related issues. According to this perspective, the purpose of this research is to advance an adaptation from Walton's quality of work-life model, and the scale of answers was converted into a Likert scale work with five alternatives. It was achieved by the verification of the inner consistency of the instrument from Cronbach's alpha coefficient with a value of 0.893. This result guarantees high consistency with the adopted instrument. It can be said that the adaptation from the model of Walton, which was proposed in this study, allows for a more clarified question and a more objective scale of answers.

Keywords: Quality of work life, Walton model, Consistency, Guarantee, employee

INTRODUCTION:

Employees' welfare determines the effectiveness and efficiency of organizations set up to achieve specific objectives. Ensuring employees' job satisfaction, working in a safe environment, and exercising self-control over their work are all examples of how important it is for organizations to prioritize humanitarian conception. Creating positive work conditions also emphasizes the importance of these factors. Moreover, workers who are in a happy work environment produce better work. Employees' job satisfaction will increase when their workplace is favorable, which is vital for academic institutions. This will help in the improvement of performance. Academicians, who think that their work is of high Caliber and do not think of leaving. For this reason, academicians' work quality is essential in many aspects. People spend a considerable portion of their life at workplaces. Because of the high Caliber of these working environments, employees are more motivated and self-assured. To reduce job-related stress and boost organizational effectiveness, the idea of scholars doing high-quality work has arisen.

The term "Quality of Work Life" now refers to a variety of topics, including managing work and relationships, exercising self-control, employment safety, compensation, and career path. (Arslan, 2018). The concept of academicians' Quality of Work requires improvements in working conditions, job satisfaction, productivity, and social balance (Aba, 2009); this can be achieved by implementing changes in the current work environment that improve the quality

of life while also increasing productivity and trying to improve the skills of those who work there and ensure their satisfaction (Erginer, 2003). The state of physical and mental health in the workplace promotes workers' integration with the entire work environment (Bilgin, 1995).

The working conditions, happiness and discontentment of the employees, productivity, social climate at the company level, style of management, and the relation of work to social life all have a direct correlation with the Caliber of the work by the academicians (Martel & Dupuis, 2006). High-caliber work by academicians retains employees and promotes sustainability (Sandrick, 2003). By establishing the working environment, academicians' high Caliber of work can improve the productivity and job happiness of the employees. An academician who works in a bad environment and with a heavy workload produces work of lower quality. Demir (2016). A large portion of an employee's time is spent at work and productivity increases when job happiness does (Yalcin, 2014). Employees can enhance their commitment to their work and do their best for the task at hand in a positive workplace environment (Aydın, 2006).

The need for professors to produce quality work has been changed with the realization that employees have a direct impact on the performance of the organization.

We can conclude that employee performance directly impacts the efficiency of the organization. Pay, benefits, and professional advancement chances can also be a mix of factors that lead to job satisfaction. With attained job satisfaction, employees can be highly productive and effective (Demir, 2019). Although academics need the qualifications, it is not enough as work quality improvement and just, effective, and efficient employment of teachers at the national level are also necessities for this same reason (Dilaver, 1996). Academic environments in which faculty members produce work of unsatisfactory quality can have an impact on the members' incentives, relationships, work-life balance, and job satisfaction (Barker, 1986; Bolduc, 2002). Academics, who effectively implement the Institute's activities and carry considerable duties and responsibilities for its success and productivity, must also be provided the opportunity to balance their personal and professional life, working conditions, job satisfaction, general well-being, and self-regulation of work and family to have a sufficient quality of work life.

The most important factor of success can be described as administrators' and academicians' commitment to the Institute and their work, their satisfaction with it, their ability to cope with stress and burnout, their ability to develop close relationships with students, parents, and colleagues, or, in other words, their high Caliber of output (Erdem, 2008). Teachers' job satisfaction is claimed to be determined by the Caliber of their work in this way. Job satisfaction is that feeling that an employee has in realizing that his or her work and what they do meets their needs and personal value judgments (Barutçugil, 2004). It is also the appreciation that an individual has of their work or work life as a situation that brings about a satisfied feeling or positivity (Luthans, 2011). As a result of the perception of the employee's worth and what he or she receives in return, job satisfaction is the feelings and thoughts toward the job (Akehurst, Comeche & Galindo, 2009). For workers, job happiness is a must.

It is possible for businesses to achieve their objectives, ensure the job happiness of the workers, and improve the quality of life of the workers.

Regulation of working conditions and environment, requirement satisfaction of the employees' psychological needs, economic needs, and social needs, as well as decrease of issues occurring in working life, could also improve the quality of work (Gürsel, Izgar & Altınok, 2003). Employee motivation, self-worth, performance, and productivity increase when there is job satisfaction. Negative attributes such as stress, concern, complaints, and tension would decrease due to these positive factors (Akşit Aşık, 2010). Poor working, absenteeism, and an intention to leave the organization are some negative outcomes that are developed when job satisfaction cannot be achieved (Luthans, 2011).

One of the most important elements influencing organizational behaviors is job satisfaction since a person who is very satisfied with his work will have good attitudes and behaviors related to his work (Gamsız, Yazıcı & Altun, 2013). Positive attitudes and behaviors among employees will also reduce their intent to leave, as high job satisfaction among employees prevents issues with absences, tardiness, and other issues related to leaving the office (Hayes, Pallas & Duffield, 2006).

QUALITY OF WORK LIFE

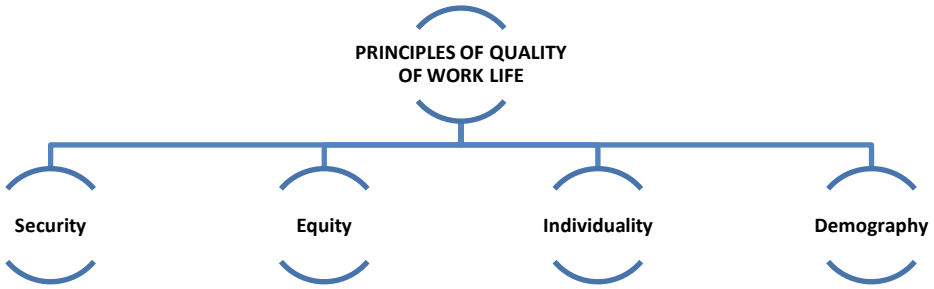
An Evolution:

Many laws have been enacted around the world, particularly in India, to protect workers from workplace mishaps, and employer exploitation, and to offer welfare and safety measures. In the present scenario, QWL has become a fad word. The idea of QWL was first introduced in the American Research Journals in 1970. It would be impossible to exaggerate the role of Maslow, Herzberg, and McGregor in QWL. The term "humanization of work" currently refers to the QWL. Treating employees like human beings is the fundamental tenet of this notion. The goal of almost all significant organizations is to create a more compassionate workplace.

The terms intellectual capital, social capital, human capital, human resource asset, talent investors, etc. are now often used to refer the knowledge workers. People are bundles of energy that can't be replicated. If the company takes good care of its QWL, it may eventually become the company's most treasured asset. Today, modern management is paying respect to all workers and this is why quality work lives among all the workers in all multi-national companies.

1.Specialists and division of work have erased the social bonding within the employees' network.
2.Employees have also become mere 'pieces' that are replaceable parts of a system due to excessive reliance on policies, procedures, and organizational hierarchies.
3. Despite the general agreement that an employee should work 8 to 9 hours a day, many organizations have individuals working 14 to 15 hours a day. The employees are now tense and under stress.

4. The inescapable byproducts of the modern way of life include monotony, work-related stress, burnout, and other health risks. Poor health might result from job strain due to drug, alcohol, and smoking addiction.
5. Many organizations hire workers on a contract or temporary basis. In such organizations, employees do not have job security. These people overwork, which reduces their overall level of happiness.
6. Due to the lowering of national borders and the increase in worker mobility brought about by globalization, the work environment in factories and offices has changed significantly.
7. The literate workforce is changing, and its needs are moving toward non-monetary issues such as organizational privacy, flexible scheduling, self-respect, and recognition.



Security:

Modern knowledge workers have greater expectations from their work life than just monetary remuneration. The first on their list is job security. The current period is rapidly shifting towards one where both spouses work and earn two incomes. Such employees need greater flexibility in many areas, such as pay, benefits, and working hours. An employee who is not fearful of losing his or her job adds greater value to the organization.

Equity:

There should not be any differences or discrimination between employees, management, and owners according to the law. A fair reward should be provided to all of them. The owners and employees should share the profits of the company proportionate to the contribution of each.

Individuality:

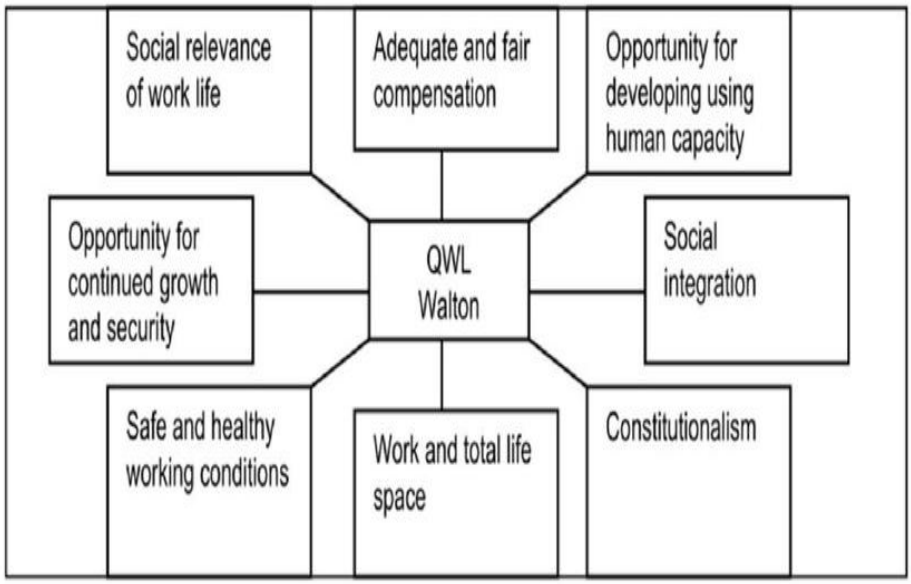
This has to do with the freedom and autonomy given to employees in how to set their work pace, method, and priority of jobs. In relation to this, each employee must be motivated to attain his full potential and to utilize his available abilities, according to the principle of individuality.

Demography:

According to this view, there should be a democratic air in the workplace. Some rights, for instance, freedom of speech and privacy rights, must be enjoyed by employers. When workers participate in managing the affairs, it shows that an organization is democratically built.

WALTON'S MODEL OF QUALITY OF WORK LIFE

The most commonly used model in the relevant literature is that proposed by Richard Walton. It is considered to be the scientific model of QWL and the one that offers more favorable circumstances for evaluation. According to Walton (1973), this paradigm, which takes into account the wants, desires, and social duties of workers, has a direct correlation with people's motivation, self-esteem, and pleasure. It outlines social, political, and economic aspects that have impacts on work-life quality and can be able to highlight the advantages and disadvantages of that quality from the viewpoint of the workforce. QWL, according to Walton (1973), is not restricted to a person's career and does not stop when he or she leaves the organization. The balance of the employee's life at work and other areas must be maintained. The social responsibility of the organization and worker well-being, quality of work life, and productivity are also to be considered.



Adequate and fair remunerations:

The pay scale among the employees has to be legitimate, justifiable, and acceptable. It shall ensure just earnings to the employee so that workers can afford some respectable standard of living. The employee's rights were protected through the Earning Payment Act passed during the years 1936 and 1948. Minimum Wages Act. Sufficient and effective remunerations should not involve only monetary rewards. To fulfill their primary and higher-order needs to enhance their quality of life, the knowledge workers are paid very handsomely.

Safe and Healthy working conditions:

The Factories Act 1948 in India has several laws related to the health and safety of workers. In order to outperform their rivals, employers are making a greater effort to give their employees better working circumstances. The quality of work life is greatly impacted by flexible work schedules, low-risk physical work environments, and safety measures against noise, pollution, fumes, and gases, among other things.

Opportunity to use and develop human capacities:

If the occupations provide people with enough freedom and authority, the QWL will be enhanced. The workers should be allowed to plan and execute the work using their talents, abilities, and initiative. The workers may get prompt feedback from the top personnel along with continuous supervision and watchfulness. Based on this feedback, corrective actions can be taken immediately.

Opportunity for growth and security:

Promotion ladders and other routes for employee advancement in the firm raise QWL. Each worker has a need to progress up the job career ladder. Let the employee know at the initial stages if it is a dead-end job.

Social integration in the work organization:

A worker gets an identity in the company for which he works. Social integration is being marred due to discrimination on grounds of age, sex, caste, creed, and religion among employees. Social integration increases workers' self-respect and improves the quality of work life.

Constitution in the work organization:

Every employee should have some rights, like the right to speech, the right to privacy, the right to fair treatment, and so on. There needs to be regulations and legislation about it. That is, the constitution of the enterprise must delineate the "Rule of Law".

Work and Total Life Period:

Some employees must work late shifts, undergo frequent transfers, or travel extensively as part of their job. Since they are separated from their family for an extended length of time, this undoubtedly affects their quality of life.

The social relevance of work life:

Commercial firms that execute their social duties benefit QWL. Employees of a company that does not adhere to its social responsibilities cannot hope for a better QWL. Indicators of low QWL include poor employment practices, poor quality products, and no pollution control.

RESEARCH METHODOLOGY

Research Design:

This study was designed as a survey model, which is one of the quantitative research methods. The aim of the survey model is to identify the consistency of Walton's model of Quality of Work Life among academicians. The participants of the study are 100 academicians working at schools and colleges in and around Madurai City. Participation of academicians was on a volunteer basis and 68 academicians provided feedback. Since all the participants were contacted in the scope of the study no samples were taken.

Data collection:

In the study, the data was collected by using the Questionnaire. The questionnaire consisted of eight dimensions of Walton's Model (1975).The questionnaire consists of eight dimensions and 34 questions as follows: 4 Questions in the dimension of adequate and fair compensation,

6 Questions in the dimension of working conditions, 5 Questions in the dimension of use of capacity at work, 4 Questions in the dimension of opportunities at work, 4 Question in the dimension of social integration of work, 4 Question in the dimension of constitutionalism at work, 3 Question in the dimension of occupied space by the work in life and 4 Question in the dimension of social relevance and importance of work. The scale, developed as a 5-point Likert type, was graded as Highly Dissatisfied (1), Dissatisfied (2), Neutral (3), Satisfied (4), Highly Satisfied (5).

Statistical tool:

This is a statistical instrument developed by Lee Cronbach in 1951, which uses Cronbach's alpha coefficient to assess how reliable a questionnaire is. That is done based on its internal consistency. With this formula:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k}\sigma_y^2}{\sigma_x^2}\right)$$

The categorization proposed by Freitas and Rodrigues (2005), who recommend the following scale to check Cronbach's alpha coefficient, will be based on the consistency of the instrument verified.

α Value	**Reliability**
$\alpha \leq 0.30$	Very low
$0.30 < \alpha \leq 0.60$	Low
$0.60 < \alpha \leq 0.75$	Moderate
$0.75 < \alpha \leq 0.90$	High
$\alpha > 0.90$	Very High

ANALYSIS & INTERPRETATION

The following were the results from the application of Cronbach's alpha coefficient in assessing the internal consistency of instrument adoption on the eight Walton-proposed Quality of Work Life aspects (1975). All eight dimensions are characterized by a high degree of consistency according to Freitas and Rodrigues (2005) categorization of alpha values. The overall instrument's alpha was determined to be 0.893, which indicates a high level of inner consistency for the chosen instrument used in this investigation.

DIMENSIONS	**α Value**
Fair and Adequate Compensation	0.860
Work Conditions	0.807
Use of Capacity at Work	0.953
Opportunities at Work	0.825
Social Integration at Work	0.898
Constitutionalism at Work	0.937
Occupied Space by the Work in Life	0.941
Social Relevance and Importance of Work	0.930
Average αValue	0.893

The findings of applying the modified version of Walton's Quality of Work Life model show the adaptation designed in this work contains a very high degree of internal consistency and hence is equivalent to the original version of Walton.

The following table represents the Statistical analysis of the QWL Dimensions:

DIMENSIONS	Mean	Standard Deviation
Fair and Adequate Compensation	3.301	0.901
Working Conditions	3.872	0.915
Use of Capacity at Work	3.776	0.976
Opportunities at Work	3.558	1.105
Social Integration at Work	3.808	1.005
Constitutionalism at Work	3.823	1.006
Occupied Space by the Work in Life	3.607	1.070
Social Relevance and Importance of Work	3.941	0.921

*Source: Primary Data

Those with a mean score of 3.710 or 74% on a scale of 1 to 5 were found to be positive or factors of satisfaction in the work environment through the assessment of the scores derived from the adapted version application of Walton's Quality of Work Life model. A score less than three would fall under unsatisfactory or negative for quality of work-life. The standard deviation for the dimension "Fair and Adequate Compensation" is the lowest, which means that the group under analysis has a relatively uniform impression of this characteristic. The dimension "opportunity at work" has the highest standard deviation, meaning that the individuals' perceptions of this dimension are the most asymmetrical. In other words, this is the dimension where the respondents show the biggest disparity in perception. The standard deviation of Walton's model (1975) is generally low, which means that the perceptions of the collection of attributes suggested by this model are convergent for servers. Thus, it is clear that the dimension "Fair and Adequate Compensation" is one of the dimensions that contribute most to respondents' satisfaction with their QWL and is also associated with a more uniform perception of the servers. Conversely, it is observed that the dimension "opportunity at work" generates the lowest satisfaction score concerning QWL and also the most diversified opinion among the respondents.

CONCLUSION

It was revealed that the model's dimensions correlate directly with QWL satisfaction levels: the level of satisfaction on one dimension positively correlates with overall QWL satisfaction. Lastly, it was illustrated that the eight model dimensions of the overall QWL satisfaction level were significantly positively related to each of the dimensions for eight out of eight dimensions. The dimension "fair and adequate remuneration" is considered a hygiene factor based on the facts collected. The dimensions of the model and the outcome of employee happiness are connected. All eight parameters of the study have a positive and significant correlation with the QWL satisfaction level. It is evident that when one of the dimensions enjoys higher levels of satisfaction, QWL enjoys higher levels of satisfaction as well. We have been able to arrange the dimensions in increasing order of significance

through analysis of each level of significance. Conducting an overall evaluation of QWL, our research reveals that employees exhibit a "high" degree of satisfaction with QWL.

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Data-Driven Innovation: Big Data and AI for Sustainability

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Abstract

In the age of digital transformation, data-driven innovation has emerged as a powerful catalyst for addressing global sustainability challenges. Big Data and Artificial Intelligence (AI) are central to this transformation, enabling more effective decision-making, resource management, and environmental stewardship. This paper explores the role of Big Data and AI in driving sustainability initiatives across industries such as energy, agriculture, transportation, and urban development. By analyzing large volumes of data, these technologies help uncover patterns and insights that guide the optimization of processes, reduction of waste, and promotion of environmentally conscious practices. The paper also discusses the potential of AI in predictive modeling, climate forecasting, and the development of smart, sustainable systems. Additionally, it highlights ethical considerations, challenges, and the importance of fostering inclusive innovation that benefits society as a whole. Through a combination of case studies, theoretical insights, and future trends, this paper demonstrates how the convergence of Big Data and AI is reshaping the sustainability landscape and offers pathways for continued innovation.

Keywords: Digital Transformation, Innovation, Artificial Intelligence, Big Data

1. Introduction

The rapid advancements in Big Data and Artificial Intelligence (AI) have led to transformative shifts across multiple industries. These technologies are reshaping not only how businesses operate but also how societies address critical challenges such as climate change, resource depletion, and environmental degradation. Data-driven innovation, leveraging vast amounts of data coupled with AI-driven analytics, is a powerful tool for achieving sustainability goals.

2. The Role of Big Data in Sustainability

Big Data refers to the massive volumes of data generated through diverse sources such as IoT devices, sensors, satellite imagery, social media, and environmental monitoring systems. With the increasing digitalization of various industries, Big Data provides valuable insights into environmental processes and trends, offering opportunities to mitigate the adverse effects of human activities on the planet. In the context of sustainability, Big Data allows for the identification of inefficiencies, the optimization of resources, and the development of data-driven solutions that aim to reduce environmental impacts and improve overall sustainability.

Big Data enables real-time analysis, predictive modeling, and long-term forecasting, making it a key tool in addressing sustainability challenges across various sectors, including energy, agriculture, water management, waste management, and climate change. In this section, we explore two key ways in which Big Data plays a critical role in promoting sustainability: monitoring and optimizing resource use, and supporting environmental impact assessments.

2.1. Monitoring and Optimizing Resource Use

The monitoring and optimization of resource use is one of the most immediate and impactful applications of Big Data in sustainability. With the increasing demand for natural resources and growing concerns about environmental degradation, it is essential to efficiently manage resources like energy, water, and raw materials. Big Data provides the tools to achieve this by enabling real-time monitoring, which allows organizations to identify areas of waste, inefficiency, and high consumption, thereby helping to reduce their ecological footprints.

Smart Meters and IoT Devices

Smart meters, IoT sensors, and other connected devices are becoming increasingly ubiquitous across industries and residential areas. These technologies provide continuous, real-time data about resource consumption. For example, smart meters track energy usage at the household or industrial level, enabling more precise monitoring of energy consumption patterns. By analyzing this data, utilities and businesses can detect irregularities or areas where energy use is higher than necessary, allowing for targeted interventions to optimize consumption. The same principle applies to water usage, with smart water meters helping to identify leaks or inefficiencies in irrigation systems.

Remote Sensing and Satellite Imagery

Satellite imagery and remote sensing technologies offer invaluable insights into environmental processes, including land use, deforestation, and resource depletion. For example, satellite-based monitoring systems can track changes in forest cover, crop health, and water levels in reservoirs. This data can be integrated with other Big Data sources to provide a more comprehensive understanding of how natural resources are being used, where depletion or environmental degradation is occurring, and which areas need urgent attention. This information is crucial for policymakers and industries to take preemptive actions and develop sustainable practices.

Smart Grids and Energy Distribution

In the energy sector, smart grids are transforming the way electricity is distributed. A smart grid uses real-time data from sensors to optimize the flow of electricity across the grid, balancing supply and demand more efficiently than traditional systems. It can also incorporate renewable energy sources, such as solar and wind power, whose availability can fluctuate depending on weather conditions. By integrating predictive models and real-time data, smart grids can optimize energy distribution, reduce wastage, and promote the use of cleaner energy sources. This reduces both operational costs and carbon emissions, contributing to a more sustainable energy system.

Waste Reduction and Circular Economy

Big Data also aids in the reduction of waste through better tracking and management of resources. By analyzing data related to waste generation and disposal, organizations can better predict waste trends, improve recycling processes, and reduce landfill usage. For example, AI-driven systems can optimize waste collection routes based on real-time data,

reducing the environmental impact of transportation. Additionally, Big Data allows for better management of the circular economy, ensuring that resources are reused and recycled to minimize waste and conserve resources.

2.2. Environmental Impact Assessments

Environmental impact assessments (EIAs) are essential tools in understanding the potential effects of human activities on the environment. By integrating Big Data with environmental and socioeconomic datasets, these assessments can be made more precise, timely, and actionable. Big Data provides deeper insights into the interconnectedness of ecosystems, human activities, and environmental variables, allowing for more informed decision-making when planning infrastructure, urban development, and industrial projects.

Integrating Multiple Data Sources

Traditionally, EIAs relied on limited, localized data and expert judgment. Today, Big Data enables the integration of diverse datasets, such as real-time environmental monitoring, socio-economic data, satellite imagery, and even crowd-sourced information. This rich combination of data allows for more accurate and comprehensive assessments. For example, when planning a new industrial facility, an EIA can incorporate data on local air and water quality, climate patterns, biodiversity, and social impacts. This integration provides a holistic view of how a project could potentially affect the environment and the local community.

Predictive Modeling for Climate Change and Ecosystem Impacts

Predictive modeling is a powerful tool enabled by Big Data that helps assess the long-term environmental impacts of certain projects or policies. For instance, using machine learning algorithms, environmental experts can simulate the potential effects of deforestation on local climates, biodiversity, and carbon sequestration. By analyzing historical data and future trends, these models can predict the environmental consequences of large-scale industrial projects, helping to identify negative outcomes before they occur.

Urban Planning and Sustainable Development

Urbanization is a major driver of environmental degradation, and effective urban planning is essential to mitigate its impact. Big Data plays a critical role in supporting sustainable urban development by providing data on population growth, land use, traffic patterns, pollution levels, and resource consumption. By analyzing these datasets, urban planners can design cities that optimize energy use, reduce waste, promote green spaces, and improve overall sustainability. For example, Big Data can help identify areas in cities that are most vulnerable to climate change, such as flood-prone neighborhoods, and inform strategies for building climate-resilient infrastructure.

Industrial Applications and Compliance Monitoring

For industries, Big Data enhances the ability to monitor environmental compliance and minimize adverse environmental impacts. For example, oil and gas companies can use sensors and IoT devices to continuously monitor emissions, detect leaks, and identify inefficiencies in production processes. These real-time data streams enable companies to take

corrective actions promptly, reducing their environmental footprint. Furthermore, Big Data allows for better tracking of regulatory compliance by automating the collection and reporting of environmental data, ensuring that companies meet environmental standards and avoid costly penalties.

Improving Conservation and Biodiversity Management

Big Data is also invaluable in the field of conservation and biodiversity management. Using large-scale environmental monitoring systems, conservationists can track species populations, habitat quality, and ecological changes. Data from satellite imagery, sensors, and drones can monitor large, remote areas, such as rainforests and ocean ecosystems, in real-time. By combining these data sources with machine learning techniques, conservation efforts can be more targeted and effective, allowing for early intervention when threats to biodiversity arise, such as illegal poaching or habitat destruction

3. Artificial Intelligence for Sustainability

Artificial Intelligence (AI) is rapidly transforming various industries and sectors, and its impact on sustainability is profound. By enabling more accurate predictions, automating processes intelligently, and optimizing complex systems, AI provides powerful tools to address some of the most pressing environmental challenges. From reducing carbon emissions to increasing agricultural efficiency, AI is driving innovation in sustainable practices across multiple domains. In this section, we explore how AI is being used to address sustainability challenges in three key areas: predictive analytics for climate change, AI in agriculture and food security, and sustainable transportation systems.

3.1. Predictive Analytics for Climate Change

Climate change is one of the most critical global challenges of our time, and AI is playing a crucial role in better understanding, predicting, and mitigating its impacts. Predictive analytics powered by AI allows for the processing and analysis of vast datasets related to weather patterns, carbon emissions, and other environmental variables. Machine learning models, in particular, are helping scientists and policymakers make more accurate predictions about future climate scenarios, enabling them to plan and respond more effectively to changing environmental conditions.

Climate Modeling and Simulation

AI-powered climate models are helping researchers simulate future climate conditions more accurately than ever before. Traditional climate models often require significant computational resources and rely on assumptions about future greenhouse gas emissions, which can lead to uncertainty in predictions. Machine learning algorithms, however, can analyze historical climate data, detect patterns, and make more reliable predictions about climate trends. These models can simulate various scenarios, including temperature increases, changes in precipitation patterns, and the effects of different mitigation strategies (e.g., carbon pricing, reforestation). For example, AI can enhance the accuracy of weather forecasting, predicting extreme weather events such as hurricanes, floods, and droughts. By

identifying risk areas and patterns, governments and organizations can take preemptive actions to minimize the damage caused by these events.

Carbon Emission Tracking and Mitigation

AI is also helping track and reduce carbon emissions, which is essential for achieving global climate goals. Through AI-powered sensors and IoT devices, it is possible to monitor carbon emissions in real-time across industries such as energy production, manufacturing, and transportation. Machine learning models analyze this data to detect inefficiencies and suggest ways to optimize processes to reduce emissions. These systems can help industries adopt low-carbon technologies and contribute to efforts to meet international climate agreements like the Paris Agreement.

3.2. AI in Agriculture and Food Security

Agriculture plays a crucial role in global sustainability, and AI is proving to be an indispensable tool in making farming practices more efficient, resource-conscious, and sustainable. By integrating AI and Big Data, farmers can optimize various aspects of their operations, reduce environmental impacts, and improve food security. The application of AI to agriculture is known as "precision farming," which uses data-driven insights to maximize yields while minimizing resource use.

Optimizing Irrigation Systems

Water scarcity is a growing global concern, and inefficient irrigation practices can waste precious water resources. AI-driven irrigation systems can help farmers optimize water usage by predicting the precise amount of water crops need at different stages of growth. By combining weather forecasts, soil moisture levels, and crop type, machine learning algorithms can automatically adjust irrigation schedules and water flow to reduce waste. This ensures that crops receive the right amount of water at the right time, leading to water conservation and improved crop health.

Predicting Crop Yields and Monitoring Crop Health

AI is also helping farmers predict crop yields with greater accuracy by analyzing historical yield data, soil health, weather conditions, and other factors that influence agricultural productivity. Machine learning models can predict which crops are likely to thrive in particular regions, optimizing crop selection. Additionally, AI-powered systems can monitor the health of crops in real-time using drones, satellite imagery, and sensors. These systems can detect early signs of diseases, pests, or nutrient deficiencies, enabling farmers to take immediate action, reducing the need for pesticides and fertilizers, and preventing crop loss.

Sustainable Use of Fertilizers and Pesticides

AI is helping minimize the environmental impact of fertilizers and pesticides by recommending the optimal amount and timing for their application. By analyzing data from sensors and drones, AI systems can assess soil health and nutrient levels, advising farmers on

how to apply fertilizers more efficiently. This minimizes the overuse of chemical inputs, reduces runoff into nearby water bodies, and improves soil quality over time.

Supply Chain Optimization and Reducing Food Waste

AI is also revolutionizing food supply chains by helping optimize the logistics of food production, transportation, and distribution. Using AI algorithms to forecast demand and optimize delivery routes, food producers and distributors can reduce spoilage and waste, ensuring that food reaches consumers more efficiently. Furthermore, AI-powered systems can track the shelf-life of perishable goods and help retailers manage inventory more effectively, reducing waste in the food retail sector.

3.3. Sustainable Transportation Systems

Transportation is a major contributor to carbon emissions, and optimizing transportation systems is essential for achieving sustainability goals. AI is transforming the transportation industry by improving traffic flow, reducing congestion, and enhancing fuel efficiency. Moreover, autonomous vehicles and AI-driven logistics are promising solutions for reducing emissions and making transportation more sustainable.

Smart Mobility and Traffic Optimization

AI-powered smart mobility systems are reshaping how cities approach traffic management. By integrating data from sensors, GPS devices, and traffic cameras, AI can optimize traffic flow in real-time, reducing congestion, and minimizing fuel consumption. AI algorithms can predict traffic patterns, adjust signal timings, and suggest alternate routes, leading to smoother traffic and less time spent idling. This not only reduces the environmental impact of transportation but also improves urban air quality and quality of life for residents.

Autonomous Vehicles (Self-Driving Cars)

Autonomous vehicles, powered by AI, are poised to revolutionize transportation systems by reducing energy consumption, emissions, and road accidents. Self-driving cars can optimize routes, improve fuel efficiency, and reduce traffic congestion. Moreover, autonomous vehicles are typically designed to be electric, further reducing emissions associated with fossil fuel-based transportation. By replacing human drivers with AI, autonomous vehicles also have the potential to reduce traffic fatalities and improve the efficiency of public transport systems.

AI-Driven Logistics and Supply Chain Management

AI is also playing a pivotal role in optimizing logistics and supply chain systems. Using real-time data from various sources (e.g., traffic patterns, weather forecasts, vehicle performance data), AI algorithms can optimize shipping routes, delivery schedules, and inventory management. This leads to reduced fuel consumption, fewer emissions, and cost savings for businesses. For example, AI-powered delivery trucks can use real-time traffic data to avoid congested routes, reducing the overall carbon footprint of deliveries. Additionally, AI can optimize freight transportation by determining the most efficient routes and minimizing empty miles.

Electrification of Transport

AI is also accelerating the transition to electric transportation. In electric vehicle (EV) systems, AI plays a role in optimizing battery management, charging infrastructure, and route planning for EVs. By analyzing data from electric vehicles, charging stations, and grid systems, AI can ensure efficient energy use, reduce charging times, and improve the overall sustainability of electric transportation networks

4. Case Studies of Data-Driven Innovation for Sustainability

This section explores real-world examples where Big Data and AI have contributed to sustainability goals.

4.1. Case Study: Smart Cities and Urban Sustainability The implementation of AI and IoT in cities worldwide has resulted in more efficient resource management. Smart traffic systems reduce congestion, and energy management systems ensure optimized electricity use. Cities like Barcelona and Singapore have adopted such technologies to create more sustainable urban environments.

4.2. Case Study: AI in Renewable Energy AI-driven solutions in renewable energy, such as wind and solar power, allow for better forecasting of energy production. Companies use AI to predict weather patterns and adjust energy grid operations accordingly, ensuring that renewable energy sources are maximally utilized, thereby reducing dependency on fossil fuels.

4.3. Case Study: Waste Management in Circular Economy AI technologies are used to optimize waste collection, recycling processes, and waste-to-energy systems. Companies in the circular economy space utilize machine learning to predict waste generation trends, improve recycling rates, and reduce landfill waste.

5. Ethical and Social Considerations

While Big Data and AI hold immense potential for driving sustainability, they also raise important ethical issues that must be addressed.

5.1. Data Privacy and Security The extensive use of data in sustainability applications often involves the collection of personal and sensitive information. It is crucial to ensure that data privacy and security measures are robust, and that data is used responsibly to avoid misuse.

5.2. Equity and Inclusivity in Innovation Sustainability innovations should be inclusive, ensuring that marginalized communities benefit from data-driven solutions. Policymakers and businesses must focus on equitable distribution of AI and Big Data benefits to avoid creating or exacerbating social inequalities.

5.3. Accountability and Transparency AI models can sometimes be seen as "black boxes" where their decision-making processes are not easily understood. Transparency in how AI algorithms are developed and used is essential to build trust and ensure accountability, particularly in sectors related to environmental impact.

6. Challenges and Future Opportunities Despite the potential of Big Data and AI, several challenges remain that need to be addressed for these technologies to reach their full potential in sustainability.

6.1. Data Quality and Integration Ensuring high-quality, interoperable data across different sources is essential for effective AI application. Many datasets are fragmented, incomplete, or inconsistent, making it challenging to extract meaningful insights.

6.2. Technological and Infrastructural Barriers The development and deployment of AI and Big Data solutions require significant technological infrastructure, such as high-performance computing and data storage. For many regions, especially in the developing world, these resources may be out of reach.

6.3. Policy and Regulation Governments and international organizations need to develop and enforce policies that encourage the responsible use of Big Data and AI in sustainability. This includes setting standards for data usage, environmental protection, and technology adoption.

Conclusion

Data-driven innovation, powered by Big Data and AI, holds immense promise for promoting sustainability and solving the world's most pressing environmental challenges. By enabling more accurate decision-making, resource optimization, and predictive modeling, these technologies are facilitating the transition to a more sustainable future. However, careful consideration must be given to ethical, social, and technological challenges in order to ensure that these innovations are deployed responsibly and equitably. As the world continues to face climate change and resource scarcity, the integration of Big Data and AI into sustainability efforts will be crucial for fostering long-term environmental stewardship and achieving a sustainable future.

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Deficit Irrigation and Arbuscular Mycorrhiza as a Water-Saving Strategy for Eggplant Production

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Abstract

Crop cultivation in arid and semi-arid areas needs continual irrigation to ensure plant development and yield. However, water-saving measures such as deficit irrigation, when paired with beneficial soil microorganisms like arbuscular mycorrhizal fungi (AMF), can improve water use efficiency (WUE) and plant tolerance to drought stress. This study looks at the impact of AMF inoculation on eggplant (*Solanum melongena* L.) under various watering regimes. A controlled experiment was carried out with varied degrees of evapotranspiration (ET) restoration, including full irrigation (100% ET) and deficit irrigation (80% ET). Under water-limited circumstances, AMF-inoculated (AM+) plants showed considerably better biomass accumulation, nitrogen (N) and phosphorus (P) absorption, stomatal conductance (gs), and photosynthetic rate (Pn) than non-inoculated plants. Notably, AM+ plants treated to 80% ET restoration-maintained yields equivalent to those under full irrigation, therefore saving 20% of the water. Furthermore, the yield response factor (Ky) was considerably lower in AM+ plants, indicating greater drought tolerance. These findings highlight the potential of AMF-assisted deficit irrigation as a long-term method for increasing eggplant yield in water-scarce regions. Integrating AMF into irrigation management strategies can improve WUE, reduce drought-induced stress, and keep crops productive while using less water. This strategy provides an environmentally beneficial and resource-efficient option for enhancing agricultural sustainability in dry environments.

Keywords:
Deficit irrigation, Arbuscular mycorrhizal fungi, Water use efficiency, Nutrient uptake, Eggplant production

Introduction

Water shortage is an increasing worldwide issue, especially in arid and semi-arid regions where agricultural output is strongly reliant on good water management practices (Farooq et al., 2023; Zhang et al., 2024). Climate change, population increase, and over-extraction of groundwater worsen water scarcity, necessitating novel techniques to improving water use efficiency (WUE) in agricultural production (Khan et al., 2023). In this setting, deficit irrigation (DI) has emerged as a viable approach for increasing water productivity and reducing yield losses. DI entails providing water at levels lower than complete crop evapotranspiration (ET), allowing plants to develop adaptation mechanisms for water stress tolerance (Chai et al., 2023; Gohari et al., 2024). Several studies have found that DI may considerably enhance WUE in a variety of crops, including cereals (Zia et al., 2023), vegetables (Ali et al., 2024), and fruits (Xu et al., 2023). However, the efficacy of DI varies according to crop variety, development stage, and soil conditions, prompting more research into crop-specific responses.

Arbuscular mycorrhizal fungi (AMF) are helpful soil microorganisms that form symbiotic relationships with plant roots to aid nutrient and water absorption (Smith & Read, 2023). These fungi are critical in boosting soil fertility, increasing plant drought tolerance, and alleviating the negative impacts of abiotic stress (Wang et al., 2023). AMF improve nutrient intake, notably nitrogen (N) and phosphorus (P), by increasing the root absorptive surface area via extraradical hyphae (Bahadur et al., 2023). Furthermore, AMF improves plant hydraulic conductivity by controlling aquaporin activity and root shape, which increases WUE under dry situations (Zhang et al., 2023).

Recent studies have shown that AMF has the ability to improve crop resilience under water stress. Under DI circumstances, AMF inoculation has been demonstrated to improve wheat and maize growth, photosynthetic efficiency, and antioxidant activity (Chen et al., 2023; Liu et al., 2023). Similarly, in vegetable crops such as tomato and bell pepper, AMF treatment has been associated to enhanced water retention, stomatal control, and greater fruit output when irrigation is reduced. However, little study has been conducted on the combined use of DI and AMF in eggplant (*Solanum melongena* L.), a commonly produced food with high economic value.

Although earlier research has looked at the impacts of DI and AMF on plant development and water stress responses separately, their combined influence on eggplant yield and WUE is not well established (Jones et al., 2024). Given eggplant's importance in worldwide vegetable production and vulnerability to water stress, research into the synergistic effects of DI and AMF is critical for creating sustainable agriculture techniques.

This study seeks to fill a knowledge gap by studying the influence of arbuscular mycorrhizal fungus (AMF) inoculation at various irrigation levels. It assesses plant growth, physiological responses, and yield indices to determine the efficacy of AMF association in enhancing drought resistance and water usage efficiency. Furthermore, the study investigates the efficacy of recovering 80% of evapotranspiration (ET) in conjunction with AMF inoculation as a water-saving method for sustainable eggplant (*Solanum melongena* L.) production. This study aims to give insights into enhancing crop production while lowering water inputs in arid and semi-arid environments by incorporating AMF into irrigation management. This study aims to improve resource use and contribute to the establishment of climate-resilient agricultural systems by combining DI and AMF.

