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A Multidisciplinary Research Journal

St. Xavier's College Jaipur

Volume - 5, 2026

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A Peer Reviewed Multidisciplinary Research Journal

St. Xavier's College Jaipur

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Continuing with its tradition of excellence in all aspects of Higher Education, especially research, the Research and Development Cell (RDC) of St. Xavier's College Jaipur has come out with its new online journal titled अनुसन्धक (Anusandhak). The Journal is committed to forwarding and encouraging multidisciplinary outlook, quality research that is socially relevant and addresses contemporary issues with either an interdisciplinary perspective or an in-depth expertise in a particular field of study.

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Balancing Work and Life: Exploring the Link Between Psychological Well-Being and Quality of Life in Working Women

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Abstract
Two ways in which time pressure, role conflicts and other stressors affect the mental health of employed women have clearly become important to understand, not only the impact. Work is a significant part of an individual's life, as it provides purpose, identity, and, most importantly, stability. A woman's experience in the organisation and overall quality of life influence her health and well-being, as well as organisational outcomes. This study explains the link between an individual's quality of life and psychological well-being. The study comprised a sample of 100 women aged 25 to 45 selected through purposive sampling from various organisations in Jaipur. Data were collected using two standardised tools: the Quality of Life Scale (QOLS-SSNN; Sharma & Nasreen, 2014), and Ryff's Psychological Well-Being (Ryff & Singer, 1998). These tools were highly applicable for our population and have high reliability and validity. To interpret the collected data, descriptive statistical methods along with Pearson product-moment correlation were applied with the help of SPSS version 26. The results revealed a significant relationship between an individual's QOL and PWB. The findings provide insight into two aspects of the workplace and working environment that contribute substantially to an employee's overall well-being. Therefore, the study suggests that Human Resource (HR) managers should take into account their employees' QoL while designing organisational strategies and policies.
Keywords: Quality of Life, Psychological Well-Being, Women's Mental Health, Autonomy, Personal Growth

Introduction
In the contemporary world, women's participation in the workplace has increased, transforming traditional gender roles and family dynamics and contributing to economic growth and development. Employment offers economic independence, self-development, personal fulfilment, social engagement and recognition, but it simultaneously exposes women to a wide range of psychological and social challenges such as multiple roles across domains like professional, family, and social; these can influence their overall quality of life. Mental wellness is not just an individual attribute but an important determinant for working women, specifically those in early to middle adulthood, of how they perceive, manage and integrate their life demands into a coherent sense of well-being. So, understanding this becomes an increasingly important concern from the point of view of research studies.

Absence of mental disorders is not only the core determinant of good mental health, but now it also includes the presence of positive mental and emotional functioning and human development. This is captured by the concept of psychological well-being, which emphasises a person's capacity to function normally, maintain emotional balance, control over choices, and experience life as meaningful.

Psychological well-being has been conceptualised by Carol Ryff (1989), who defined it as a multidimensional construct that includes self-acceptance, positive reactions with others, autonomy, environmental mastery, purpose in life and personal growth. It means that just a state of absence of mental illness, feeling positive, and functioning effectively is not considered as being psychologically well, but it is a state of prospering. It's a multidimensional idea that balances hedonic with eudaimonic for overall mental and emotional health. Psychological well-being refers to a state of optimal psychological functioning that emerges from the satisfaction of basic universal and psychological needs for autonomy (freedom and control of choices), competence (need to feel effective), and relatedness (sense of belongingness), enabling individuals to function effectively and experience a sense of fulfilment in life (Deci & Ryan, 2000).

In the context of working women, psychological well-being is highly related to motivation, interpersonal relationships, resilience and the ability to navigate occupational challenges. Psychological well-being in this context emphasises strengths and adaptive functioning because it plays a central role in influencing sense of control, coping strategies, long-term psychological health, life satisfaction and managing the cumulative pressures arising from work.

Quality of life represents a broader construct which reflects an individual's subjective perceptions of their physical and psychological functioning, relationships and overall satisfaction. According to the World Health Organisation (1997), Quality of life refers to an individual's personal lens of perception of their position in life within the positive context of their cultural and value systems, and concerning their aims, anticipation, norms, and concerns. Quality of life represents a holistic appraisal of well-being. According to Ed Diener, quality of life is related to a person's cognitive judgements about their life experiences and satisfaction. This highlights that quality of life is influenced by how an individual thinks and feels about their lives. Components of quality of life include physical health, mental well-being, social relationships, material and economic factors, environment and surroundings and education and work.