Materials and Methods

The research was carried out in the Dongargaon Research Farm in Taluka Niphad, District Nashik, Maharashtra, India, which has a semi-arid climate. The region receives an average annual rainfall of 500-700 mm, with temperatures ranging from 10°C to 40°C. Because of the region's limited water supplies and high evapotranspiration, effective irrigation strategies are essential for maintaining agricultural yield (Patil et al., 2023). The experimental soil is sandy loam, with moderate organic carbon content and a poor water retention capacity. Eggplant (*Solanum melongena* L.) was chosen as the experimental crop because of its susceptibility to water stress and propensity to benefit from mycorrhizal

symbiosis, especially in water-stressed environments (Singh et al., 2023). The experiment used a randomized complete block design (RCBD) with split-plot configurations to examine the interaction between irrigation levels and mycorrhizal inoculation.

The experiment was designed to assess the combined effects of deficit irrigation (DI) and arbuscular mycorrhizal fungus (AMF) inoculation on eggplant growth, yield, and water use efficiency (WUE). Irrigation treatments were based on crop evapotranspiration (ET), which was determined using the FAO Penman-Monteith technique. The following irrigation treatments were used: 100% ET (full irrigation), 80% ET (moderate deficit irrigation), 60% ET (severe deficiency irrigation), and 40% ET. For the AMF treatment, transplanted eggplant seedlings were infected with *Rhizophagus intraradices* at a rate of 1000 propagules per plant (Zhang et al., 2024). The treatments included AM+ (with AMF inoculation) and AM− (without AMF inoculation). Each treatment combination was duplicated four times, with each experimental plot measuring 3 m x 3 m. The planting density was 60 cm between plants and 90 cm between rows, for a total of 15 plants per plot.

Plant height, leaf area, root length, and biomass were assessed to evaluate the effects of both water stress and mycorrhizal inoculation. Yield data, including fruit weight and quantity of fruits, were collected to assess productivity under each treatment. Water-use efficiency (WUE) was measured as the ratio of yield to water applied, which aids in determining how efficiently water was used across various irrigation regimes and AMF treatments. The soil moisture content was measured on a regular basis to verify that the ideal moisture levels were maintained throughout each treatment. In addition, mycorrhizal colonization rates in plant roots were measured to evaluate the efficiency of the AMF inoculation and to investigate its function in nutrient intake, particularly during drought circumstances.

At harvest, many yield parameters were measured to determine the impact of deficit irrigation (DI) and arbuscular mycorrhizal fungus (AMF) inoculation on eggplant production. These included overall production (measured in kilograms per plant and kilograms per hectare), fruit count per plant, and average fruit weight (measured in grams per fruit). These parameters were chosen based on prior research indicating that both DI and AMF can have a considerable impact on fruit output, particularly under water-limited situations (Liu et al., 2023; Rahman et al., 2024). The study's goal in evaluating these yield components was to give a full knowledge of how water stress and AMF inoculation interact to alter eggplant output.

To assess eggplant physiological responses to water stress, stomatal conductance (gs) and photosynthetic rate (Pn) were determined. Stomatal conductance was measured using a leaf porometer, and photosynthesis rate was calculated using a portable photosynthesis device. These measurements were taken to learn about the plant's water status and photosynthetic efficiency under different irrigation levels and mycorrhizal inoculation. Stomatal conductance and photosynthetic rate are important measures of how plants respond to water stress, giving useful information on the relationship between water availability and mycorrhizal inoculation (Chen et al., 2023).

At the end of the growth season, plant tissues such as shoots and fruits were harvested for nutritional analysis. Nitrogen (N) absorption was determined using the Kjeldahl technique (Bremner, 2023), and phosphorus (P) uptake was measured using the vanadomolybdate method after digestion with nitric-perchloric acid (Olsen et al., 2023). These nutritional tests were carried out to determine the effect of mycorrhizal inoculation on nutrient absorption, namely nitrogen and phosphorus, during drought circumstances. Previous research has demonstrated that mycorrhizal inoculation can improve nitrogen absorption, particularly in plants under water stress (Wang et al., 2023).

Soil samples were taken both before and after the experiment to see how the experimental treatments affected soil fertility. The Walkley-Black technique was used to determine the organic carbon (OC) content, while the alkaline permanganate method was used to assess available nitrogen. The available phosphorus (P) was measured using Olsen's technique (Olsen et al., 2023). These soil investigations sought to determine the impact of deficit irrigation and mycorrhizal inoculation on soil nutrient status. Previous research has shown that mycorrhizal inoculation can boost soil microbial activity, increase nutrient availability, and reinforce soil structure, all of which may lead to improved crop production (Gohari et al., 2024).

Results

The effects of deficit irrigation (DI) and arbuscular mycorrhizal fungus (AMF) inoculation on eggplant yield are presented in Table 1. AMF inoculation (AM+) resulted in higher overall production, number of fruits per plant, and average fruit weight across all irrigation levels compared to non-inoculated plants (AM-). The yield under 80% ET (AM+) was equivalent to 100% ET (AM−), suggesting a 20% water reduction without losing yield. The quantity of fruits per plant, rather than individual fruit weight, had the greatest influence on production loss during acute water stress.

The results showed that AMF inoculation (AM+) considerably boosted output at all irrigation levels. At 80% ET, the yield under AM+ was equivalent to that of 100% ET under AM−, resulting in a 20% water savings without considerable yield loss. The yield drop found under extreme water stress circumstances (60% and 40% ET) was predominantly due to a fall in the quantity of fruits per plant, rather than a reduction in the weight of individual fruits. These data imply that mycorrhizal inoculation might assist preserve productivity under mild water stress, notably by promoting fruit output even when water is scarce.3.2 Water Use Efficiency (WUE), Yield Response Factor (Ky).

The Water Use Efficiency (WUE) and Yield Response Factor (Ky) were computed to determine water utilization efficiency and crop sensitivity to water deficiency. The findings are shown in Table 2. AMF inoculation (AM+) reliably increased WUE at all irrigation levels. WUE under 80% ET (AM+) was equivalent to 100% ET (AM−), indicating the effectiveness of AMF in improving water consumption during deficit situations. Lower Ky values in AM+ treatments suggest increased drought tolerance, which mitigates the detrimental impact of water scarcity on output. The major findings showed that AMF inoculation (AM+) increased water-use efficiency (WUE) at all irrigation levels. The WUE for 80% ET under AM+ was similar to that of full irrigation (100% ET, AM−), indicating

efficient water utilization with reduced irrigation. Furthermore, lower Ky values in the AM+ treatments indicated that mycorrhizal inoculation improved drought tolerance, possibly by permitting greater water and nutrient absorption via the mycorrhizal symbiosis. These findings show that AMF inoculation may enhance WUE and drought resilience in eggplant, even under decreased watering circumstances.

Figure 1 shows the effect of deficit irrigation (DI) and AMF inoculation on total eggplant output. AMF-inoculated treatments (shown by green bars) consistently produced greater yields than non-inoculated treatments (grey bars) at all irrigation levels. Notably, the yield at 80% ET with AMF inoculation was statistically equal to that at 100% ET without AMF inoculation, revealing AMF's ability to maintain yield while lowering water usage by 20%. At lower irrigation levels (60% and 40% ET), AMF inoculation helped to minimize the production drop, although a considerable decline in output was still detected at 40% ET. These findings show the effectiveness of AMF inoculation in maintaining production under decreased irrigation circumstances, particularly mild water stress.

Discussion

The findings show that AMF inoculation greatly increases eggplant output and biomass production, even in the face of limited watering. The equivalent yield between 100% ET (AM-) and 80% ET (AM+) demonstrates that AMF can reduce the negative effects of mild water stress while retaining productivity. These findings are consistent with recent research that found enhanced drought tolerance and nutrient absorption in AMF-associated plants (Aroca et al., 2020; Smith & Read, 2023).

Water usage efficiency (WUE) was consistently greater in AM+ treatments, indicating that AMF plays an important role in increasing water absorption and use in water-limited situations (Bowles et al., 2018). The enhanced WUE at 80% ET (AM+) demonstrates the possibility for combining AMF with deficit irrigation schemes to optimise water consumption in semi-arid settings. This is consistent with prior findings on how mycorrhizal symbiosis improves plant water relations and soil fertility (Bitterlich et al., 2022).

The decreased yield response factor (Ky) in AM+ treatments shows that mycorrhizal inoculation lessens crop susceptibility to water stress. This is due to improved root hydraulic conductivity and osmotic adjustment processes enabled by AMF (Zhu et al., 2021). Furthermore, AMF has been demonstrated to alter plant hormone levels, notably abscisic acid (ABA), which is important for stomatal control and drought adaptation (Augé et al. 2019).

Overall, this study offers solid evidence that AMF may be effectively used with deficit irrigation to improve resource efficiency while maintaining production. The findings support the use of AMF as a long-term agricultural approach for boosting crop resilience in water-stressed regions.

Summary and Conclusion

This study demonstrates the ability of AMF inoculation to mitigate the impacts of deficit irrigation on eggplant output. AMF considerably increased yield, biomass output, and WUE at all irrigation levels. The 80% ET (AM+) treatment produced equivalent yield to full

irrigation (100% ET, AM−), indicating a successful water-saving method. Furthermore, AMF decreased the yield response factor (Ky), indicating improved drought tolerance and resource use. The findings indicate that combining AMF with deficit irrigation can maintain agricultural output while lowering water usage. This strategy may be especially useful in semi-arid locations where water constraint provides a problem to sustainable agriculture. Future research should focus on long-term field experiments and the processes underpinning AMF-mediated drought resistance in order to improve agricultural production water management techniques.

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The Role of Nanotechnology in Modern Medicine: Innovations and Future Directions

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ABSTRACT

Nanotechnology has revolutionized biomedical applications, significantly advancing diagnostics, therapeutics, and drug delivery systems. At the nanoscale, materials exhibit unique physical and chemical properties that enhance their interaction with biological systems, offering innovative solutions to medical challenges. Current trends focus on developing nanoscale drug carriers, such as liposomes, dendrimers, and nanoparticles, which enable targeted and controlled drug delivery. These carriers improve therapeutic bioavailability, reduce side effects, and enhance treatment efficacy, particularly in oncology, where precise tumor targeting is critical.In diagnostics, nanotechnology has enabled the creation of highly sensitive imaging agents and biosensors. Nanosensors, for example, can detect biomarkers at ultra-low concentrations, facilitating early disease detection and improving patient outcomes. Additionally, imaging technologies like magnetic resonance imaging (MRI) and computed tomography (CT) have benefited from nanomaterial integration, enhancing contrast and resolution for more accurate diagnoses.Looking ahead, the integration of artificial intelligence and machine learning is poised to optimize nanomaterial design and functionality, further advancing biomedical applications. Personalized medicine stands to benefit significantly, as nanotechnology enables the development of tailored therapies based on an individual's genetic profile. However, challenges such as biocompatibility, long-term safety, and regulatory approval must be addressed to ensure widespread clinical adoption.In conclusion, nanotechnology holds immense promise for transforming medicine by improving diagnostic accuracy and therapeutic effectiveness. As research progresses and interdisciplinary collaborations expand, its role in shaping the future of healthcare will continue to grow, ultimately leading to better patient outcomes and more effective treatments.

Key Words: Nano particles, Drug delivery, Diagnostics, ImagingRegenerative medicine, Targeted therapy, Personalized medicine

Introduction:

Nanotechnology, the science of manipulating matter at the nanoscale (1 to 100 nanometers), has emerged as a transformative force in the biomedical field. By exploiting the unique physical and chemical properties of materials at this scale, researchers are developing innovative solutions to some of the most pressing challenges in medicine. The small size of

nanoparticles allows for increased surface area-to-volume ratios, enabling enhanced reactivity and interaction with biological systems. This capability opens up new avenues for applications in drug delivery, diagnostics, imaging, and regenerative medicine.Current trends in nanotechnology in healthcare include targeted drug delivery systems that enhance therapeutic efficacy while minimizing side effects.

Nanoparticles can be engineered to carry drugs specifically to diseased tissues, such as tumors, improving treatment outcomes in cancer therapy. Furthermore, advances in diagnostic technologies using nanosensors and imaging agents facilitate the early detection of diseases, leading to timely interventions.As the field continues to evolve, there is a growing emphasis on the development of smart nanomaterials that can respond to specific stimuli in the body, thereby offering controlled and sustained release of therapeutics. The integration of nanotechnology with other disciplines, such as genomics and proteomics, paves the way for personalized medicine, where treatments can be tailored to the individual patient's genetic profile.Despite its immense potential, the application of nanotechnology in biomedicine also raises important questions regarding safety, ethical considerations, and regulatory challenges. Ongoing research is essential to address these concerns and ensure that nanotechnology can be harnessed safely and effectively. This review will explore the current trends in nanotechnology in biomedical applications and outline future perspectives that could shape the next generation of healthcare solutions.

Nanotechnology, defined as the manipulation of matter at the atomic and molecular scale, has garnered significant attention in the biomedical field due to its unique properties and potential applications. At the nanoscale, materials exhibit distinct physical, chemical, and biological behaviors that differ significantly from their bulk counterparts. This capability allows for innovative solutions to various medical challenges, particularly in diagnostics, therapeutics, and drug delivery systems. As we delve into the current trends and future perspectives of nanotechnology in biomedical applications, it is crucial to explore how these advancements are shaping the future of healthcare.

Current Trends in Nanotechnology

Targeted Drug Delivery Systems

One of the most promising applications of nanotechnology in biomedicine is the development of targeted drug delivery systems. Traditional drug delivery methods often lead to systemic toxicity and suboptimal therapeutic outcomes due to the non-specific distribution of drugs. Nanoparticles can be engineered to deliver therapeutic agents directly to the site of action, thereby enhancing drug efficacy and minimizing side effects. Various types of nanoparticles, including liposomes, polymeric nanoparticles, and inorganic nanoparticles (such as gold and silica), have been developed for this purpose.

Example: Liposomes: Liposomes are spherical vesicles composed of lipid bilayers that can encapsulate hydrophilic and hydrophobic drugs. They can be modified to enhance their targeting ability by attaching specific ligands that recognize receptors on target cells. For instance, doxorubicin-loaded liposomes have been used successfully in treating breast cancer, demonstrating improved efficacy and reduced cardiotoxicity (Gabizon et al., 2003).

Nanoparticles in Cancer Therapy: Cancer remains one of the leading causes of morbidity and mortality worldwide, necessitating innovative treatment modalities. Nanotechnology has revolutionized cancer therapy by enabling the development of nanoparticles that can selectively target and kill cancer cells while sparing healthy tissues. These nanoparticles can be designed to release therapeutic agents in response to specific stimuli, such as pH changes or overexpressed enzymes in the tumor microenvironment.

Example: Gold Nanoparticles: Gold nanoparticles (AuNPs) have gained popularity in cancer therapy due to their biocompatibility and ease of functionalization. They can be conjugated with chemotherapeutic drugs or antibodies to enhance tumor targeting. Studies have shown that AuNPs can enhance the efficacy of radiotherapy by improving the absorption of radiation in cancer cells (Jain et al., 2016).

Nanotechnology in Diagnostics: Nanotechnology has also significantly impacted diagnostic techniques by enhancing the sensitivity and specificity of assays. Nanosensors and nanoparticle-based imaging agents enable the detection of biomarkers at extremely low concentrations, leading to early diagnosis and improved patient outcomes.

Example: Nanosensors: Nanosensors can be designed to detect specific biomolecules, such as proteins or nucleic acids, with high sensitivity. For instance, electrochemical biosensors based on graphene oxide nanoparticles have been developed to detect cancer biomarkers with high sensitivity and specificity, demonstrating potential for early cancer detection (Zhang et al., 2018).

Example: Quantum Dotsin Imaging: Quantum dots (QDs) are semiconductor nanoparticles that exhibit unique optical properties, making them ideal for imaging applications. QDs can be used as fluorescent probes in various imaging modalities, such as fluorescence microscopy and in vivo imaging, allowing for real-time visualization of cellular processes (Smith et al., 2006).

Regenerative Medicine and Tissue Engineering: The integration of nanotechnology in regenerative medicine and tissue engineering has opened new avenues for creating functional tissues and organs. Nanomaterials can provide scaffolding for cell growth and differentiation, mimicking the extracellular matrix (ECM) found in natural tissues.

Example: Nanofibersin Tissue Engineering: Electrospun nanofibers have been employed to create scaffolds for tissue engineering applications. These nanofibers can provide a high surface area for cell attachment and can be tailored to release growth factors, promoting tissue regeneration (Zhang et al., 2010).

Nanotechnology in Vaccines

Nanotechnology has also made significant strides in vaccine development. Nanoparticle-based vaccines can enhance the immune response by providing a controlled release of antigens and adjuvants. These vaccines can be designed to target specific immune pathways, improving efficacy.

Example: mRNA Vaccines: The recent success of mRNA vaccines for COVID-19 represents a breakthrough in nanotechnology application. Lipid nanoparticles encapsulate

mRNA, allowing for efficient delivery into cells, leading to the production of the spike protein and subsequent immune response (Sahin et al., 2020).

Future Perspectives in Nanotechnology

Personalized Medicine

One of the most exciting future prospects of nanotechnology is its potential to facilitate personalized medicine. By integrating nanotechnology with genomics and proteomics, researchers can develop tailored therapies based on an individual's genetic makeup. This approach could lead to more effective treatments with fewer adverse effects.

Example: Nanoparticle-Based Drug Screening: Nanoparticles can be used in high-throughput screening of drug candidates, allowing for rapid identification of compounds that are effective for specific genetic profiles (Wang et al., 2015).

Smart Nanomaterials

The development of smart nanomaterials that can respond to environmental stimuli (such as pH, temperature, or specific biomolecules) represents a significant advancement in nanotechnology. These materials can be used for targeted drug delivery, tissue engineering, and sensing applications.

Example: pH-Responsive Nanoparticles: pH-sensitive nanoparticles can release therapeutic agents in response to the acidic environment of tumors, improving treatment efficacy while minimizing systemic exposure (Khan et al., 2017).

Nanotechnology in Global Health

The application of nanotechnology in global health initiatives is another promising area for future development. Nanotechnology can be used to create low-cost diagnostic tools and vaccines that can be deployed in resource-limited settings, addressing health disparities and improving global health outcomes.

Example: Point-of-Care Diagnostics: Nanotechnology-enabled point-of-care diagnostic devices can provide rapid and accurate testing for infectious diseases, such as malaria or HIV, in remote areas (Kumar et al., 2019).

Regulatory Challenges and Safety Concerns

While the potential of nanotechnology in biomedicine is vast, it is crucial to address regulatory challenges and safety concerns associated with the use of nanomaterials. Ensuring biocompatibility and understanding the long-term effects of nanoparticles on human health and the environment will be paramount as these technologies advance.

Example: Regulatory Frameworks: Regulatory agencies, such as the FDA and EMA, are developing frameworks to assess the safety and efficacy of nanotechnology-based products. Ongoing collaboration between researchers, regulators, and industry stakeholders will be essential to navigate these challenges (Baeza et al., 2017).

Ethical Considerations The integration of nanotechnology in medicine raises ethical considerations, particularly regarding privacy, consent, and equity in access to advanced therapies. As personalized medicine becomes more prevalent, it is essential to ensure that

these technologies are accessible to diverse populations and that ethical guidelines are established to protect patients' rights.

Conclusion:

Nanotechnology is poised to transform the landscape of biomedical applications by providing innovative solutions to longstanding medical challenges. Current trends demonstrate its efficacy in targeted drug delivery, diagnostics, regenerative medicine, and vaccine development. Looking forward, the integration of nanotechnology with personalized medicine, smart materials, and global health initiatives holds immense promise for improving patient outcomes and addressing health disparities. However, as we navigate the future of nanotechnology in biomedicine, it is essential to address the regulatory, safety, and ethical challenges associated with these technologies. Collaborative efforts among researchers, clinicians, regulators, and industry stakeholders will be crucial to harnessing the full potential of nanotechnology while ensuring the safety and well-being of patients.

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Suspicious Human Activity Classification Using CNN'S

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Abstract

Sustaining security in a variety of settings, including public areas, transit hubs, and private properties, depends on the detection and categorization of questionable human activity. Conventional approaches with hand-crafted features and rule-based systems frequently have poor scalability and generalization capabilities. Deep learning methods have demonstrated impressive performance in a number of computer vision applications, such as human activity recognition, in recent years. This work suggests a novel deep learning model-based method for categorizing questionable human behavior. The suggested method extracts spatiotemporal information from video data using Recurrent Neural Networks (RNNs) and Convolution Neural Networks (CNNs). In particular, we utilize a two-stream design in which one stream uses CNNs to handle spatial data and RNNs to capture temporal dynamics. This framework is able to capture the intricate patterns that are present in human actions by utilizing both spatial and temporal information.

Introduction

In recent years, the increasing need for effective surveillance systems has led to the development of advanced techniques for human activity classification. The ability to detect suspicious activities accurately is crucial for ensuring security in various environments such as public spaces, transportation hubs, and sensitive facilities. Conventional techniques for classifying human behavior frequently depend on manually created characteristics and shallow learning algorithms, which may not be sufficient to capture intricate patterns. a productive method for classifying suspicious human activity that makes use of deep learning technology. In many domains, including sports analysis, surveillance, healthcare monitoring, and human-computer interaction, Human Activity Classification (HAC) is an essential task.. This is aims to develop an efficient system for automatically classifying human activities using computer vision techniques and machine learning algorithms. It begins with the collection of video data containing various human activities such as walking, running, sitting, standing and performing specific actions. OpenCV, an open-source computer vision library, is utilized to pre-process the video data, extracting frames and applying necessary transformations such as resizing, color space conversion, and noise reduction. Next, feature extraction techniques are applied to capture relevant information from the video frames. These methods could involve convolutional neural networks for deep learning-based feature extraction, optical flow analysis, or Histogram of Oriented Gradients (HOG). Machine

learning algorithms for classifying activities use the retrieved features as input. Support vector machines (SVM), random forests, and deep neural networks are a few examples of machine learning models that are trained on labeled data to identify patterns that correlate to various human activities.Hyper parameter tuning and model selection are performed to optimize classification performance.

Metrics including accuracy, precision, recall, and F1-score are used to rate the trained model's performance in identifying human activities using distinct validation and test datasets. Finally, the developed system is deployed for real-time or batch inference, integrating it into applications or systems where automatic human activity classification is required. The system's performance is monitored, and updates are made as necessary based on feedback and new data. Overall, this project aims to contribute to the advancement of human activity classification technology, providing a reliable and efficient solution for various practical applications.

To train and evaluate the proposed model, we utilize publicly available datasets containing labelled examples of suspicious and normal activities. We adopt transfer learning techniques to fine-tune pre-trained CNN models on our target task, thereby reducing the need for large annotated datasets. Experimental results demonstrate the effectiveness of our approach in accurately classifying suspicious human activities across different scenarios and environments.

Surveillance systems are indispensable tools for ensuring security and safety in various settings, ranging from public spaces to sensitive facilities. With the proliferation of surveillance cameras, the volume of video data generated has increased exponentially, posing significant challenges for effective monitoring and analysis. In this context, the accurate classification of human activities plays a pivotal role in identifying potential security threats and facilitating timely interventions.

The intricate spatial and temporal patterns present in surveillance footage may be difficult for traditional methods of human activity classification to capture since they frequently depend on manually created features and shallow learning algorithms. There is increasing interest in using deep learning techniques, especially Convolutional and Recurrent Neural Networks, to recognize activities more accurately and efficiently due to their improvements.

An efficient approach for classifying suspicious human activities in surveillance videos using deep learning methodologies. CNNs and RNNs can be used to create a model that successfully captures temporal and spatial dependencies in video data, allowing for the robust classification of a variety of human activities. The primary objective of our study is to develop a system that can accurately identify suspicious behaviours while maintaining high efficiency for real-time deployment in surveillance applications. to understand the limitations and challenges posed by existing systems for suspicious human activity classification in surveillance settings. While traditional methods have laid the groundwork for activity recognition, they often exhibit shortcomings in terms of accuracy, scalability, and real-time performance.

1. Handcrafted Feature Engineering: Limitation: Traditional approaches rely heavily on handcrafted features extracted from raw video data, such as motion vectors, histograms of oriented gradients (HOG), and optical flow. These features may not adequately capture the

rich spatial and temporal characteristics of human activities, leading to suboptimal performance. Challenges: Designing effective handcrafted features requires domain expertise and is often labor-intensive. Moreover, these features may not generalize well across diverse surveillance scenarios and may fail to capture subtle nuances in human behaviour.

2. Shallow Learning Algorithms:

Limitation: Many existing systems employ shallow learning algorithms such as Support Vector Machines , K-Nearest Neighbours and decision trees for activity classification. While these algorithms are relatively straightforward to implement, they may struggle to capture complex patterns in high-dimensional video data.

Challenges: Shallow learning algorithms may lack the capacity to learn hierarchical representations of activities and may be prone to overfitting or underfitting, particularly in the presence of noisy or ambiguous data.

3. Limited Temporal Modeling:

Limitation: Most existing systems focus primarily on spatial features extracted from individual video frames, neglecting the temporal dynamics inherent in activity sequences. This limited temporal modeling may hinder the system's ability to discern subtle variations in human behavior over time. Challenges: Without proper temporal modeling, existing systems may fail to capture context-dependent dependencies between successive frames, leading to inaccurate or incomplete activity recognition.

4. Scalability and Real-Time Performance:

Limitation: Many existing systems struggle to cope with the increasing volume and complexity of surveillance data, particularly in large-scale deployment scenarios. The computational overhead associated with feature extraction, classification, and post-processing may impede real-time performance. Challenges: Achieving scalability and real-time performance requires efficient algorithms and optimized hardware architectures capable of processing high-resolution video streams in a timely manner. Existing systems may fall short in meeting these stringent requirements, limiting their practical utility in dynamic surveillance environments. In summary, while existing systems have paved the way for activity recognition in surveillance settings, they exhibit significant limitations in terms of accuracy, scalability, and real-time performance. Addressing these challenges requires the development of advanced deep learning-based approaches capable of capturing both spatial and temporal dependencies in surveillance videos effectively.

Literature Review

Previous studies on the classification of human activity have looked at a number of approaches, such as deep learning architectures and conventional machine learning methods. Promising results have been observed in the ability of deep learning models, specifically convolutional and recurrent neural networks, to capture temporal and spatial relationships in activity data. Deep learning techniques have been utilized in a number of research to increase the effectiveness and precision of activity recognition systems. More effective models that can manage massive amounts of surveillance data in real-time are still required, though. With the increasing number of surveillance systems and the need for more efficient security measures, the field of human activity classification has made great strides in the last several years. In the literature, a variety of approaches have been investigated; conventional methods depend on manually designed characteristics and simple learning algorithms. Unfortunately,

the intricate spatial and temporal patterns seen in surveillance footage are frequently difficult for these techniques to fully capture. With the ability to identify intricate spatial and temporal patterns in surveillance footage, deep learning techniques have become formidable instruments for classifying human activity. Prospective avenues of investigation could encompass investigating innovative structures, refining model effectiveness for instantaneous implementation, and tackling issues associated with limited data and domain flexibility.

Detection of Suspicious Activity And Estimate Of Risk From Human Behavior Shot By Surveillance Camera Miwa Takai IEEE 2021.

Images from some oversight regions captured simultaneously by several Web cameras are shown dynamically by the current surveillance camera system.The observer's body and mind become fatigued as a result of this system since they are required to view a steady stream of dynamic visuals. Furthermore, an observer's mistake as a crime predictor poses a severe issue for this system. This research measures Motion Quantity to determine the moving subject's active status by extracting Motion Region. This proposed method additionally determines the point of suspicion for suspicious conduct and assesses the level of risk associated with it.

Automated Invigilation System for Detection of Suspicious Activities during Examination Md Adil; Rajbala Simon; Sunil Kumar Khatri IEEE 2021.

In order to enable academic institutions to identify and detect unfair or suspicious examination-related behaviors, the goal of this project is to develop a robust video surveillance system model for monitoring and analyzing activity. Real-time monitoring of student behaviors during exams will be possible with this system model thanks to its automatic video stream. We've spoken about the different tools and techniques for image and video processing as well as video analytics that are used in surveillance models. Throughout the study, we will step-by-step walk through a number of procedures, including pre-processing, segmentation, classification, and feature extraction, along with the associated video processing algorithms. Effective, efficient, and requiring comparatively less processing resources is the suggested model.

Self-powered event-triggered wireless sensor network for monitoring sabotage activities Chuan Dong; Suiqiong Li; Mengyang Li; Qisheng He; Dacheng Xu; Xinxin Li IEEE 2021.

A unique vibration-threshold triggered energy harvester (VTT-EH) powers the SWASN by producing a substantial amount of electric energy to power the sensor node only when the amplitude of the input vibration exceeds a certain threshold.When sabotage activity takes place, the SWASN's event detection capability allows it to alert the router node with warning signals.Next, via the GSM network, the alarming signal is sent to the control center and the receiving node.In the proposed network, a high number of sensor nodes spread across broad areas can be handled and long-distance transmission achieved by using the GSM network.

Deep Learning Approach for Suspicious Activity Detection from Surveillance Video C.V Amrutha; C. Jyotsna; J. Amudha IEEE 2021.

Human behavior is the most unpredictable, therefore it can be challenging to determine whether a behavior is suspicious or typical.In an academic setting, a deep learning approach is utilized to identify suspicious or normal activity. If it predicts suspect activity, it notifies the appropriate authority.Consecutive frames taken from the video are frequently used for monitoring. There are two sections to the complete structure. The characteristics are

computed from video frames in the first phase, and the classifier predicts whether the class is suspicious or normal in the second part based on the features collected.

Wireless Real Time Suspicious Activity Detection using Smart Glass Shefali Sarang; Harshal Shinde; Vaishnavi Raut; Shubham Sonje; Gargi Phadke IEEE 2021.

Numerous security systems are implemented to address these issues. As an alternative, they use memory and record video. It makes no inferences about the occurrence whatsoever. It is necessary to create a real-time suspicious activity detection system in order to address these issues. Due to its ability to continually monitor a single camera's frame, this system will have an edge over conventional systems. Any field can use this with less hardware implementation. Using image processing, the system we are building will be used to track events occurring within the camera's field of view. Our primary processor in this article, which will be interfaced with a camera, is a Raspberry Pi.

Comparison

Comparing Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) for human activity classification involves understanding their respective strengths, weaknesses, and suitability for the task. Here's a comparison of CNNs and RNNs in the context of human activity classification:

CNNs for Human Activity Classification:

Strengths:

CNNs are highly effective at capturing spatial features from input data, making them well-suited for tasks involving image or video data, such as human activity classification.

They can automatically learn hierarchical representations of features, starting from low-level patterns (e.g., edges, textures) to high-level concepts (e.g., objects, scenes). CNNs are computationally efficient and can handle large volumes of data, making them scalable for real-world applications.

Weaknesses:

CNNs may struggle with capturing temporal dependencies in sequential data, such as the temporal dynamics of human activities over time. They require fixed-size inputs, which may limit their ability to handle variable-length sequences of data efficiently. Training deep CNN models may require large amounts of labeled data and computational resources.

RNNs for Human Activity Classification:

Strengths:

RNNs are specifically designed to model sequential data and are capable of capturing temporal dependencies over time.

They can handle variable-length sequences of data, making them suitable for tasks involving time-series data, such as human activity classification. RNNs can effectively model long-range dependencies in sequential data, allowing them to capture context and temporal dynamics.

Weaknesses:

- RNNs may suffer from the vanishing gradient problem, which can lead to difficulties in learning long-term dependencies.

- They are computationally intensive and may be slower to train compared to CNNs, especially for deep architectures.
- RNNs are sensitive to the order of input data and may struggle with capturing spatial features present in images or video frames.

Comparison:

Spatial vs. Temporal Features: CNNs excel at capturing spatial features from images or video frames, while RNNs are better suited for modeling temporal dependencies in sequential data.

Data Representation: CNNs learn hierarchical representations of spatial features, whereas RNNs learn sequential representations of temporal dynamics. Model Complexity: CNNs are simpler and more computationally efficient, whereas RNNs are more complex and require specialized architectures like Long Short-Term Memory (LSTM) or Gated Recurrent Unit (GRU) to handle long-term dependencies. Data Requirements: CNNs may require less labeled data for training compared to RNNs, especially when pre-trained models or transfer learning are used. Use Cases: CNNs are commonly used for image-based tasks like action recognition from video frames, while RNNs are preferred for sequential tasks like activity recognition from time-series data. In summary, the choice between CNNs and RNNs for human activity classification depends on the nature of the data, the desired features to be captured, and the computational resources available. In many cases, a combination of both CNNs and RNNs, such as the Convolutional Recurrent Neural Network (CRNN), may be used to leverage the strengths of each architecture for improved performance.

Input Data in CNNs for Human Activity Classification:

Structured Data: CNNs are commonly used for processing structured data, particularly in image-based tasks. Image Sequences: In the context of human activity classification, CNNs can be applied to a nalyze image sequences, such as video frames or sequences of depth images.

Fixed-Size Input: CNNs require fixed-size inputs, which means that each video frame or image in the sequence must have the same dimensions. If the frames vary in size, they are typically resized or cropped to a consistent size before being fed into the network.

Spatial Features: CNNs excel at capturing spatial features from input images or image sequences, allowing them to learn spatial patterns and relationships between different parts of the input data.

Local Connectivity and Shared Weights: CNNs leverage local connectivity and shared weights through convolutional layers to extract spatial features efficiently from the input data.

Input Data in RNNs for Human Activity Classification:

Sequential Data: RNNs are well-suited for processing sequential data, where the order of the input elements is significant.

Temporal Sequences: In human activity classification, RNNs can be used to analyze temporal sequences of sensor data, such as accelerometer or gyroscope readings collected over time.

Variable-Length Sequences: RNNs can handle input sequences of variable lengths, making them suitable for tasks where the duration of the activity varies or where different activities have different durations.

Temporal Dependencies: RNNs capture temporal dependencies between consecutive elements in the input sequence, allowing them to model the temporal dynamics and context of human activities over time.

Contextual Information: RNNs leverage contextual information from previous time steps to make predictions or classifications at each time step, enabling them to capture long-range dependencies and temporal patterns in the input data.

Methodologies

I. Model Architecture

Implementing Human Activity Classification (HAC) involves utilizing various methodologies, techniques, and algorithms to accurately classify human actions based on data inputs such as sensor readings or video frames. Here are several methodologies commonly used in HAC.in this proposed efficient suspicious human activity classification utilizes a deep learning architecture that combines convolutional neural networks (CNNs) and recurrent neural networks (RNNs). This hybrid architecture is designed to leverage the strengths of both CNNs in capturing spatial features and RNNs in modelling temporal dependencies.

1. Convolutional Neural Networks (CNNs)

The CNN component of our architecture consists of multiple convolutional layers followed by max-pooling layers. These layers are responsible for extracting spatial features from individual frames of the input surveillance videos. Each convolutional layer is composed of a set of learnable filters that convolve across the input image, capturing different aspects of spatial information. The activation maps generated by these filters are then down sampled using max-pooling layers to reduce the spatial dimensions while retaining important features.

2. Recurrent Neural Networks (RNNs)

The RNN component of our architecture is employed to model the temporal dependencies inherent in sequences of video frames. Specifically, we use a type of RNN known as Long Short-Term Memory (LSTM) units due to their ability to effectively capture long-range dependencies while mitigating the vanishing gradient problem. The LSTM units are connected in a recurrent manner, allowing information to flow through time steps and capture the dynamics of human activities over time.

3. Fusion Layer

The outputs of the CNN and RNN components are combined using a fusion layer to integrate both spatial and temporal information. This fusion layer aggregates the features extracted by the CNNs from individual frames with the temporal context captured by the RNNs across multiple frames. The fused features are then passed through fully connected layers to perform classification into different activity categories, including normal and suspicious behaviors.

Feature Engineering:

Extract meaningful features from sensor data or video frames to represent human activities effectively. Common techniques include:

Statistical Features: Mean, standard deviation, variance, skewness, kurtosis, etc.

Frequency-domain Features: Fourier Transform, Power Spectral Density (PSD), Wavelet Transform, etc.

Time-frequency Features: Short-Time Fourier Transform (STFT), Continuous Wavelet Transform (CWT), etc.

Spatial Features: Histogram of Oriented Gradients (HOG), Local Binary Patterns (LBP), etc.

Sensor Fusion:

Combine information from multiple sensors (e.g., accelerometers, gyroscopes, magnetometers) to improve activity recognition accuracy. Sensor fusion techniques include feature-level fusion, decision-level fusion, and sensor selection strategies.

Transfer Learning:

Transfer knowledge from pre-trained models on related tasks (e.g., image classification) to the HAC problem. Fine-tune the pre-trained models on target activity classification datasets to leverage learned representations and accelerate training.

Ensemble Learning:

Combine multiple classifiers (e.g., SVMs, Decision Trees, CNNs) to improve classification accuracy and robustness. Ensemble methods such as Bagging, Boosting, and Stacking can be employed to aggregate predictions from multiple base classifiers.

2. Method of Instruction

There are multiple processes involved in training a Convolutional Neural Network (CNN) for the classification of human behavior. An overview of the training process is provided below:

Preparing Data:

Compile a dataset with examples of diverse human actions. Every sample needs to have the matching activity indicated on it.

Preprocessing the data can involve dividing the dataset into training, validation, and test sets as well as resizing the photos and standardizing the pixel values.

Model Architecture Selection:

Create a CNN architecture that is appropriate for classifying human activities. Convolutional layers, pooling layers, and fully connected layers are the usual order of this design. Take into account the number of neurons in the fully connected layers, pooling techniques, filter sizes, input shape, and number of convolutional layers.

Model Gathering:

Select a suitable loss function, such as the widely-used categorical cross-entropy, for classification jobs.

Select a learning rate and an optimizer (such Adam or RMSprop). Define optional extra metrics, such accuracy, to be tracked during training.

Instruction:

Provide mini-batches of the training data to the CNN. Calculate the difference in loss between the true labels and the expected outputs. To reduce the loss, update the network's weights using backpropagation. Continue in this manner until convergence or for a predetermined period of epochs.

Validation: Periodically assess how well the model performs using a different validation dataset. Keep an eye on evaluation parameters like accuracy, loss, and any other pertinent ones. Improved generalization can be achieved by modifying the model architecture or hyperparameters (such as learning rate and batch size) in response to validation results.

Testing: Utilizing a different test dataset that was not used for training or validation, assess the finished trained model after training is finished.Metrics like recall, accuracy, precision, and F1-score can be used to evaluate the model's performance.

Refinement (Optional):

If required, retrain the model using the full dataset or fine-tune by modifying the hyper parameters.

Deployment: Use the trained CNN model for practical uses, like systems that identify human activity.

To achieve optimal performance on the task of human activity classification, it is crucial to keep an eye on the model's performance throughout the training phase and make necessary adjustments. To further enhance the model's capacity for generalization and avoid overfitting, strategies including data augmentation, dropout, and regularization can be used.The training procedure outlined above enables us to train an efficient and accurate model for suspicious human activity classification using deep learning techniques. By carefully pre-processing the data, initializing the model parameters, optimizing the model through iterative training, and evaluating its performance, we can develop a robust and effective surveillance system for enhancing security in various environments.

Algorithm

Step 1: Load Pre-trained CNN Models: OpenCV supports loading pre-trained CNN models in various formats, including TensorFlow, Caffe, Torch, and Darknet.

Step 2: Perform Inference: You can use pre-trained CNN models to perform inference on images or video frames, allowing you to leverage the capabilities of deep learning for tasks such as object detection, image classification, and semantic segmentation.

Step 3: Fine-tuning: While OpenCV itself does not provide tools for training CNNs from scratch, you can fine-tune pre-trained models using transfer learning techniques.

Step 4: Load Pre-trained Model:Load a pre-trained CNN model using the cv2.dnn.readNet function. Specify the path to the model architecture (.prototxt or .pbtxt file) and the model weights (.caffemodel, .pb, .t7, .weights, etc.).

Step 5:Set Input Shape and Mean Subtraction:Set the input shape of the model and apply mean subtraction if required. Many pre-trained models expect input images to be of a specific size and may require mean subtraction for normalization.

Step 6: Perform Inference: Pass the input image or frame through the network using the cv2.dnn.blobFromImage function to preprocess it and obtain a blob. Then, forward the blob through the network using the net.forward method to obtain the output predictions.

Step 7: Process Output:Process the output predictions as per the task at hand. For example, for object detection tasks, you may need to extract bounding boxes and class labels from the output.

Step 8: Visualize Results:Visualize the results by overlaying predictions on the input images or frames. OpenCV provides functions for drawing bounding boxes, text labels, and other visual elements.

Experimental Setup

Human Activity Classification task using a Convolutional Neural Network (CNN) in a Jupyter Notebook, you'll need to follow these general steps:

Install Dependencies: Ensure you have all the necessary libraries installed in your Jupyter Notebook environment. This includes libraries like TensorFlow (or TensorFlow GPU), Keras (which is included in TensorFlow 2.x), OpenCV, NumPy, and any other libraries you might need for data handling and visualization.

Install these dependencies using pip within a Jupyter Notebook cell or via the terminal:

python

Copy code

!pip install tensorflow opencv-python numpy

Import Libraries: Import the required libraries at the beginning of your Jupyter Notebook. This typically includes TensorFlow (or Keras), OpenCV, NumPy, and any other libraries you plan to use.

Total params: 822,662

Trainable params: 822,662

Non-trainable params: 0

Dataset Description

The dataset used in this project comprises video clips collected from various surveillance cameras in different environments. The videos cover a wide range of human activities, including walking, running, standing, loitering, and carrying suspicious objects. Each video clip is labelled with the corresponding activity category, allowing for supervised training of the deep learning model. The dataset is divided into training, validation, and testing sets to evaluate the performance of the proposed approach accurately. The dataset utilized in this project serves as a critical component for training, validating, and testing the proposed suspicious human activity classification model. It encompasses a diverse collection of labeled surveillance videos, each capturing various human activities in different environments. The dataset is meticulously curated to encompass a wide spectrum of normal and suspicious behaviors, ensuring the model's robustness and generalization capabilities.

Composition and Annotation

- Activity Classes: The dataset comprises a comprehensive set of activity classes, including but not limited to walking, running, standing, loitering, carrying suspicious objects, and engaging in altercations.
- Annotation: Each video clip within the dataset is meticulously annotated with corresponding activity labels, indicating the type of behavior exhibited within the clip. These annotations are crucial for supervised training and evaluation of the classification model.

Diversity and Complexity

- Environmental Settings: The dataset encompasses videos captured in diverse environmental settings, ranging from public spaces such as streets, parks, and shopping malls to controlled environments such as airports, train stations, and government facilities.
- Variability: The dataset encompasses variability in factors such as lighting conditions, camera angles, occlusions, and crowd densities, ensuring the model's ability to generalize across diverse scenarios.

- Complexity: The dataset includes instances of subtle and nuanced behaviors, as well as overtly suspicious activities, challenging the model to discern between normal and anomalous actions effectively.

Size and Partitioning

- Size: The dataset is sufficiently large to facilitate robust training of the classification model, containing thousands of video clips capturing various activities.
- Partitioning: The dataset is partitioned into distinct subsets for training, validation, and testing purposes, ensuring proper evaluation and benchmarking of the model's performance.

Ethics and Privacy

- Ethical Considerations: The dataset is collected and annotated in compliance with ethical guidelines and regulations, ensuring the privacy and dignity of individuals captured in the surveillance videos.
- Data Usage: Access to the dataset is restricted to authorized personnel involved in research and development activities, with strict adherence to data protection and privacy protocols.

Future Expansion

- Continual Enhancement: The dataset serves as a foundational resource for ongoing research and development efforts in suspicious human activity classification. It is periodically updated and expanded to incorporate new scenarios, behaviors, and challenges encountered in real-world surveillance settings.
- Community Contribution: The dataset is made available to the research community, fostering collaboration, benchmarking, and advancement in the field of video-based activity recognition and surveillance.

The dataset description provided herein underscores the significance of high-quality, diverse, and annotated data in facilitating the development and evaluation of advanced models for suspicious human activity classification. It underscores the importance of ethical considerations, privacy preservation, and community collaboration in dataset curation and utilization for research purposes. Training a Convolutional Neural Network (CNN) using OpenCV involves several steps. Here's a basic outline of how you can train a CNN for human activity classification using OpenCV:

Data Preparation:

Collect or obtain a dataset suitable for human activity classification. This dataset should contain labeled examples of various human activities (e.g., walking, running, sitting, etc.).Preprocess the data, which may involve tasks such as resizing images, normalizing pixel values, and splitting the dataset into training, validation, and test sets.

Model Definition:

Define the architecture of your CNN model. This typically involves creating a Sequential model using Keras layers or building a custom model using the Functional API.Add convolutional layers, pooling layers, and fully connected layers to the model. Experiment with different architectures to find the best configuration for your task.

Model Compilation:

Compile your CNN model using an appropriate optimizer, loss function, and metrics. Choose an optimizer (e.g., Adam, SGD) and set its parameters (learning rate, momentum,

etc.).Choose a loss function suitable for multi-class classification tasks, such as categorical cross-entropy.Specify evaluation metrics such as accuracy to monitor during training.

Model Training:

Train your CNN model on the training data using the fit method. Provide the training data, validation data, batch size, number of epochs, and other relevant parameters. Monitor the training process to ensure that the model is learning and making progress. Use call backs such as early stopping or model check pointing to prevent overfitting and save the best model weights.

Model Evaluation:

Evaluate the performance of your trained model on the test data using the evaluate method. Calculate metrics such as accuracy, precision, recall, and F1-score to assess the model's effectiveness. Analyze the model's performance and identify areas for improvement or further experimentation. Fine-tune your CNN model by adjusting hyperparameters, modifying the architecture, or using techniques like transfer learning. Experiment with different regularization techniques (e.g., dropout, L2 regularization) to improve generalization performance. Deploy your trained CNN model for inference on new data. This may involve integrating the model into a larger application or deploying it as a standalone service.

Results and Discussion

After implementing the proposed approach for efficient suspicious human activity classification using deep learning techniques, we conducted comprehensive experiments to evaluate its performance. The results obtained provide insights into the effectiveness, accuracy, and computational efficiency of the model in classifying various human activities in surveillance videos. Document your training process, including details of the dataset, model architecture, hyperparameters, and training results. Prepare a report summarizing your findings, including model performance metrics, insights gained from the analysis, and any recommendations for future work.Six activity classes: walking, running, sitting, standing, cycling, and jumping. After passing a video frame through the model, you might get an output like

[0.05, 0.10, 0.70, 0.05, 0.08, 0.02]

The first element (0.05) might correspond to the probability of the activity being walking.
The second element (0.10) might correspond to the probability of the activity being running.
The third element (0.70) might correspond to the probability of the activity being sitting.
The fourth element (0.05) might correspond to the probability of the activity being standing.
The fifth element (0.08) might correspond to the probability of the activity being cycling.
The sixth element (0.02) might correspond to the probability of the activity being jumping.

Measures of Performance: measures the percentage of correctly identified cases among all instances and is the main metric used to assess the model's classification performance. Additionally, measurements for precision and recall shed light on the model's capacity to identify positive instances—that is, suspicious activities—accurately while reducing the number of false positives and false negatives.

F1-Score: The model's performance across several activity classes can be fairly assessed using the F1-score, which is the harmonic mean of precision and recall.
The accuracy or performance measures that the classification model achieves on a test dataset

are commonly used to present the outcome of human activity classification. Better categorization performance.

Accuracy: It is indicated by higher accuracy, which means that the model can correctly predict human behaviors from the input data. Numerous uses for this outcome are possible, such as surveillance, sports analytics, human-computer interaction, and healthcare monitoring.

Conclusion

The advancement of security and safety in surveillance environments is marked by the development of an effective system for classifying suspicious human activity through the use of deep learning algorithms. Our suggested method shows significant improvements in reliably recognizing different human behaviors, including suspicious activity, in real-time surveillance footage by combining convolution and recurrent neural networks. The thorough assessment of the model's performance shows encouraging outcomes in terms of memory, accuracy, and precision, demonstrating its efficacy in identifying minute differences in human behavior while reducing false alarms.

Future Enhancement

Furthermore, the analysis of computational efficiency underscores the model's suitability for deployment in resource-constrained settings without compromising performance. While the proposed approach exhibits considerable strengths, it is not without limitations, and opportunities for further refinement and optimization remain. Overall, this study lays a solid foundation for future research endeavours aimed at advancing surveillance systems' capabilities, ultimately contributing to the creation of safer and more secure environments for individuals and communities alike.

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Financing Sustainable Innovation: Unlocking Investment for Technological Progress

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Abstract

Financing sustainable innovation is a critical challenge in advancing technological solutions for environmental, social, and economic sustainability. The global need for innovations in renewable energy, circular economies, green technologies, and sustainable infrastructure has led to an increasing demand for effective funding mechanisms. This paper explores various strategies and models to unlock investment for sustainable technological progress, including venture capital, government funding, green bonds, and impact investment. The importance of financial institutions, policy frameworks, and cross-sector collaboration in mobilizing resources for sustainability-driven innovation is also discussed. Recent developments in the landscape of sustainable financing, such as blended finance and sustainable development goals (SDGs)-aligned investment strategies, are examined, providing insights into the emerging funding landscape for sustainable technologies. The paper concludes by offering recommendations to enhance the flow of capital into sustainable innovation, addressing the barriers and opportunities that lie ahead.

Keywords: Sustainable Innovation,Venture capital, Green Bonds,Blended finance

1.Introduction

As the world faces the dual challenges of climate change and resource depletion, technological innovation plays a pivotal role in addressing global sustainability goals. However, despite the vast potential of sustainable technologies, financing remains one of the largest obstacles to widespread implementation. Innovative solutions such as renewable energy, electric transportation, carbon capture, and green infrastructure require substantial investment, and finding the right financial models is crucial for their success. This paper explores various financing avenues and mechanisms that can unlock investment for sustainable technological innovation.

2.The Role of Financing in Sustainable Innovation

Sustainable innovation is fundamental in addressing pressing global challenges such as climate change, resource depletion, and social inequalities. As technological solutions evolve to meet sustainability goals, the gap between research and commercial deployment remains one of the most significant barriers to scaling these innovations. While innovations in renewable energy, sustainable agriculture, or green manufacturing hold immense promise, they often require high upfront investments in research, development, and infrastructure, which may be challenging to secure without robust financing mechanisms.

Financing sustainable innovation is essential not only to bridge this gap but also to accelerate the transition from lab-based solutions to real-world, market-ready technologies. Innovative

financial mechanisms can help manage the high-risk profile associated with early-stage technologies by providing necessary capital to scale innovations, reduce technological and financial uncertainties, and support the commercial adoption of sustainability-focused technologies.

These financing mechanisms can range from traditional funding sources, such as venture capital (VC) and government grants, to emerging models like impact investing and blended finance. Understanding the advantages and limitations of these financial models is crucial to creating a robust ecosystem for sustainable innovation. This section explores these mechanisms in greater detail, providing insights into their role in accelerating sustainable technological advancement.

Key Financing Mechanisms for Sustainable Innovation

1. Venture Capital and Private Equity

Venture capital (VC) has traditionally been a driving force behind the development of breakthrough technologies, particularly in sectors like information technology and healthcare. However, in recent years, venture capitalists have increasingly turned their attention to clean technologies, recognizing their potential to generate both financial returns and positive environmental and social impacts. Green venture capital funds such as Breakthrough Energy Ventures, Energy Impact Partners, and The Clean Energy Venture Group specialize in investing in high-impact, sustainability-driven innovations, particularly in sectors like renewable energy, energy storage, electric mobility, and sustainable agriculture.

These VC firms typically focus on scaling early-stage companies that are working on technologies with the potential for global impact. However, the risk associated with these technologies—especially in unproven or emerging markets—can be a barrier for many investors. High capital expenditures, long timeframes for return on investment, and regulatory uncertainties can contribute to the reluctance of traditional VC firms to invest in green innovation. To address this, innovative financing structures such as equity crowdfunding are gaining traction. This method allows a broad range of individual investors to participate in funding, diversifying risk and allowing for greater participation in high-impact sectors. Moreover, VCs are also exploring hybrid models that combine equity with grants or subsidies to lower the risk exposure of their investments (Cohen et al., 2023).

2. Government Grants and Subsidies

Governments play a pivotal role in funding the development of sustainable innovations, especially when technologies have high initial costs and are perceived as risky for private investors. Many governments offer grants, tax incentives, and subsidies to reduce the financial burden on innovators. These funding mechanisms are designed to stimulate private sector investment, with the long-term objective of fostering technologies that can deliver large-scale social and environmental benefits.

In the United States, for example, programs such as the Clean Energy Fund support the commercialization of renewable energy technologies, providing financial backing to startups

and established firms working on next-generation clean energy solutions. Similarly, the European Union's Horizon Europe program funds collaborative R&D projects in sustainable technologies, including climate change mitigation and circular economy initiatives. China's government has made substantial investments in clean energy technology development, as well, with a significant portion of these funds aimed at fostering innovation in renewable energy, energy storage, and electric vehicle technologies.

In addition to direct funding, governments can incentivize private sector investment through tax breaks, subsidies, or low-interest loans, particularly in sectors that align with broader sustainability goals. By reducing the financial risk associated with early-stage technology development, government support enhances the attractiveness of sustainable technologies for private investors, enabling innovation to move from prototype to full commercialization.

3. Green Bonds and Climate Bonds

The issuance of green and climate bonds has become one of the most popular mechanisms for financing sustainability projects. Green bonds, in particular, are debt instruments issued by governments, corporations, or financial institutions to raise capital for projects that aim to address environmental challenges. These bonds provide investors with an opportunity to contribute to projects that focus on renewable energy, energy efficiency, sustainable transportation, and environmental conservation.

The green bond market has seen rapid growth in recent years. According to the Climate Bonds Initiative (2024), the global market for green bonds reached $500 billion in 2023, demonstrating both growing investor interest and the increasing recognition of the financial viability of sustainability-focused projects. Investors are attracted to green bonds because they offer relatively stable returns while supporting impactful projects. At the same time, the growing market for these bonds reflects the increasing demand for sustainable investment opportunities that can contribute to the achievement of global climate and sustainability goals.

Climate bonds—related to the broader category of green bonds—are specifically targeted at financing projects that contribute to climate change mitigation and adaptation. As international organizations, sovereign governments, and multinational corporations issue these bonds, they help direct substantial amounts of capital toward large-scale projects aimed at reducing greenhouse gas emissions and increasing resilience to climate change impacts. The green bond market is expected to continue growing, especially as more investors seek to align their portfolios with environmental and social governance (ESG) criteria.

4. Impact Investing

Impact investing is a growing sector within the broader field of sustainable finance, focused on directing capital to projects that generate measurable social and environmental benefits alongside financial returns. Impact investors are motivated not just by financial returns but by the opportunity to drive positive change through their investments. This long-term

perspective makes impact investing particularly suitable for sustainable technologies, which may take years to develop and deploy but offer significant long-term benefits.

Impact investing is typically carried out by institutions like impact funds, foundations, family offices, and high-net-worth individuals who are interested in aligning their investments with their values. A key feature of impact investing is the use of standardized metrics to measure the social, environmental, and financial impact of investments. The Global Impact Investing Network (GIIN) has developed a set of guidelines to ensure that impact investors can track and report on the outcomes of their investments, making it easier to scale impact investing practices across sectors.

In sustainable innovation, impact investors have supported a range of technologies, including clean energy solutions, sustainable agriculture practices, water management systems, and affordable housing initiatives. Impact investors typically focus on companies or projects that contribute to the United Nations Sustainable Development Goals (SDGs), creating opportunities for innovation while driving systemic change in addressing global challenges (Klein et al., 2022).

5. Blended Finance

Blended finance is an innovative financing model that combines public and private capital to support projects that may otherwise be considered too risky for private investors. By integrating concessional funding from public or philanthropic sources with private sector investment, blended finance mechanisms make it easier to finance large-scale sustainability projects, particularly in emerging markets and developing economies.

One of the primary advantages of blended finance is its ability to de-risk investments for private investors. Development agencies, philanthropic organizations, and multilateral institutions often provide concessional funding or guarantees to attract private investment into projects with high potential for positive social and environmental impact but high financial risk. Blended finance can also help address the funding gaps that exist in sectors such as renewable energy, climate adaptation, and infrastructure development, where early-stage risks may discourage private investors.

The Global Environment Facility (GEF) has been a leading proponent of blended finance in the sustainability sector, working to channel both public and private funds into projects that address environmental challenges. The GEF's funding has been instrumental in driving investment into clean energy projects, sustainable land use, and biodiversity conservation efforts in developing countries (Batta et al., 2023).

3.Challenges in Financing Sustainable Innovation

While there has been a noticeable increase in the availability of financing models for sustainable innovation, significant barriers still hinder the flow of capital into the sector. The complexities associated with financing technologies that aim to address global sustainability challenges are multifaceted and varied. Below are some of the key challenges faced in financing sustainable innovation:

3.1. Perception of High Risk in Sustainability Technologies

Sustainability technologies—such as renewable energy solutions, clean mobility, and circular economy models—are often perceived as high-risk investments, particularly in emerging markets or for early-stage startups. Several factors contribute to this perception:

- **Technological Uncertainty**: Many sustainability technologies are still in the development or demonstration phase, meaning they have not yet proven their scalability or economic feasibility. Even when promising innovations show early success, the path to large-scale deployment can be fraught with unforeseen challenges. For instance, solar energy technologies have significantly advanced, but challenges related to energy storage, efficiency, and grid integration still present substantial uncertainties.
- **Uncertain Market Adoption**: While sustainability technologies may solve critical global challenges, there is often uncertainty about how quickly and to what extent these technologies will be adopted in the market. Consumer behavior, regulatory changes, and market demand can vary dramatically, making it difficult for investors to predict returns. The slow adoption of electric vehicles, despite advances in technology, is a classic example of market resistance due to infrastructure constraints, lack of consumer awareness, or regulatory hurdles.
- **Long Payback Period**: Sustainable technologies often require substantial upfront capital with relatively long payback periods. Investors may be unwilling to commit large amounts of capital if they expect it will take many years (or decades) for a return on investment. This is especially true for technologies like carbon capture and storage or large-scale renewable energy infrastructure, which may only generate returns after a decade or more.

These factors often make sustainability projects appear too risky, especially when compared to traditional investments that promise faster, more predictable returns. As a result, many investors choose to focus on shorter-term or less risky opportunities, leaving the sustainability sector underfunded.

3.2. Regulatory Hurdles and Policy Uncertainty

One of the major challenges in financing sustainable technologies is the regulatory environment. While many governments have made commitments to addressing climate change and supporting sustainability, the regulatory landscape remains fragmented, inconsistent, and subject to rapid changes. Some of the key regulatory-related barriers include:

- **Policy Instability**: Investors often face uncertainty due to shifts in political leadership, changing regulations, and the inconsistency of government policies across regions. For example, the introduction of new environmental policies or energy subsidies can significantly impact the financial viability of renewable energy projects. Conversely, the rollback of environmental regulations (as seen in some jurisdictions)

can also create a perception that investments in green technologies may become less favorable if policies change unfavorably.

- **Lack of Clear Standards and Regulations**: The lack of clear, consistent standards and regulations for sustainable technologies also hinders investment. In emerging markets, for instance, the absence of clear environmental laws and regulations on emissions or energy efficiency can result in confusion for investors who are uncertain about the regulatory framework in which they are operating. In the absence of enforceable standards, it is difficult for investors to confidently assess the risk and reward associated with particular technologies or projects.
- **Fragmentation Across Markets**: In some sectors, the regulatory environment may vary significantly between regions, leading to difficulties for innovators attempting to scale their solutions globally. In the clean energy sector, for example, the regulatory landscape is vastly different across countries and continents, making it difficult for investors to determine where to allocate capital. While some countries offer generous subsidies and regulatory support for renewable energy, others may have weaker incentives, limiting the growth potential of these technologies in those markets.
- **Permitting and Approval Delays**: Many sustainable projects, particularly large infrastructure projects like renewable energy installations, require extensive permitting and regulatory approval. The process can be time-consuming, costly, and subject to unpredictable delays, all of which increase the financial uncertainty surrounding these projects. This can deter investors who are wary of dealing with bureaucratic hurdles or project delays.

These regulatory challenges make it difficult for investors to confidently assess the risk of sustainability-focused projects, hindering the mobilization of capital into these technologies.

3.3. Market Volatility and Financial Uncertainty

While sustainability technologies have significant long-term potential, they are often subject to market volatility, especially in the early stages of their deployment. Volatility in both the financial markets and the broader economy can create instability for investors looking to fund innovative solutions:

- **Fluctuating Commodity Prices**: Some sustainable technologies, such as biofuels or electric vehicles, rely on certain raw materials like lithium, cobalt, or rare earth metals. Prices for these commodities can fluctuate dramatically based on market supply and demand, geopolitical events, and other external factors. These price fluctuations create uncertainty for investors, making it more difficult to forecast the economic viability of a particular technology over the long term.
- **Financial Market Instability**: Sustainable technologies often require long-term financing, but broader financial market instability (such as inflation, interest rate hikes, or economic recessions) can introduce additional risk. For example, a rise in interest rates may increase the cost of financing for large-scale renewable energy projects, making them less attractive to potential investors. When economic

uncertainty increases, investors tend to pull back from riskier projects, including sustainability innovations.

- **Short-Term Financial Pressures**: Traditional investors, especially those representing institutional investors (e.g., pension funds or insurance companies), often focus on short-term returns due to fiduciary responsibilities and pressure from stakeholders. The long-term nature of many sustainable projects may not align with the financial goals of these investors, especially when more immediate returns are available from conventional investments. Consequently, investors may be hesitant to allocate capital to technologies that require extended timelines to generate substantial returns.

3.4. Lack of Standardized Metrics and Impact Measurement

The absence of standardized metrics for measuring the social, environmental, and financial impacts of sustainable technologies further exacerbates the challenges of financing these innovations. Traditional financial models often rely on metrics like return on investment (ROI), payback periods, and net present value (NPV), but these metrics fail to capture the full value of sustainability-driven technologies, particularly their long-term environmental and social benefits.

- **Difficulty in Measuring Impact**: While financial returns can be quantified in traditional investments, social and environmental returns are often harder to measure and quantify. Investors may be concerned that there are no universally accepted standards or metrics for evaluating the effectiveness of a sustainability technology in achieving climate goals, reducing emissions, or benefiting communities. For instance, how do investors assess the full lifecycle environmental impact of a product or the social impact of a renewable energy project in a developing country?
- **Impact Washing and Greenwashing:** Without standardized impact measurement, there is a risk of impact washing or greenwashing—when companies or projects exaggerate or misrepresent the environmental or social benefits of their technologies. This undermines investor confidence and creates skepticism about the true value of sustainable investments. Clear, rigorous, and consistent impact measurement frameworks, such as those established by the Global Impact Investing Network (GIIN), are critical to ensuring that investors can make informed decisions based on credible, transparent data.
- **Misalignment of Goals Between Innovators and Investors**: Due to the difficulty in measuring the social and environmental impact, there is often a misalignment between the goals of investors and innovators. While investors may be focused primarily on financial returns, innovators in the sustainability sector may prioritize environmental and social outcomes over immediate financial gains. This misalignment can lead to tensions and difficulties in securing funding if both parties are not on the same page regarding the project's objectives and expected outcomes.

4.Recent Trends and Developments

The recent surge in global attention to climate change and sustainable development has spurred new developments in the financing landscape. The integration of the United Nations

Sustainable Development Goals (SDGs) into investment strategies is becoming more common, with investors increasingly aligning their portfolios with sustainability objectives. In 2023, over $1 trillion in investments were directed toward SDG-related projects, with a significant portion focused on clean energy and climate adaptation technologies (UN PRI, 2023).

Another emerging trend is the increasing importance of corporate sustainability initiatives. Many corporations are using their balance sheets to fund sustainable innovations through corporate venture arms or direct investments in startups. Companies such as Google, Microsoft, and Tesla are examples of large corporations that are heavily investing in sustainability-driven technologies both for financial return and to meet their own sustainability targets.

5.Recommendations for Unlocking Investment

5.1. Enhance Public-Private Partnerships (PPPs)

Public-Private Partnerships (PPPs) have long been recognized as an effective mechanism for fostering innovation, combining the strengths of both the public and private sectors to solve complex societal challenges. Governments can reduce the inherent risks of investing in sustainable technologies by leveraging PPPs, which align the interests of public agencies and private investors, making it easier to scale sustainable innovations. Several actions can help enhance the effectiveness of PPPs for sustainable innovation:

- **Creating Supportive Policies and Incentives**: Governments can play a key role by enacting policies that reduce investment risks for private companies. This includes offering tax incentives, grants, and loan guarantees to incentivize private sector participation. For example, renewable energy projects in various regions, like wind or solar energy, often receive public subsidies that reduce the financial risks for private investors. Governments can further support innovation by streamlining regulatory approval processes and offering legal protections for investors in emerging sectors.
- **De-risking Innovation:** Governments can provide upfront funding or grants to help companies meet initial R&D or commercialization milestones. By taking on some of the early-stage risks, public entities can make it more appealing for private investors to come on board. For example, the European Union’s Horizon 2020 program has supported various green technologies through grants, which encouraged private investors to come in with more confidence.
- **Leveraging Private Sector Expertise**: Governments can also facilitate the sharing of expertise between the private and public sectors to ensure the success of sustainability projects. In clean tech, for example, private companies can contribute valuable technical expertise, supply chain management, and market knowledge that can help scale and deploy innovations faster. These partnerships can help overcome technical challenges and promote the commercialization of emerging technologies.
- **Fostering Long-Term Collaborations:** Successful public-private partnerships should be structured with long-term goals in mind, with flexibility built in to account for the changing landscape of technology, policy, and market needs. By creating a stable,

transparent framework for collaboration, governments and private investors can work together more effectively to scale sustainable innovations across sectors.

By enhancing PPPs, governments can effectively mobilize private investment and expertise, reducing risk while accelerating the transition to sustainable economies.

5.2. Develop Standardized Impact Metrics

A critical barrier to unlocking more investment in sustainable innovation is the lack of standardized metrics for measuring the social, environmental, and financial impacts of these technologies. Without consistent measurement and reporting frameworks, investors face difficulties in evaluating the value of their investments. Standardizing impact metrics would enable investors to make more informed decisions and create greater transparency in the market. Key actions to develop and implement standardized impact metrics include:

- **Collaboration on Impact Measurement Standards:** Organizations such as the Impact Management Project (IMP), Global Impact Investing Network (GIIN), and the Sustainable Development Goals (SDG) Impact Standards are already working toward creating frameworks for impact measurement. However, these efforts need broader adoption and integration into financial markets. Governments, financial institutions, and innovation hubs should collaborate to establish common guidelines that include both financial and non-financial indicators of success.
- **Integrating ESG Criteria into Investment Decision-Making**: Many investors already integrate Environmental, Social, and Governance (ESG) criteria into their decision-making. However, a lack of standardized methodologies for measuring impact hinders widespread adoption. By aligning metrics across the industry and embedding them into existing financial analysis processes, investors can more effectively assess the full value of sustainability-focused technologies.
- **Supporting Data Transparency and Reporting**: To make standardized metrics work, it is crucial for organizations and startups to adopt transparent reporting practices. Sustainable innovations should undergo third-party evaluations to ensure accuracy and consistency in the reported impact. For instance, adopting frameworks like the Green Bond Principles for impact measurement can help create clarity for investors and stakeholders. By publishing clear, concise impact reports that follow a standardized methodology, companies can build investor trust and attract capital more easily.
- **Utilizing Technological Solutions for Real-Time Impact Monitoring:** Advances in data analytics and blockchain technology can play a significant role in improving transparency in impact reporting. Real-time tracking of emissions reductions, energy savings, or other relevant impact metrics can enhance credibility and make it easier for investors to gauge performance. Technologies such as digital platforms for carbon accounting or supply chain transparency can provide investors with continuous updates on how projects are achieving their social and environmental goals.

By developing and implementing standardized impact metrics, investors can better assess the financial, social, and environmental returns on sustainable innovation, which will lower uncertainty and attract more capital to the sector.

5.3. Increase Blended Finance Initiatives

Blended finance is a powerful mechanism to unlock investment in sustainability-focused projects, especially in regions or sectors where risks are perceived as too high for private investors to commit significant capital. By combining public and philanthropic funds with private sector investment, blended finance initiatives reduce risk for investors and increase the scale of funding available for sustainability projects. Expanding blended finance could play a key role in bridging the financing gap for high-impact, high-risk innovations. Several strategies can help expand blended finance:

- **Scaling Up Development Finance**: Development finance institutions (DFIs) and multilateral institutions such as the World Bank, International Finance Corporation (IFC), and the Global Environment Facility (GEF) should expand their role in providing concessional funding and guarantees that can attract private capital. By offering risk mitigation tools, DFIs can encourage private sector investment in projects that are essential for meeting global sustainability goals but may have high initial capital requirements, such as renewable energy infrastructure, energy storage, and sustainable urban development.
- **Creating Structured Investment Funds:** Structured investment funds that pool public, philanthropic, and private capital are effective in channeling funds toward sustainable innovation. These funds can focus on sectors such as clean energy, water access, or sustainable agriculture, which often require long-term capital commitments and are not traditionally attractive to private investors. By blending public or concessional funds with private equity or debt, these funds can de-risk the projects and offer more favorable terms to private investors.
- **Targeting High-Impact Sectors**: Blended finance models should focus on sectors that offer both high social or environmental impact and significant financial returns. For example, sectors like clean energy, affordable housing, sustainable agriculture, and circular economy projects hold enormous potential but require capital to overcome early-stage risk. In these areas, blended finance can accelerate the transition to more sustainable, scalable models while leveraging private capital to drive innovation.
- **Expanding to Emerging Markets and Developing Economies**: While blended finance is widely used in some regions, it is crucial to expand its reach to emerging markets and developing economies, where sustainable innovation is most needed. In many developing regions, the risk-reward profile of sustainability technologies is seen as unfavorable for private investors due to infrastructure gaps, policy instability, and market volatility. By combining public sector support with private capital in these

regions, blended finance can help overcome these barriers and promote inclusive, sustainable development.

- **Promoting New Financial Instruments**: New financial instruments, such as sustainable impact bonds or green development bonds, can be integrated into blended finance structures to further attract private capital. These instruments offer both financial returns and impact metrics tied to sustainable outcomes, providing clear incentives for investors and driving innovation in key sectors.

By increasing the use of blended finance, governments and development agencies can help reduce the perceived risk of sustainable innovation projects, enabling more private capital to flow into critical sectors and accelerating the achievement of sustainability goals.

Conclusion

The financing of sustainable innovation is a critical factor in achieving global sustainability goals. Although there are many financing models available, unlocking capital for technological progress requires overcoming barriers related to risk, transparency, and alignment of goals. By strengthening partnerships, creating standardized impact metrics, and expanding blended finance, we can accelerate the flow of investment into sustainable technologies and help build a more resilient, equitable, and environmentally sustainable future.

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Homeopathy Medicinal System

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Abstract

Homeopathy is a holistic medical system that aims to treat patients by stimulating their body's natural healing processes. Founded by Samuel Hahnemann in the late 18th century, this system is based on the belief that "like cures like," meaning that substances causing symptoms in healthy individuals can be used in diluted forms to treat similar symptoms in the diseased state. Homeopathy emphasizes individualized treatment, considering both physical and emotional factors of the patient. The treatment approach involves highly diluted medicines, and practitioners use a thorough diagnostic process to identify the right remedy. This chapter explores the history, principles, and practices of homeopathy, including the role of dilution in medicines, and its applications in modern healthcare. It also provides insights into commonly used homeopathic remedies and market products, highlighting their therapeutic benefits.

Keywords: Homeopathy, Samuel Hahnemann, Holistic treatment, Dilution factor, Remedies, Diagnosis, Treatment, Homeopathic medicines, Therapeutic use, Market products.Introduction of Homeopathy

- Founder of Homeopathy
- History of Homeopathy
- Fundamental principles include in Homeopathy
- Dilution factor
- Diagnosis
- Treatment
- Drug and it's uses with market products.

Introduction

Homeopathy System*:*

The Homeopathy is derived from the Greek word with combinations of two words Homoeo + Pathos ; meaning of Homoeo is ***similar or like*** and meaning of Pathos is ***suffering.*** The medical System is nearly 200 years old it is also known as replacing the medicinal system to allopathy. The medical system help to cover the disorder or disease this accepts the **Principle of Similia**. It is helpful to diagnosis the disorder or disease. and claim that the body which helps to respond the function as antibodies

Introduction of Founder: *Dr.Samuel Christian Friedrich Hahnemann (1755-1845)*

He was a German physician and chemist based on the natural law of healing
He is ***Founder of homeopathy system***
He also introduced The term "allopathy" was invented by him that conjoined allos "opposite" and pathos "suffering" as a referent to harsh medical practices of his era which included bleeding, vomiting etc and the administration of highly toxic drug

History of Homeopathy system: In **1796** Dr.Samuel Christian Friedrich Hahnemann introduced the Homeopathy System.

In **1825** this system was introduced to the United States.

In **1835** the first American homeopathic school opened.

In **1901** United States developed 22 College's and 1500 practitioners

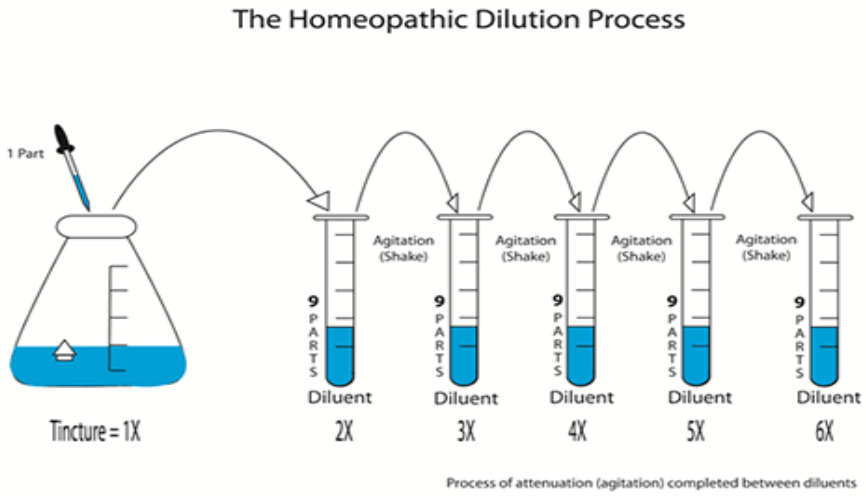
In the middle of the 19th century when Homoeopathy was gaining popularity The **Babu Rajendra Lal Dutta** came forward to support Homoeopathy and established a homeopathic hospital in India.

In 1948 Government of India recognised homeopathy after the homeopathic enquiry commission's report

Fundamental principles of Homeopathy

- **1.Principle of Similia (like cures like)** :"A substance that can artificially produce certain disease-like symptoms on a healthy person; only that substance can cure a similar disease."
  Explanation: It cure with diluted and inactive form of virus. (Kills itself)
- **2.Principle of simplex**: "Treating as a whole with one single remedy which is most similar in all his sufferings"
  Explanation: Only one medicine at the time also avoid the combination
- **3.Principle of Minimum dose**:"The dose of medicine has to be minimum to ensure that the treatment is safe and free from side-effects."
  Explanation: Due to this the patient can easily administered the medicine
- **4**. **Principle of Proving or Law of Proving:** "The Dr. prescribes only those medicines whose medicinal properties are known through 'drug proving'."
  Explanation: there are many drug to treat disease but which drug give action and that action has known it should only prescribe
- **5.Principle of Individualisation:** "No two patients get the same remedy even though they may be having the same disease."
  Explanation: In this system the diagnosis is done by also with patients history behavior etc due to this the patient have same disease but different medicine are prescribed
- **6.Principle of Vital force:** "There is a subtle energy within the body that responds to the remedy and enables the body to heal itself."
  Explanation: In this the body response to the medicine and help to cure fast
- **7.Principle of Dynamisation**: "The process of dilution combined with succession to increase healing potency runs counter to the modern principles of Pharmacology."
  Explanation: It is nothing but the drug that is treated with other substances to make combinations and give the action as well as it is also known as dilution factor.

5. Dilution factor: The system believe that more diluted the substance, the more potent its healing power



Homeopathy Dilution Image1.1
https://images.app.goo.gl/Hw8KqA9siwgKyJ8t6

6.**Diagnosis:**

- In this system to diagnosed the patient required the more time than allopathy and less time than Ayurveda
- The communication between doctor and patient it's play the important part in the system

By following points observed during diagnosis :

- Medical history of patient
- Current symptoms
- Major symptom's location
- Presence/absence of symptoms according to changes in weather, season, time of day.
- Patient's mood
- Behavior of patient
- Likes & dislike.
- Responses to stress conditions
- Reactions to food or medicines

These points are discussed with patient and identify or diagnose the disease.

7. **Treatment**

•It Cures Diseases From Its Roots.
•It works on seven fundamental principles.
•It is easily to available
•It is easy to administration
•It increases the immune system naturally.
•It is safe than other systems.

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Impact of Government Policies on Entrepreneurial Growth and Development

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ABSTRACT

Entrepreneurship is a key driver of economic growth, job creation, and innovation. However, the success and sustainability of entrepreneurial ventures largely depend on the policy framework established by governments. This study examines the impact of government policies on entrepreneurial growth and development, focusing on financial support, regulatory frameworks, tax policies, and business development initiatives. By analyzing various government interventions, this research highlights how policies can either foster or hinder entrepreneurship. The study explores key areas such as access to funding, ease of business registration, market regulations, and innovation incentives. Through a review of existing literature, case studies, and policy analysis, the research identifies best practices and challenges faced by entrepreneurs due to government regulations. The findings indicate that while supportive policies, such as startup grants and tax benefits, encourage business growth, excessive regulations and bureaucratic hurdles can act as barriers. This study concludes that a balanced and flexible policy framework is essential to creating a thriving entrepreneurial ecosystem. Recommendations are provided for policymakers to enhance the effectiveness of entrepreneurship support programs, ultimately contributing to economic development and business sustainability.

Keywords--- Government Policies, Entrepreneurial Growth, Business Incubators, Entrepreneurship Ecosystem

INTRODUCTION

Neuromarketing is a strategy that uses the knowledge of neuroscience and cognitive science to accurately identify customer needs, desires, and preferences. It studies consumers' responses to marketing stimuli and assesses non-conscious reactions to specific advertising campaigns, packaging, design, etc. The approach helps develop effective marketing campaigns and strategies that resonate with the target audience.

SCOPE OF THE STUDY

This study investigates the impact of government policies on entrepreneurial growth and development, with a focus on financial support mechanisms, regulatory frameworks, taxation policies, and innovation-driven initiatives. The research aims to evaluate how government interventions influence the success of startups, the sustainability of small businesses, and the

broader economic development. Specifically, the study will explore key policy areas such as financial incentives (loans, grants, subsidies), business registration and licensing processes, taxation policies, and government initiatives for innovation, skill development, and business incubation. The geographical scope may focus on specific regions or countries to assess local policy impact, while also considering sectoral differences in industries like technology, manufacturing, and services. By examining recent government policies and their challenges, this study aims to provide insights into how public policy can effectively foster entrepreneurship in today's economic climate.