In the context of working women, quality of life is influenced by interactions among social support, psychological functioning, work-life balance, professional demands, and psychological well-being, making it a multidimensional variable in research. When organisational environments provide recognition, support, role clarity, psychological balance, and equal work participation, they lead to a sense of purpose and life satisfaction; on the other hand, misalignment between personal and occupational demands and values deteriorates quality of life.

The age 25 to 45 years is a pivotal stage of adulthood which includes amplified role engagement and vital life transitions. During this phase, women are engaged in either establishing or advancing their careers while also working on their personal identities, forming long-term

partnerships, and managing caregiving responsibilities. These overlapping demands associated with these roles lead to substantial strain on well-being, reduced life satisfaction, emotional burden and exhaustion. Understanding the factors that affect psychological well-being and quality of life during this stage is of considerable importance.

In an organisational context, working women frequently encounter challenges such as limited flexibility, role ambiguity, organisational pressures, gender stereotypes and work-family balance. Recognising the role of organisations and institutions helps highlight the importance of examining psychological well-being and quality of life within a broader socio-occupational framework.

Although previous studies have evidenced a meaningful association between psychological well-being and quality of life, studies focusing particularly on working women within the 25 to 45 age group remain limited. The unique challenges and responsibilities associated with this life stage and age group make a clear need for research that examines psychological well-being and quality of life.

Review of Literature

Studying the relationship between an individual's psychological well-being and quality of life is crucial, particularly among working women. The available research in this field is extensive, but limited in the Indian context. Some of the recent research in this field is as follows: -

Amin, S. M., El-Gazar, H. E., Zoromba, M. A., El-Sayed, M. M., Awad, A. G. E., & Atta, M. H. R. (2025). A study was conducted to examine mindfulness for menopausal women: The role of a randomised controlled intervention in promoting quality of life and psychological well-being. The sample size of the study was 60. The variables of the study were quality of life and psychological well-being. The study concluded that MBIS significantly improved menopause-specific QoL. Also pointed out that MBIS enhances mindfulness and reduces anxiety, stress, and depression in menopausal women.

Guerrini Usubini, A., Bottacchi, M., Bondesan, A., Caroli, D., Grugni, G., Castelnuovo, G., & Sartorio, A. (2025). A study assessed quality of life and psychological well-being using the Health Survey for the Short Form and the Psychological General Well-Being Index questionnaires in Italian adults with Prader-Willi syndrome. The sample comprised 11 men and 19 women. The study variables were quality of life and psychological well-being. The study concluded that adults with Prader-Willi Syndrome had worse physical health and social functioning but higher vitality as compared to normal-weight individuals, who had better self-control. Both scales measured similar things consistently. Although BMI was unrelated to well-being, there was a small link with general health and vitality.

Ibrahim, F. M., Fadila, D. E., Elshatarat, R. A., Ibrahim, A. M., & Abd Elmawla, D. A. (2024). A study was conducted on Egyptian older adults to investigate the effect of a home-based simplified Tai chi exercise program on sleep quality, daytime sleepiness, quality of life, and psychological well-being. The study sample size was 152. The variables of the study were sleep quality, quality of life and psychological well-being. The findings support that in Egyptian older adults, a simplified Tai Chi exercise program shows good effects on sleep quality, QoL, and psychological well-being.

Goñi-Balentziaga, O., & Azkona, G. (2024) conducted a study in Spain to examine the perceived mental well-being and professional quality of life among animal facility staff. The sample size was 80. The variables of the study were quality of life and mental well-being. The study concluded that animal facility personnel showed low burnout and good mental well-being. Empathy was higher among those working with small carnivorous animals and primates. Mental well-being was directly proportional to empathy and compassion satisfaction, whereas inversely related to burnout and secondary traumatic stress, especially in those working with farm animals.

Sainudheen, S., Arun, R., & Zebukumar, N. (2024). Conducted a study on working and non-working menopausal women to investigate perceived stress and psychological well-being. The sample size was 60. The variables for the study were stress and psychological well-being. According to this study's findings, non-working women show lower psychological well-being as compared to working menopausal women.

Chandra, N., Sinha, A. R., & Ram, J. (2024). Conducted a study in Muzaffarpur district, Bihar, comparing working and non-working women to examine psychological well-being. The sample size of the study was 100. The variable for the study was psychological well-being. The results demonstrate that there is no significant difference between working and non-working women's psychological well-being in Muzaffarpur district of Bihar.