OBJECTIVES OF THE STUDY

More specifically the study makes an earnest attempt by having the following as its objectives:

1. To analyze the role of government policies in fostering entrepreneurial development and business growth.
2. To examine the effectiveness of financial incentives such as tax benefits, subsidies, and grants in supporting startups and small businesses.
3. To identify challenges and barriers faced by entrepreneurs due to government policies and suggest policy improvements.
4. To evaluate the role of government initiatives in promoting entrepreneurship.

REVIEWS OF LITERATURE

Entrepreneurship has long been recognized as a crucial factor in economic growth and innovation. However, the role of government policies in shaping the entrepreneurial ecosystem has been widely debated. Various studies have explored the impact of financial incentives, regulatory frameworks, and institutional support on entrepreneurial growth and development.

According to Acs et al. (2008), government policies play a pivotal role in fostering entrepreneurship by providing financial assistance, regulatory support, and infrastructure development. Policies such as tax incentives, subsidies, and funding programs significantly influence the ability of startups to thrive in competitive markets. Similarly, Shane (2009) argues that government intervention in entrepreneurship should focus on reducing bureaucratic barriers and enhancing access to capital.

Access to financial resources is a major determinant of entrepreneurial success. Stiglitz and Weiss (1981) highlight that government-backed financial schemes, such as microfinance programs and startup grants, improve capital accessibility for small businesses. Additionally, Lerner (2010) emphasizes that venture capital policies and public funding initiatives contribute to fostering high-growth startups and innovation-driven enterprises.

Djankov et al. (2002) suggest that regulatory policies, including business registration, licensing, and compliance requirements, influence the ease of doing business. Countries with streamlined business registration processes and lower bureaucratic hurdles experience higher entrepreneurial activity. On the other hand, excessive regulations can stifle business growth, as noted by Baumol (1990), who argues that over-regulation leads to unproductive entrepreneurship and limits innovation.

Tax policies significantly impact entrepreneurship by affecting business profitability and investment decisions. Romer (1990) finds that lower corporate tax rates encourage business formation, while excessive tax burdens can deter new ventures. In contrast, Cullen and Gordon (2007) argue that tax incentives alone are insufficient; a stable and transparent tax regime is essential for long-term entrepreneurial sustainability.

Governments often implement initiatives to foster innovation-driven entrepreneurship. Audretsch and Thurik (2001) highlight the role of research and development (R&D) policies in promoting technological advancements and business innovation. Moreover, Mazzucato (2013) stresses that government-led investments in innovation and technology incubation centers significantly contribute to the success of startups.

Despite positive intentions, several studies highlight the challenges in government policy implementation. Storey (1994) points out that policy effectiveness varies across regions due to differences in institutional quality and governance structures. Furthermore, Minniti (2008) notes that policies targeting entrepreneurship should be adaptable to changing economic conditions to remain effective.

RESEARCH METHODOLOGY

The results of the study show that exploratory research is necessary to analyze the impact of government policies on entrepreneurial growth and development. In addition, exploratory research aims to establish the framework for further investigations or assess whether the observations can be explained by and evaluated in the context of the body of current literature. As a result, secondary data, already published literature reviews, fact sheets from journals, and periodicals are used in qualitative research.

ANALYZING THE ROLE OF GOVERNMENT POLICIES IN FOSTERING ENTREPRENEURIAL DEVELOPMENT AND BUSINESS GROWTH

Government policies play a crucial role in shaping the entrepreneurial ecosystem by providing financial support, regulatory frameworks, infrastructure, and business development programs. A well-structured policy environment can encourage entrepreneurship, drive innovation, and contribute to economic growth.

1. Financial Policies and Access to Capital

Entrepreneurs often struggle with obtaining adequate funding for their ventures. Governments support businesses through subsidized loans, grants, tax incentives, and venture capital programs. Policies such as startup funds, low-interest business loans, and angel investor networks provide financial security to emerging businesses, reducing the risks associated with new ventures.

2. Regulatory Framework and Ease of Doing Business

A supportive regulatory environment is essential for fostering entrepreneurship. Governments simplify business registration, licensing processes, and legal compliance to reduce bureaucratic hurdles. Countries with business-friendly policies, streamlined tax structures,and minimal bureaucratic red tape see higher entrepreneurial activity and business sustainability.

3. Taxation Policies and Incentives

Tax incentives are a major tool used by governments to encourage entrepreneurship. Policies that offer corporate tax reductions, tax holidays, and investment credits provide financial relief to startups and small businesses. However, excessive taxation and complicated tax structures can discourage new businesses from entering the market.

4. Innovation and Research Support

Governments play a key role in fostering innovation by investing in research and development (R&D), technology hubs, and startup incubators. Initiatives such as public-private partnerships, patent protection laws, and university-led entrepreneurship programs drive innovation and create a competitive business environment.

5. Infrastructure and Market Access

Government investment in physical and digital infrastructure enables businesses to scale efficiently. Policies that enhance internet access, transportation, logistics, and industrial zones create a favourable environment for businesses to thrive. Additionally, government-led initiatives that promote local businesses in international markets help entrepreneurs expand their reach.

EXAMINING THE EFFECTIVENESS OF FINANCIAL INCENTIVES IN SUPPORTING STARTUPS AND SMALL BUSINESSES

Financial incentives such as tax benefits, subsidies, and grants play a crucial role in fostering entrepreneurship by reducing financial burdens, encouraging investment, and promoting business sustainability. These incentives help startups and small businesses overcome initial capital constraints, enhance innovation, and expand operations. However, their effectiveness varies based on accessibility, implementation, and economic conditions.

1. Tax Benefits and Business Growth

Tax incentives, such as corporate tax reductions, tax holidays, and investment credits, provide startups with financial relief, allowing them to reinvest profits into business expansion. Studies indicate that countries with lower tax rates and simplified tax structures experience higher entrepreneurial activity.

2. Subsidies and Their Impact on Sustainability

Government subsidies, such as low-interest loans, energy cost reductions, and infrastructure support, help small businesses manage operational costs. These incentives are particularly beneficial in manufacturing, agriculture, and technology-based startups. While subsidies ease financial pressures, challenges such as bureaucratic inefficiencies, favoritism, and misallocation of resources may hinder their impact.

3. Grants and Startup Development

Grants provide non-repayable financial support to startups and small businesses, often focusing on innovation, research and development (R&D), and social entrepreneurship. Programs such as government-backed startup incubators and innovation funds have proven effective in scaling businesses. However, rigorous application processes, eligibility

restrictions, and inconsistent funding availability limit their accessibility for many entrepreneurs.

4. Challenges in Financial Incentive Implementation

Despite their benefits, financial incentives often face challenges such as delayed disbursement, complex application processes, and limited reach in rural or underserved areas. Additionally, some businesses become over-dependent on government support, leading to inefficiencies and reduced competitiveness.

IDENTIFYING CHALLENGES AND BARRIERS FACED BY ENTREPRENEURS DUE TO GOVERNMENT POLICIES

Government policies play a significant role in shaping the entrepreneurial landscape by providing financial support, regulatory frameworks, and business development programs. However, despite these initiatives, many entrepreneurs face significant challenges and barriers that hinder business growth and sustainability. These obstacles often arise due to policy inefficiencies, bureaucratic hurdles, and a lack of accessibility. Identifying these challenges and proposing effective policy improvements is essential for fostering a more inclusive and thriving entrepreneurial ecosystem.

1. Bureaucratic and Regulatory Hurdles

Entrepreneurs often struggle with complex business registration processes, lengthy approval timelines, and excessive regulatory compliance. Strict labor laws, licensing requirements, and taxation policies can discourage startups, especially in developing economies where regulatory processes are not streamlined.

2. Limited Access to Financial Support

Although governments offer various funding schemes, many startups and small businesses face difficulties in securing loans, grants, and venture capital due to high eligibility criteria, lack of collateral, and lengthy application processes. Additionally, government-backed financial programs may not be widely accessible, particularly for rural and women entrepreneurs.

3. Inconsistent and Unstable Policy Frameworks

Frequent changes in government policies, taxation structures, and business regulations create uncertainty for entrepreneurs. Inconsistent policies make long-term business planning challenging, discouraging investment and innovation. Entrepreneurs require policy stability and transparency to ensure business sustainability.

4. High Tax Burden and Compliance Costs

Heavy taxation, multiple tax filings, and complicated compliance procedures add financial stress to small businesses. Many entrepreneurs struggle with high corporate taxes, value-added tax (VAT), and import/export duties, reducing their profitability and growth potential.

5. Lack of Awareness and Access to Government Programs

Many entrepreneurs, especially those in rural or underdeveloped areas, are unaware of government incentives, training programs, and financial assistance schemes. The lack of an

effective communication and outreach strategy prevents startups from benefiting from available resources.

EVALUATING THE ROLE OF GOVERNMENT INITIATIVES IN PROMOTING ENTREPRENEURSHIP

Government initiatives play a crucial role in fostering entrepreneurship by providing financial assistance, training programs, incubation support, and networking opportunities. These initiatives help reduce barriers to entry, encourage innovation, and create a supportive ecosystem for startups and small businesses. The effectiveness of such programs depends on factors like accessibility, implementation efficiency, and alignment with market needs.

1. Business Incubators and Startup Growth

Business incubators provide startups with workspace, mentorship, access to investors, and networking opportunities. Research indicates that businesses supported by incubators have higher survival rates due to structured guidance and access to critical resources. However, challenges such as limited incubator availability, selection biases, and lack of industry-specific mentoring can reduce their effectiveness.

2. Skill Development Programs and Entrepreneurial Competency

Skill development programs aim to enhance the technical, managerial, and financial capabilities of entrepreneurs. Governments invest in initiatives such as entrepreneurship training, digital skills development, and vocational education to prepare individuals for self-employment. While these programs improve business acumen and innovation, their impact depends on curriculum relevance, industry partnerships, and accessibility to aspiring entrepreneurs in rural or underprivileged areas.

3. Funding Schemes and Financial Support

Government-backed funding schemes, including subsidized loans, seed funding, venture capital programs, and grants, provide essential financial assistance to startups. These initiatives help reduce financial constraints and encourage business expansion. However, challenges such as complex application procedures, limited outreach, and delays in fund disbursement can restrict access to these resources.

CONCLUSION

Government policies play a pivotal role in shaping the entrepreneurial landscape by providing financial support, regulatory frameworks, skill development programs, and business-friendly incentives. Policies such as tax benefits, funding schemes, business incubators, and infrastructure investments contribute to fostering entrepreneurship, driving innovation, and boosting economic development. However, despite these efforts, bureaucratic inefficiencies, regulatory hurdles, limited financial accessibility, and policy instability continue to pose challenges for entrepreneurs. To maximize the positive impact of government policies on entrepreneurial growth, it is crucial to adopt a holistic approach that ensures simplified regulatory processes, improved access to funding, targeted skill development programs, and

greater public-private collaboration. By addressing these challenges and enhancing policy effectiveness, governments can create a more conducive environment for entrepreneurship, leading to job creation, economic diversification, and long-term sustainable business growth.

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Impact of Mental Health Services on College Students: A Pathway to Academic Success and Well-Being.

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Abstract

"Mental health needs a great deal of attention. It's the final taboo and it needs to be faced and dealt with." — Adam Ant

Now more than ever, mental illnesses are affecting college students, which has a significant impact on their overall well-being and academic performance. The very transition to college life exposes students to numerous stressors, such as academic pressure, social difficulties, and financial burdens, which make them susceptible to mental health concerns. The focus of this study is on exploring the role of campus mental health services in addressing these issues, particularly as they impact academic success, retention rates, and emotional resilience. Research shows that taking part in counseling and peer support programs and awareness campaigns is associated with improved emotional stability, academic engagement, and reduction in the likelihood of dropping out of school. Even though the benefits of mental health services are evident, the barriers limiting their effectiveness include stigma, limited access, and insufficient institutional support. Because they fear being judged or are not aware of the resources available to them, many students are hesitant to make assistance requests. This study stresses the need for an upgrade of mental health services with functioning campaigns for awareness and a more involved incorporation of mental wellness programs into the college frame. Addressing this issue will further enhance institutions' ability to provide a culture that drives academic success along with personal well-being.

Keywords: Mental health, college students, academic performance, student well-being, counseling services.

Objectives:

1.To examine how well mental health services affect college students' academic performance, retention rates, and overall well-being.

2.To identify challenges preventing the performance of mental health services and make suggestions for enhancing accessibility, awareness, and utilization for students.

Methodology used:

In this article, qualitative and descriptive methods are used to give description of different concepts. The sources of the article are collected from secondary sources. Data are collected mainly from books, journals, websites, and articles.

Review of related literature:

1.The study titled, "Persistence of Mental Health Issues and Help-seeking Behavior Among Students" conducted by Zivin, Eisenberg, Gollust, and Golberstein specifically examined the

prevalence, persistence, and help-seeking behavior of mental health issues among college students over a two-year span. They conducted an online survey in 2005 and a follow-up survey in 2007 at a large, public university. The conditions examined included anxiety, depression, eating disorders, self-harm, and suicidal ideation. Results showed a high prevalence of poor mental health, with more than half of the students reporting at least one problem on both waves of the analysis. Alarmingly, of those students reporting a mental health concern initially, 60% continued to experience these concerns at the two-year follow-up. Fewer than half of the students experiencing mental health problems sought treatment or received services. The study shows an urgent need for the increased mental health awareness, early intervention, and improved access to support services for students on college campuses.

2.The study titled, "Increased Demand for Mental Health Services on College Campuses: Perspectives from Administrators" was constructed by Watkins, Hunt, and Eisenberg. These authors detail the increasing demand for mental health services on college campuses, according to administrators from Campus Counseling and Mental Health Centers (CCMHC). Qualitative interviews were conducted as part of the Healthy Minds Study highlighted key trends and challenges. Increased numbers of students with serious mental health issues and increased service demands were noted by the administrators. Also there was a shift in the psychosocial profile of today's college students-neutralizing an impact on mental health demands. With such a shift, counseling centers are quickly moving toward a focus on wellness. However, according to many, the pressure is too much, with limited resources being combined with overwhelmed staffing. Conclusions point to an urgent need for colleges to rethink and improve mental health services to ensure decent health care for their students.

3.The study titled, "Mental Health Issues Among Undergraduate University Students: Challenges and Institutional Support" by UAldiabat, Matani, and Le Navenec's background paper deals with problems of mental health among undergraduate university students in order to create awareness, identify risk factors, and propagate preventive strategies. The study analyses existing research on the prevalence and consequences of mental health problems and barriers to help-seeking through a literature review. Academically stressful, socially challenged, and independence struggling situations are stressors contributing to mental disorders. These objections can often trigger academic failure in students, compelling them to withdraw from their studies. While students acknowledge mental health support, many hesitate to seek it due to stigma or other barriers. A plea is made for the development of culturally sensitive mental health programs and collaboration among administrators, educators, and clinicians to create a supportive campus environment.

4.The research conducted by Shim, Eaker, and Park was aimed at assessing the effectiveness of psychoeducational tools in increasing mental health awareness and decreasing stigma among college students. Using a quantitative research design, 147 college students were involved as participants in the study. Participants were asked to complete demographic questions, the Beliefs Towards Mental Illness Scale (BTMI), and the Stig-9 questionnaires before and after the course. The result shows a substantive change in beliefs from the students, in particular about the awareness of mental health and reduced stigma among the

students." After the course, students saw mental illness as more treatable and less shameful, highlighting the positive impact of mental health education in framing attitudes and reducing stigma.

5.The study titled, "Factors Influencing Mental Health of University and College Students in the UK" by Campbell, Blank, and Gordon considers key factors affecting the mental health of students in universities and colleges in the UK. The review uses observational studies on general well-being and poor mental health, with data provided from five databases covering studies from 2010 through 2020. Risk factors identified include childhood trauma, increased susceptibility among LGBTQ+ students, and American culture which places students at greater risk than usual. Conversely, the stable social contact, with the added insight of better preparation for student life, maintain a well to do mental health. Studies of behaviors also show such low academic engagement combined with recreational engagement in place of study are significantly linked to declining mental health. With the wide variety of factors all appearing to play a part, the study does provide a narrative interpretation instead of pure mathematics and statistics, placing great emphasis on targeted mental health intervention within higher education.

Introduction

College life is a period of transition that involves challenges of an academic, social, and personal nature. This phase opens the door for growth but also thrusts upon the individual numerous pressures, strains, expectations, and opportunities for the building or waning of relationships. Serious development of anxiety, depression, and other mental health problems can stem out of such situations and affect student's academic performance and relationships in various ways. If there is no timely intervention, poor academic performance will increase along with withdrawal of support and dropout from college. The role of counseling, therapy, and wellness services in the lives of students cannot be overstated; they help students tackle these very challenges. These services create a safe haven for students to discuss troubling issues, develop coping mechanisms, and foster emotional resilience. Studies show that students usually make more progress academically, are more positive in their attitudes, and manage stress better when they have access to proper mental health resources. Sadly, not every student finds it easy to access help; some experience stigma, some have financial restraints, and others simply don't know where to go. It leads not only to a positive impact on the individual psyche of the students but also to the overall development of the institution. Living in a climate that considers and holds value for mental health promotes an inclusive culture on campus, in which the student is often valued and understood. If colleges target mental health issues before they worsen, they can increase retention rates, student engagement, and ultimately academic success. The paper discusses mental health support and its influence on college students, barriers that limit access to mental health services, and ways to improve mental health support on campuses.

Positive Effects of Mental Health Services on College Students

Improved Academic Performance

Mental health challenges act as barriers for students to concentrate, retain knowledge, and submit assignments on time. Access to mental health services helps students better equipped,

to deal with time management, coping strategies, and emotional resilience, leading to their better academic performance. Students who have used counseling services tend to carry higher GPAs and lower dropout rates than those who have not.

Higher Retention Rates

Strong mental health support sees improved retention of students. Overwhelming stress, burnout, or untreated mental health conditions are among the most common reasons for dropping out of college. Counseling services, peer support groups, and wellness programs help students receive emotional and psychological support needed to overcome obstacles. These programs increase retention rates by assisting students in their studies and in earning their degrees.

Enhanced Emotional Well-Being

Mental health services improve emotional stability as they help identify issues like stress, self-doubt, and feelings of loneliness. Counselling and support groups create an atmosphere where students can develop their emotional intelligence and self-awareness. As a result, they deal with academic pressure and personal challenges way better. Greater self-confidence following the adoption of mental health services leads to an improved sense of well-being.

Stronger Social Relationships

Mental health issues lead to isolation and the inability to form meaningful connections with others. Counseling and mental health programs allow students to improve their communication skills, strengthen emotional connections, and become involved in social interactions. These services help alleviate anxiety, depression, and social fears, thus cultivating a feeling of community and belonging on campus.

Reduced Crisis Situations

Through early intervention with these counseling and mental health education services, severe psychological crises can be avoided, such as thoughts of suicide, self-injurious behavior, and substance abuse matters. Oftentimes, students struggle in silence and may begin to act out, sometimes tragically, without appropriate assistance. This is when the proactive services come in, such as crisis hotlines, suicide prevention programs, and first aid training in mental health to avert crises and offer timely assistance.

Encouragement to Participate

Students who receive mental health support are more likely than others to take on extracurricular, leadership, and even internship opportunities. Mental well-being further stimulates motivation, creativity, and engagement, and every student will give each other much to experience and learn in campus life. Healthy students are more successful, resilient, and prepared for academic and professional success.

Challenges Hindering the Effectiveness of Mental Health Services in Colleges

Stigmatization and Cultural Problems

Many students themselves hesitate to seek mental health support for fear of their peers, family members, and professors judging them. In some cultures, discussing or addressing mental illness is an absolute taboo. Therefore, admitting the needs of students becomes

difficult and problematic. This very stigma denies many students access to available resources, thus aggravating the issue indeed.

Lack of Information and Outreach

A huge issue is students' ignorance about the mental health services provided on campus. The failure most colleges have encountered is in marketing their therapy services. That leaves the student not sure of which doors to knock on for help. Focus on some general awareness campaigns coupled with workshops and free and low-cost mental health communication means may benefit the students imparting the "sure" information that those can access confidential services free or at a subsidized cost.

Inadequate Funding and Resources

Many colleges do not set aside enough budgets to fund mental health services, leading to counseling centers that have inadequate staff, dated facilities, and not enough mental health programs. Institutions that don't allocate more money for this type of service would not be able to provide enough counselors, enough therapy sessions, or enough mental health initiatives. This results in an already overburdened system that cannot adequately meet student needs.

Accessibility Issues and Scheduling Conflicts

Students are juggled with packed schedules and inconvenient days filled with classes, assignments, part-time jobs, and some social activities, making it difficult to find time to fit in clinics or counseling classes. A lot of mental health services work only during regular office hours.Long waitlists, limited openings, and lack of accessibility may deter a student from going to get help when he/she should most.

Acute Shortage of Qualified Mental Health Professionals

The growing demand for mental health services has outstripped the availability of trained professionals on a number of college campuses. Inadequate counselors to cope with the rising numbers of students needing help find themselves struggling with long waits to get their students assistance. Those long waits can worsen the condition of some, leading to circumstances sometimes requiring interventions at the crisis stage that could have been avoided.

Self-reliance Mindset Hinders

Many students think they should handle their own mental health issues, and that asking for help shows weakness, or they may feel that their problems aren't "serious enough" for professional intervention. This attitude may lead to the delay or avoidance of mental health care until the situation becomes dire and recovery is more complicated.

Strategies to Improve Accessibility, Awareness, and Utilization of Mental Health Services in Colleges

Conducting Campaigns to Reduce Stigma

Hold workshops, seminars, and peer discussion groups to normalize the conversation around mental health.

Encourage faculty, staff, and student leaders to speak freely on mental health subjects and create a space for openness and support.
Use social media and campus platforms to spread success stories of students who have profited from mental health services.

Developing Awareness and Outreach Campaigns

Ensure the introduction of mental health services is done during student orientation programs.
The posters, brochures, and email should clearly define how students can access counseling services.
Partner with student organizations to promote mental health resources during events and social media campaigns.

Increasing Funding and Staffing for Mental Health Services

Promote higher institutional and governmental grants for expansion of the counseling center and hiring of additional professionals.
Train the faculty and staff in basic mental health first aid to help during the first moments of intervention.
Set up paid internships for psychology students to help in peer counseling programs.

Enhancing Accessibility Through Flexible Services

Extend counseling center hours to evenings and weekends to accommodate students with busy schedules.
Provide teletherapy or online counseling options for remote and online students.
Create drop-in counseling sessions where students can seek immediate support without prior appointments.

Implementing Peer Support and Mental Health Ambassadors

Train student volunteers as peer counselors to provide support and encourage help-seeking behavior.
Establish student-led mental health clubs that organize stress-relief activities, mindfulness sessions, and mental health awareness events.
Create anonymous support groups where students can share their experiences without fear of judgment.

Integrating Mental Health Education into the Curriculum

Include mental health and stress management topics in general education courses.
Train professors to recognize signs of mental distress and guide students toward appropriate resources.
Encourage self-care practices, mindfulness techniques, and resilience-building strategies as part of student development programs.

Conclusion:

Mental health services play a vital role in shaping the academic success, retention rates, and overall well-being of college students. With increasing mental health challenges, it is essential for institutions to connect students' emotional well-being with their academic performance. Counseling, peer support, and wellness programs contribute to decreasing stress levels, improved concentration, and tackling personal issues for better learning than the

existing rates of retention in colleges. Nevertheless, other challenges have greatly hampered the success of existing mental health services, including stigma, lack of awareness, funding constraints, and access issues. If no effective interventions are put in place, students will suffer silently, impacting their educational progression and personal development in the long term. Therefore, colleges and universities must deploy proactive approaches that aim at overcoming existing barriers and include efforts and awareness campaigns, extensive funding for mental health services, making such services accessible, offering flexible service options, and allowing mental health education to become part of the curriculum. A strong mental health support system benefits not only the individual student but also the institution as a whole. A mental health program set up at an institutional level can improve campus climate, drop-out decrease rates, and instill a culture of resilience and well-being. Going forward, there will be a great need for collaboration between educational institutions, policymakers, faculty, and students to build a mental health framework that is more inclusive and supportive. By giving priority to mental health, colleges will allow students to excel academically while still caring for their emotional and psychological well-being.

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Implementation of Artificial Intelligence in Human Resource Functions – A Review Analysis

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Abstract

Human resource plays a considerable role in organizations. The tasks are carried out only through human resources. This paper tries to analyze the adaptability and adoption of AI in human resource process.

Keywords: Human resource, artificial intelligence

Introduction

HRM in organizations was considered an administrative function, focusing, digitize'' the human resources is essential. While implementation of AI technology within the process and HR Functions it is important to earn the trust worthiness of employees. Adaptability do play a vital role. The employees mind set should be made to aware the benefits that would yield if AI is implemented in daily process of the organizational management functions. Multi-dimensional technological and AI analytics have been implemented by organizations to have an efficient outcome of the HR Functions ((Forbes, 2019). Industry 4.0 has been the main reason for implementation of advanced technologies in to various aspects of process in organizations. Industry 4.0 deals with implementation of emerging and advance technologies in to various areas in manufacturing, supply chain management and other functional aspects (Mohanta et.al., 2020). Usage of digital technologies has been vital for every business. It helps to leverage the business in various aspects and helps to earn profitability in the long run (Fitzgerald et.al., 2014).

Human resource functions comprise of both management and various human resource functions. It helps to procure hirers, employee retention, talent acquisition and various employee engagement practice. This paper provides a review analysis as to the studies on AI implementation in HR as to various organizations.

S.No	Year	Number of studies
1	2025	1300
2	2024	11,100
3	2023	17,600
4	2022	12,400
5	2021	12,700

Source: google scholar

The above highlights the number of studies conducted for implementation of AI in human resource functions in various organizations.

Review of Literature

Due to Industry 4.0 advancements technologies have started to play and change the working environment. It not only changes the way of working but also changes the ways leaders working in organizations (Serban et.al., 2015).

AI integration in business and process is not only tool, organizations wants its employees to learn new skills and competencies relating to technology. This helps to create value for various stake holders like employees, consumers, suppliers and more (Chowdry et.al., 2023). The craze for AI integration in process has been increasing every year. In 2025 it has been 204 billion dollars as per the international Data Corporation. The value of the AI industry has been increasing year by year. By 2028 it is expected to increase by 1 trillion dollars.

Such an effective tool, has been yielding good results in all the HRM functions. It has been used in recruitment functions for the purpose of video screening, resume screening, gamification and better candidates for hiring purposes (Albassam, W. A. 2023).

On the other hand, organizations are seeking better quality hirer for the work. It has been proved to exponential times better when compared to traditional methods.

Social media has also proved to be more efficient for recruitment of candidates for organizations (Koch et.al., 2023). AI has been useful in predicting the turnover of employees in recent years. Facial recognition and candidate ranking has been useful by the modern AI tools (Mujtaba, D. F., & Mahapatra, N. R. 2019).

AI helps to bring strategic business outcomes for the organizations as per the study by (Wirtz, J. 2019). It provides customer engagement, operational efficiency, good service quality and better customer outcomes (Malik, A., De Silva, M. T. T., Budhwar, P., & Srikanth, N. R. 2021).AI has been useful in performance analytics, talent acquisition for modern day organizations (Malik et al., 2020)

The organizations do face challenges in adoption of AI in the hrm process. The one side the infrastructure of IT investments has been increased by the organizations. The investment in AI helps or leads to employee retention in certain sector (Azeem, et.al., 2024). Implementation of AI also leads to environment sustainable and tries to bring positive outcomes as per the study by (Kim et.al., 2024). On the other hand there is cost component playing a vital role. Market competition compuls organizations to implement AI in the organizations (Petersson et.al, 2022). Implementation of AI also changes the organizations dynamics as per the study by (Johnston,2009).

Conclusion

Even though various challenges exists, the implementation and adoption of AI have started to increase among organizations.

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INSOLVENCY AND BANKRUPTCY LAWS IN INDIA

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Introduction

In the 1990s, India's reforms prioritized unfettered entrance. Globalization, privatization, and liberalization were brought about by it. Discretionary licenses were replaced with registration entitlements. It made it possible for businesses that satisfied the qualifying standards to raise funds to support freedom of entry without needing special state approval. The goal of the 2000s reforms was to establish fair and unrestricted market competition. In order to encourage competition among businesses in the marketplace, it shifted away from the rule of monopolies. Dominance or size in and of itself was no longer viewed negatively; abuse of it was. The changes guaranteed competitive neutrality and level playing fields, and they made it illegal for businesses to impede the freedom of other businesses to do.

Enactment of these laws in INDIA:

The index of economic freedom assesses how well an economy's policies and institutions support economic freedom. India has seen significant progress since the 1990s. The result has been remarkable. Since 1992, the average growth rate in the post-reform era has more than doubled compared to the pre-reform era. India now has the sixth largest economy in the world and the fastest growing, trillion-dollar economy. Marketwise without exit replaced socialism with restricted entrance in the Indian economy, resulting in high exit costs (GOI, 2016). India need a structured market mechanism to address the scarcity of resources and common failures in a dynamic economy. Continuously reallocate insufficiently utilized resources to more effective applications and shield business owners from failure. In the 1960s and 1970s, the absence of this process resulted in ailing private sector firms being taken over by the government and nationalized sectors, highlighting its importance. There have been multiple attempts to establish institutional and legal frameworks for handling debt default.

Nevertheless, these had fallen behind the shifts in the Indian economy. Even though the Indian Contract Act of 1872 and special laws like the Recovery of Debts and Bankruptcy Act of 1993 and the Securitization and Reconstruction of Financial Assets and Enforcement of Securities Interest Act of 2002 provided provisions for recovery action by creditors, they did not produce the intended results. Additionally, the Sick Industrial Companies (Special measures) Act of 1985 and winding-up measures under the Companies Act of 1956 were not effective. Very beneficial for firm restructuring or lender recovery. The Presidential Towns Insolvency Act of 1909 and the Provincial Insolvency Act of 1920, which dealt with individual insolvency, were both antiquated and unsuited to the evolving demands of the period. Lender confidence was impacted, which in turn affected the debt market. Although bank-secured credit was the most common type of credit, the market for corporate debt had not yet grown (GOI, 2016).

THE 2016 INSOLVENCY AND BANKRUPTCY CODE'S ENACTMENT: Despite fruitless attempts, stressed assets in the financial sector reached unacceptably high levels by

the end of 2015. By September 2016, it had reached approximately 9% of gross. Loans from all banks and 12% of public sector banks' gross loans, which together made up over 80% of all non-performing assets (NPA). Large corporations were functioning with an interest coverage ratio below 1, which suggests that they are unable to pay their debts. The Twin Balance Sheet problem arose when both banks and corporations struggled with poor loans. The Insolvency and Bankruptcy Code, 2016 (Code) was enacted on May 28, 2016, to modernize the existing institutions.

The law governing insolvency and bankruptcy resolution has been modernized and restructured, replacing the previous system. The Code's goal is to streamline and modify the laws pertaining to corporate entities, partnership firms, and individuals' reorganizations and insolvency resolution in a timely manner in order to maximize the value of their assets, encourage entrepreneurship, increase credit availability, and balance the interests of all parties involved. Companies, limited liability partnership firms, other body of corporate, personal guarantors, and partnerships are all covered by the Code, which unifies insolvency rules. Businesses, sole proprietorships, and private citizens. It creates a collective, linear procedure that all parties involved—creditors, debtors, and others—must follow. It gives creditors an opportunity to evaluate the corporate debtor's (CD) viability in the event of corporate insolvency. A procedure for resolving corporate insolvency (CIRP) The Code requires either a resolution plan to rebuild the failing CD or the beginning of liquidation proceedings. One of two ways that individual insolvency procedures can progress is by a new start procedure that leads to the either through the insolvency resolution process, which would provide debtors an opportunity to discuss payment terms, or through the write-off of qualified debts. Failure of the insolvency resolution process may result in a bankruptcy process, which entails the sale of the debtor's assets.

India had no prior experience with a proactive, incentive-compliant, market-led, and time-bound bankruptcy resolution law. Numerous organizations are needed to implement and there was no strong, contemporary insolvency regime in place. In many respects, the Code and the transformation it envisioned were an economic legislative experiment. There is most likely no comparable speed to the enactment and implementation of the code, either domestically or internationally.

Four main issues with the previous corporate insolvency law are addressed by the Code: 1.over time, the firm's enterprise value decreases significantly due to extended uncertainty regarding its prospect of settlement may seem distant due to ownership and control issues as well as widespread concerns about insolvency. To maintain the value, the Code requires that the resolution process be closed within a certain amount of time.

2. Resolution comprises both adjudicatory and commercial choices. The Code gives the Adjudicating Authority (AA) and the firm's stakeholders the authority and ability to quickly decide on issues falling under their purview. The Committee of Creditors (CoC) is empowered under the Code to make all business decisions.

3. Equity and debt are used to finance a business. Equity controls the entire company if debt is paid off. In the event that the company defaults on the obligation, the Code gives the creditors control of the company in order to resolve insolvency. The "creditor-in control" model replaced the "debtor-in-possession" model in the Code.

4. Under the previous administration, creditors might negotiate a settlement or resolution with the current promoters. They can now bring in any resolution applicant for insolvency resolution thanks to the Code. Additionally, it forbids anyone who suffers including promoters from submitting a resolution plan, from any of the disabilities listed. If a company goes through CIRP, there is a real risk that its management and control will shift away from its current promoters and managers, probably indefinitely.

NCLT role in IBC

The Code's establishment of four institutional infrastructure pillars is one of its major innovations. The class of regulated individuals known as Insolvency Professionals (IPs) is the first of these pillars. They are essential to the effective operation of the bankruptcy, liquidation, and insolvency procedures. A new sector of the information utilities (IUs) business makes up the second pillar. These prevent delays and factual disputes when default occurs by storing information about lenders and loan terms in electronic databases. The third is the AA, which consists of the Debt Recovery Appellate Tribunal for individual insolvencies and the National Company Law Tribunal (NCLT) for corporate insolvencies. The regulator, namely the Insolvency and Bankruptcy Act, is the fourth pillar. Insolvency and Bankruptcy Board of India (IBBI), which is in charge of regulating the professions and procedures covered by the Code.[1]

In addition to establishing a statutory framework for bankruptcy and insolvency resolution, it created the Insolvency and Bankruptcy Board of India (IBBI), a regulatory body with the ability to proactively adapt to shifting conditions. The IBC has been successful in creating unique insolvency resolution jurisprudence. By putting the law into effect, the government and the IBBI have also taken the initiative to address problems as they arise and provide clarification. This explains why the IBC and the many regulations published under it are frequently amended. Nevertheless, it raises some concerns that the IBC is still not fully functioning over eight years after it was enacted.

Prior to becoming the AA for corporate bankruptcy resolution and liquidation, the National firms Law Tribunal (NCLT) served as a place for firms to adjudicate their issues. With a docket mostly consisting of insolvency matters, the NCLT has emerged as a leading forum for bankruptcy settlement and liquidation since the IBC went into effect.[2]
Over 40,000 insolvency cases were filed under IBC by September 2024. Creditors recovered 3.55 lakh crore. This exceeded the estimated liquidation value but fell short of total claims. Liquidation orders outnumbered resolutions, contradicting the IBC's revival objective. The IBC aims to resolve insolvencies efficiently, maximizing asset value.[3] there are 39 members at present for a sanctioned strength of 63 and the depletion of the strength of the members will adversely affect the smooth functioning of the Tribunals.[4] One of the main goals of the IBC was to enforce judicial discipline in the resolution of insolvency. Many contend that the

[1] Indian Insolvency Law

[2] Overview of India's Insolvency and Bankruptcy Code - Global Restructuring Review

[3] https://legal.economictimes.indiatimes.com
[4] https://www.scconline.com

IBC's record is far from adequate in this regard, despite the fact that it has fared significantly better than its predecessor, SICA. The IBC set a rigorous 180-day timeframe for the corporate insolvency resolution process (CIRP), which the AA may choose to extend by an additional 90 days. In 2019, the IBC was amended to further extend this to 330 days. The average period for CIRPs that produced resolution plans, excluding time allowed by AAs, is 581 days, according to statistics made public by the IBBI. Additionally, it took an average of 654 days for the CIRPs that ended up in liquidation to conclude. Many cases take a much longer (the CIRP for Essar Steel, for example, took up to 866 days to finish).

Referencing its numerous previous rulings regarding the applicability of the limitation law to IBC proceedings, the Supreme Court held that an application under the IBC would not be barred by limitation because it had been filed after three years from the date the corporate debtor's loan account was declared a non-performing asset, provided the corporate debtor acknowledged the debt prior to the three-year period of limitation. The statute of limitations would be extended by an additional three years in such a scenario.[5]

The Apex court held that entries in the accounts/balance sheet of a company can be treated as an acknowledgement of liability in respect of debt payable to a financial creditor. In that case the corporate debtor had acknowledged its liabilities in its financial statements from 2008-09 to 2016-17. Thus, the corporate insolvency application was well within the extended period of limitation.[6]

The settled position of law was that a creditor had to demonstrate the existence of debt and default to initiate insolvency proceedings—a standard widely perceived as objective and consistent. This test is similar to the 'cash flow test' under English law, where a company is deemed insolvent if it is unable to pay its debts as and when they fall due. In *Vidarbha*, the Court departed from existing precedent and held that even if debt and default were proved, the National Company Law Tribunal ('NCLT') may consider other 'relevant factors' in deciding whether to admit the debtor into insolvency proceedings.[7]

Recent Legislations:

Perhaps the most often revised law in recent years is the IBC, and some of the amendments were required to prevent unforeseen repercussions. The prompt completion of the CIRPs has been the main emphasis of the IBC's legislative amendments during the past year. Following the promulgation of the Insolvency and Bankruptcy Code (Amendment) Ordinance 2021 in April 2021 to introduce the pre-packaged insolvency resolution process (PPIRP) for micro, small, and medium-sized enterprises (MSMEs) as defined by the Micro, Small, and Medium Enterprises Development Act 2006, the government enacted the Insolvency and Bankruptcy Code (Amendment) Act 2021 on August 12, 2021. It was believed that this adjustment was required to assist MSMEs in overcoming the widespread hardship that the epidemic had caused or made worse. The corporate debtor needs the consent of unaffiliated financial creditors accounting for 66% of the debt, as well as the consent of its members by special resolutions or three-quarters of its partners, in order to start the PPIRP.[8]

[5] Dena Bank (now Bank of Baroda) v. C Shivakumar Reddy and Anr (2021)
[6] *In Asset Reconstruction Company (India) Limited Vs. Tulip Star Hotels Limited & Ors. (2022)*
[7] *In Vidarbha Industries Power Ltd. Vs. Axis Bank (2022),*
[8] https://ibclaw.in/

Knowledge Transmission in Ayurveda: from root texts to modernity

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Abstract

In this paper, we will examine how medical knowledge is currently transmitted in traditional medicine and refer to foundational texts in search of the ideal model described therein. This exploration includes an analysis of contemporary educational practices in Ayurveda, such as curriculum structure, teaching methodologies, and practical training in state-recognized institutions. By comparing these modern practices with the traditional guidelines and principles outlined in classical Ayurvedic texts, we aim to identify the extent to which ancient wisdom is preserved and adapted in current educational frameworks. This approach will provide insights into the continuity and evolution of Ayurvedic education, shedding light on the balance between tradition and modernity in knowledge transmission.

Introduction

The transfer of knowledge is a continuous process in which all humankind participates. We learn or teach at every stage of our lives, often without even noticing our involvement. For example, a child learns social and physiological skills from birth that are essential for successful survival in society. This knowledge is acquired from parents, the surrounding environment (nature), peers, and even strangers. Similarly, adults in society are constantly engaged in teaching or learning. Therefore, we can say that the transfer of knowledge is inseparable from human existence in society. It is a constant component, often unnoticed.