Kim, Y., Bae, S., Chang, H. H., & Kim, S. W. (2023) conducted a study to investigate the prevalence of long COVID and its impact on quality of life 2 years after acute COVID-19. The study sample size was 132. The variables for the study were COVID symptoms and quality of life. The findings of the study concluded that although long COVID usually improves over time, neuropsychiatric symptoms can persist for up to 24 months after an acute infection and occur more frequently than other symptoms. Patients with mild COVID-19 disease may continue to have a poor quality of life.

Pereira, I. N., & Hassan, H. (2022). conducted a study to investigate the impact of botulinum toxin for facial aesthetics on psychological well-being and quality of life. The sample size of the study was 3016. The variables of the study were botulinum toxin, psychological well-being and quality of life. The study showed statistically significant improvement in psychological well-being and quality of life, but a multimodal treatment approach targeting several upper facial regions produced the important results.

Bagheri, M. J., Farid, A. A., & Nasrolahi, B. (2022). Conducted a study on the elderly to examine the mediating role of psychological well-being between self-efficacy and quality of life. The sample size of the study was 200. The variables of the study were self-efficacy, quality of life and psychological well-being. The study concluded that self-efficacy had a direct positive relationship with PWB and also with QOL. It was also found that PWB is indirectly related to QOL through self-efficacy.

Mascia, M. L., Agus, M., & Penna, M. P. (2020). conducted a study on student well-being and quality of life to investigate the relationship between emotional intelligence, self-regulation, and smartphone addiction. The sample size of the study was 215. The variables of the study were emotional intelligence, self-regulation, well-being and quality of life. The findings emphasise that the relationship between self-regulation and well-being becomes

weaker in the presence of greater smartphone addiction. No confirmed moderation effect was found on the relationship between emotional intelligence and well-being.

Hanna, M., & Strober, L. B. (2020). Conducted a study to investigate anxiety and depression in multiple sclerosis's antecedents, consequences, and differential effects on well-being and quality of life. The sample size of the study was 183. The variables of the study were well-being and quality of life. Findings suggest that both depression and anxiety are common among individuals with MS and are related to many outcomes. With a few exceptions, anxiety proved to be more impactful than depression when examining these outcomes. When evaluating the risk contributors for anxiety, social support and for depression, lower education, social support and substance abuse were consistent predictors. Additionally, younger age and shorter duration of illness were linked with higher levels of anxiety.

Objective

The objective of the present research is to explore the link between Psychological Well-Being and Quality of Life in Working Women.

Hypothesis

There will be a significant positive correlation between quality of life and psychological well-being among working women.

Sample and Sampling Techniques

The sample of the study encompasses 100 working women (N = 100) between the age range of 25-45 years, using purposive sampling from different organisations in Jaipur. The reason for selecting individuals (working women) in the age range of 25-45 years in the sample is that this developmental and crucial phase includes personal responsibilities and psychological concerns, in addition to the multiple role demands of society. So, exploring the association between PWB and QOL becomes vital to understand how women who have stronger social as well as workplace support and connections report higher levels of life satisfaction, mental and emotional well-being and better quality of life, whereas women experiencing lower psychological well-being may struggle with role ambiguity, overload, time pressure, and exhaustion, which negatively impact the quality of life.

Tools

1. **Quality of Life: -** The Quality of Life scale was used to identify the level of quality of life. This scale was developed by Sarika Sharma & Dr Nakhat Nasreen (2014). The quality of life scale includes 42 items and 3 points. The internal consistency reliability of the quality of life scale was assessed using Cronbach's alpha, which yielded a coefficient of .806 for the total scale, indicating great overall reliability. The tools have satisfactory face and construct validity.
2. **Ryff's Psychological Well-Being: -** This tool was used to identify the level of psychological well-being. This scale was developed by Carol Ryff (Ryff & Singer, 1998). A total of 18 items are included in the tool. The RSPWB has a test-retest reliability of .82. The tool has high validity.

3. **Demographic information form: -** A Self-constructed Demographic information online form was used to collect personal information of the subjects, which includes personal details like age, type of job and others.

Result

This section summarises the statistical analysis used to evaluate the hypothesis of this research. Table 1 below describes the Descriptive Statistics.

Table 1: Descriptive Statistics

	Total Population	Mean	SD
Psychological Well-Being	100	99.61	8.064
Quality of Life	100	104.73	10.477

Table 1 shows that the values of SD and Mean for Psychological well-being are 8.064 and 99.61, respectively; the values of SD and Mean for Quality of Life are 10.477 and 104.73, respectively.