Knowledge transfer is not merely about the exchange of information. It also involves the sharing of experiences, values, and cultural practices, which collectively shape our understanding of the world. For instance, traditional storytelling has been a vital medium for passing down wisdom and cultural heritage across generations. In contemporary settings, digital technologies play a crucial role, facilitating the instantaneous spread of knowledge globally. Online platforms, social media, and e-learning tools have revolutionized how knowledge is disseminated and consumed, making it more accessible than ever before.

When discussing the transfer of medical knowledge, it's important to recognize that medicine is not merely a collection of practices and tools related to maintaining health. Medicine serves as a foundation for a happy life. For instance, the traditional medical system of Ayurveda translates from Sanskrit as "the science of life." Such an understanding of medicine indicates that the transfer of medical knowledge from teacher to student is not just a technical

process of imparting skills. It also encompasses ideological and philosophical aspects, approaches to health, and views on the human body.

In traditional medical systems, such as Ayurveda, the transmission of knowledge is deeply rooted in the relationship between the teacher and the student. This bond is not only about the transfer of practical skills but also about instilling a holistic understanding of life, health, and well-being. The student is often required to live with the teacher, absorbing not just the knowledge but also the wisdom and ethical values essential for a healer. This method ensures that the medical knowledge imparted is comprehensive, integrating scientific, ethical, and spiritual dimensions.

The transmission of traditional medical knowledge, such as that seen in Eastern systems, often involves preserving centuries-old practices and adapting them to contemporary contexts. This process of adaptation and preservation ensures that traditional knowledge remains relevant and effective in modern healthcare settings.

Understanding the socio-cultural factors involved in the transmission of traditional knowledge is crucial for the success of health interventions. Perceptions of disease and health significantly shape specific behavior patterns within communities. A deep appreciation of these factors enables health professionals to design and implement strategies that are culturally sensitive and more likely to be accepted by the target population.

Knowledge Transmission in Ayurveda According to Sushruta Samhita

To objectively assess the changes and trends in the transmission of Ayurvedic knowledge in contemporary India, it is imperative to consider the ideal model of knowledge transmission as outlined in traditional texts. Currently, there is limited detailed information about the educational processes in traditional Gurukuls. However, it is understood that this system was predicated on intimate relationships between teacher and student, with education often taking place in the teacher‘s home. The primary goal of this education was not only the impartation of technical skills but also the holistic development of the individual.

The student body in a Gurukul was usually very small, with a rigorous and selective admission process. In an era of low population density and simple lifestyles, this educational system became the gold standard for transmitting Ayurvedic knowledge, which comprises numerous subjective aspects. The transmission of subjective knowledge necessitated close interactions between teacher and student for effective transfer, often facilitated through non-verbal communication. The Gurukul system focused on quality, relying heavily on intensive, personalized training. The core idea was for the most capable students to learn from the most skilled teachers. However, this system was not designed to produce large numbers of practitioners (Bharadwaj, 2017).

In contrast, the university system, as exemplified by the ancient universities of Takshashila and Nalanda, offered a wide array of subjects taught by numerous competent teachers. Both the Gurukul and university systems emphasized competence and the selection of the best

minds for the preservation and transmission of knowledge. The university system was more structured, providing a formalized curriculum and accommodating a larger number of students, thus contributing to a broader dissemination of knowledge.

Additionally, the familial transmission of Ayurvedic knowledge became a common practice. The desire to monopolize and protect commercial secrets likely encouraged this system, where practitioners passed on their knowledge solely to their descendants, thereby creating familial traditions of Ayurveda. During the period of colonization and the subsequent modernization of Ayurveda, these family traditions gradually declined, leading to the emergence of modern Ayurvedic institutions.

Understanding these traditional methods of knowledge transmission allows for a deeper appreciation of the evolution and current state of Ayurvedic education in India. This historical context provides crucial insights into how contemporary educational practices can preserve and adapt the rich legacy of Ayurveda. By critically examining both the traditional and modern methods of instruction, we can ensure that the integrity and depth of Ayurvedic knowledge are maintained for future generations. Furthermore, recognizing the strengths and limitations of each system can inform the development of educational frameworks that honor traditional wisdom while embracing necessary advancements (Bhat, 2016).

Unfortunately, not much information has survived about how Ayurvedic education was conducted before and during colonial times. However, some foundational texts provide detailed descriptions of the origins of Ayurveda and the educational process. Let's refer to these texts to understand the ideal model of how knowledge should be transmitted in Ayurveda. The primary text we will refer to is the "Sushruta Samhita."

Sushruta — an ancient Indian physician and scholar — is considered the author of one of the most significant texts in the history of medicine, the "Sushruta Samhita."

Brief Biography:

Era: Sushruta lived around 800 to 600 BCE. The exact dates of his life are unknown, but it is believed he practiced during the late Vedic or early classical period of India.

Education and Training: According to legend, Sushruta was a disciple of Dhanvantari, the god of medicine and healing in Hindu mythology. Dhanvantari is also regarded as an incarnation of Vishnu, underscoring the divine status of the medical knowledge passed to Sushruta.

Location: It is believed that Sushruta practiced and taught in the ancient city of Kashi (modern Varanasi, India). Varanasi was an important center of learning and culture, and it is likely that Sushruta conducted his practice and taught his students there (Gulati, 2020).

Contributions to Medicine:

Sushruta Samhita: This text is an extensive guide on medicine and surgery, including information on diagnosis, treatment, anatomy, and various medical procedures. The

"Sushruta Samhita" is divided into several books and chapters, covering all aspects of medical practice of that time.

Surgery: Sushruta is considered the "father of surgery" due to his detailed descriptions of over 300 surgical procedures, 120 surgical instruments, and approaches to treating various wounds and injuries. The text also mentions reconstructive surgeries for the nose and ears, indicating a high level of development in plastic surgery in ancient India.

Anatomy: The "Sushruta Samhita" contains detailed descriptions of human anatomy, including the study of various organs, tissues, and bones. The text discusses methods of dissection and anatomy education, which was revolutionary for its time.

Medical Practice: The text also addresses issues of ethics and morality in medical practice, emphasizing the importance of physician training and stringent standards of medical education (Kumar, 2014).

Legends and Myths:

Divine Inspiration: In Hindu mythology, Sushruta is considered not only a historical figure but also an embodiment of divine knowledge. His connection with Dhanvantari highlights the spiritual and sacred nature of his medical teachings.

Literary and Cultural References: In the epics "Mahabharata" and the "Puranas," Sushruta is mentioned as an outstanding physician and teacher, indicating his high status in ancient Indian culture.

Historical Legacy:

Education and Teaching: The teaching methods described in the "Sushruta Samhita" influenced the structure of medical education in India for centuries and remain relevant in modern Ayurveda.

Impact on Modern Medicine: Many concepts and procedures described by Sushruta have been passed down through generations and are reflected in modern medical practice, including principles of sterilization, reconstructive surgeries, and wound treatment methods.

The "Sushruta Samhita" not only outlines the practical and theoretical aspects of ancient Indian medicine but also provides insights into the educational methods and ethical considerations of the time. These texts describe a comprehensive system where the student learned directly under the supervision of the teacher, emphasizing hands-on experience and direct observation. This apprenticeship model ensured that knowledge was transmitted effectively and accurately.

Additionally, the emphasis on moral and ethical practices in the "Sushruta Samhita" underscores the holistic approach of Ayurveda, where the character and integrity of the

physician were considered as important as their technical skills. This holistic approach is still a cornerstone of Ayurvedic practice today.

By understanding these traditional methods of knowledge transmission, we can better appreciate the evolution and current state of Ayurvedic education in India. This historical context provides valuable insights into how modern educational practices can preserve and adapt the rich legacy of Ayurveda, ensuring its relevance and application in contemporary medicine. By critically examining both traditional and modern methods of instruction, we can ensure that the integrity and depth of Ayurvedic knowledge are maintained for future generations (Jain, 2020).

Sushruta Samhita is an ancient Sanskrit text on medicine and surgery, one of the most significant treatises on the subject that has survived from ancient times. This collection is one of the foundational texts of Ayurveda (traditional Indian medicine), alongside Charaka Samhita, Bhela Samhita, and the medical parts of the Bower Manuscript.

Sushruta Samhita is considered one of the two foundational texts on medicine and surgery from ancient India. It plays a crucial role in the development and transmission of Ayurvedic knowledge alongside other important treatises.

The text includes unique historical chapters describing surgical training, instruments, and procedures, many of which remain relevant in modern surgical science. This makes Sushruta Samhita an important historical document linking ancient and modern medical practices.

One of the oldest manuscripts of Sushruta Samhita on palm leaves is preserved in the Kaiser Library in Nepal. This manuscript dates back to the 12th-13th centuries, highlighting its historical value and durability as a source of medical knowledge. The surgical techniques and instruments described in Sushruta Samhita have influenced modern surgery, demonstrating the importance of ancient knowledge in the development of contemporary science. For instance, methods such as rhinoplasty and wound treatments described by Sushruta are still applied and adapted in modern medical practice.

The approaches to surgical training outlined in the text continue to be significant in the context of medical education, emphasizing the necessity of rigorous training and practical experience. The educational system described in Sushruta Samhita included a strict selection process for students and intensive training, ensuring high standards of medical practice. Although the text was written in the 12th-13th centuries, some associated artworks date to the 18th-19th centuries, such as the palm leaf manuscripts of Sushruta Samhita from Nepal housed in the Los Angeles County Museum of Art. These artifacts demonstrate a long tradition of respect and preservation of the medical knowledge transmitted through generations (Madhusudhan, 2021).

Sushruta Samhita is part of the rich heritage of Hindu scriptures and texts, including:

Shruti and Smriti: Primary categories of Hindu sacred texts, transmitted orally and later written down.

Vedas and Upanishads: Fundamental philosophical and religious texts forming the basis of Indian culture and spirituality.

Other Writings:Including Vedangas, Puranas, Itihasas, and Shastras, covering a wide range of knowledge from mythology to practical instructions.

Sangam Literature:Ancient Tamil literature rich in poetry and prose.

Shastras and Sutras: Practical and philosophical guides aimed at regulating various aspects of life and knowledge.

Sushruta Samhita is not only an important medical text but also a cultural treasure that continues to influence medical practice and education. Its historical and practical significance is preserved through careful preservation and study, making it an invaluable source of knowledge for contemporary and future generations. This work not only connects us with the ancient Indian medical tradition but also serves as a bridge between the past and present, ensuring the continuity and development of medical science. The legacy of Sushruta Samhita underscores the timeless nature of its teachings and their relevance in both historical and modern contexts. Through continuous study and application, the knowledge contained within this ancient text continues to benefit humanity, demonstrating the enduring power of traditional wisdom in advancing contemporary medical science.

Let us analyze the first chapter of the Sushruta Samhita, which provides information on how and for what purpose Ayurveda should be taught. We begin with a quote from the sages' request to King Dhanvantari, where they explain their desire to study the science of life—Ayurveda:

"Venerable Sir, we are greatly pained to see the people of the world, though having many well-wishers, behaving as though having none, suffering from different kinds of miseries, produced by diseases of the body, mind, and external causes, indulging in improper activities and crying for help; we desire to learn Ayurveda (the science of life) being taught here, in which are enshrined the benefits of present and future lives, for the sake of curing diseases of the sick and those seeking happiness; for carrying on our own activities of life and for the benefit of the people of the world at large; so we have come to you, venerable sir, as your disciples.» (Sushruta, n.d.).

Several important points need to be highlighted in the context of our study. First, the goal-setting. As seen from the quote, the treatment of the physical body was not the primary objective of Ayurveda for the sages of antiquity. Later, we will consider how modern students choose their specialization and how contemporary teachers perceive their role in teaching Ayurveda. For now, it is essential to note that the aim of a future Ayurvedic doctor in tradition is the complete existence of a person as a member of society, as an individual, and as a spiritual being. There is a clear connection between improper actions and a person's health if health is understood as a happy and fulfilling life.

At the end of the first chapter of Sutra Sthana, we encounter an aphorism related to the reward for studying Ayurveda:

"He who studies this eternal science, propounded by Swayambhu (Lord Brahma) and propagated by Kasipati, King of Kashi (Divodasa Dhanvanthri), becomes a person of virtuous deeds, worshipped by kings on this earth and attains the world of Indra (Lord of Heaven) after death.»(Sushruta, 2003)

It is challenging to realize, but traditional medicine is not medicine in the sense we are accustomed to. It was not even initially called medicine; that term came later. Originally, it was the science of life, including principles not only physical but also moral, describing how to live to be happy. Happiness, in the understanding of a person of Tradition, is inextricably linked to the spiritual path. This is where a significant divergence from Western thought occurs, the main goal of which is power. Any foundational texts of traditional medicine, clearly written for doctors, describe not just treatment techniques but what the learner should be like and, subsequently, the doctor. The goal of educational texts is to nurture not just a doctor but a pious, virtuous doctor. Piety is defined by the moral law relevant to a particular culture. However, all cultures for which the moral law is defining can find common ground.

In the modern context, such an approach to training doctors may seem inappropriate. However, it fits perfectly into the structure of Gurukuls, schools where knowledge is directly transmitted from teacher to student. The student adopts all behavioral patterns of the teacher, not just practical information. But if we look at the modern system of Ayurvedic education, which is as open as possible and where 90% of students study because they did not score enough points for Western medicine, it becomes evident that the moral, ethical, and religious component often remains outside.

The second part of Sutra Sthana, "Initiation of the Pupil," describes the principles of selecting students and the teacher's responsibility for their choice. Interestingly, it details not only the spiritual qualities of the prospective student, such as caste affiliation, chastity, bravery, cleanliness, right conduct, politeness, and strength, but also their physical appearance:

"...whose lips, tongue, and teeth are thin; mouth, eyes, and nose are straight."

This highlights the traditional understanding that physical and spiritual aspects are interconnected. The text further outlines the obligations that a future Ayurvedic doctor must undertake:

"You should remain here, avoiding/forgoing desires, anger, greed, infatuation, pride, egoism, jealousy, harsh speech, finding fault with the speech of others, speaking untruths, laziness, and acts of ill repute; keep yourself clean by cutting undesirable nails and hairs; put on ochre-colored robes, maintain truthfulness; cultivate celibacy and the habit of prostrating (to gods, preceptors, elders, etc.) essentially: go only to such places, use only such bed, seat (for sitting), food and the mode of study which are approved by me; indulge in such activities

which are liked by me and beneficial to me; doing anything other than these will be unrighteous on your part, your knowledge becomes futile and will not earn reputation."

This passage is noteworthy as it explicitly states that if a student does not lead a virtuous, almost monastic life, their knowledge becomes useless. Sushruta directly connects spiritual practice and medical practice, asserting that one cannot exist without the other. Without this union, the practice ceases to benefit humanity and fails to meet the stated goals of Ayurveda.

Moreover, the text emphasizes the teacher's responsibility towards the student, which is critical to understanding how Ayurveda developed as a major tradition:

"If, on the other hand, I misunderstand you though you are behaving properly and act otherwise (punish, not teach), then I will also acquire sin and my knowledge becomes futile."

Teacher and student are bound by mutual responsibility before God, who can revoke their ability to heal if they violate the rules. This underscores that without spiritual practice, and without adhering to both medical protocols and a virtuous path, the full practice of an Ayurvedic doctor is impossible.

The second part of Sutra Sthana also emphasizes the inclusivity of Ayurveda. Despite the popular prejudice that Ayurveda is a practice of Brahmins, the text indicates that:

"Even a pupil belonging to the Sudra caste (lowest caste) possessing good qualities (knowledge, behavior, etc.) may also be initiated but without chanting of sacred hymns and without initiating and then teaching (of the science) imparted."

This inclusivity challenges the notion that Ayurveda is exclusive to higher castes, suggesting a broader, more inclusive approach to medical education and practice.

The text highlights the holistic nature of Ayurvedic education, where the cultivation of moral virtues and personal conduct are as crucial as the acquisition of medical knowledge. This approach ensures that the practitioner not only excels in the science of healing but also embodies the principles of a balanced and ethical life. The emphasis on physical appearance and spiritual qualities reflects the belief that the healer's internal state profoundly impacts their external practice and effectiveness.

The obligations imposed on the student to lead a life free from negative emotions and behaviors, maintain cleanliness, and adopt a disciplined lifestyle underscore the comprehensive nature of the training. This rigorous training aimed not only at imparting medical knowledge but also at developing a well-rounded, ethical, and spiritually attuned individual capable of contributing positively to society.

The connection between teacher and student, bound by mutual responsibility and accountability to a higher power, further emphasizes the sacred nature of the healing profession in Ayurveda. The teacher's role extends beyond mere instruction to include moral

and spiritual guidance, ensuring that the student adheres to the high standards expected of an Ayurvedic practitioner.

In conclusion, the teachings of the Sushruta Samhita highlight the integrated approach to education in traditional Ayurveda, where spiritual, moral, and physical training are all vital components of becoming a proficient healer. This holistic framework not only ensures the competence of the practitioner but also preserves the integrity and ethical foundation of the Ayurvedic tradition.

In the third part of the Sutrastana, comprehensive commentaries are presented, revealing the methodology of teaching and studying Ayurveda. One of the key rules is the study of both theoretical aspects and practical skills. This dual approach ensures that students not only understand the principles underlying Ayurvedic practices but also develop the ability to apply these principles effectively in real-world scenarios.

"One who possesses knowledge of the science only in theory but cannot apply it in practice becomes helpless before a patient, like a coward on the battlefield."

A physician who lacks theoretical knowledge but acts contrary to the theoretical foundation of Ayurveda "*deserves punishment from the king."*This statement underscores the critical importance of a solid theoretical foundation, as well as the practical application of that knowledge. The integration of theory and practice is vital for the effective treatment of patients and the overall success of Ayurvedic practitioners.

According to the Sutrastana, an important aspect of education is the repetition and memorization of shlokas. The instructor should recite the shlokas slowly, and the student should repeat them multiple times (depending on the student's abilities). This methodical repetition aids in the internalization of complex concepts and ensures that students can recall and apply these teachings accurately in their practice. The teacher is obliged to decipher and explain each spoken word, facilitating a deeper understanding of the material. The goal of such education is to achieve complete clarity, correct understanding, boldness, efficiency in work, constant practice, and success. This rigorous approach ensures that students are well-prepared to handle the challenges they will face as practitioners.

The fourth part of the Sutrastana explains the significance of oral commentaries and explanations.

"One who practices medicine, having learned the science from a preceptor and constantly recapitulating it, can only be called a physician, whereas all others are impostors.»

This highlights the importance of continuous learning and reflection in the practice of Ayurveda. It is not enough to simply acquire knowledge; one must constantly revisit and refine that knowledge to maintain proficiency and effectiveness.

Analyzing sections of the foundational texts devoted to the methodology of learning Ayurveda, several key motifs can be identified that are regularly repeated throughout the text.

High moral standards for both the student and the teacher are emphasized. The term "purity" is frequently mentioned, indicating not only physical but also moral purity. The punishment for violating the moral code is sacral in nature — the deprivation of power. As noted earlier, the practice of a physician becomes useless if they do not adhere to the moral code. Similarly, a teacher who does not uphold moral standards and does not pay proper attention to the student cannot effectively impart knowledge. This ethical framework is designed to ensure that both teachers and students conduct themselves with integrity and respect for the traditions of Ayurveda.

Strong bond between student and teacher. In the beginning of the Sushruta Samhita, instructions emphasize that the student should follow all directions and prescriptions of the teacher. The teacher, in turn, must be attentive and sensitive to the student. This reciprocal relationship is fundamental to the learning process. Students are selected based on their moral qualities and intellectual capabilities. If a student does not meet the required standards, they cannot find their mentor. This selection process ensures that only the most dedicated and capable individuals are chosen to carry on the traditions of Ayurveda.

Openness of Ayurveda. Although preference is given to educating students from higher castes, Ayurveda indicates that representatives of other castes can also gain knowledge without performing rituals. From Sushruta's perspective, the practice of such a physician may be less effective, as adherence to religious rites is an essential component of medical practice according to Ayurvedic texts. However, theoretically, Ayurveda has never been a closed medical system. This inclusivity allows Ayurveda to adapt and evolve, incorporating diverse perspectives and practices.

Importance of memorization and recitation of shlokas. The text does not directly indicate the need to memorize the teachings by heart; however, it describes in detail the methodology of multiple repetitions of the same lines with the correct speed and intonation. This promotes deep assimilation of the material and its practical application. The repetitive nature of this practice helps to engrain the teachings in the minds of students, making them second nature.

Importance of oral instructions. According to the texts, the teacher must provide commentaries on almost every word spoken in the shlokas. Subsequently, oral instructions and commentaries on each studied section must be received. This helps students to understand and apply the acquired knowledge more deeply in practice, ensuring their successful integration into professional activities. The detailed explanations provided by the teacher help to clarify complex concepts and ensure that students fully grasp the material. In conclusion, the methodology outlined in the Sutrastana emphasizes a holistic approach to learning Ayurveda, combining rigorous theoretical study with practical application, ethical conduct, and a strong teacher-student relationship. This comprehensive approach ensures that students are well-equipped to become proficient and ethical Ayurvedic practitioners.

Ayurvedic Education in Modern Colleges in India

Since the 1970s, the Central Council of Indian Medicine (CCIM) has functioned as the main regulatory body overseeing Ayurvedic education. Complex procedures for establishing

Ayurvedic colleges have been instituted, requiring thorough documentation and significant infrastructure investments. Recently, the CCIM has emphasized the necessity of creating a minimum infrastructure for opening Ayurvedic colleges. This has undoubtedly helped limit the emergence of dubious Ayurvedic educational institutions in small rented buildings lacking even basic amenities and teaching staff. CCIM has also played a crucial role in unifying and standardizing Ayurvedic education in modern India by defining curricula, developing structured syllabi, and creating bachelor's and master's degree programs in Ayurveda. Now, Ayurvedic teaching is conducted under affiliation with recognized universities. Despite these significant improvements, Ayurvedic education still seems to fall short of its primary goal—cultivating key skills that could transform young aspiring students into confident Ayurvedic physicians. Modern Ayurvedic colleges are organized similarly to Western medical colleges. Education follows the Bologna system, which includes several levels: bachelor's, master's, and PhD. Students are admitted to college by passing a common entrance exam (for example, NEET) for the bachelor's level. Bachelor's education lasts four years, plus one year of internship, i.e., practice in a hospital.

In the first year of study, students take the following subjects:

Padartha Vigyan and Ayurved Itihas— Philosophy and History of Ayurveda

Sanskrit — Study of Sanskrit

Kriya Sharir — Ayurvedic and Western (modern) Physiology

Rachana Sharir — Anatomy

Maulik Siddhant Avum Ashtang Hridaya — Basic Principles and Ashtanga Hridaya

In the second year, the curriculum includes:

Dravyaguna Vigyan — Pharmacology and Materia Medica

Roga Nidan — Ayurvedic Diagnostics

Rasashastra — Iatrochemistry and Ayurvedic Pharmacy

Charak Samhita — Charaka Samhita

The third year includes:

Agadtantra — Toxicology, Forensic Medicine, and Medical Jurisprudence

Swasthavritta — Healthy Lifestyle

Prasuti Tantra Evum Stri Roga — Obstetrics and Gynecology

Kaumarbhritya Parichaya — Pediatrics

Charak Samhita (Uttarardha) — Charaka Samhita (Second Part)

The fourth year includes:

Kayachikitsa — Therapy

Panchakarma — Panchakarma

Shalya Tantra — Surgery

Shalakya Tantra — Ophthalmology

Research Methodology and Medical Statistics

To enter an Ayurvedic college, students must pass the NEET exam along with applicants entering Western medical colleges for the MBBS degree. The National Eligibility cum Entrance Test (NEET-UG) is the unified entrance exam for admission to MBBS courses in India. Candidates must score a certain number of points to be admitted. For the general category, the minimum score for MBBS admission ranges from 720 to 164, for the SC/ST/OBC category (Scheduled Castes, Scheduled Tribes, and Other Backward Classes) from 163 to 129, for the General-PH category (General Category for Persons with Disabilities) from 163 to 146, for the SC/OBC-PH category from 145 to 129, and for the ST-PH category from 141 to 129. However, for admission to an Ayurvedic college, it is necessary to score significantly fewer points compared to Western medical colleges. Therefore, if an applicant does not score enough points to enter a Western medical college, they often opt for an Ayurvedic college. Out of ten students interviewed by the author, eight entered an Ayurvedic college for this reason. This fact is significant in the context of the topic being considered, as it directly relates to the process of knowledge transmission in traditional medicine and the selection of students.

Education in modern Ayurvedic colleges is based on a comprehensive approach, combining theoretical and practical aspects of learning. The standardization of curricula introduced by CCIM ensures uniform quality of education across all institutions, enhancing the professionalism of graduates. An important aspect is the introduction of modern technologies and teaching methods, such as electronic educational materials, simulation centers, and distance learning, which expand the opportunities for students to acquire knowledge and skills. In addition to academic training, modern Ayurvedic colleges strive to instill high moral and ethical standards in students, which is an important part of the traditional education system. Special attention is paid to the study of Sanskrit and Ayurvedic philosophy, allowing students to gain a deeper understanding and appreciation of India's cultural heritage. Fostering respect for traditional values and adherence to the principles of ahimsa (non-violence) and satya (truthfulness) contributes to the development of well-rounded specialists.

Despite significant improvements in the Ayurvedic education system, certain challenges remain, such as the need to enhance the profession's prestige and attract motivated students. An important direction is the development of international cooperation and exchange of experience, which will allow integrating best practices from different medical systems and ensuring broader access to knowledge. In this context, supporting research activities and

developing scientific studies in Ayurveda is of particular importance, contributing to the recognition and dissemination of traditional Indian medicine worldwide.

In large colleges such as MGAC&H or JSS College of Ayurveda, the total number of students in a single batch can reach 100-120 individuals. These students are divided into groups of 10-20 people each. They attend common lectures as a large group and participate in practical classes in smaller groups.

Approximately 40 percent of the educational process is dedicated to subjects of Western medicine, while the remaining hours are allocated to the study of Ayurvedic texts. During the research, I had the opportunity to attend both general lectures and small group sessions.

Lectures generally resemble those in other conventional colleges. The instructor delivers a lecture on a specific subject, and students take notes. Periodically, the instructor asks questions, to which students often respond in unison. When explaining a particular shloka, the instructor writes it on the board, provides an oral translation, and explains its meaning. Instruction is conducted in English.

Ayurvedic colleges are integrated with hospitals, and the instructors also serve as practicing physicians. Consequently, from the first year, students have the opportunity to observe their instructors in practice. Practical classes in small groups are often conducted in the hospital setting.

For example, during research at the government Ayurvedic college in Mysore, the author attended clinical (practical) classes in the ophthalmology department. These sessions were held directly in the consulting room of the instructor, who simultaneously conducted the class and attended to patients. The setup was as follows:

The consulting room was a small space divided into two parts — the consultation area and the treatment area. The consultation area had a doctor's desk, a chair for the patient, and an eye chart. The treatment area contained a couch and tools for preparing Ayurvedic medicines (drops, lotions, etc.). During the class, the instructor sat at the desk, and students stood in a semicircle around her with their textbooks. Students took turns reading aloud from the textbook, and the instructor periodically paused to ask questions or provide verbal instructions. Patients waited in the corridor, and at regular intervals, the instructor called in a patient for an examination, explaining and commenting on her actions for the students. Depending on the year of study, the instructor might involve students in the diagnosis, questioning, or examination of the patient. During these procedures, she provided commentary or corrections. Occasionally, if the instructor was called away, she asked the students to independently conduct the examination and questioning of the patient.

Similar practical classes are conducted in all hospital departments, giving students an understanding of the work of a doctor in various specialties. The choice of a specific specialty occurs at the postgraduate level. Senior undergraduate students also participate in

Panchakarma procedures and have significantly more opportunities and responsibilities. However, they do not make independent decisions or prescriptions.

Despite the instruction being in English, during small group sessions, the instructor might use the local language of the region where the college is located. For example, in small group practical sessions in the specialty of Svasthavritta, Dr. Rekha often switched to Kannada, as all students in the group were from Karnataka.

Observations conducted in several colleges in Karnataka revealed the following important patterns in the educational process of modern Ayurvedic colleges:

Large student numbers and lack of strict selection: Ayurvedic colleges often admit those who could not gain entry into Western medical colleges. This, of course, affects the motivation of both students and instructors. As a result, the quality of incoming students can vary, impacting the overall educational process. This influx of less-prepared students might dilute the academic rigor and create a challenging environment for serious learners.

Contact with instructors: Interaction mainly occurs during practical classes, but instructors cannot remember and know all students, complicating the individual approach. Undergraduate students typically lack a favorite instructor, which can decrease their motivation and interest in learning. The high student-to-teacher ratio can hinder personalized education and mentorship opportunities, potentially leading to a less engaging and supportive learning environment.

Openness of the educational process:Colleges admit representatives of various religious denominations and states, creating a multicultural learning environment. There are no restrictions based on religious or regional criteria, fostering inclusivity in education. However, this inclusivity might also pose challenges in addressing the diverse cultural and educational backgrounds of the students, requiring instructors to adapt their teaching methods to accommodate a wide range of learning needs.

Self-directed learning: Students must study a large volume of material independently, highlighting the importance of self-learning. This requires students to have a high degree of self-discipline and responsibility for their education. While this approach promotes autonomy, it can also be overwhelming for students who lack adequate guidance and support, potentially leading to gaps in knowledge and skills.

Language of instruction: Instruction is conducted in English, but in small group sessions, the instructor may use local languages. Most students have limited proficiency in Sanskrit, knowing it only at the level of reading and memorizing shlokas. According to students, the hours allocated for Sanskrit study in college are insufficient for full mastery, and those who started learning Sanskrit in school have a better grasp of the language. The insufficient emphasis on Sanskrit, which is crucial for understanding classical Ayurvedic texts, may limit students' ability to fully engage with and interpret traditional literature.

Secular nature of education: Despite the presence of images of the god Dhanvantari in the rooms, spiritual practices and rituals are excluded from the educational process. This reflects the secular character of modern Ayurvedic education. While this approach aligns with contemporary educational standards, it might also lead to a disconnect from the holistic and spiritual aspects that are integral to traditional Ayurvedic practice.

Integrative approach: Alongside Ayurvedic texts, students also study Western medicine, providing them with a comprehensive medical education and broadening their professional opportunities. This integration facilitates a more complete understanding of medical sciences and enhances the competitiveness of graduates in the job market. However, balancing the curriculum to ensure adequate coverage of both Ayurvedic and Western medical principles remains a challenge, potentially leading to a superficial understanding of both systems. In conclusion, while modern Ayurvedic colleges strive to provide a balanced and inclusive education, they face several critical challenges. The variability in student preparedness, the need for self-directed learning, and the balancing of integrative approaches all present significant hurdles. Addressing these issues is essential to ensure that the educational process effectively prepares students to become competent and holistic practitioners of Ayurveda, capable of integrating traditional wisdom with modern medical knowledge.

Conclusions

The institutionalization and standardization of Ayurvedic education have significantly influenced the methods of instruction. Several important points can be highlighted. Firstly, this has affected the student selection process. Given that there is a single exam for all medical colleges, including traditional medicine colleges, the criteria for student selection are based on scoring a certain number of points sufficient for admission. This leads to the fact that people often enroll in Ayurvedic colleges not out of their own desire but due to a lack of other options. This significantly impacts both the motivation of students and the attitude of instructors toward the educational process. Many students embrace Ayurveda during their studies and become its advocates, but many eventually move into the field of Western medicine. It is important to note that this situation can reduce the quality of education and motivation to study Ayurveda, as students may approach the learning process without proper interest and enthusiasm. Secondly, the large number of students. Classical texts describe fairly close interaction between student and teacher, which allows for the transmission of knowledge in a more individualized format. In modern Ayurvedic colleges, this is practically impossible due to the high workload of instructors and the large number of students. Often, the instructor does not even remember all their students; the intense work schedule, numerous lectures, and patients do not allow the teacher to not only teach but also be a mentor. This creates certain barriers in the educational process and reduces the quality of knowledge transmission. Thirdly, adherence to moral principles. According to the core texts, both the teacher and the student should be distinguished by piety, possess methods of physical treatment of a person, and be a moral compass, fulfilling religious prescriptions. This imposes a certain responsibility on both the teacher and the student, as the texts indicate that violating moral principles can lead to the loss of medical skills, or in the worst case — death.

According to student testimonies, this part of Ayurveda, like most information related to the spiritual existence of a person and religion, remains outside the scope of the modern educational process. This leads to the loss of a significant part of the cultural and spiritual context, which is an integral part of traditional medicine.

Fourthly, the openness of Ayurveda. It was previously mentioned that although the initial selection of students was made from the higher castes, people from lower castes with good intellectual abilities could also become students. Currently, Ayurvedic colleges have become even more secular, and students from different confessions, castes, etc., study there. This promotes inclusivity and the democratization of education, which is a positive aspect. However, it is important to consider that such openness requires the creation of adaptive programs and teaching methods that take into account the diversity of students and their cultural characteristics.

However, while inclusivity is beneficial, it also poses the risk of diluting the essence of traditional Ayurvedic teachings. The integration of Western medical subjects into the curriculum, while aimed at providing a comprehensive medical education, can lead to the overshadowing of traditional Ayurvedic knowledge. The unique principles and practices of Ayurveda may be compromised or misunderstood when taught alongside Western medicine, which operates on fundamentally different paradigms. There is a danger that the holistic and preventive aspects of Ayurveda could be undervalued in favor of the more symptomatic treatment approaches of Western medicine. Furthermore, significant attention should be paid to the development of critical thinking in students, which is a key element of modern education. It is important for students to not only memorize shlokas and treatment methods but also critically evaluate and apply knowledge in various clinical situations. This will help prepare qualified specialists who can effectively integrate traditional knowledge with modern medical practices. However, this integration must be approached with caution to ensure that the core values and methodologies of Ayurveda are not lost. It is crucial that students develop a deep understanding and respect for the traditional knowledge, recognizing its unique contributions to health and wellness.

Thus, modern Ayurvedic colleges face a number of problems that need to be addressed to preserve and transmit authentic knowledge and methods of traditional Indian medicine. The integration of classical teaching methods with modern pedagogical technologies, as well as the adaptation of educational programs to the needs of modern students, can significantly improve the quality of Ayurvedic education and its relevance to contemporary requirements. Nonetheless, it is vital to maintain a careful balance to ensure that the traditional essence of Ayurveda is preserved and not overshadowed by Western medical practices. This balance will help safeguard the rich heritage of Ayurveda while equipping students with the skills necessary to navigate the complexities of modern healthcare.

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Emerging Trends in Workforce Dynamics: Contemporary Buzzwords in Corporate Culture

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Abstract

In recent years, the landscape of workforce management, human resource management (HRM), leadership strategies, and the corporate culture has undergone significant transformation. This paper examines the latest buzzwords and emerging trends shaping the modern workplace. These trends reflect a shift in employee behaviour, employer expectations, and the overall work culture, influencing key areas such as talent management, compensation, leadership, and performance evaluation. Buzzwords like "ghost jobs," "quiet firing," and "rage applying" highlight a growing tension between employer practices and employee sentiments, shedding light on how corporate dynamics are changing. Furthermore, terms like "bare minimum Mondays" and "career cushioning" reflect a new focus on work-life balance and employee well-being, challenging traditional notions of productivity and engagement. This research delves into how organizations are navigating these evolving trends, adopting flexible leadership approaches, and redefining performance metrics to foster a supportive and resilient workforce. By exploring these trends, the paper provides valuable insights into the future of work, to successfully align organizational strategies with the shifting demands of the modern workforce. Ultimately, this paper contributes to a deeper understanding of the changing nature of work and provides a framework for organizations to thrive in an increasingly complex and competitive environment.

Keywords: Emerging Trends, Workforce Dynamics, Human Resource Management, Leadership Practices, Business Management, Management Buzzwords, Corporate Culture

Introduction

The modern workforce is experiencing a rapid evolution, influenced by a variety of social, economic, and technological factors. As organizations strive to stay competitive in a fast-changing global market, new trends and concepts have emerged that are reshaping traditional management, human resource management (HRM), and leadership approaches. These shifts are often encapsulated in contemporary buzzwords that reflect the changing nature of employee engagement, workplace culture, and organizational strategies. Terms like "quiet quitting," "career cushioning," and "ghost jobs" highlight the nuanced realities of the modern workplace, where employee expectations are diverging from traditional corporate structures.

In this context, it becomes essential to explore these emerging trends to better understand their impact on organizational effectiveness, employee well-being, and leadership practices. As workforce dynamics continue to evolve, management practices must adapt to address the shifting expectations of employees who prioritize flexibility, work-life balance, and meaningful work experiences. Moreover, HRM strategies are evolving to accommodate these

changes, emphasizing personalization in compensation, performance evaluations, and talent management. This paper aims to contextualize these contemporary buzzwords, exploring how they represent broader changes in workforce dynamics. Through this exploration, the paper seeks to contribute to the growing body of knowledge on how organizations can adapt to and thrive amidst the emerging trends shaping the workplace of tomorrow.

Buzzwords fromContemporary Corporate World: An Exploratory Study

Ghost Jobs:Fake Job Postings

Ghost jobs refer to job postings that remain active despite the position being filled, the company not actively hiring, or the job being non-existent. Employers may use ghost jobs for various reasons, such as maintaining a pipeline of potential candidates, projecting an image of growth, or gathering market intelligence on salary expectations and available talent. While this practice may benefit employers, it can be frustrating for job seekers who invest time and effort into applying for positions that do not lead to employment opportunities.

Causes of Ghost Jobs

- **Employer Branding:** Organizations may post jobs to appear competitive and dynamic, signalling to investors, customers, and prospective employees that they are expanding or actively hiring, even when they are not.
- **Market Research:** Employers use applications to gauge industry talent and salary trends. By keeping job postings active, companies can analyze the qualifications and salary expectations of potential candidates without actually committing to hiring them.
- **Continuous Recruitment:** Some businesses maintain evergreen postings to collect resumes for future hiring needs, ensuring they have a pool of pre-vetted candidates available when a real vacancy arises.
- **Automation and Systemic Errors:** Some job postings remain active due to delays in updating recruitment platforms. Automated systems and third-party job boards may continue displaying outdated listings, leading to confusion among applicants.

Implications of Ghost Jobs

- **Wasted Effort for Job Seekers:** Applicants invest time and emotional energy into non-existent opportunities, leading to frustration and disillusionment with the job market.
- **Erosion of Trust:** Repeated experiences with ghost jobs can damage a company's reputation, making it harder for organizations to attract high-quality talent in the future.
- **Ethical Concerns:** The practice raises concerns about fairness and transparency in recruitment, as misleading job postings may manipulate job seekers into engaging with a company under false pretences.

Quiet Vacationing:Pretending to Work

Quiet vacationing refers to employees taking time off without formally notifying their employer. This trend arises due to fear of backlash, lack of formal leave policies, or the normalization of overwork, which discourages employees from openly requesting time off. Instead, employees may reduce workloads, log in minimally, or work remotely from vacation locations without disclosing their absence.

Causes of Quiet Vacationing

- **Workplace Culture:** Some organizations foster a culture where taking time off is stigmatized. Employees feel pressured to always be available, leading to covert methods of securing rest.
- **Job Security Concerns:** Employees may fear negative consequences for requesting leave, such as being viewed as less committed or missing out on career advancement opportunities.
- **Technological Accessibility:** The ability to work remotely blurs the lines between work and vacation. Employees can easily check emails and complete minor tasks while technically being away, making it easier to engage in quiet vacationing.
- **Burnout Prevention:** Employees use quiet vacationing as a coping mechanism to balance work stress. When formal leave is difficult to obtain, employees may resort to unofficial breaks to protect their mental and physical well-being.

Implications of Quiet Vacationing

- **Workplace Trust Issues:** If discovered, quiet vacationing can damage employer-employee trust, leading to stricter monitoring and reduced flexibility in workplace policies.
- **Productivity Concerns:** Covert absences may disrupt team operations and accountability, especially when an employee's responsibilities require collaboration with colleagues.
- **Employee Well-Being:** Employees may not fully disconnect from work, leading to incomplete recuperation and prolonged stress, ultimately affecting their long-term productivity and satisfaction.

Quiet Firing:Forcing Exit Silently

Quiet firing is a management practice where employers subtly create unfavorable working conditions to encourage employees to resign rather than explicitly terminating them. This can take the form of limiting growth opportunities, reducing responsibilities, excluding employees from decision-making, or creating a toxic work environment.

Causes of Quiet Firing

- **Cost Avoidance:** Employers may use this strategy to avoid severance packages, unemployment claims, and potential legal risks associated with direct termination.

- **Performance Management Issues:** Instead of direct feedback and performance improvement plans, managers resort to passive-aggressive tactics to push employees out.

- **Cultural and Leadership Deficiencies:** Poor leadership or an unhealthy workplace culture fosters disengagement. Weak managerial skills often result in indirect conflict resolution methods such as quiet firing rather than addressing issues transparently.

Implications of Quiet Firing

- **Employee Disengagement:** Affected employees may experience frustration, stress, and decreased morale, leading to reduced performance and eventual resignation.

- **Legal and Ethical Risks:** Companies practicing quiet firing risk reputational damage and potential lawsuits related to workplace discrimination or constructive dismissal.

- **Impact on Workplace Culture:** Other employees may feel insecure and unmotivated, reducing overall productivity. When employees witness colleagues being quietly fired, it fosters a culture of fear and uncertainty, diminishing trust in leadership.

Hushed Hybrid: The Silent Shift in Workplace Communication

As hybrid work models (a mix of remote and in-office work) become the norm, many employees find themselves in a "hushed hybrid" statewhere engagement is minimal, conversations are transactional, and spontaneity fades.

A marketing team has three remote workdays and two in-office days. While working remotely, employees primarily communicate via emails and scheduled meetings, limiting casual discussions. Even when in the office, they hesitate to engage in spontaneous brainstorming or watercooler talk, as they have become accustomed to digital interactions. Over time, creativity declines, and team cohesion weakens.

Implications:

- Encourages deep, focused work with fewer interruptions.
- Gives introverts a structured space to express themselves in a controlled manner.
- Reduces informal learning opportunities that usually happen in spontaneous office conversations.
- Limits team bonding, leading to disengagement and weaker collaboration.
- Can make remote employees feel isolated or invisible in career advancement opportunities.

To counteract the downsides, companies should introduce structured virtual check-ins, encourage informal team chats, and use collaborative digital tools to maintain engagement.

Corporate Accent: The Language of Professional Success

In corporate environments, employees often modify their speech, vocabulary, and tone to align with professional norms. This "corporate accent" can include neutralizing regional

accents, adopting industry jargon, or speaking in a more polished, structured manner. A new analyst at an international consulting firm originally speaks with a strong regional accent and uses casual phrases like “What’s up?” and “I don’t get it.” Over time, they refine their speech to sound more polished saying “Hello, how are you?” and “Could you clarify that point?” This adjustment helps them appear more professional and confident in meetings.

Implications:

- Enhances clarity and professionalism in business communication.
- Helps employees integrate better into global work environments.
- Increases credibility and influence, especially in leadership roles.
- Can cause employees to feel disconnected from their personal identity.
- Overuse of corporate jargon may alienate colleagues who prefer clear, straightforward communication.
- Enforcing a rigid corporate accent may discourage linguistic diversity and inclusion.

While refining speech is useful, organizations should value diverse communication styles and create an inclusive environment where authenticity is respected.

Corporate Flirting: The Subtle Art of Influence

Corporate flirting is not about romantic advances but rather the strategic use of charm, humour, and social skills to build professional relationships. It involves engaging conversation, well-placed compliments, and an inviting demeanour rwithout crossing professional boundaries. A sales executive preparing for a high-stakes pitch starts by complimenting the client’s latest business achievements. They maintain eye contact, use an engaging tone, and add light humour to ease tension. Their charisma makes the interaction pleasant, increasing the chances of securing the deal.

Implications:

- Helps in negotiations and persuasion by creating a warm, engaging atmosphere.
- Strengthens professional relationships by making interactions more enjoyable.
- Boosts personal branding and workplace likability.
- If overused, it can come across as manipulative or insincere.
- Misinterpretations may lead to ethical concerns or HR complaints.
- Power dynamics can make certain interactions uncomfortable, especially if used inappropriately by senior professionals toward junior employees.

Employees should ensure their charm remains professional, ethical, and appropriate, avoiding any behaviour that could be perceived as favouritism or manipulation.

"Rage Applying" refers to the act of impulsively applying to multiple jobs in response to frustration, stress, or dissatisfaction with a current job. Employees do this out of anger, often after a negative experience such as being denied a promotion, feeling undervalued, or dealing with a toxic work environment. A marketing specialist works late nights, exceeding targets, only to be passed over for a promotion in favor of a less-experienced colleague. Feeling

unappreciated, they apply to 50 jobs in one night without much consideration for the roles. A few days later, they receive multiple interview calls, proving they are valued elsewhere.

Implications:

- Employees may land better job opportunities, often with higher pay and better work conditions.
- Employers may be forced to address workplace dissatisfaction to retain talent.
- Impulsive applications may lead employees to accept jobs that are not a good fit, leading to job-hopping cycles.
- Companies experience higher turnover, affecting team stability and increasing hiring costs.
- Employees who "rage apply" may make emotional decisions rather than strategic career moves.

Employees should channel their frustration into strategic career planning rather than impulsive applications. Organizations should improve workplace communication, recognize employee contributions, and offer clearer career advancement paths.

Loud Quitting: The Bold Exit Strategy

Loud Quitting is when employees openly express dissatisfaction and disengagement before resigning, often making their frustrations public through vocal complaints, social media rants, or dramatic exits. Unlike "Quiet Quitting," where employees silently disengage, Loud Quitting is an outspoken and sometimes performative act of protest. A software developer, frustrated by constant unpaid overtime, announces in a team meeting: "I'm done with this toxic environment. I have another offer, and I won't be exploited anymore!" They then post on LinkedIn about their experience, gaining support from others with similar grievances.

Implications:

- Forces companies to address toxic work cultures and improve policies.
- Raises awareness about unfair labour practices, encouraging industry-wide changes.
- Can burn bridges and damage an employee's professional reputation.
- May lead to legal or HR conflicts if public statements violate company policies.
- Negatively affects team morale, leaving remaining employees in a tense work environment.

Employees should weigh the risks before loud quitting, ensuring they have a solid backup plan. Companies should foster transparent communication and listen to employee concerns before frustrations escalate to public resignations.

Bare Minimum Mondays: The Antidote to Burnout

Bare Minimum Mondays is a workplace trend where employees intentionally do only the essential tasks on Mondays to ease into the workweek and reduce burnout. This approach challenges the traditional "grind culture" and prioritizes mental health and balance.

A project manager who normally jumps into back-to-back meetings and responds to hundreds of emails on Mondays decides to start the day slowly checking only urgent emails, completing essential tasks, and taking extra breaks. This helps them feel less overwhelmed and more productive throughout the week.

Implications:

- Helps reduce stress and burnout, leading to sustainable productivity.
- Encourages better work-life balance by challenging toxic overworking habits.
- Can increase overall efficiency, as employees avoid Monday exhaustion and decision fatigue.
- If misunderstood, it can be seen as laziness or a lack of motivation.
- Might create delays in team projects if employees avoid tackling urgent tasks.
- Some companies may penalize employees for perceived disengagement.

Organizations should embrace flexible work policies and recognize that productivity isn't about overworking on Mondays but maintaining long-term efficiency. Employees should ensure they still meet deadlines while setting boundaries for a balanced start to the week.

Career Cushioning: A Safety Net for Job Security

Career cushioning refers to preparing for job loss or career transitions while still employed by upskilling, networking, freelancing, or applying for jobs. This trend has grown due to economic instability, mass layoffs, and the realization that no job is fully secure. A marketing manager notices restructuring in their company and fears potential layoffs. Instead of waiting, they start taking online courses in digital marketing, updating their LinkedIn profile, and attending networking events. When layoffs happen, they already have multiple job interviews lined up.

Implications:

- Employees stay prepared for job shifts, reducing financial stress.
- Encourages continuous learning and professional growth.
- Gives workers negotiation power, as they have backup options.
- Divided focus may lower productivity and engagement in the current role.
- If discovered, employers may see it as a lack of loyalty or commitment.
- Can create a culture of instability, where employees are constantly seeking exits instead of investing in their roles.

Employees should practice career cushioning discreetly while continuing to perform well. Companies should improve retention efforts by providing career growth opportunities internally.

Snail Girl Era: Choosing Slow Success Over Hustle Culture

The Snail Girl Era is a movement where individualsparticularly womenreject hustle culture and embrace a slower, more intentional lifestyle. Instead of rushing up the corporate ladder, they prioritize work-life balance, mental health, and personal happiness over career ambition. A software engineer is offered a promotion to a managerial role with higher pay but longer

hours. Instead of taking it, she chooses to stay in her current role, work flexible hours, and spend more time on hobbies and self-care. She values peace over prestige.

Implications:

- Helps prevent burnout and mental exhaustion.
- Encourages individuals to make career choices aligned with their well-being.
- Challenges toxic "grind culture", fostering healthier work environments.
- May be seen as a lack of ambition, leading to fewer career advancements.
- Could result in slower financial growth, affecting long-term stability.
- Organizations that rely on high productivity and ambition-driven employees may struggle to adapt.

Companies should embrace flexible work models and mental health support. Employees should strike a balance between maintaining a stress-free life and securing financial independence.

Self-Promoters: The Power of Personal Branding

A "Self-Promoter" is someone who actively markets their achievements, skills, and personal brand to gain recognition, promotions, or opportunities. This can be done through social media, networking, public speaking, or consistently highlighting contributions at work. A data analyst regularly shares insights, projects, and industry trends on LinkedIn. Over time, they gain visibility and attract job offers and speaking engagements without actively searching.

Implications:

- Helps professionals gain visibility and career growth opportunities.
- Encourages confidence and assertiveness in the workplace.
- Can lead to higher salaries and job offers due to increased recognition.
- Over-promotion can appear self-centered or inauthentic.
- May create resentment among colleagues who feel overshadowed.
- If done without real achievements, it can harm credibility.

Employees should practice strategic self-promotion, ensuring they add value while showcasing their work. Companies should encourage a culture of recognition, so employees don’t feel the need to excessively promote themselves.

Health Equity

Health equity ensures that all individuals, regardless of socioeconomic status, race, gender, or geography, can achieve optimal health. Unlike equality, which provides uniform resources, equity acknowledges diverse needs and tailors support accordingly to eliminate health disparities. Marginalized women often face higher maternal complications due to healthcare inaccessibility and socioeconomic barriers. Health equity addresses this by:

- Providing free prenatal care for uninsured women.
- Offering education and mental health support.
- Ensuring transportation access to healthcare facilities.

Implications of Health Equity

1. **Social:** Empowers underrepresented communities, reduces health disparities, and enhances overall well-being.
2. **Economic:** Lowers healthcare costs through preventive care and boosts workforce productivity.
3. **Ethical:** Upholds social justice, ensuring fair healthcare access as a fundamental human right.
4. **Political/Systemic:** Calls for policies prioritizing equity, funding underserved communities, and cross-sector collaboration.
5. **Public Health:** Improves population health, curbs disease spread, and fosters community-driven solutions.

Conclusion

The evolving workforce landscape presents both challenges and opportunities for organizations striving to remain competitive in a dynamic environment. Contemporary buzzwords such as "quiet quitting," "career cushioning," and "ghost jobs" encapsulate the shifting expectations of employees and the changing nature of workplace dynamics. These trends highlight the need for organizations to adopt flexible management approaches, innovative HRM strategies, and adaptive leadership styles to address emerging workforce challenges effectively. This research underscores the importance of understanding and responding to these emerging trends to create sustainable and effective workforce strategies. By embracing adaptability, fostering innovation, and prioritizing employee-centric policies, organizations can build a future-ready workforce that thrives in an era of continuous change. Ultimately, recognizing and addressing these trends will not only enhance organizational success but also contribute to a more engaged, productive, and satisfied workforce in the long term.

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Problems of Teacher Education in North East India

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Abstract

Teacher education in North East India faces several challenges that hinder its ability to produce well-trained educators, impacting overall educational quality. The chapter explores historical policy interventions, infrastructural constraints, and pedagogical limitations affecting teacher education in the region. Historically, teacher training lacked standardization, with reforms introduced through various commissions and national policies. However, persistent issues such as inadequate infrastructure, faculty shortages, and policy implementation gaps continue to undermine progress. The region's geographical isolation further exacerbates access to quality teacher education. The lack of integration of modern pedagogical techniques and limited professional development opportunities result in outdated teaching practices, negatively influencing classroom engagement and student learning outcomes. Furthermore, linguistic and cultural diversity presents challenges in implementing a standardized teacher education curriculum that aligns with regional needs. The chapter also highlights how these issues contribute to declining interest in the teaching profession due to employment uncertainties and lower remuneration. The impact of these deficiencies extends beyond the classroom, perpetuating socio-economic inequalities and limiting regional development. To address these challenges, policy reforms, investment in infrastructure, and research-driven pedagogical improvements are crucial. Solutions such as curriculum modernization, ICT integration, capacity-building initiatives, and localized teacher training approaches can bridge the existing gaps. The chapter underscores the necessity of a holistic and sustainable approach to revitalize teacher education in North East India, ensuring the development of a skilled and motivated teaching workforce.

Keywords: Teacher Education, Pedagogical Challenges, Policy Implementation, North East India, Educational Infrastructure

INTRODUCTION:-

The practice of teaching is a complex and multifaceted endeavor that demands an instructional approach emphasizing both cognitive and emotional development. In the wake of technological progress, evolving societal demands, and increasing educational inequalities, the significance of an educator's role has never been more evident. Each educational stage has distinct goals designed for specific age groups, necessitating teachers to acquire specialized knowledge to achieve these objectives effectively. As stated in the Goods Dictionary of Education, "teacher education" encompasses all structured and unstructured activities and experiences that equip an individual to fulfill their responsibilities as an educator more proficiently.The National Council for Teacher Education (NCTE) defines teacher education as "a curriculum of learning, inquiry, and skill development aimed at preparing individuals to teach from early childhood to higher education levels. According to the International Encyclopaedia of Teaching and Teacher Education, "Teacher education can be categorized into three stages: pre-service, induction, and in-service." These three stages

are regarded as components of an ongoing process. Teacher education is a continuous system that integrates various elements, including inputs, procedures, and outcomes.

HISTORICAL BACKGROUND

From the earlier period, the teacher education sector was forsaken. Anyone having knowledge about a certain field was hired as a teacher to teach; no extra steps were taken to ensure the level of mastery they possess of their claimed field. These faulty practices came to a halt after the recommendation of different committees. University Education Commission. (1948-49): The University Education Commission recommended that proper care should be taken in the selection procedure of a teacher for the appointment as a professor, reader, lecturer, and instructor, as well as for his or her salaries. Each university should have some research fellows. Besides these, definite rules regarding the Provident Fund, leave, and hours of work should be followed by a university. It also recommended that refresher courses be organized by the universities for high school and intermediate college teachers. Secondary Education Commission (1952-53): The Secondary Education Commission suggested higher secondary teachers should be given two-year training and graduates should be given one-year training. Pupil teachers should be trained in one or more extracurricular activities. There should be provision for refresher courses and practical training and workshops in training colleges. Teachers who have three years of teaching experience only should be eligible for an M.Ed. Kothari Commission (1964-66): The Commission exhorted that professional preparation of teachers was pivotal for qualitative amelioration of education and endorsed measures like qualitative improvement in teacher education programs, introduction of new courses for headmasters/teacher educators and educational administrators, and expansion of teacher education institutions and recommendations of the training facilities. National Policy on Education (1968): The NPE proposed significant reforms to improve teacher working conditions, safeguard their academic freedom, and strengthen opportunities for professional development through in-service training. National Commission on Teachers (1983-85): The Commission suggested that the minimum obligation of any training program should enable the trainee to acquire the basic skills and pedagogic knowledge for being a teacher. They should also be able to cater to the individual differences that exist in every classroom situation and should possess the ability to communicate with the students in simple language and answer their queries logically. National Policy on Education (1986): The NPE 1986 recommended various measures to elevate the working conditions of the teachers by creating opportunities and an atmosphere that promotes autonomy and innovation among teachers. Introduction of reforms in the system of selection of teachers. Involving teachers in the planning and managing of education in the country. The National Curriculum Framework (NCF 2005): The National Curriculum Framework highlighted the needs of the teachers; it addressed that the teachers require freedom, space, flexibility, and respect, the same as the students. The teachers' recommendations should also be considered while forming a curriculum by the higher-ups, which will immediately affect the classroom life and culture in the school. This National Curriculum Framework for Teacher Education (NCFTE, 2009): The NCFTE 2009 gave importance to preparing teachers as reflective practitioners who promote equity, inclusion, and lifelong learning. It recommended shifting the theoretical curriculum to a more practical-based approach. The framework also advocates extending the

teacher education programs (e.g., 2-year B.Ed. or 4-year integrated courses) and decentralizing curricula to reflect local needs. It also calls for institutional reforms, ethics in teaching, and fostering innovation through research.

Problems of Teacher Education in North East India:-

Teacher education in North East India faces several challenges that hinder the development of a robust and effective education system. One of the primary concerns is the lack of adequate infrastructure in teacher training institutions. Many colleges suffer from poor physical facilities, insufficient libraries, and inadequate laboratory resources, which negatively impact the quality of training provided to aspiring teachers. Additionally, the region's difficult terrain and connectivity issues further exacerbate access to quality teacher education.Another significant issue is the shortage of qualified teacher educators. Many teacher training institutions in the North East struggle with a lack of experienced faculty, leading to compromised pedagogical training. The absence of continuous professional development programs for teacher educators also results in outdated teaching methodologies, which do not align with contemporary educational needs. Furthermore, the limited integration of technology in teacher education programs restricts trainees from acquiring modern teaching skills essential for 21st-century classrooms.Policy implementation challenges further add to the complexity of teacher education in the region. Despite various government initiatives and funding schemes, there is often a gap between policy formulation and execution. Bureaucratic delays, lack of monitoring mechanisms, and inadequate funding allocation lead to inefficiencies in program implementation. The linguistic and cultural diversity of the North East also poses a challenge, as standardized teacher education curricula may not always cater to the region's unique socio-cultural contexts. Moreover, issues related to employment opportunities and career prospects for trained teachers remain critical concerns. Many trained teachers in the region struggle with delayed recruitment, lack of permanent employment, and lower salary structures compared to other parts of India. These factors contribute to reduced motivation among aspiring teachers and result in a declining interest in pursuing the teaching profession.The challenges encountered by educators in India include the limited duration of teacher training programs. These programs are generally short-term, with a typical duration of one year for graduates. However, the actual effective training period is restricted to six to seven months. During this timeframe, institutions organize structured classes to facilitate coordination between teachers and learners, ensuring the acquisition of essential pedagogical knowledge. The primary objective of teacher education programs is to equip educators with adequate competencies in areas such as health, attitude formation, ethical values, and professional principles.

Impact of Teacher Education Problems on the Quality of Education:-

The challenges associated with teacher education significantly impact the overall quality of education, particularly in regions such as North East India, where infrastructural and institutional constraints exacerbate the issue. A lack of adequately trained educators, outdated curricula in teacher training programs, and limited professional development opportunities contribute to ineffective teaching methodologies. Consequently, students receive suboptimal learning experiences, which hinder their cognitive and skill development. The absence of

continuous training mechanisms results in teachers struggling to adapt to evolving pedagogical trends, technology integration, and diverse classroom needs, ultimately diminishing the quality of instruction.The repercussions of these teacher education challenges manifest in students' academic performance and engagement. Poor instructional delivery, stemming from inadequately prepared teachers, leads to lower comprehension levels, reduced motivation, and increased dropout rates. When educators lack pedagogical proficiency, they fail to employ student-centric approaches that promote critical thinking, creativity, and problem-solving skills. As a result, students often develop a superficial understanding of concepts, leading to weaker foundational knowledge and reduced competitiveness in higher education and employment sectors. Moreover, the inability of teachers to cater to diverse learning needs, particularly in multilingual and socio-economic disadvantaged communities, further exacerbates educational inequalities. In the long run, these deficits in teacher education have profound socio-economic implications for North East India. A poorly trained teaching workforce produces graduates with limited employability skills, contributing to higher unemployment and underemployment rates in the region. The lack of a strong education system perpetuates cycles of poverty and restricts opportunities for economic mobility, thereby widening socio-economic disparities. Furthermore, inadequate teacher preparation limits the region's ability to leverage human capital for economic and technological advancements, slowing down overall development. Addressing teacher education challenges through policy reforms, investment in teacher training infrastructure, and research-driven pedagogical improvements is crucial for fostering sustainable educational and socio-economic growth in North East India.

Recommendations and Solutions for Teacher Education:-Teacher education in the north-eastern region of India plays a pivotal role in shaping the broader educational landscape, thereby influencing the socio-economic development of the country. However, this sector remains underdeveloped due to inadequate governmental intervention. To address these challenges, it is imperative for the government to implement curriculum reformation by revising teacher education curricula and integrating contemporary knowledge and skills, such as modern pedagogical approaches, ICT-based instruction, and innovative teaching methodologies. Furthermore, initiatives such as capacity-building programs, including both pre-service and in-service training, should be established to ensure the continuous professional development of educators throughout their careers. The establishment of dedicated research centresis also crucial, as these institutions would systematically analyze, the educational challenges specific to the north-eastern region and propose evidence-based solutions to mitigate existing impediments. A significant emphasis should be placed on infrastructural development, which entails equipping teacher training institutes with state-of-the-art facilities, including well-resourced libraries, laboratories, and digital learning platforms. These enhancements will foster the holistic professional growth of aspiring educators. Additionally, language barriers must be addressed, considering the region's linguistic diversity. Employing local language experts as trainers will facilitate effective communication and comprehension among educators and students alike. To cater to the region's unique educational challenges, region-specific policies should be devised and implemented, alongside a robust framework for periodic monitoring and evaluation of teacher

education programs. Moreover, financial incentives such as scholarships and fellowships should be introduced to encourage students, particularly those from economically disadvantaged backgrounds, to pursue teacher education. The effective administration of these measures has the potential to transform the teacher education system in north-eastern India, ultimately contributing to the advancement of the national educational framework.

Conclusion

Teacher education in North East India is a crucial determinant of the region's educational and socio-economic progress. However, persistent challenges—including inadequate infrastructure, a shortage of qualified educators, outdated curricula, and policy implementation gaps—continue to hinder the effectiveness of teacher training programs. These systemic inefficiencies negatively impact the quality of instruction, limiting students' academic growth, reducing employability, and exacerbating regional educational disparities. Addressing these challenges requires a multi-pronged approach. Reforming teacher education curricula to incorporate contemporary pedagogical strategies, expanding professional development programs, and improving institutional infrastructure are imperative. Additionally, policies should be adapted to accommodate the region's linguistic and cultural diversity, ensuring that training programs align with local educational needs. Strengthening monitoring mechanisms and increasing government investment in teacher training institutions will further enhance the sustainability of these efforts. A well-trained and motivated teaching workforce is essential for fostering an inclusive, high-quality education system that equips students with the skills needed for personal and professional success. By prioritizing structural reforms and research-driven strategies, North East India can build a resilient teacher education framework that supports long-term educational and socio-economic development.

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Professional Ethics of Elementary School Teachers: A Study

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Abstract

Professional ethics are the principle that govern the behaviour of a person.Professional ethics provide rules on how a person should act towards other people and institution in such an environment. A successful teaching profession is depended on the professional ethics of a teacher. Those teachers follow professional ethics they can achieve more success in their teaching career. The objective of the study was to measure the professional ethics of male and female elementary teacher as well as elementary teacher of Government and private school. The researcher has selected the sample through random sampling 200 teachers were selected from elementary of Goalpara District Assam. To collect the data of professional Ethics an Inventory has used prepared by the investigators. The findings of the present study revealed that female teacher have high professional ethics than male teacher and private school teacher have high professional ethics than govt. school teacher.F

Keyboard: Professional Ethics, Teacher, Elementary School.

INTRODUCTION:

Education is a cornerstone of harmonious development of any areas human life, and in this regard elementary school teachers play a pivotal role in shaping the future character of society, values, and future of young generation. As role models, teachers' behaviour, decision-making, and adherence to professional ethics have profound implications for the holistic development of children. Professional ethics in teaching encompass a wide range of all kind of responsibilities, including fostering fairness to all, maintaining integrity, respecting all the members, and prioritizing the welfare of student's wealth above personal or institutional interests. These ethical standards guide teachers in addressing the moral and professional challenges they encounter daily.

In the context of Goalpara district of Assam, a region characterized by its unique cultural diversity and socio-economic diversities, the role of professional ethics among elementary school teachers becomes more significant. Teachers in this regard not only impart academic knowledge but also serve as role of social cohesion and transformation. Their ability to navigate ethical dilemmas while addressing the unique challenges of the district—such as linguistic diversity, varying economic conditions, and access to educational resources—is crucial for ensuring inclusive and equitable education.

The present study aims to explore the professional ethics of elementary school teachers in Goalpara district in relation to gender and Management, analysing how these ethical principles influence their teaching practices, interactions with students, and engagement with the community. It also seeks to identify the challenges teachers face in upholding ethical standards and the strategies they adopt to overcome them. By shedding light on these aspects, the present study aspires to contribute to the broader discourse on ethical practices in

education and provide actionable insights for policymakers, educators, and stakeholders in the region.

This research underscores the importance of ethical awareness to the teachers and practice in fostering a nurturing and supportive learning environment. The present study is significant as the study made efforts to know the professional ethics of male and female teachers as well as the study made efforts to study the professional ethics of teachers who are working both Govt and private sectors.

RATIONALE& BACKGROUND OF THE STUDY:

Rationale of the Study

The concept of Professional ethics in elementary level as the teacher of elementary school directly deal with the holistic development of students during their formative years. In Goalpara district, where we found socio-economic and cultural diversity presents unique challenges and opportunities, examining the professional ethics of teachers is crucial. The present study seeks to identify how adherence to professional ethical principles impacts teaching effectiveness, student outcomes, and the overall educational environment. The present study aims to provide insights into teachers' understanding of their professional responsibilities, the challenges they face in upholding ethical standards, and the strategies they use to address these issues. By exploring this research, the study will contribute to creating a framework for ethical practices in elementary school teaching, fostering a culture of integrity and accountability, and ultimately improving the quality of education in the Rationale of the Study. The role of elementary school teachers is extending to beyond the academic instruction which include shaping students' future character, values, and social skills. Professional ethics of teachers serve as an ethical principle for teachers to fulfil these roles with fairness to all students, respect, and a commitment to the well-being of their students. However, in districts like Goalpara, socio-economic disparities, limited resources, and cultural variations can pose significant ethical dilemmas for educators.

Previous studies on professional ethics in education have highlighted the need for contextual understanding to address specific regional challenges. In Goalpara, with its diverse demographic and rural setting, teachers often encounter situations that test their ethical judgment, such as dealing with students from underprivileged backgrounds or balancing personal biases with professional responsibilities. This study is therefore vital to examine how teachers in this region navigate these complexities and adhere to ethical standards in their daily practices. The research will provide a detailed understanding of the ethical dimensions of teaching of elementary school teachers in Goalpara district, offering practical recommendations to policymakers, educators, and training institutions for fostering ethical awareness and practice among teachers.

Objectives of the Study:

1. To study the professional ethics of male and female teachers of primary schools.
2. To study the professional ethics of teachers of Govt and private primary schools.

Hypotheses of the study:

1. **Ho_1** There is no significant difference in professional ethics between male and female teachers.

2. **Ho_2**There is no significant difference in professional ethics between Govt and Private primary school teachers

Delimitations:

The present study delimited as follows-

- Only the Government provincialised Elementary schools of Goalpara District will be selected for the present study.
- Only the teachers of elementary schools will be selected as sample.

Research Method:

In the present study descriptive survey method has used.

Population and Sample:

All the teacher of elementary school of Lakhipur Block under Goalpara District is considered as the population of present study.

Again 200(100 male and 100 female) elementary school teachers were selected by using random sampling technique.

Tools: Questionnaire for professional ethics was prepared by investigator.

Analysis and Interpretation of the Study:

Objective 1. To study the professional ethics of male and female teachers of primary schools.

Ho_1There is no significant difference in professional ethics between male and female teachers.

Table: showing the Mean ,S.D, Std. Error , 't'- Value and level of significance of 100 male and 100 femaleprimary school teachers on their professional ethics

Variable	Male			Female			df	t-value
	M	S.D	Std.Err mean	M	S.D	Std.Err mean		
Professional Ethics	21.23	3.330	.333	22.41	2.843	.284	198	2.695

Figure 1

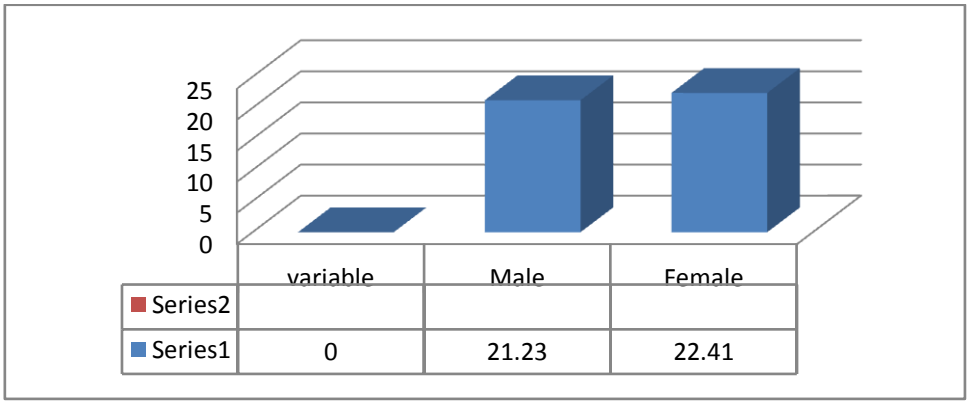

Figure 1: Graphical representation of Means of Male and Female teachers on their professional ethics

Findings and Interpretation: From the above Table, it has been seen that the mean of total professional ethics score of male s is 21.23 and that of female is 22.41 and also the calculated t-value is 2.695, which is significant. Hence the t value we can say that the null hypothesis has been rejected. From the observation of the data analysis, it can be said that, there exists a significant difference between male and female teachers on their professional ethics.

Objective 2. To study the professional ethics of Govt and Private teachers of primary schools.

Ho_1There is no significant difference in professional ethics between Govt and Private teachers.

Table: showing the Mean ,S.D, Std. Error , 't'- Value and level of significance of 100 Govt and 100 Privateprimary school teachers on their professional ethics.

Variable	**Govt**			**Private**			**df**	**t-value**
	M	S.D	Std.Err mean	M	S.D	Std.Err mean		
Professional Ethics	31.95	7.412	.741	33.94	7.216	.722	198	1.924

Figure 2

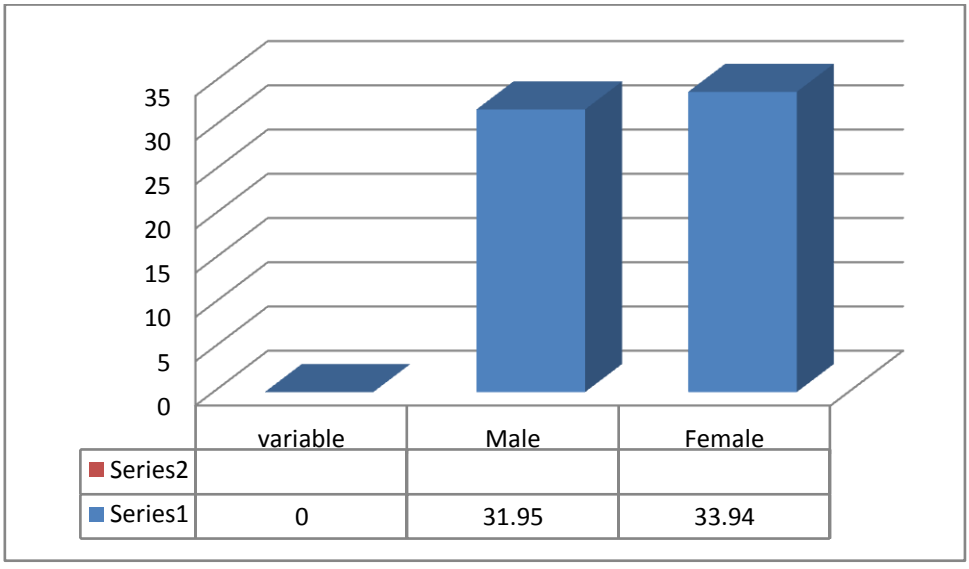

Figure 2: Graphical representation of Means of Govt and Private teachers on their professional ethics

Findings and Interpretation:

From the above Table, it has been seen that the mean of total professional ethics score of Govt teachers is 31.95 and that of private teachers is 33.94 and also the calculated t-value is 1.924, which is significant. Hence the t value we can say that the null hypothesis has been rejected. From the observation of the data analysis, it can be said that, there exists a significant difference between Govt and Private teachers on their professional ethics.

Major findings of the present study:

1. The present study revealed thatfrom the mean score of professional ethics Female teachers have more professional ethics than male teachers.
2. The study also found that from the mean score of professional ethics private teachers have more professional ethics than Govt teachers.

Conclusion

The study concluded that, as the major aimed of the study was to examine the professional ethics of elementary school teacher. The results from the study showed that. Again, the study reveals that there exists a significant difference between male and female teachers on their professional ethics. Thus from the study the researcher found that from the mean score of professional ethics Female teachers have more professional ethics than male teachers. The study also found that from the mean score of professional ethics private teachers have more professional ethics than Govt teachers.

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Recent Trends and Development in Artificial Intelligence for Logistics and Supply Chain Management

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ABSTARCT

The article examines current advancements and trends in supply chain management (SCM) and logistics using artificial intelligence (AI). Logistics efficiency, cost reduction, and decision-making are being improved by AI technologies such as robotics, machine learning, and predictive analytics. The study examines prospects for integrating AI in SCM in the future and evaluates existing AI trends. While secondary data comes from industry publications, primary data is gathered from logistics experts and supply chain management. Key AI trends are identified, along with issues like data security and high prices, and potential future developments like driverless delivery and predictive maintenance are also examined. The results are intended to assist companies in using AI effectively for increased resilience and efficiency.

Key words: Artificial Intelligence,Logistics, Supply chain management, Machine learning and Robotics.

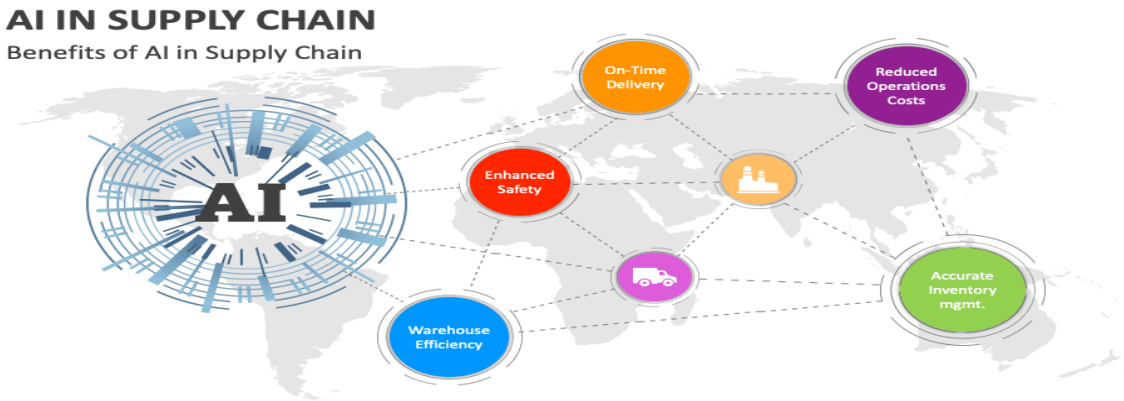
INTRODUCTION

Artificial Intelligence in Logistics

AI is revolutionizing the logistics sector through process automation, increased productivity, and better decision-making. Logistics firms must deal with issues like demand swings, route optimisation, inventory control, and last-mile delivery as international trade and e-commerce grow. By streamlining distribution, storage, and transportation processes, artificial intelligence (AI) technologies including machine learning, predictive analytics, robotics, and the Internet of Things are assisting in overcoming these obstacles. AI-powered route optimisation lowers fuel usage and transportation expenses, while predictive analytics allows precise demand forecasting, minimising stockouts. Drones and autonomous cars are also becoming more popular for quicker, more affordable delivery. AI improves sorting, packaging, and inventory management while decreasing the need for manual labour by enhancing warehouse automation through robotics. AI helps fleet management by reducing delays through automated scheduling, predictive maintenance, and real-time tracking. Chatbots and virtual assistants driven by AI enhance customer service by providing real-time shipping updates and assistance. Notwithstanding its advantages, obstacles including exorbitant installation expenses, problems with integration, and worries about data security prevent broad adoption. But as AI develops, its application in logistics is anticipated to increase, making supply chain more robust, nimble, and economical.

Artificial Intelligence in Supply Chain Management

AI is revolutionizing Supply Chain Management (SCM) by improving efficiency, automation, and decision-making across various stages of the supply chain. Companies are leveraging AI to enhance demand forecasting, inventory management, supplier selection, and transportation planning. Predictive analytics helps forecast demand accurately, preventing stockouts and overstocking, while machine learning algorithms analyse sales data, market trends, and external factors to optimize inventory planning. AI-powered warehouse automation increases storage efficiency, reduces errors, and speeds up order fulfilment, while AI-driven route optimization and real-time tracking improve logistics operations. AI also improves fleet management and last-mile delivery using drones and driverless cars, which lowers operating costs and boosts productivity. Furthermore, chatbots and virtual assistants driven by AI enhance supplier connection and offer real-time shipment updates. High implementation costs, data security issues, and integration difficulties continue to be major obstacles in spite of its benefits. But as AI technology develops, supply chains should become more resilient, agile, and economical, offering companies a competitive edge by cutting down on inefficiencies and improving responsiveness.



METHODOLOGY

This study uses secondary data analysis to explore AI trends in logistics and SCM. Data is sourced from academic databases, industry reports, and company white papers**.** Bibliometric

and thematic analyses identify key AI applications, including warehouse automation, predictive analytics, AI-driven transport, and blockchain integration**.** Trend mapping highlights growth areas, challenges, and future directions. Findings are validated through cross-referencing, and the study concludes with strategic recommendations for AI adoption and future research**.**

OBJECTIVES

- To analyse recent trends in the application of Artificial Intelligence in logistics and SCM.
- To explore future opportunities for integrating advanced AI technologies into logistics and SCM.

REVIEW OF LITERATURE

Blockchain applications in contemporary logistics were examined by Xiaofeng Xu and Yangyang He (2024), with an emphasis on information exchange, security, and transaction effectiveness. The paper summarized blockchain applications using a two-stage analytical scheme based on the latent Dirichlet allocation topic model. Supply chain finance, logistics tracking, and process optimization were among the six major logistics domains that were identified. The results highlighted how blockchain may improve transparency, lower operating expenses, and prevent fraud. The report made management suggestions to boost the use of blockchain in logistics.