The relationship between psychological well-being and Quality of Life is analysed by using the correlation method.

Table 2 below describes the correlation.

Table 2: Correlation between Psychological Well-Being and Quality of Life

Correlation Matrix:

		PWB	QOL
PWB	Pearson's r	-	
	df	-	
	p-value	-	
	N	-	
QOL	Pearson's r	0.349	-
	df	98	-
	p-value	<.001	-
	N	100	-

(2-tailed)

Table 2 represents the correlation value. The result indicates a statistically significant moderately positive correlation (r = 0.349) between Psychological Well-Being and Quality of Life. Where the df value is 98. p-value is less than 0.001.

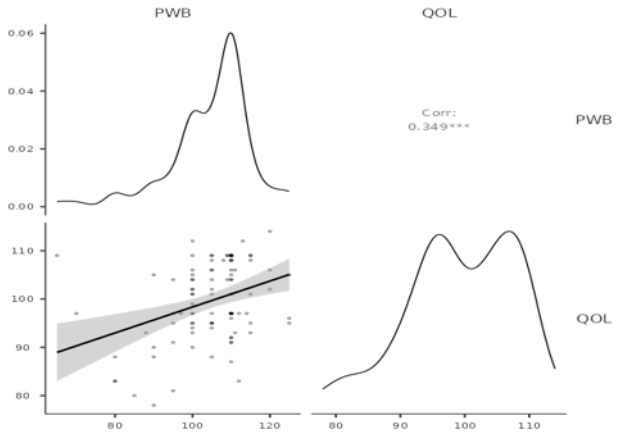

Figure 1: Shows the relationship between Psychological Well-Being and Quality of Life

Discussion & Conclusion

Working women are another unique group of the population that is exposed to various psychological, social, and occupational demands, making them a particularly relevant population for investigating the relationship between psychological well-being and quality of life. Employment offers economic growth that allows women to pursue their dreams and talents, work toward their life goals, and engage socially. However, it also introduces role-related stressors and challenges, such as insufficient time for their families, conflicts of interest, job insecurity, workload, and work-life imbalance. Many working women face work-family conflict, resulting in cumulative role strain that significantly impacts mental and psychological health, life satisfaction, and overall life quality.

This particular age interval for women, especially working women, is considered crucial because it includes minor as well as major life transitions, including career establishment and development, relationship formation, marriage, and childbearing, all of which demand psychosocial responsibilities. As these factors are somewhat overlapping and put considerable pressure on psychological resources, it is crucial to study the association between psychological well-being and quality of life.

The study aims to examine the relationship between psychological well-being and quality of life in working women aged between 25 and 45 years. A total of 100 individuals (working women) were selected through purposive sampling. Data were collected using an online demographic form, which included demographic variables such as age, job title, and others, to measure psychological well-being; Ryff's Psychological Well-Being Scale (1998) was used. To measure Quality of Life, the Quality of Life Scale (2014) was used, which has been effectively used in numerous Indian studies.

This research explored the link between psychological well-being and quality of life in working women aged 25 to 45 years. The research hypotheses were that there would be a significant positive correlation between psychological well-being and quality of life in working women; this was supported by the results, which showed a moderate positive correlation between PWB and QOL. This study was conducted on 100 individuals.

Results of this study were consistent in demonstrating a moderate association between psychological well-being and quality of life in adult women and working women, although the strength of this relationship may change depending on socio-cultural factors, mental health

state, working conditions and access to social support. Some previous studies, such as (Bagheri, M. J., Farid, A. A., & Nasrolahi, B., 2022), show that psychological well-being had a direct positive relationship with quality of life. The present study reinforced this literature by associating this relationship particularly with the 25-45 age group.

In conclusion, the present study provides robust evidence of a significant positive correlation between psychological well-being and quality of life among working women aged 25-45 years, the findings emphasize psychological well-being as a critical determinant of quality of life and provide a deep understanding of two aspects that are, work and working environment that contributes significantly towards a female employee's well-being.

Limitations and Suggestions

This study focuses only on the relationship between these two factors and does not put forward effective and efficient methods or measures to improve them, because it maintains its focus on the problem over the solution for now. Besides, the location of sample collection and the sample size were limited in the study. So future research studies should explore the link between psychological well-being and quality of life in working women on a large sample size, and also data from various locations and sources. The study also relies on self-report inventories, which may be influenced by socially desired responses or participants' current mood states; also, this study did not control for variables such as marital status, number of children, working conditions, and pay level that can impact the accuracy of the reported link.

References

Amin, S. M., El-Gazar, H. E., Zoromba, M. A., El-Sayed, M. M., Awad, A. G. E., & Atta, M. H. R. (2025). Mindfulness for Menopausal Women: Enhancing Quality of Life and Psychological Well-Being Through a Randomised Controlled Intervention. *Journal of Nursing Scholarship: An Official Publication of Sigma Theta Tau International Honour Society of Nursing*, *57*(4), 563–575. https://doi.org/10.1111/jnu.70003

Bagheri, M. J., Farid, A. A., & Nasrolahi, B. (2022). The relationship between self-efficacy and quality of life through the mediating role of psychological well-being in the elderly. *Aging Psychology, 8*(1), 39–54. 10.22126/JAP.2022.7431.1602

Chandra, N., Sinha, A. R., & Ram, J. (2024). PSYCHOLOGICAL WELL-BEING BETWEEN WORKING AND NON-WORKING WOMEN OF MUZAFFARPUR DISTRICT IN BIHAR . *ShodhKosh: Journal of Visual and Performing Arts*, *5*(2), 414–421. https://doi.org/10.29121/shodhkosh.v5.i2.2024.2206

Goñi-Balentziaga, O., & Azkona, G. (2024). Perceived professional quality of life and mental well-being among animal facility personnel in Spain. *Laboratory animals*, *58*(1), 73–81. https://doi.org/10.1177/00236772231187177

Guerrini Usubini, A., Bottacchi, M., Bondesan, A., Caroli, D., Grugni, G., Castelnuovo, G., & Sartorio, A. (2025). Assessment of Quality of Life and Psychological Well-Being in Italian Adult Subjects with Prader-Willi Syndrome Using the Health Survey Short Form and the Psychological General Well-Being Index Questionnaires. *Healthcare (Basel, Switzerland)*, *13*(2), 158. https://doi.org/10.3390/healthcare13020158

Hanna, M., & Strober, L. B. (2020). Anxiety and depression in Multiple Sclerosis (MS): Antecedents, consequences, and differential impact on well-being and quality of life. *Multiple sclerosis and related disorders*, *44*, 102261. https://doi.org/10.1016/j.msard.2020.102261

Ibrahim, F. M., Fadila, D. E., Elshatarat, R. A., Ibrahim, A. M., & Abd Elmawla, D. A. (2024). Effect of a Home-Based Simplified Tai Chi Exercise Program on Sleep Quality, Daytime Sleepiness, Quality of Life, and Psychological Well-Being in Egyptian Older Adults: A Quasi-Experimental Study. *Biological research for nursing*, *26*(2), 202–218. https://doi.org/10.1177/10998004231205014

Kim, Y., Bae, S., Chang, H. H., & Kim, S. W. (2023). Long COVID prevalence and impact on quality of life 2 years after acute COVID-19. *Scientific reports*, *13*(1), 11207. https://doi.org/10.1038/s41598-023-36995-4

Mascia, M. L., Agus, M., & Penna, M. P. (2020). Emotional Intelligence, Self-Regulation, Smartphone Addiction: Which Relationship With Student Well-Being and Quality of Life?. *Frontiers in psychology*, *11*, 375. https://doi.org/10.3389/fpsyg.2020.00375

Pereira, I. N., & Hassan, H. (2022). Impact of botulinum toxin for facial aesthetics on psychological well-being and quality of life: Evidence-based review. *Journal of plastic, reconstructive & aesthetic surgery : JPRAS*, *75*(12), 4450–4463. https://doi.org/10.1016/j.bjps.2022.08.063

Sainudheen, S., Arun, R., & Zebukumar, N. (2024). Perceived stress and psychological well-being among working and non-working menopausal women. *IJAR*, *10*(8), 156-159. https://dx.doi.org/10.22271/allresearch.2024.v10.i8c.11947

2

Social Intelligence and Emotional Regulation among open education vs regular college enrolled students of undergraduate in professional courses: A Comparative Study

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Abstract
The present study investigates the relationship between Social Intelligence and Emotional Regulation among undergraduate students enrolled in professional courses through Regular College and Open Education modes in Rajasthan. It aims to understand how the educational environment influences students' interpersonal adaptability skills and emotional control. A comparative correlational design was used with a sample of 100 students aged 18–23 years, of whom 50 were enrolled in regular classes and 50 in open/distance education mode. The study used the Tromsø Social Intelligence Scale (TSIS), developed by Silvera et al. (2001), and the Emotion Regulation Questionnaire (ERQ), developed by Gross & John (2003), to measure levels of Social Intelligence and Emotional Regulation, respectively. The findings revealed a significant difference in both social intelligence and emotional regulation between regular and open education students. There was also a significant positive correlation between social intelligence and emotional regulation across both groups.
Keywords: Social Intelligence, Emotional Regulation, Undergraduate Students, Regular College, Open/Distance Education, Comparative Correlational Design.