In the study of AI and IoT applications in intelligent transportation, Pawan Whimg et al. (2024) concentrated on traffic control systems and driverless cars. The study emphasized how AI may improve efficiency, facilitate smart city planning, and lessen human error in transportation. There was discussion of issues like cybersecurity threats and the potential legal repercussions of AI-driven judgments. Future mobility solutions were shown to be significantly facilitated by IoT-based transport networks. Results indicate that AI improves route optimization, vehicle automation, and traffic control.

Indradevi Ramasamy et al. (2024) looked into how supply chain management and logistics were influenced by automation, IoT, and AI. The study examined AI's application in last-mile deliveries, inventory optimization, and predictive maintenance. Results showed that supply chain resilience and demand forecasting are improved by AI-driven analytics. The three main issues were determined to be cybersecurity, workforce transformation, and ethical issues. According to the study's findings, AI greatly raises customer happiness and operational effectiveness.

STATEMENT OF THE PROBLEM

Artificial Intelligence (AI) in logistics and supply chain management (SCM) has advanced quickly, revolutionising processes by improving decision-making, efficiency, and cost reduction. Nevertheless, despite its promise, businesses still face several obstacles when implementing AI, such as high adoption costs, privacy issues with data, legal restrictions, and technological constraints. AI-driven logistics also needs to handle supply chain interruptions, sustainability issues, and complicated real-time decision-making. Although the use of AI is

growing, little is known about how it will affect operational sustainability, scalability, and resilience in the long run. The purpose of this study is to examine current AI trends in supply chain management, pinpoint adoption barriers, and investigate potential future integration opportunities for AI to improve supply chain resilience.

SCOPE OF THE STUDY

This research examines the latest developments in artificial intelligence (AI) in supply chain management (SCM) and logistics, with an emphasis on decision-making, cost reduction, and operational efficiency. It looks at AI applications including blockchain, autonomous delivery, predictive analytics, and smart warehousing. The study highlights several obstacles to AI adoption, such as exorbitant expenses, data security, and legal restrictions. The impact of AI on improving supply chain resilience in the face of disruptions is also assessed. Future prospects for deep learning, IoT-driven SCM systems, and AI integration are also examined.

The use of AI in demand forecasting, inventory control, supply chain resilience, last-mile delivery, route optimization, and warehouse automation is the main topic of this study. It also assesses how artificial intelligence enhances SCM risk management, operational effectiveness, and decision-making. Academics, industry experts, and politicians may learn from the findings how AI might revolutionize contemporary supply chains and promote sustainable growth.

Research Gap:

Despite advancements in AI for logistics and SCM, research gaps remain. Real-world implementation studies are limited, with most research focusing on theoretical models. AI's role in sustainability and data privacy concerns in SCM need further exploration. There is also a lack of studies on AI-driven decision-making during disruptions **and** adoption barriers for SMEs**.** Addressing these gaps will enhance AI's practical, secure, and inclusive implementation in logistics and SCM.

LIMITATIONS

- AI-driven logistics are susceptible to cyberattacks and difficulties with regulatory compliance, such as GDPR, due to data security and privacy concerns.
- Due to the high installation costs and maintenance requirements of AI, small and mid-sized logistics organizations face difficulties.
- AI adoption is challenging for conventional supply chains due to the complexity and considerable changes required for integration with existing systems.

FINDINGS

- Demand forecasting, warehouse automation, route optimization, and customer service are all using AI technologies like machine learning, predictive analytics, robots, and the Internet of Things more and more.
- Chatbots and virtual assistants driven by AI improve customer service and communication.
- Drones and autonomous cars are becoming more popular for last-mile deliveries that are quicker and less expensive.

- Delivery expenses and fuel consumption are reduced via intelligent route optimization.
- AI dramatically increases operational effectiveness, lowers expenses, and improves logistics and supply chain management decision-making.
- Accurate demand forecasting is made possible by predictive analytics, which also minimizes inventory waste and maximizes stock levels.
- Adoption of AI is hampered by issues with data privacy, interoperability with legacy systems, high implementation costs, and a shortage of qualified staff.
- Broad adoption is hampered by regulatory obstacles and the complexity of real-time decision-making.
- AI increases supply chain visibility and aids in risk and disruption prediction and management.
- Autonomous delivery systems, predictive maintenance, and sustainable solutions for resource optimization are examples of opportunities.

SUGGESTIONS

- To reduce implementation costs, make strategic investments in AI technology and make use of affordable cloud-based solutions.
- Utilize government grants and incentives to lower the cost of adoption.
- To reduce interruptions, gradually integrate AI with current systems.
- Make use of scalable AI systems to handle expansion and new developments in the future.
- Assure strong data security procedures to handle privacy issues and legal requirements.
- Use cybersecurity solutions powered by AI to safeguard private supply chain information.
- To improve workforce preparedness and develop AI-related skills, fund staff training initiatives.
- Work together with academic institutions to create a pool of qualified candidates for logistics AI.
- For supply chain resilience, use AI-driven risk management solutions and predictive analytics.
- Use AI simulations to create backup plans for efficient crisis management.

CONCLUSION

This study examines current advancements and trends in artificial intelligence (AI) for supply chain management (SCM) and logistics, emphasizing how it can enhance decision-making, efficiency, and cost reduction. In order to improve operational efficiency, artificial intelligence (AI) technologies like as robotics, machine learning, and predictive analytics are frequently employed for demand forecasting, warehouse automation, and route optimization. Adoption is hampered by obstacles including exorbitant prices, integration problems, and data security worries, despite its advantages. But as AI develops its use in SCM and logistics will only increase, enhancing the resilience and agility of operations. Future prospects in

predictive maintenance and autonomous delivery systems are also identified by the study. Businesses must proactively invest in AI and have a competent staff if they want to realize the full promise of this technology.

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National Study of National Education Policies in the 21th Century on Rural Areas in the Introduction of Digital Education

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ABSTRACT

The National Education Policy 2020 points towards the significance of online creation and technology in education to rise in the overall rate of enrolment. But there has to be numerous infrastructure facilities and equipment throughout the nation. The suggestion of establishing the National Educational Technology Forum (NETF) is aimed at education innovation and enhancing classroom procedures and teacher training. Basic facilities for rural digital education are still not available. This research considers rural exclusion from online education and technology within National Education Policy 2020. The subjects for this research belonged to rural villages in Madurai district. Unresolved questions and semi-structured interviews were applied for data collection. Findings indicate that 91% of the participants used smartphones for academic purposes. Device prices are one of the greatest challenges, and network coverage as a significant hurdle to technology and smartness is also utilized as a medium barrier for conducting online training in rural regions.

Keywords: National Education Policy, Online, Technology, Education, and Rural area.

INTRODUCTION

Education consists of transfer of knowledge, skills and characteristics and comes in all forms. Institutions play a key role in numerous aspects of education. Companies that make up the education sector are schools, universities and the Ministry of Education. A large variety of people directly participate in education, including students, teachers, principals and curriculum developers. The Indian education system is categorized into different levels: The system was designed to prepare learners for higher academic activities and vocational training. National Education Policy 2020 has implemented a 5+3+3+4 education system in India. Students will spend five years on the foundation of the preparation phases of three years until mid-term level and four years until mid-term level. For intensive overall development and critical thinking. 34 years after that, the National Education Policy 2020 was launched. Among the chief objectives is to raise the overall enrolment rate for university creation, including vocational training from 26.3% (2018) to 50% by 2035. National Politics (NPE) in 1986.

According to the fundamental principles of access, equity, quality, affordability and accountability are the 2030 agenda for sustainable development and the 2030 agenda to change India into a dynamic knowledge society, and the schools. It speaks to the knowledge

objectives for university education as well as to knowledge. Century and all learners are attempting to actualize the distinctive potentialities of teaching.

Outcomes of the national education policy:

i. Universalization of ECCE (Early Childhood Care and Education) to Secondary by 2030, as per SDG 4.
ii. Foundational learning and numeracy achievements through a national mission by 2025.
iii. Attainment of 100% GER (Gross Enrolment Ratio) from preschool to secondary by 2030.
iv. Bringing back into school two million out-of-school children and integrating them into the mainstream teaching and learning process.
v. Capacity building of teachers for assessment reforms by 2023.
vi. Creating an inclusive and equitable education system across the nation to improve and showcase the engagement of all groups in society by 2030.
vii. Applying uniform standards of learning in public and private schools Developing board exams to test core concepts and the application of knowledge, as well as the applicability of that knowledge in practical situations, instead of testing only factual knowledge.

CURRENT EDUCATION SYSTEM

By now, the world has transitioned to online and digital learning fields. This is the emphasis of the National Education Policy 2020 to open up learning chances through online learning and learning. Course delivery undergoes a dramatic transformation because of new developments in online learning technology. Even knowing what to teach and how to teach it alters. Student choice of learning styles is also taken into account while developing an online learning strategy. This widespread change can only be realized through promotion of online and digital training.

Incorporating tools in a more comprehensive manner to address learner needs and expectations is yet another part of ensuring the quality and development of online formation. A crucial element of online learning is to utilize its potential to provide expanded learning opportunities to everyone. The government of India has initiated a national mission for education using ICT (NMEIC) to make online learning available to all. Different programs have been launched to facilitate digital education like Swayam, Swayam Prabha, Shodhganga -Flibnet, National Digital Library and the Academic Deposits of the National Ministry of Human Physical Development. Along with these websites, MHRD has developed Diksha apps and channels and a number of initiatives to enhance online learning in India. 50%. Features like MOOCs online courses and digital libraries, research grants, enhanced student affairs, credits from MOOCs based on loans, and so on are executed to fulfil the highest quality programs in your class.

A comprehensive proposal for further growth of online training. This because of the recent emergence of epidemics and pandemics to maintain motivation with alternative quality formation when conventional teaching cannot be conducted anytime, anywhere. Special

divisions are established in MHRD to oversee the development of digital infrastructure, digital content and capacity structures to implement the e-educational needs of school and university development.

TECHNOLOGY IN EDUCATION

National Educational Technology Forum (NETF), a self-standing body, is established to encourage an open exchange of ideas with regard to technology use for enhanced learning, evaluation, planning and management. Masu. It effectively integrates technology into education at all levels, enhances classroom procedures, facilitates professional development for teachers, enhances access to disadvantaged groups, and maximizes education planning, management and management. Technology-focused education platforms like Diksha/Swayam are integrated more effectively into both school and university structure. University Institutions (HELs) are actively involved in the study of disruptive technology and learning material and course development, including online offerings in emerging areas. The emphasis on digital education in the guidelines actually serves to assist students from economically poor backgrounds initiating online formations at the top 100 universities to properly qualify those who are excluded from the education system.It appears to be a guideline to exclude.

The guidelines speak about the setting up of an autonomous company, the National Forum of Educational Technology (NETF), to advance enhancements in learning, assessment, planning, administration, and more for schools as well as universities. The guidelines don't address how digital divides and regional variations are removed. It doesn't describe that it aims to enhance the affordability and accessibility of the digital tools used for such training in rural settings.

OBJECTIVES OF THE STUDY

(1) To summarize the online education and education technology policy in National Educational Policy 2020.

(2) To enhancement of Online education and education technology in rural areas to implement National Education Policy 2020 effectively for its realization.

RESEARCH METHODOLOGY

The methodology entails a discursive discussion on emphasizing the essence of the national education policy framework, emphasizing different parts of the NEP 2020 policy.The data was gathered by semi-structured interviews, open-ended questions, and Phone call. The below questions were used to gather the data from participants.All the study participants are from a rural region (villages) of the Madurai district in Tamil Nadu. All the participants are undergraduates. Due to their stay in rural. 271 rural undergraduate students participated in this study. Convenience sampling is employed.

FINDINGS AND ANALYSIS

Table 1: Percentage Analysis of Rural students' perception on technology in education

Factors		Total No. of respondents	Number of respondents	Percentage
Availability of gadgets	Smartphone	271	247	91
	Desktop / Laptop		24	9
Cost of Gadgets	High	271	187	69
	Moderate		84	31
Network	Fiber optic internet	271	0	0
	Mobile data		271	100
Internet coverage	Interrupted	271	173	64
	Un-interrupted		98	36
Electricity supply	Interrupted	271	49	18
	Un-interrupted		222	82
knowledge to access web-based technology	Yes	271	127	47
	No		144	53
Interest to access web-based technology	Interested	271	241	89
	Not-Interested		30	11
Knowledge about educational platforms	Known	271	27	10
	Un-known		244	90
Time and space to access internet at home	Yes	271	149	55
	No		122	45
Digital literacy among parents	Literate	271	152	56
	Illiterate		119	44

Participants collected data, and data which were collected on analysis rates were evaluated. Participants viewed the affordability of the device as the largest barrier (n = 187, 69%), whereas other participants viewed the moderate barrier (n = 54, 31%). It was reported that 91% (n = 247) of participants make use of a smartphone for schooling. All of the participants utilized mobile data (100%; n = 271). Glass fibre internet connectivity is not present in rural areas. 64% of the respondents (n = 173) have patchy network coverage in their area. 82% of the respondents (n = 222) had uninterrupted power sources in their area. 47% of the respondents (n = 127) prefer to use technology in learning and are also aware of access to web-based technology. 89% (n = 241) of the participants are highly interested in knowing about web technology. 10% (n = 27) only know Swayam, Swayam Prabha and other learning platforms. The learning platform is not aware of a large number of respondents. The 149 (55%) who were interviewed had time and space to go online at home, whereas others had nowhere to go online at home. 56% of

parents (n = 152) employ smartphones, while others do not get to know one another by way of devices and their setups that are at least somewhat accustomed to male parents who have

devices and cellular technology. Parents know about devices and technology first and foremost.

Table- 2: Rural Students perception of technology usage frequency of software program

Programme	N	Mean	SD
Internet Browser	271	4.66	0.51
Word Processor	271	3.94	0.69
Power Point	271	3.26	0.90
Photo editing/sharing	271	3.0	1.01
Video editing/sharing.	271	2.65	1.07
Educational games	271	2.63	1.14
Video/Audio play	271	2.56	1.05
Work sheets	271	2.18	0.81

Rural students' perceptions of software program technology frequency:

Rural Students' view regarding the frequency of software program uses for technology Only Internet Browsers (like Chrome, Mozilla Firefox, were used by most ($\bar{x}$=4.66) of the participants. The word processor was used at least once a week ($\bar{x}$=3.94), whereas Power Point presentations were utilized ($\bar{x}$=3.26) rarely. Few ($\bar{x}$=2.18) of the participants used worksheets and spreadsheets, and younger people effectively utilized photo and video editing ($\bar{x}$= 3.0 &$\bar{x}$=2.65). Educational games also influence the students ($\bar{x}$=2.63) Audio/Video playback for learning was occasionally used ($\bar{x}$=2.56).

i) Participants were forced into rural areas in Madurai district of Tamil Nadu.
ii) This study could not rely directly on participants and rely on voluntary answers.

CONCLUSION

India is encouraging digital education. This will serve to encourage innovative skills among the students and youths in the country. This will revolutionize the Indian education sector and the government and authorities should encourage and facilitate young minds towards overall development and not towards learning. There are quite noticeable differences between the quality of education in the rural and urban regions of the nation. Compensations should be made in order to meet the quality of education across India so that there is equal fair and

equitable knowledge and fair opportunity for all. Particularly in the rural regions, better infrastructure should be generated. Since the government is putting its emphasis on e-education, efforts will have to be made to establish all the necessary facilities in rural regions.

Certain participants complained about the utilization of certain learning methods. For instance, if you happen to be at a given geographical point at a specific time, you might require a reputation for video and interactive television sessions. Certain participants were concerned with the economic effects of access and utilization of the Internet. The majority of individuals who have experience on the Internet have discovered major difficulties associated with access and continued support.

The issue was very prevalent in the countryside. Notwithstanding the difficulties, most respondents reported that in the future education and learning should happen via internet care, not just to make learning more enjoyable, but also to put newer technologies into practice. I was assured that it was "inevitable" (on the other hand, except for utilizing the advantages of new media provide (e.g. presentations) (e.g. World Wide Web). Even so-called simple technology like voicemail is the optimal. You do require some skill that can be utilized effectively to deliver remote lessons. The greater utilization of technology can offer distance learning students need, particularly academic and social assistance students' desire. The guidelines, there is no ultimate implementation plan that may give rise to misunderstanding and uniform use nationwide.

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The Evolving Role of MSME's in India S Viksit Bharat Vision for A Developed Economy

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Abstract

In the journey towards Viksit Rashtra, industries specifically Micro, Small, and Medium Enterprises (MSMEs) play an important role in driving economic growth while checking other dimensions of sustainability. This article delves into the role of MSMEs and their contribution as the agents of sustainability, and how the government schemes, technological advancements, and financial support can assist them in continuing doing so. By analyzing case studies across sectors such as textiles, automotive, agriculture, and IT, this work demonstrates how MSMEs have successfully adopted sustainable practices which can help in reducing the environmental damage and enhance economic competitiveness. The findings highlight the importance of government interventions, such as the Credit Linked Capital Subsidy Scheme (CLCSS) and the Technology and Quality Upgradation Support (TEQUP) scheme, in overcoming financial barriers and promoting energy efficiency, waste reduction, and social inclusivity. The cases necessitate policy tweaking and seamless execution of the same, and highlighting that MSMEs, when equipped with the right resources, can significantly contribute to India's sustainability agenda and global climate goals. India's path to a sustainable and developed future depends on a delicate balance between economic growth, social equity, and environmental protection. These are the three pillars of sustainability that are also underpinned by the United Nations' Sustainable Development Goals (UN SDGs), a global blueprint to achieve a better and more sustainable future. As India strives toward the ambitious Viksit Bharat@2047 vision, which includes each aspect of sustainability, aiming to transform the country into a fully developed and inclusive economy by its 100th year of independence, MSMEs have turned up as key contributors to this sustainable future.

Keywords: MSME, SDG, Sustainability, Viksit Bharat

INTRODUCTIION

Human progress is a continuous interaction of dreams and reality. Our ability to imagine a better world and turn those visions into tangible outcomes has driven this civilization forward. In this context, sustainability has emerged as a guiding principle, balancing economic growth with environmental preservation. For Bharat or India, a nation with immense cultural heritage, diversity and ambition, the transition to a developed economy sustainably is a monumental task, one that requires the active participation of every sector, particularly MSMEs. MSMEs, comprising over 63 million enterprises, are the lifeblood of India's economy, contributing significantly to employment, exports, and Gross Domestic

Product (GDP). These industries are engaged in production, manufacturing, processing, preservation and even promotion of Khadi and Village goods. Yet, their role extends beyond economics. These enterprises are critical to achieving India's net-zero goals due to their substantial collective environmental impact. They are spread evenly across urban and rural parts of the nation and also involve socially vulnerable groups and women as the owners. The challenge lies in transforming MSMEs from passive participants into active drivers of sustainability.

The journey toward sustainability has taken centre stage in global economic discussions, particularly in developing nations. For India, MSMEs contribute nearly 30% to the country's GDP, 40% of total exports and 45% to its manufacturing output [3]. MSMEs employ over 120 million of the nation's workforce and are integral to the socio-economic fabric of the nation. However, their widespread operations across resource-intensive industries also mean that they are key contributors to environmental degradation. It should come as no surprise that industries are a big reason for pollution. There are as many as 200 energy intensive manufacturing clusters in India. Not to mention that India ranks very highly on the presence of PM 2.5 in atmosphere [9]. Our capital city is well known for being in headlines for the notorious air pollution alongside several cities of China, but multiple cities, hosting the clusters of small industries are now going through the same problem. Our MSMEs energy usage is equivalent to 50 million metric tonnes of oil per year. There is still a heavy dependence on fossil fuels, primarily coal. Vulnerability of these industries is such that whenever a disaster strikes, they are affected in the worst possible manner. During Covid-19 crisis, almost 70 percent of these industries closed. These types of pauses can lead to serious disruption in the supply chains as well as in the prices of goods.

MSMEs are essential to the nation's economic growth, as they create employment, and promote regional economic development. However, despite their importance, they face numerous challenges in adopting sustainable practices, like financial constraints and affordable green technology [7]. The government has launched several programs, such as the Zero Defect Zero Effect (ZED) scheme, to help MSMEs reduce their carbon footprint and integrate themselves into sustainable global supply chains [10]. In line with the abovementioned things, this article provides a deeper understanding of how MSMEs can become active participants in India's sustainability agenda through examples and other suggestions.

CASE STUDY

This section analyses some of the successful cases from Indian MSMEs, which are working towards the goal of sustainable and Viksit Bharat. To gather data and review case study we have utilised various scholarly literature and here we are highlighting the few case studies.

Sustainable Contributions of MSMEs in Pune

The case study that we are looking at here examines the sustainable initiatives undertaken by selected MSMEs in Pune. For this we looked at MSMEs with a focus on their contribution to the SDGs. By integrating sustainable practices into their business models, these MSMEs have

demonstrated how small enterprises can drive impactful change in environmental stewardship while maintaining economic profitability. These MSMEs have adopted several innovative approaches to sustainability, from water conservation to energy-efficient technologies. The case studies explored in this research illustrate how these enterprises not only comply with environmental regulations but also go beyond compliance to actively promote sustainability.

These practices contribute to the SDGs, specifically SDG 6, SDG 7, and SDG 12. Water Conservation by ME Energy ME Energy, which is a heavy engineering company based in Pune, has implemented significant water conservation measures. Earlier, they faced challenges of water scarcity in the region; to overcome that, the company built a water retention wall and implemented techniques to capture rainwater runoff. This initiative has led to the replenishment of groundwater levels, which benefited both the company and the surrounding communities. These efforts closely align with the SDG 6's target 6.5, whose one of the targets is sustainable water management.

Karur District MSMEs: A Hub of Economic and Social Progress The Karur district of Tamil Nadu is known for its emerging MSMEs, particularly in the textile, engineering, and home furnishing sectors. These MSMEs are important to the local economy, they provide employment opportunities and contribute to [6]. These MSMEs employ a significant portion of the local population, with 45% of the district's manufacturing output and 40% of exports being generated by these enterprises [6]. The region's textile industry, in particular, has gained global recognition for producing high- quality home textiles, which are exported to international markets. This contribution greatly aligns with India's goal of increasing exports and strengthening its position in the global market.

In addition to economic growth, Karur's MSMEs have played a crucial role in social development. By providing jobs to thousands of local residents, reducing poverty and improving the standard of living in the region. They have adopted inclusive employment practices by hiring marginalised groups and ensuring gender diversity in the workforce. By doing so, they contribute to the SDGs of reducing inequality and promoting decent work and economic growth [6]. The region benefits from MSME-driven social initiatives like improving infrastructure and offering fair wages to rural workers [6].

Women-Led MSMEs: Empowering Women and Driving Inclusive Growth Women led MSMEs in India have become a powerful force in promoting gender equality and driving socio-economic development. These enterprises, particularly in rural areas, empower women by providing them with entrepreneurial opportunities, helping them to contribute significantly to household incomes and community development. The FICCI Ladies Organisation (FLO) has been a key player in supporting and encouraging women entrepreneurs across diverse sectors [2].

The FLO Compendium of 100 Success Stories of Women in MSME highlights several inspiring women entrepreneurs who have successfully established businesses in various sectors, for example textiles, handicrafts, technology, and food processing. These women not just only create jobs within their communities but also contribute to the national economy by

producing goods that are culturally rooted and in demand both domestically and internationally. For instance, enterprises like Aarohana Eco Social Developments have pioneered sustainable practices by producing eco-friendly products, which helps in preserving India's cultural heritage while progressing towards economic growth [2].

Women-led MSMEs have benefited from government schemes, such as the Prime Minister Employment Generation Programme (PMEGP) and the Stand-Up India initiative, which provide financial assistance and training to aspiring women entrepreneurs. Organisations like the Federation of Indian Women Entrepreneurs (FIWE) offer mentoring and networking opportunities, which supports women in scaling their businesses and integrating into global value chains [11]. These efforts align with SDG 5 and SDG 8 [2].

Maharashtra MSMEs: Innovation and Regional Growth [5]

Maharashtra is one of India's leading states when we talk about industrial development. The MSME sector in Maharashtra is highly vibrant, which contributes significantly to both industrial output and employment. These enterprises, particularly in the Konkan and Vidarbha regions, have demonstrated innovation in sectors such as agro-processing, manufacturing, and technology, driving regional economic balance and growth [5].

As per a data from 2013, there were 181,119 registered MSMEs in Maharashtra, providing employment to 23.36 lakh individuals. These enterprises contribute extensively to the state's economy, especially in terms of employment generation. Regional disparities exist, with Western Maharashtra accounting for the largest share of MSMEs at 41.45%, followed by the Konkan region with 26.49%. Despite these regional differences, MSMEs remain pivotal to Maharashtra's industrial and economic ecosystem [5].

Adding to their economic contributions, these MSMEs in the state have helped to reduce regional disparities by promoting industrialisation in rural and semi-urban areas. This decentralisation of industries supports balanced regional development and provides livelihood opportunities, mitigating the challenges of unemployment and migration. The Vidarbha region, for example, contributes 13.60% of the state's MSMEs, which significantly boost local employment [5].

Sustainable MSMEs: Environmental Practices in Action

The ongoing adoption of sustainable practices by MSMEs is essential to balance economic growth with environmental responsibility. Many MSMEs in India have adopted eco- friendly production techniques which focus on minimising environmental impact while maintaining profitability [1].

Some of the good examples of sustainable MSMEs can be seen in the renewable energy and green products sectors. MSMEs operating in solar energy, waste management, and organic farming are driving innovations which help reduce dependency on fossil fuels and enhance resource efficiency. These enterprises contribute significantly to the SDGs, particularly SDG7, SDG 13, and SDG 11

The Surat Textile and Diamond Processing Industry

One interesting case is that of Surat. The city is one of the oldest textile and diamond processing and trading hubs in the nation. Industrial development of this city is dependent on these units and petrochemical plants. But the ecological damage has been sustained due to this, with air quality taking a major hit. The presence of inefficient small boilers and coal to produce energy are cited as the major reason for the emission of Particulate Matters. Furthermore, the absence of Air Pollution Control Devices is widespread among the plants. A study by the World Resource Institute predicted that installation of efficient units along with control devices can reduce the pollution in the cluster by 70%.

Broader Implications for Policy and Practice

The integration of sustainability into MSME operations can provide these enterprises with a competitive edge in an increasingly eco-conscious global economy. Green certifications, such as ISO 14001, and the adoption of energy-efficient technologies and circular economy principles can help MSMEs access new markets, compete globally and enhance their reputation with environmentally conscious consumers and businesses [12]. The social effect of this will also be felt, especially when there is a promotion of self-employment and entrepreneurship in the Viksit Bharat plan. The World Bank states the economic losses associated with air pollution to be significant for India, showcasing the need to prioritise the actions-based approach and equipping MSMEs to limit the problem.

Another plan could be to design a model and figure out the variables, which can help in ranking different units across the nation based on their performance and effort in the sustainable direction. This approach can help in incentivizing those working and motivate others to do the same.

Lack of data is a major challenge to evaluate the energy consumption and emissions, with a large number of units not monitoring their fuel consumption. Awareness regarding the simple automations and productivity boost due to reduced energy use can work in everyone's favour. Multiple studies voice out the similar challenges. Many small businesses avert from the technical adoption of better practices due to above stated reasons. There exist many plans to assist industries with their conversion to clean energy measures. However localisation and execution of these plans is still an issue. This shows why the goal of good governance is necessary to be there in Viksit Bharat. Pollution control boards, specific ministries and development authorities can address this issue by forming cluster-specific'Resource Efficiency Plans' to address the environmental concerns of small-scale industries [9]. These cases have also shown that many simple and basic changes can make the overall process more efficient and environment friendly, and it just needs a basic pushover to do so.

CONCLUSION

The journey of MSMEs toward sustainability offers crucial lessons for India's Viksit Bharat aspirations. As demonstrated by the cases, MSMEs can become drivers of sustainability through targeted government support, access to finance, and innovative practices. The

successful adoption of energy-efficient technologies, circular economy principles, and socially inclusive practices in sectors such as textiles, automotive, agriculture, and IT underscores the economic and environmental benefits of sustainable transitions. Government schemes like CLCSS, TEQUP, MSE-GIFT and MSE-SPICE have been instrumental in providing the financial backing necessary for MSMEs to make sustainable investments, while green financing schemes have enabled enterprises to adopt energy- efficient technologies. Moreover, the integration of circular economy principles can be economically viable [8]. The social impact of sustainability, powered by the EDSP scheme, highlights how MSMEs can contribute to inclusive growth. The organic farming enterprise in Maharashtra exemplifies how sustainability and social development can coexist, providing employment opportunities and promoting gender equality.

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Problems Faced By Women Entrepreneurs in the Fast-Food Industry in Kerala

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Abstract

Women entrepreneurship plays a pivotal role in fostering economic development, reducing gender disparities, and promoting social empowerment. This study explores the challenges faced by women entrepreneurs in Kerala's fast-food industry. The study follows a descriptive research design with a sample size of 68 women entrepreneurs managing fast-food hotels. The findings of the study revealed that financial constraints remain the most significant challenge due to limited access to credit, collateral demands, and high-interest rates. Health-related issues, driven by long working hours and stressful working conditions, also pose substantial risks. Cultural expectations, coupled with societal norms, limit women's entrepreneurial potential, while work-life balance struggles and gender bias further compound the problem.The study concludes that empowering women entrepreneurs through financial support, skill development, technological integration, and gender-sensitive policies can unlock their full potential. Such initiatives would not only enhance their business success but also contribute to the broader socio-economic development of the region.

Keywords: Economic Development, Fast-Food Industry, Financial Constraints, Women Entrepreneurs

Introduction:

A woman entrepreneur is an individual who takes on challenging roles, driven by the desire to fulfill personal aspirations, achieve economic independence, and contribute meaningfully to society. She demonstrates leadership, innovation, and resilience while managing the complexities of business operations. Women entrepreneurs play a pivotal role in the country's socio-economic development by driving innovation, creating jobs, and contributing to GDP growth.India has witnessed a remarkable increase in the number of entrepreneurs over the past decade. From running small home-based businesses to leading large enterprises, Indian women are transforming various sectors such as technology, retail, agriculture, and services.This surge is fueled by several factors, such as increased access to

education, supportive government policies, and the rise of digital platforms enabling businesses to scale without the need for significant physical infrastructure.

Kerala, where women entrepreneurs excel in diverse sectors such as handicrafts, agro-based industries, food processing, and tourism etc. Their ventures often blend traditional skills with modern entrepreneurial practices, creating unique products and services that cater to both local and global markets. Supported by initiatives like Kudumbashree, Kerala Startup Mission (KSUM), and other state programs, these women are overcoming challenges such as limited capital, societal expectations, and market competition. Kudumbashree has significantly impacted women's entrepreneurship in Kerala. The fast-food industry is a highly competitive and dynamic sector characterized by evolving consumer preferences, intense competition, and operational complexities. While this sector offers immense business potential, women entrepreneurs in this field often encounter specific challenges related to socio-cultural norms, limited access to resources, and operational constraints. The fast-food sector in Kerala, with its growing demand and evolving consumer base, presents both opportunities and hurdles for women entrepreneurs. However, limited research has been conducted to explore the unique challenges faced by women in this industry. The present study explore the problems faced by women entrepreneurs in the fast-food industry in Kerala.

Review of literature

(Kabahinda et. al., 2024)investigated the impediments to the growth of businesses owned by women in a developing country, specifically Uganda. The researchers utilized random sampling to select 13 women entrepreneurs. The study identified several significant challenges that women entrepreneurs face, includingCompetition from male-dominated market, Financial Challenges, Discrimination and Harassment, LimitedFamily support, etc. The study suggested that empowering women through training and improved access to financial resources is essential for enhancing their entrepreneurial capabilities. **(Senthilkumar, 2024)**examined the problems and challenges of women entrepreneursin Tamil Nadu. The study identified various challenges that women entrepreneurs encounter, which include limited access to finance, lack of training and mentorship, societal norms, and balancing family responsibilities.The study concluded that despite the existing government schemes and empowerment programs, there is a significant need for enhanced support to women entrepreneurs. **(Rupamoni,2024)** examined the difficulties encountered by female entrepreneurs in India.The study highlighted the role of education and awareness in empowering women. Awareness of the challenges and providing educational resources, women can be better equipped to navigate the entrepreneurial landscape. The study also noted that, despite a rise in entrepreneurial activities in India, the participation of women remains disproportionately low.The paper concluded that despite progress towards gender equality, female entrepreneurs in India continue to face significant barriers. **(Ahmed et al., 2019)** conducted a case study on the entrepreneurial journey of three sisters in Bangladesh, highlighting how they achieved success despite facing various socio-cultural challenges. The study examined the constraints imposed by traditional practices, customs, and religious beliefs that limit women's access to economic and socio-cultural rights. It concluded that the sisters' entrepreneurial success were influenced by factors such as access to resources, peer

support, political pressure, and a strong need for achievement.**(Deivanai, 2014)**identified the challenges faced by fast food entrepreneurs in Madurai. The researcher collected data from 150 fast food entrepreneurs. The study indented the major problems such as Financial Deficiency, Lack of Education, Non-awareness of Government Scheme, Lack of proper training, Lack of systematic planning and working, Health problem etc.**(Gunasekaran&Suryamoorthi, 2023)** identified the problems faced by women entrepreneurs in Coimbatore city. The researcher used a descriptive research design and collected data from 120 respondents by usingconvenience-sampling method. The researcher identified the problems such as Poor funding prospectus, Lack of industrialknowledge, Lack of safety, Lack of social &institutional support, and Lack of mobility.

Numerous studies have explored the challenges faced by women entrepreneurs across various sectors, limited research has specifically examined challenges faced by women entrepreneurs in the fast-food industry. Therefore, the researcher aims to explore the problems faced by women entrepreneurs in Kerala's fast-food sector.

Objectives of the study:

- To identify the major challenges faced by women entrepreneurs in the fast-food industry in Kerala.
- To examine the socio-demographic profile of the respondents.

Research methodology:

The study employs a descriptive research design to investigate the problems faced by women entrepreneurs in the fast-food industry in Kerala. This design helps provide a detailed understanding of the challenges encountered by women entrepreneurs operating fast-food businesses. The primary data collected through structured questionnaires and personal interviews with women entrepreneurs in fast-food hotels. Sample Size of the study includes 68 women entrepreneurs managing fast-food hotels. The researcher used Convenience sampling method for collecting the primary data. The data collection was conducted in Calicut district, Kerala, where the fast-food industry has a significant presence. Secondary data obtained from published reports, government records, industry publications, and relevant academic literature etc.

Result and Discussion:

Table 1 Demographic Profile of the sample respondent

Items		**Frequency**	**Percent**
Age	Below 25	7	10%
	26-40	19	28%
	41-60	28	41%
	Above 60	14	21%
	Total	***68***	***100%***

Area	Urban	36	53%
	Semi-Urban	18	26%
	Rural	14	21%
	Total	***68***	***100%***
Daily Income	Below 500	12	18%
	501 – 1,000	23	34%
	1,000-1,500	13	19%
	1501-2,000	16	23%
	Above 2,000	4	6%
	Total	***68***	***100%***
Marital Status	Single	7	11%
	Married	41	60%
	Divorced	9	13%
	Widowed	11	16%
	Total	***68***	***100%***
Time Spent on Business Operations	Less than 4 hours	6	9%
	4-6 hours	23	34%
	7-9 hours	28	41%
	10 hours or more	11	16%
	Total	***68***	***100%***
Number of Employees	1-2 employees	21	31%
	2-5 employees	39	57%
	More than 5 employees	8	12%
	Total	***68***	***100%***

(Source: Computed from primary data)

Table 1 represents, the demographic profile of the sample respondents of women entrepreneurs in Kerala's fast-food industry. The majority of respondents (41%) are in the age group of 41-60 years, indicating that mid-career entrepreneurs dominate this sector. The next significant group is 26-40 years (28%), reflecting active participation from younger entrepreneurs. Based on the area of business operation, most respondents operate businesses in urban areas (53%), indicating that fast-food ventures thrive in urban settings due to better market access and consumer demand. Semi-urban (26%) and rural (21%) areas also contribute, highlighting a growing trend of entrepreneurial ventures extending beyond cities.

The majority (34%) of women entrepreneurs earn a daily income of □ 501-□ 1,000, reflecting moderate profitability. A significant portion earns □ 1,500-□ 2,000 (23%), indicating varied

income levels depending on business scale and location. Only 6% earn above □ 2,000 daily.Based on the marital status, most respondents are married (60%), 13% are divorced, and 16% are widowed, indicating that entrepreneurship provides financial independence and empowerment, even in challenging personal circumstances. Based on the Time Spent on Business Operations, 41% of respondents work 7-9 hours daily, 34% dedicate 4-6 hours, likely balancing household and business duties simultaneously. Most businesses (57%) employ 2-5 employees, indicating the predominance of small-scale enterprises. Around 31% operate with only 1-2 employees, reflecting the micro-enterprise nature of many fast-food businesses.

Table 2 Problems faced by women entrepreneurs in the fast-food industry in Kerala

Variables	Rank
Financial Constraints	1
Balancing Work and Family Responsibilities	4
Market Competition	6
Cultural and Social Barriers	3
Legal and Regulatory Challenges	7
Health Issues	2
Safety Issues	8
Gender Bias and Discrimination	5
Limited Marketing and Promotion	9
Access to Technology	10

(Source: Computed from primary data)

Table 2 represent the problems faced by women entrepreneurs in the fast-food industry in Kerala. Financial difficulties emerge as the most critical issue, reflecting challenges in securing startup capital, working capital, and access to credit. This may stem from limited collateral, high-interest rates, and complex loan processes. Health problems rank second, indicating the physically demanding nature of fast-food businesses, including long working hours, exposure to heat, and stress related to managing daily operations. Cultural expectations and societal norms ranked as third. Managing both business and household responsibilities is a critical challenge and ranked as fourth position. This reflects the dual roles many women play, often with minimal support from family or society. Gender Bias and Discrimination ranked fifth, indicating unequal treatment in accessing funding and market opportunities. Market Competition ranked sixth, as intense competition from established businesses and new entrants limits business growth. Legal and Regulatory Challenges ranked seventh, involves licensing issue, tax compliance, and food safety regulations. Safety Issues ranked eighth, concerning workplace security and risks faced by women working late hours. Limited

Marketing and Promotion ranked ninth, showing a lack of marketing expertise and budget constraints that hinder business visibility. Access to Technology ranked tenth, indicating limited use of advanced tools and online platforms essential for modern business operations.

Conclusion and Suggestions:

The fast-food industry in Kerala has emerged as a promising entrepreneurial space, offering women a pathway toward financial independence and social empowerment. However, the journey of women entrepreneurs in this sector is fraught with numerous challenges that hinder their growth and long-term sustainability. This study examined critical issues faced by women entrepreneurs, ranked by severity, including financial constraints, health problems, cultural and social barriers, work-family balance struggles, and gender discrimination. Financial difficulties rank highest, indicating limited access to capital and credit facilities. Health issues are also significant due to long working hours and the physically demanding nature of the business. Balancing work and family responsibilities and gender discrimination further complicate their entrepreneurial journey. From the above findings and conclusion following suggestions will be offered for improving the current situation. If possible government can direct the banks to provide financial assistance to women entrepreneurs to reduce the time lag for financing them and also the existing procedures and formalities for submission of documents are to be simplified by the banks. Efforts should be taken to build confidence in the minds of the women entrepreneurs the district level association of Kudumbasree units come forward to conduct Special personality development session exclusively for women can be arranged. Necessary steps should be taken to give training to women students to develop a set of entrepreneurial skills needed to start a venture. The DICs of Government of Kerala can play a important role in this respect. Women entrepreneurs in Kerala's fast-food industry show remarkable resilience and determination, they continue to face multifaceted challenges that require targeted interventions from stakeholders, including the government, financial institutions, and civil society. Policy reforms focusing on financial support, health and safety measures, skill development, gender equality, and technological integration are essential. Empowering women entrepreneurs can unlock their full potential, contributing significantly to the economic development of Kerala and fostering an inclusive entrepreneurial ecosystem.