Introduction
In today's higher education, a student's success is not determined by intelligence or academic knowledge alone. More focus is now on socio-emotional skills that help people manage relationships, handle their emotions, and adjust to school and work settings. Social intelligence and emotional regulation are among these skills and play a vital role in a student's engagement, well-being, and readiness for their careers. This is especially true for undergraduate students in professional courses. Teamwork, hardiness, and adaptability are very important. In India, especially in culturally diverse states like Rajasthan, higher education encompasses not only conventional face-to-face learning but also open or long-distance learning. Such models of education vary considerably in terms of exposure and interaction with others. These differences may affect students' social-emotional growth across different models of education. But there is not much research exploring this aspect.
This proposed study will help address the gap by exploring the concepts of social intelligence and emotional regulation in undergraduates pursuing professional degrees in both conventional and open educational systems in the state of Rajasthan. To clarify the proposed study, the following sections present an introduction to the concepts, theories, and previous work on social intelligence and emotional regulation.

Social Intelligence

Social intelligence can be described as the ability or skill to understand, control, and cope with social relationships. It requires sensitivity to social cues, empathy, effective interpersonal skills, and the ability to adjust one's behaviour according to a social situation. In fact, the very first definition of social intelligence is attributed to Thorndike in 1920. He felt social intelligence is the ability "to understand and control men and women, boys and girls; to act wisely in human relations."

Later views built on this idea. Wechsler in 1944 saw social intelligence as a key part of general intelligence. It shows how well an individual can relate to others. The definitions today give it a more complex explanation. For instance, Goleman (2006) defined social intelligence as knowing the feelings of others, understanding the dynamics involved in social interactions, and acting appropriately in accordance with such knowledge. Albrecht (2006) explained social intelligence as a combination of social awareness, situational awareness, and interpersonal skills that enable a person to function efficiently in their relationships.

These definitions showcase social intelligence as an adjustable mental skill that integrates thought, feeling, and action in social settings.

Theoretical Framework

The formal study of social intelligence began in the early 20th century. Thorndike's (1920) tripartite model of intelligence includes abstract, mechanical, and social aspects. It was the first to clearly identify social intelligence as a unique area. However, early research struggled with how to define and measure it, leading to questions about its uniqueness.

Wechsler argued, in the mid-20th century, that social intelligence was not independent; rather, it was an aspect of general intelligence (Wechsler, 1944). As psychometric methods took over intelligence research, social intelligence received less attention.

Social intelligence gained momentum once again during the end of the 20th century, due in part to theories of emotional and multiple intelligences. Gardner's (1983) theory of multiple intelligences introduced the construct of interpersonal intelligence. The construct is very closely related to the concept of social intelligence, emphasising one's awareness of the emotions, motivations, and intentions of others. Building on this, Goleman's notion of socio-emotional abilities gained popularity in his books in 1995 and again in 2006, introducing a model of social intelligence comprising both social awareness and skills, which encompass influence, harmony, and concern.

Today, theories consider social intelligence as a skill that can be learned. It is influenced by culture, education, and social experience. This approach can be very important in understanding differences between students in conventional and open education since they are in different social contexts.

Types and Importance of Social Intelligence

These include Social awareness, empathy, communication skills, adaptability, and relationship management (Goleman, 2006). Social awareness means being able to understand the emotions of other people. Social skills is the skill that enables one to react in a suitable manner when faced with varied circumstances.

For undergraduate students enrolled in professional courses, social intelligence may be a vital tool for teamwork, leadership, conflict management, and employability. Research has shown that students who exhibit high levels of social intelligence tend to perform well in a team, cooperate actively in class, and are better suited to working within a work-related setting (Kaukiainen, 2002). Social intelligence can play a huge role in ethical decision-making, customer handling, and success at work in management, teaching, healthcare, and law.