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Computational Toxicology in Green Chemistry: A Path to Safer Innovations

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Abstract

Green Chemistry is a transformative approach aimed at reducing or eliminating hazardous substances in chemical processes to ensure sustainability and environmental safety. This study highlights the principles and importance of Green Chemistry, focusing on eliminating hazards instead of controlling exposure to minimize risks. Computational toxicology, a key part of Green Chemistry, uses *in silico* methods to predict chemical toxicity. These methods, including OSIRIS Property Explorer, LAZAR, and Weka-based machine learning models, offer cost-effective and efficient alternatives to traditional *in vivo* and *in vitro* toxicity testing. The study assesses the reliability of these tools by comparing their predictions with experimental toxicology data. OSIRIS effectively identified mutagenic, tumorigenic, and irritant properties in known toxic chemicals, while LAZAR proved reliable in predicting carcinogenic and mutagenic risks. The Random Forest model in Weka delivered highly accurate classifications, highlighting the potential of machine learning for chemical risk assessment. The findings emphasize the vital role of computational toxicology as a Green Chemistry approach for early identification of toxic effects, enabling safer chemical design and promoting sustainable development.

Key Words: Weka, *in silico*, Random Forest,toxicity, Green Chemistry

1. Introduction

1.1 Green Chemistry - A New Horizon of Science

Modern chemistry enhances society by improving our quality of life, boosting agricultural productivity, purifying drinking water, and developing life-saving drugs and pharmaceuticals. Equally important, it provides the tools to explore the vast wonders of the universe. However, producing various chemical products requires feedstocks, catalysts, and solvents, many of which pose significant risks to human health, ecosystems, and the planet. While chemistry offers numerous benefits, it also presents the challenge of managing hazardous byproducts responsibly.During the second half of the 20^{th} century, a series of global environmental disasters dispelled the illusion of environmental safety. The harmful effects of reckless pesticide use on ecosystems were exposed years ago.Meanwhile, environmental education began to spread, raising awareness of the collective toxic effects of chemicals in the environment. As understanding deepened, the hazardous impacts of these substances became more widely recognized.Some of the most well-known environmental disasters from the past few decades include:

- **Minamata Disease, Japan** – Caused by the release of methylmercury in industrial wastewater from a chemical factory, contaminating the water supply from 1932 to 1968.
- **Cuyahoga River Fire, Ohio** – Due to extreme chemical pollution, the river became so contaminated that it caught fire multiple times.

- **Seveso Disaster, Italy (1976)** – An accidental release of toxic chemicals, including dioxin, led to the death of farm animals and long-term health issues for many residents.
- **Love Canal Incident, Niagara** – In the 1940's and 50's, nearly 22,000 tons of hazardous chemical waste, including polychlorinated biphenyls (PCBs), dioxin, and pesticides, were dumped in the area by the Hooker Chemicals and Plastics Corporation, leading to severe environmental and health consequences.
- **Bhopal Gas Tragedy, India (1984)** – A catastrophic gas leak at the Union Carbide plant released methyl isocyanate, resulting in the deaths of nearly 4,000 people and long-term health effects for thousands more.
- **Three Mile Island Accident, USA (1979)** – A partial meltdown at the Three Mile Island nuclear power plant in Pennsylvania led to the release of radioactive gases, raising concerns about nuclear safety.
- **Endosulfan Tragedy, Kerala, India** – The aerial spraying of the highly toxic pesticide endosulfan over cashew plantations for years caused severe health issues, including congenital disabilities, cancer, and neurological disorders in local communities.
- **Chernobyl Disaster, Ukraine (1986)** – A nuclear reactor explosion at the Chernobyl power plant released massive amounts of radioactive material into the atmosphere, causing long-term environmental damage and severe health consequences.

1.2 Major environmental laws

Treatment and remediation were the keysto environmental techniques. Almost all major environmental laws since the 1970 Clean Air Act (US) dealt with pollution control and gave priority to waste management. The 'End of the pipe' approach to pollution control focused on capturing rather than avoiding/reducing the toxic materials. The laws only dealt with how to control the pollutants after it is formed.Thus, chemists have been blamed for the generation of pollutants as well as for the failure in effective handling of the pollutants. Acts of the US EPA, Montreal Protocol to Protect the Ozone Layer, Global Treaty on Persistent Organic Pollutants, Rio Declaration of Environment and Development, and Kyoto protocol are the major environmental laws. Shortly after the passage of the Pollution Prevention Act of 1990 (US), the Office of Pollution Prevention and Toxics (OPPT), US explored the idea of developing new or improving existing chemical products and processes to make them less hazardous to human health and the environment by preventing pollution. This paved the way for the birth of **Green Chemistry**.

Treatment and remediation were the primary environmental techniques used for pollution control. Almost all major environmental laws since the 1970 Clean Air Act (US) prioritized waste management and focused on controlling pollution. The **"end-of-the-pipe"** approach to pollution control aimed at capturing pollutants rather than preventing or reducing their formation. As a result, these laws primarily addressed how to manage pollutants after they were produced, rather than eliminating them at the source. Consequently, chemists were often blamed not only for generating pollutants but also for the failure to handle them effectively.

Several significant environmental agreements and regulations have since been introduced, including the US EPA Acts, the Montreal Protocol to Protect the Ozone Layer, the Global Treaty on Persistent Organic Pollutants, the Rio Declaration on Environment and Development, and the Kyoto Protocol.

Following the passage of the Pollution Prevention Act of 1990 (US), the Office of Pollution Prevention and Toxics (OPPT) explored ways to develop new or improve existing chemical products and processes to make them less hazardous to human health and the environment by preventing pollution at its source. This initiative ultimately led to the birth of Green Chemistry.

1.3Importance of Green Chemistry

Instead of limiting Risk by controlling Exposure, Green Chemistry aims at reducing or rather eliminating the Hazard thus opposing the necessity to control Exposure. If we donot produce or use a hazardous substance during a manufacturing process the Risk is zero which does not require any treatment.

The credit for establishing the field of Green Chemistry goes to Paul T. Anastas, who introduced this concept during his tenure at the U.S. Environmental Protection Agency (EPA). He served as the Chief of the Industrial Chemistry Branch and later as the Director of the Green Chemistry Program. According to Anastas, Green Chemistry is *"the invention, design, and application of chemical products and processes to reduce or eliminate the use and generation of hazardous substances."*

Green Chemistry is crucial because it focuses on sustainability at the molecular level, ultimately leading to more environmentally friendly products and processes. The global adoption of Green Chemistry is essential as it serves as a pathway to both economic and environmental prosperity.

The philosophy of Green Chemistry promotes the redesign of chemical processes to prevent the use or production of hazardous substances. The negative perception of chemists as polluters and destroyers of the planet must be changed. While chemistry has significantly improved the quality of life, it must also play a key role in environmental preservation. Green Chemistry seeks to minimize or eliminate hazardous substances in chemical processes, including feedstocks, reagents, solvents, products, and byproducts. It also advocates for the use of sustainable raw materials and energy sources in manufacturing.

By focusing on hazard reduction, Green Chemistry eliminates risks at the source, thereby reducing potential consequences. The risk associated with any substance is defined as a function of hazard and exposure:

$$\text{Risk} = f(\text{Hazard}, \text{Exposure})$$

Instead of merely controlling exposure to limit risk, Green Chemistry aims to reduce or eliminate the hazard itself, thereby negating the need for exposure control. If a hazardous substance is neither produced nor used during a manufacturing process, the risk becomes zero, eliminating the need for costly treatments or remediation.

1.4Twelve great principles of Green Chemistry

1. Prevention: It is better to prevent the creation of waste than to treat or clean it up after it has been generated.

2. Atom Economy: Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product, minimizing waste.

3. Less Hazardous Chemical Syntheses: Whenever possible, synthetic methods should be designed to use and generate substances with minimal toxicity to both human health and the environment.

4. Designing Safer Chemicals: Chemical products should be designed to perform their intended function while minimizing their toxicity and potential harm.

5. Safer Solvents and Auxiliaries: The use of auxiliary substances, such as solvents and separation agents, should be made unnecessary whenever possible, or at least non-toxic when used.

6. Design for Energy Efficiency: Energy requirements for chemical processes should be minimized, considering both environmental and economic impacts. When possible, processes should be conducted at ambient temperature and pressure to reduce energy consumption.

7.Use of Renewable Feedstocks: Raw materials or feedstocks should be renewable, rather than depleted, whenever technically and economically feasible.

8. Reduce Derivatives: Unnecessary derivatives, such as blocking groups or temporary modifications of physical or chemical processes, should be minimized or avoided, as they often require additional reagents and generate waste.

9. Catalysis: Catalytic reagents, especially those that are as selective as possible, should be preferred over stoichiometric reagents to reduce waste and improve efficiency.

10. Design for Degradation: Chemical products should be designed to break down into non-toxic, harmless degradation products at the end of their life cycle, preventing persistence in the environment.

11. Real-time Analysis for Pollution Prevention: Analytical methodologies must be developed to allow for real-time, in-process monitoring and control, enabling the prevention of hazardous substances before they are formed.

12. Inherently Safer Chemistry for Accident Prevention: Substances and their forms used in chemical processes should be carefully chosen to minimize the potential for accidents, including chemical releases, explosions, and fires.

2. Materials and Methods

One of the primary goals of Green Chemistry, according to the Environmental Protection Agency (EPA), is to prevent the generation of toxic chemical waste and avoid using hazardous chemicals in chemical syntheses.[1]This approach is essential for conserving Earth's resources and plays a crucial role in the process of environmental de-pollution.

Toxicology is the study of the adverse effects of chemicals on living organisms, while computational toxicology is a rapidly growing field that integrates data from various sources to assess chemical safety. With the increasing demand for rapid safety assessments by industries and regulatory agencies worldwide, *in silico* methods have emerged as practical alternatives for environmental hazard assessment.[2]

Unlike traditional *in vivo* (animal-based) toxicity testing and *in vitro* (lab-based) methods, *in silico* techniques are considered more cost-effective and efficient for assessing chemical toxicity. These methods generate predictions for the toxicity of untested or even unsynthesized compounds, reducing both the time and cost associated with traditional toxicity assessments.

*In silico*methods use advanced technology to evaluate the potential risks of hazardous pollutants to human health and the environment. Tools such as OSIRIS, preADMET, and LAZAR (Lazy Structure-Activity Relationships) are commonly used to predict the toxicity of selected chemicals[3]. Additionally, the application of Weka, a machine learning software used for data mining, further enhances the predictive capabilities in toxicity assessment.

3.Objectives

The objective of this study is to evaluate the reliability and effectiveness of computational toxicology software by comparing in silico predictive modeling results with experimentally determined toxicological data for various toxic chemicals. By examining the alignment between experimental data and computational predictions, this study aims to assess the utility of these software tools, both individually and in combination. The ultimate goal is to provide insights into the capabilities and limitations of computational technologies for predicting toxic effects, thereby contributing to the advancement of *in silico* toxicology as a viable approach in chemical risk assessment.

4.Results and Discussion

The OSIRIS Property Explorer can be used to predict the molecule’s potential mutagenic, tumorigenic, reproductive, or other risks. To assess the toxicity prediction's consistency, we ran a set of toxic natural chemicals and a set of most probably non-toxic natural chemicals through the prediction. The result shows that all the toxic natural chemicals were found to bear a high or medium risk of being mutagenic, tumorigenic, irritant or reproductive effective and all non-toxicnatural chemicals were predicted to be safe. *Estragole*, which is a toxic compound was found to be mutagenic, tumorigenic and irritant by OSIRIS prediction. Another compound *aristolochic acid* was also predicted as mutagenic and tumorigenic. But *curcumin* showed no sign of any of these toxic properties. Thus,OSIRIS correctly predicted toxic chemicals as being poisonous and non-toxic as secure chemicals.LAZAR is a new tool for the prediction of toxic properties of chemical structures.

LAZAR toxicity shows that the toxic chemicals were either carcinogenic or mutagenic. *Pulegone* was found to be carcinogenic and aristolochic acid showed carcinogenic

and mutagenic properties.Finally, a model for toxicity was built by applying the data mining technique based on the software,Weka.

PowerMVsoftware was used to generate descriptors necessary for the prediction of the toxicity of selected compounds.Then Weka is used for classification. Different models such as Bayesnet, Naïve-Bayes, Decision table and Random Forest are available. Of these,in this studyRandom Forestis used, since the models on Random Foresthave highprediction accuracy and provide information on the importance of variables for classification.[4]With this model (Random Forest) all the natural toxic chemicals and non-toxic chemicals were screened and from the confusion matrix obtained, all the toxic compounds were predicted as toxic.

Conclusion

The study evaluates the reliability and effectiveness of computational toxicology software by comparing in silico predictive modelling results with experimental toxicological data. Tools like OSIRIS Property Explorer, LAZAR, and Weka-based machine learning models were used to predict toxicological risks for various chemicals. Results showed OSIRIS accurately identified mutagenic, tumorigenic, and irritant properties for known toxic compounds, while LAZAR identified carcinogenic and mutagenic properties. A Random Forest model in Weka provided highly accurate predictions. The study highlights the potential of in silico tools for chemical risk assessment but also highlights limitations and opportunities for advancement.Thus, *in silico* methods are green chemistry strategies which can be used for the identification of toxic effects of chemicals at an early stage of product development.

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Butterfly-Host Plant Dynamics in Malachira: Unveiling Biodiversity in a Watershed Ecosystem

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Abstract
As pollinators and seed dispersers, among other interactions with the environment, butterflies are important to ecosystems. The distribution and number of these amazing animals are likewise reliant on the plants, since their adults and caterpillars rely on them for sustenance.To identify several common butterflies and their host plants, the current investigation was conducted in the Malachira, a watershed area in Pulimath Panchayath. In all, 41 butterfly species from various families, including the Papillionidae, Nymphalidae, Lycaenidae, Hesperiidae, and Pieridae, as well as their host plants, were found in the area. The conservation of these delicate insects is crucial for the preservation of the habitat variety of a given area since butterflies can be regarded as bio indicators because their caterpillars are unique to the plants they eat.

Keywords: Species; Western Ghats; bioindicators; nomenclature;nectar plants

INTRODUCTION

Because of their aesthetic value and ecological significance, butterflies are a widely researched group worldwide (Ghazoul, 2002). Because they are relatively conspicuous and more interesting to humans than most other insects due to their size and coloration, butterflies play a crucial role in ecosystems and are the ideal population of organisms for studying insect phenology (Sparks, 1997).The bulk of butterfly species in India are found in the Himalayas, the north-eastern hills, and the Western Ghats. There are currently about 1.5 million known animal species, of which 140,000 are butterflies and moths. They have gained a position in the poetry and prose of many cultures due to their allure and popularity. They aid in the development of conservation plans since they are reliable indicators of seasonal and biological changes as well as climatic conditions. As vital pollinators, crucial elements of the food chain, excellent markers of environmental quality, co-evolving insects and plants, skilled colonists of novel habitat types, etc., they are economically significant. Despite all of this, community ecologists have overlooked butterflies, and there isnot muchresearch on the population dynamics, community structure, and ecoclimatic factors that impact them. As vital pollinators, crucial elements of the food chain, excellent markers of environmental quality, co-evolving insects and plants, skilled colonists of novel habitat types, etc., they are economically significant. Despite all of this, community ecologists have overlooked butterflies, and there isnotmuch research on the population dynamics, community structure, and ecoclimatic factors that impact them.

Butterflies and moths constitute 1,40,000 species among the approximately 1.5 million known species of animals. Among insects,butterflies are very magnificent and the most colourful and conspicuous. Majority of Indian butterfly species are found in Himalayas, the hills of Northeast and in the Western Ghats. India has around 1,501 species of butterflies

(Gay et al, 1992), out of which 334 species are reported from the Western Ghats and 37 species are endemic to the Western Ghats(Evans1932;Kunte2000). Out of the 334 species of butterflies of Western Ghats, 316 species have been reported from Kerala (Palotet al. 2012).The habitat of the butterflies is diverse, and it is strictly terrestrial. It is only within this restricted scope that butterflies have evolved and occupied all possible habitats, even those with scanty vegetation. The diverse habitats include tall evergreen forests, shola forests, semi evergreen forests, riparian forests, bamboo forests, watershed areas, grasslands etc. The tall evergreen forests are one of the most important habitats of butterflies.

Since almost all butterflies are related to plants, their existence is dependent upon the presence of plants. In turn, plants rely on butterflies to pollinate them. Food is frequently the most important element influencing the distribution, abundance, and movements of animals, making feeding an important task. This is especially important for butterflies since their larval and adult stages differ in terms of food and eating habits. A wide variety of plant species are consumed by various caterpillar species. Nonetheless, the majority of species eat leaves, which are essentially the same. While most caterpillars like to consume sensitive leaves, some may only eat those that are accessible on the plants they are placed on. A wide variety of plant species are consumed by various caterpillar species. Nonetheless, many species eat leaves, which are essentially the same. While most caterpillars like to consume sensitive leaves, others may only eat those that are accessible on the plants where their mothers had laid them as eggs.

Caterpillars have tight preferences for host plants, even though the majority of them eat leaves. The chemical makeup of the plant portions that the caterpillar consumes determines these stringent preferences. As a result, caterpillars that consume a specific plant species or group of species will not consume leaves from other species. Because butterflies exhibit strong seasonal and habitat specialization, a long-term study and observation are required to fully understand the biology and ecology of a given location.The present study was carried out with specific objectives such as to identify the common butterflies in Malachira in Pulimath Panchayathand to study the habit and habitat of these butterflies and finally to identify the host plants of the larva and nectar plants ofadult in the locality.

STUDY AREA AND METHOD OF STUDY

The area selected for the present study was Malachira. The area is situated in Kolluvila ward in Pulimath Panchayath, Kerala. This watershed area, Malachira, is located at the foothills of Kadalkaanipara, an interesting tourist spot in Thiruvananthapuram. This is a hilly region with evergreen plants, shrubs, grasslands, wetlands, etc. The study area enjoys a moderate eco-climatic condition and harbours habitats having watershed areas, bright sunshine, shade, bushes, hedges and tall trees which are preferred by specific groups of butterflies. Watershed areas are critical biodiversity centres because they support a wide variety of ecosystem and species.

By watching the butterflies and their home plants while strolling around a few chosen sections of the ward, they were identified. The butterflies were captured using a net, recognized, and released because it was difficult to identify them in the field. During the study period, photographs of the butterfly species were also taken. The study was conducted

over a one-year period. The time frame for the observations was 9 a.m. to 4 p.m. Species identity was confirmed with the help of the field guides byKunte(2000) andtaxonomy and nomenclature have been updated afterKunteet al. (2011). Chrysalises of butterflies were also collected during the study.

RESULTS

In the present study, a total of 41 species of butterflies were identified in selected areas of Malachira ward in Pulimath Panchayath. Out of the forty-one species identified, nine belongs to the family, Papilionidae, four belongs to the family Pieridae, three belongs to the family Hesperidae, two belongs to the family Lycaenidaeand the remaining twenty-threebelongs to the familyNymphalidae.*Troidesminos, Pachliopta hector, Pachlioptaaristalochiae, Papilio polytes, Papilio polymnestor, Graphiumsarpedon, Graphiumagamemmon, Graphiumdoson, Papilio clytia, Catopsilia Pomona, Delias eucharis, Leptosianina, Euremahecabe,Junonialemonias, Junoniaatlites, Junonia almanac, Junoniaiphita, Orsotrioenamedus, Hypolimnusbolina*, etc are some of the butterfly species identified in this study.

DISCUSSION

Since butterflies and their caterpillars rely on host plants for sustenance, the variety of butterflies in an area is a proxy for the diversity of plants in general, particularly the shrubs and herbs (Padhye et al. 2006). Most of them only favour a specific set of habitats and are completely seasonal (Kunte 1997).

Species identity was confirmed with the help of the field guides byKunte(2000) andtaxonomy and nomenclature have been updated afterKunteet al. (2011). Chrysalis of butterflies were also collected during the study.

In the present study also, more than 40 species of butterflies were identified form selected areas of Malachira, in Kolluvila ward in Pulimath Panchayath, which is watershedarea contributing water to the VamanapuramRiver originated from the Ponmudi hills in Western Ghats.The Western Ghats area is unique in endemism. Three species of endemic butterflies, namely southern bird wing, crimson rose, and blue Mormon were recorded during the present investigation. Since the study was confined to a very short period of one year, the species identified and studied were small in number.

The current study demonstrated how closely plants and butterflies are related in terms of plant propagation and vice versa. Nectar plants and larval host plants were both examined. The most significant larval host plants found were those from the following groups: *aristaolochia, thottea, nerium, calopropis, murraya, loranthus, cassia, citrus, mussaenda*, and. Common plant blossoms like *ixora, lantana, tridax, several clerodendrone species, gomphrina*, etc. were among the nectar plants. Similar research on the relationship between butterflies and plants was published by Kumar and Murugesan (2014), Aneesh et al. (2013), and Lekshmi Priya et al. (2017). Butterflies being highly fragile in nature, even minor perturbations in the environment may affect their survival so much so they have been looked upon as biotic indicators to monitor changes taking place in the environment.

Butterflies have undoubtedly been overlooked when it comes to conservation challenges.Concern for these lovely animals is growing on a local, national, and worldwide level these days. Because their caterpillars are unique to the plants they eat, butterflies might be regarded as bioindicators. Consequently, the preservation of butterflies is crucial to the preservation of the local area's diversity. Research on butterflies must transcend boundaries of curiosity and/or interest, and conservation activities must be given more priority.

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Constitutionalist Economic Sustainability in Growth & Development of Blue Economy: Ocean Fisheries Management – Challenges & Issues.

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Abstract
The Blue Economy is a recent field of study that encompasses economic activities that depend on the sea are often associated with other economic sectors, including tourism, maritime transport, energy, and fishing. Blue growth supports the sustainable growth of the maritime and marine sectors, as the oceans and seas are engines of the global economy and have great potential for growth and innovation. This article undertakes a bibliometric analysis in the terms of Blue Economy (BE), to analyse the scientific production of this field of study. The analysis of the authors' definitions of BE, provides interesting relationships divided into sustainability and governance; economics and ecosystem protection; industrial development and localization; and the growth of the ocean economy, with development as the central axis that encompasses them.

KEYWORDS : sustainability, governance ,economics ,ecosystem protection, industrial development and localization.

INTRODUCTION:

The concept of the blue economy is complex and cannot be fully encapsulated by a single definition. India has formulated its own definition of the blue economy, which emphasises the sustainable development of the oceans within its jurisdiction for socio-economic progress while maintaining the health of the marine environment. India's definition of the blue economy is all-encompassing, considering various aspects of ocean-related activities. India has also pledged to eliminate single-use plastics by 2022. To address the increasing ocean pollution and declining health of the oceans, India needs a stronger waste management strategy and behavioural changes. The MoES, through the National Centre for Coastal Research (NCCR) in Chennai, is conducting awareness programmes and assessing marine litter along the Indian coast with the help of 6900 volunteers. Nearly 30 tonnes of marine litter have been collected, mostly in the form of plastic (such as food wrappers and cups). The United Nations General Assembly (UNGA) is working on creating a binding agreement to protect and sustainably use marine resources in international waters, known as 'BBNJ' under UNCLOS. While the blue economy focuses on economic activities, it also emphasises the importance of sustainability and ocean health. Environmental sustainability needs to be addressed more seriously due to global concerns about marine pollution, particularly plastic waste. The United Nations aims to reduce marine pollution by 2025, focusing on land-based activities as the main source of plastics. India is dedicated to banning single-use plastics by 2022 and is implementing strategies to combat ocean pollution. The United Nations General Assembly is developing a binding agreement on the conservation of marine resources beyond national boundaries under UNCLOS.

IMPACT OF BLUE ECONOMY AND OCEAN FISHERIES MANAGEMENT IN INDIA:

1. Fisheries Development: Blue economy programmes have increased fisheries output, sustaining the means of subsistence for millions of people living along the coast. Sustainable management of resources is crucial through measures like setting catch limits, creating marine protected areas, and enforcing regulations to prevent overexploitation. This helps ensure the long-term sustainability of marine resources and the industries depending on them.

- Over the past four years, India's seafood exports have grown by more than 30%, reaching Rs. 61043.68 crore in 2023–2024. Posted by PIB Delhi at 5:45 PM on August 02, 2024. India's seafood exports grew by 30.81% from Rs. 46,662.85 crore in 2019–20 to Rs. 61043.68 crore in 2023–24 as a consequence of the government's numerous initiatives.

  The table below shows the total production and total export of marine goods for the last five years, broken down by year:

Years	Manufacturing (In lakh tons)	Export (In lakh tons)
2019-20	141.64	13.29
2020-21	147.25	11.68
2021-22	162.48	13.98
2022-23	175.45	17.54
2023-24	182.70	18.19

2.Tourism Growth: Beach tourism, water sports, and the observation of marine species draw visitors to India's coastal regions, which boost the country's economy.

3.Renewable Energy: By utilising offshore wind, tidal, and wave energy potential, India may become less dependent on fossil fuels and increase its energy security.

4.Marine Commerce: Improving port efficiency through the development of marine infrastructure facilitates commerce and economic integration with international markets.

5.Biodiversity Conservation: Preservation of biodiversity is essential for maintaining ecological balance and sustainable resource use, and conservation initiatives safeguard marine habitats.

OCEAN FISHERIES IN INDIA:

1. Sustainability : When fisheries are managed effectively, it ensures fish populations are harvested at levels that are sustainable, safeguarding marine ecosystems for the future by preventing overfishing**.**

2. Economic Development: By implementing sound fisheries management, it can bolster economic growth by creating numerous job opportunities in fishing and industries linked to it like processing and export.

3. Food Security: As a significant source of protein for many Indians, managing fisheries sustainably ensures continued access to this vital food source, aiding in food security efforts and poverty reduction.

4. Ecosystem Preservation: Through preventing overfishing and minimizing bycatch, effective fisheries management helps in conserving the health and diversity of marine ecosystems, supporting overall marine life and ecosystem functions**.**

5. Climate Change Resilience: By adopting sustainable practices in fisheries management, it fortifies the resilience of marine ecosystems and fisheries against the impacts of climate change, like rising ocean temperatures and acidification.

On the flip side, inadequate fisheries management can result in detrimental consequences like overexploitation, ecosystem decline, loss of biodiversity, and hardships for fishing communities. Consequently, India must prioritize implementing science-backed management strategies, enforcing regulations, encouraging stakeholder involvement, and investing in monitoring and enforcement mechanisms to ensure the longevity and sustainability of its ocean fisheries**.**

CHALLENGES RELATED TO INDIA BLUE ECONOMY

Insufficient Infrastructure: Many coastal areas in India lack necessary infrastructure like ports and airports, posing challenges for economic growth in these regions.The insufficient infrastructure in India's blue economy refers to inadequate facilities, ports, transportation networks, and related support systems required for the sustainable development of maritime industries such as fishing, shipping, aquaculture, and offshore energy. This deficiency hampers the sector's growth potential, limits efficiency, and undermines the country's ability to fully harness its maritime resources and potential.

Excessive Fishing: Overfishing in Indian coastal waters threatens fish stocks and the marine ecosystem, impacting the fishing industry and the blue economy.Excessive fishing occurs when fishing efforts surpass the sustainable limits of fish stocks, leading to depletion of marine resources. This can result in ecosystem imbalances, loss of biodiversity, economic hardships for fishing communities, and food security issues. Factors contributing to excessive fishing include overcapacity of fishing fleets, lack of effective regulations, illegal fishing practices, and increasing global demand for seafood. Sustainable management practices, such as quotas, gear restrictions, and marine protected areas, are essential to mitigate the impacts of excessive fishing and ensure long-term viability of marine ecosystems.

Marine Contamination: Pollution including oil spills and plastic waste harms marine life and the blue economy.Marine contamination in India's blue economy refers to the pollution and degradation of marine ecosystems and resources due to various human activities. This contamination can result from industrial discharge, untreated sewage, agricultural runoff, oil spills, plastic waste, and other sources. Marine contamination poses significant threats to

marine biodiversity, ecosystem health, public health, and the livelihoods of coastal communities reliant on marine resources. Addressing marine contamination requires implementing effective pollution control measures, improving waste management practices, promoting sustainable development initiatives, and enforcing environmental regulations to safeguard the health and sustainability of India's blue economy.

Effects of Climate Change: Risks from rising sea levels and climate change impacts like the negative Indian Ocean dipole can endanger coastal communities and the blue economy.Climate change has various significant effects on India's blue economy. These include alterations in ocean temperature, sea level rise, changes in monsoon patterns, ocean acidification, extreme weather events, and loss of biodiversity. These impacts can affect marine species distribution, fisheries and aquaculture production, coastal erosion, fishing communities, and marine ecosystems. To address these challenges, adaptation measures, enhancing resilience in coastal communities and industries, sustainable fishing and aquaculture practices, and reducing greenhouse gas emissions are necessary to lessen the severity of climate change on India's blue economy.

India-Sri Lanka Fishing Dispute: Unclear boundaries in the Palk Bay have caused conflicts between Indian and Sri Lankan fishermen, leading to unsuccessful attempts to negotiate agreements for regulating fishing in the area .The fishing dispute between India and Sri Lanka in the context of the blue economy involves conflicts between fishermen from both countries over fishing rights in the Palk Strait and the Gulf of Mannar. The main reasons for the dispute are overlapping maritime boundaries, historical fishing rights, and differing regulations. Due to dwindling fish stocks in their own waters, Indian fishermen often fish in Sri Lankan waters and vice versa, leading to tensions, arrests, and occasional conflicts between the two groups. This has also strained diplomatic relations between the countries. Efforts to resolve the issue have included discussions, agreements on fishing areas, and joint patrols. However, a permanent solution remains elusive, underscoring the complexities of managing shared fisheries and the need to address the socio-economic factors fueling the dispute.

ISSUES OF BLUE ECONOMY AND OCEAN FISHERIES MANAGEMENT IN INDIA

1. Overfishing: Many fish stocks are overexploited, leading to declines in populations and ecosystem imbalances.Overfishing is a significant concern within India's blue economy framework. The blue economy emphasizes sustainable use of ocean resources, but overfishing threatens this balance. India faces challenges in regulating fishing practices, enforcing laws, and promoting sustainable fisheries management to ensure long-term viability within its blue economy initiatives. Efforts to address overfishing include implementing quotas, promoting aquaculture, and enhancing marine conservation measures.

2. Illegal, Unreported, and Unregulated (IUU) Fishing: This poses a significant challenge to sustainable fisheries management, affecting both fish stocks and marine ecosystems.

3. Lack of Effective Regulation and Enforcement: Weak enforcement of regulations and governance structures can lead to unsustainable fishing practices and resource depletion.

4. Habitat Destruction: Destructive fishing methods, such as bottom trawling, can damage marine habitats and negatively impact biodiversity.

5. Climate Change Impacts: Changing ocean temperatures and ocean acidification affect fish habitats and migration patterns, impacting fish stocks and fisheries management efforts.

6. Socioeconomic Issues: Livelihoods of coastal communities depend on fisheries, and issues such as poverty, lack of alternative livelihoods, and unequal distribution of benefits from fisheries can exacerbate challenges in fisheries management.

Addressing these issues requires comprehensive policies, effective enforcement mechanisms, stakeholder engagement, and sustainable fishing practices to ensure the long-term health and productivity of India's ocean fisheries.

LEGAL FRAMEWORKS AND INTERNATIONAL CONVENTIONS:

- **PERSPECTIVE ON BLUE ECONOMY IN INDIAN**

The Blue Economy Draft Policy Framework (Government of India, 2020) acknowledges, underscores, and outlines a plan for enhancing skills in the blue economy sector. The 2030 vision for a New India also prioritizes the blue economy as a key aspect of development. The practical steps outlined in the vision statement can be broadly summarized as follows:

India must draw insights from global best practices in environmental accounting by fostering robust scientific partnerships with renowned countries and institutions to develop appropriate tools and methodologies for measuring and managing the blue economy. To ensure the reliability of data related to the blue economy, it is imperative to expand the scope of the 2008 National Industrial Classification to encompass various overlooked activities linked to the blue economy, collaborate with relevant government ministries for data collection, establish an official body to procure specific data on a granular industry level, actively participate in shaping the UN International Standard Industrial Classification of All Economic Activities (ISIC) Revision 5 and data policies, as well as implement a new National Map and Data Policy that addresses the evolving needs for data security and transparency.

The vision statement emphasizes the significance of environmental sustainability and preservation. In order to evaluate the effects of tourism, it is crucial to regularly conduct assessments to analyze the impact of tourist influx, tourism infrastructure, key attractions/products in the coastal regions and island territories of India, and evaluate their implications on environmentally-sensitive and ecologically-vulnerable areas. Furthermore, it is imperative to carry out studies resembling Natural Capital Accounting focusing on aspects like: (i) the health of oceans, (ii) identification of oceanic resources, and (iii) development of corporate ecosystem accounts to offer a comprehensive assessment of marine resources, forests, and the overall environment.

- **ASEAN'S LEGAL FRAME WORK REGARDING BLUE ECONOMY :**

The framework aims to support ASEAN's blue economy initiatives, promote regional integration and cooperation, and enhance the capacity of member states to responsibly utilize aquatic resources. It will serve as a key document on the blue economy in ASEAN,

potentially undergoing regular reviews. Importantly, it is not meant to replace existing policies or impose penalties, but rather align with international laws and agreements while upholding ASEAN values and principles. The framework's main objectives are to promote a holistic and collaborative approach to the blue economy, establish a common understanding, and drive regional actions for sustainable economic growth across various sectors and interests related to ocean and inland waters. It also aims to encourage dialogue and partnerships among ASEAN member states and with external actors on blue economy issues.

- **MAURITIUS LEGAL FRAME WORK RECODING BLUE ECONOMY**:

Mauritius is widely recognized as a leading model for other nations to emulate in the field of the Blue Economy. The success of Mauritius' strategy is attributed to the formulation of a comprehensive policy framework that was crafted through inclusive engagement with various stakeholders, encompassing civil society and the public at large. This inclusive approach fosters a distinctive level of ownership over both the process and outcomes, while also ensuring responsibility for the execution and realization of set objectives and ambitions. Additionally, pertinent laws were put into place to uphold and enforce the established policy.

PUBLIC AWARENESS AND EDUCATION :

Encouraging people to know about blue economy initiatives is essential to sustainable ocean management. The following crucial actions can be taken:

1.Educational campaigns: To inform the public about the value of the ocean, its resources, and the necessity of sustainable behaviors, hold workshops, seminars, and awareness campaigns.

2.Media outreach: Utilize various media outlets such as television, radio, social media, and print media to convey information about blue economy activities and their benefits.

3.Engage stakeholders: Involve local communities, fishers, entrepreneurs, and policymakers in talks and decision-making processes linked to blue economy policies.

4.Demonstration projects: Showcase successful blue economy initiatives and projects to encourage others and demonstrate the economic and environmental benefits of sustainable ocean practices.

5.Collaboration: To promote sustainable blue economy activities and exchange best practices, encourage cooperation between governments, NGOs, academia, and the commercial sector.

6.Youth involvement: To foster a sense of accountability and stewardship for the ocean, involve young people in educational initiatives, contests, and other events.

7.Policy advocacy: Push for laws and rules that encourage environmentally destructive activities like overfishing, pollution, and habitat destruction, and that promote sustainable ocean management.

By putting these steps into practice, we can increase support and awareness for the shift to a more sustainable blue economy, protecting our oceans' long-term health and the prosperity of coastal communities.

EDUCATIONAL SOURCES FOR LEARNING ABOUT THE BLUE ECONOMY AND MANAGING OCEANS FISHERIES:

1.Online Courses: Platforms like Coursera, edX, and FutureLearn provide specialized courses on the blue economy and fisheries management, often led by experts in the field.

2.Research Organizations and Think Tanks: Entities such as the World Ocean Observatory, the World Resources Institute (WRI), and the World Bank produce reports, articles, and case studies on various aspects of the blue economy and fisheries management.

3.Government Agencies: Departments overseeing Fisheries and Oceans, Environmental Protection Agencies, and other governmental bodies furnish educational materials, guidelines, and policy documents concerning ocean conservation and sustainable fisheries management.

4.Non-Governmental Organizations (NGOs): NGOs like Oceana, WWF, and the Marine Stewardship Council (MSC) create educational content, campaigns, and resources to promote awareness of sustainable fishing practices and the importance of the blue economy.

5.Academic Institutions: Universities and research centers often research and publish papers on marine biology, oceanography, and sustainable fisheries management. Accessing academic journals and attending conferences can offer valuable insights into current research and best practices.

6.Online Platforms and Portals: Websites like The Nature Conservancy's Mapping Ocean Wealth, the Ocean Data Viewer by FAO, and the Ocean Health Index provide interactive tools, maps, and data visualizations to aid in understanding ocean ecosystems and the blue economy.

7.Community-Based Organizations: Local initiatives and community groups offer workshops, field trips, and outreach programs focusing on sustainable fishing practices, marine conservation, and the economic advantages of healthy oceans. By utilizing these resources, individuals can enhance their knowledge of the blue economy and ocean fisheries management and contribute to efforts aimed at safeguarding marine ecosystems and fostering sustainable development.

INNOVATIVE LEGAL SOLUTIONS FOR BLUE ECONOMY AND OCEAN FISHERIES MANAGEMENT

India has innovated significantly in the fields of ocean fisheries management and the blue economy in recent years. The following significant innovations are listed:

1. Coastal Zone Management (ICZM) Integrated: India has adopted ICZM techniques to manage coastal regions effectively while balancing environmental preservation and economic

growth. To solve issues in coastal zones, this entails ecosystem-based management, spatial planning, and stakeholder participation.

2. Projects for Fisheries Management: India has embraced cutting-edge approaches to fisheries management, such as the establishment of community-based systems. By giving local populations more influence over decision-making, this strategy promotes resource conservation and more ethical fishing methods.

3. Technologies Used in Aquaculture: India has been making investments in cutting-edge aquaculture technologies in an effort to increase seafood production in a sustainable manner. Developments such as recirculating aquaculture systems (RAS) and integratedUtilizing genetically modified breeds and multitrophic aquaculture (IMTA) can boost yields while reducing environmental effect.

4. Progress in Mariculture: India is pushing for the growth of mariculture, the practice of growing marine life in coastal and offshore waterways, including seaweeds, shellfish, and finfish. Mariculture not only creates jobs but also lessens the strain on wild fish stocks and enhances the health of ecosystems.

5. Blue Economy Projects: With an emphasis on industries including marine renewable energy, seabed mining, coastal tourism, and marine biotechnology, India has been actively investigating the possibilities of the blue economy. The goal of creative investments and policies is to maximize the economic potential of marine resources while maintaining social justice and environmental sustainability.

These developments demonstrate India's dedication to sustainable growth and conscientious management of natural resources of its sea, which promotes both economic growth and environmental protection..

CONCLUSION:

In conclusion, the Blue Economy represents a significant opportunity for sustainable economic growth while ensuring the preservation and health of marine ecosystems. Through policies and initiatives, countries like India are recognizing the importance of the blue economy and are taking steps to harness its potential. Key areas of focus include sustainable fisheries management, tourism development, renewable energy, marine commerce, and biodiversity conservation. However, challenges such as inadequate infrastructure, overfishing, marine contamination, climate change impacts, and international disputes pose significant hurdles to realizing the full potential of the blue economy. Addressing these challenges requires comprehensive strategies, effective regulation, stakeholder engagement, and international cooperation. India's efforts in the blue economy sector, including coastal zone management, innovative fisheries management projects, adoption of aquaculture technologies, and promotion of mariculture, showcase a commitment to sustainable development. By leveraging these initiatives and investing in education, public awareness, and international collaboration, India and other nations can ensure the long-term viability of the blue economy while preserving marine ecosystems for future generations.

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