In the Indian context, with group values, authority relationships, and culture influencing social behaviour to a great extent, social intelligence becomes even more important. Students' social intelligence can influence their success in academic and professional careers to some extent.

There is scientific evidence supporting the link between social intelligence and positive educational outcomes. Research conducted by Saxena and Jain (2013) found that Indian college students with high levels of social intelligence demonstrated positive links with their educational achievements and self-confidence. The recent AISHE Report 2021-22 also mentioned that in India, higher education enrolled more than 38 million students, and the number is growing consistently in distance and open learning. These students tend to interact less with their peers and therefore tend to have limited campus exposure to socialisation opportunities, which may affect the development of social skills.

Worldwide, research suggests that reduced face-to-face interaction negatively impacts distance learners' acquisition of social skills. This calls for more comparative research studies.

Emotion Regulation

Emotion regulation is defined as controlling, expressing, or managing one's emotions. Gross (1998) described emotion regulation as "individual processes of monitoring, evaluating, or modifying one's emotional responses to accomplish one's goals."

This definition highlights both conscious and unconscious regulatory processes. According to Thompson (1994), emotional regulation referred to the processes that monitor, evaluate, and change emotional reactions, especially regarding their intensity and duration. Recently, Aldao, Nolen-Hoeksema, and Schweizer (2010) made a similar observation: emotional regulation strategies can predict psychological adjustment and mental health outcomes.

These definitions thus stipulate emotional regulation as the cardinal psychological skill required for effective functioning in various domains of life.

Theoretical Framework

Research on emotional regulation began with psychoanalytic theories, in which emotion regulation involved managing emotions and applying defence strategies. However, research systematically developed in the latter part of the 20th century.

A major contribution was Gross's (1998) Process Model of Emotion Regulation. This model describes regulation as happening at different stages of the emotion-generating process. These stages include situation selection, situation modification, attentional deployment, cognitive change (reappraisal), and response modulation (suppression).

Although this theory has been subject to quite extensive testing, it remains one of the prominent theories on emotion regulation.

Subsequent research has further developed the model, examining differences between individuals, cultures, and the dynamic nature of regulation over time. More contemporary work on emotional regulation conceives of this process as either a skill/competence and/or a predisposition influenced by experience, education, and environmental demands.

Types and Importance of Emotional Regulation

Emotional regulation strategies can, in turn, be categorised as adaptive or maladaptive. Cognitive reappraisal, problem-solving, and acceptance belong to the group of adaptive regulation strategies that influence positive psychological outcomes. Suppression, rumination, and avoidance belong to the maladaptive category related to distress and poor well-being (Aldao et al.,2010)

For undergraduates, the ability to regulate one's emotions is important for dealing with academic pressures, examination anxiety, and personal and professional issues. Evidence suggests that students who can regulate their emotions more efficiently are more involved in academic pursuits, less likely to suffer from burnout, and less likely to experience mental health problems (Extremera and Fernández-Berrocal, 2006).

In the Indian context, rising competition in academic institutions and career expectations have raised concerns about students' mental well-being. Emotion management skills act as protective measures to cope with the pressure that accompanies professional education.

Data obtained from the National Mental Health Survey of India conducted in the year 2015-16 revealed rising levels of stress, anxiety, and emotional problems in the young adult population of 18 to 29 years of age. Research conducted by Deb et al. in the year 2015 found Indian college students to be under high levels of academic stress, with emotional regulation playing an important role in the psychological well-being of these students.

Across the world, it has been identified by the WHO (2022) that one in seven young individuals is struggling with problems of mental health. This highlights the relevance of emotional regulation in the undergraduate stage of a person's life.

Relationship Between Social Intelligence and Emotional Regulation

Social intelligence and emotional regulation clearly go hand in hand both in theory and practice: to perform well socially, a person must regulate their emotions. At the same time, emotional regulation is often enhanced with social awareness and empathy. Studies show that people with high social intelligence use more effective emotion management strategies than those who lack it.

At the school level, these concepts affect relationships with peers, behaviour, and the formation of professional identity. For students in open education systems, reduced social interaction can affect how they develop both social intelligence and emotional regulation. This makes it especially important to examine these effects.

Rationale and Research Gap

Despite extensive research on social intelligence and emotional regulation separately, there are very few studies comparing these concepts across different types of higher education in India, especially in Rajasthan. The social experiences of open education students differ from those of typical students because their relationship with schools is different. This affects their personal growth. All the previous literature reviewed disregards this fact.

This study aims to compare the levels of social intelligence and emotional regulation among students in undergraduate professional courses who are part of regular and open education systems in Rajasthan. As this gap exists and needs to be addressed, this study can contribute to existing concepts in Educational Psychology and inform strategies that support students in different learning contexts.

Literature Review

Studies on social intelligence and emotional regulation have increased in the last few decades. These studies emphasise their relevance to academic adaptation, interpersonal relationships, and students' mental health.

Early ideas described emotion regulation as a process where individuals influence their experience and expression of emotions. Gross's process model is a useful framework that is still popular in research (Gross, 1998). This model describes regulation as a process that occurs at various stages of emotion generation. It has been proven across different cultures and age groups (Gross & John, 2003). Similarly, developments in social intelligence research describe it as a complex concept involving social awareness, empathy, understanding others, and adaptable behaviour. These ideas stem from earlier concepts of intelligence in social settings, which have been developed through frameworks of socio-emotional competence (Goleman, 2006; Kaukiainen et al., 2002).

Both social intelligence and emotional regulation have been associated with positive academic and psychological results for undergraduate students. According to meta-analytic research, positive emotion regulation strategies, such as cognitive reappraisal, correlate with psychological well-being. Conversely, the use of ineffective methods of dealing with negative emotions, including rumination and emotional suppression, correlates with the experience of psychological problems. Empirical evidence gathered in colleges and universities indicates that students who possess good emotional regulation demonstrate low stress levels, high academic results, and successful social relationships. Moreover, social intelligence has been associated with positive academic performance, social adjustment, and increased self-confidence in college settings.

Several empirical studies conducted in India confirm these findings. Research has found a strong link between social intelligence and academic and social skills in college students (Saxena & Jain, 2013; Bhat, 2016). Students with better social intelligence are better able to cope with the various demands of academic learning. On the other hand, empirical research focused on emotion regulation has found that poor emotional regulation skills increase the experience of anxiety, depression, and academic stress among college students (Deb et al., 2015; Sharma & Tiwari, 2021).

These findings are particularly important given the growing concern about students' mental well-being in Indian universities (World Health Organisation, 2022). There is clear evidence of a link between social intelligence and emotional regulation. Those who possess high levels of social intelligence employ more effective emotional regulation strategies and thus cope better with various social scenarios (Brackett et al., 2006). Components of social intelligence such as emotion perception and empathy play an important role in the regulation process and thus improve social functioning and adaptation (Gross & John, 2003).

Although these trends are emerging, few studies examine how mode of education affects socio-emotional skills. Current research into open and distance education implies that lower levels of interaction and participation may impact socio-emotional development (Teoh, 2019; Valizadeh, 2016). There is evidence that emotional intelligence and regulation play an important role in self-motivated learning, yet findings vary depending on circumstances (Teoh, 2019). The topic of socio-emotional skills among distance learners has been scarcely studied in India, despite the majority of its undergraduate students being open and distance learners (All India Survey on Higher Education, 2022).

In general, current knowledge emphasises the significance of social intelligence and emotional regulation for students' achievement but shows a significant research gap in comparative studies in this area. Not enough empirical data is available on comparing these variables among students studying in standard and open learning systems, particularly in professional undergraduate programs in regions such as Rajasthan.

Methodology

Objectives

The main objectives of this study are:

1. To assess the level of social intelligence among regular college students enrolled in professional courses.
2. To assess the level of social intelligence among open education students enrolled in professional courses.
3. To assess the level of emotional regulation among regular college students.
4. To assess the level of emotional regulation among open education students.
5. To compare the level of social intelligence between regular college and open education students.
6. To compare the level of emotional regulation between regular college and open education students.
7. To examine the relationship between social intelligence and emotional regulation in both groups.

Hypothesis

Null Hypothesis (H0): There is no significant difference in social intelligence and emotional regulation between regular college and open education enrolled students of professional courses.

Alternative Hypothesis (H1): There is a significant difference in social intelligence and emotional regulation between regular college and open education enrolled students of professional courses.

Variables

In this study, variables are categorised into independent and dependent variables.

Independent Variable

This variable differentiates the two groups being compared depending on the mode of education used for the courses students are enrolled in

- Mode of Education:
  - Regular College Students
  - Open/Distance Education Students

Dependent Variables

- Social Intelligence

  Social intelligence refers to an individual's ability to understand social cues and respond appropriately depending on adequate interpretation of situations. According to Thorndike (1920), individuals with high social intelligence possess high adaptability across different contexts. We will be using the Tromso Social Intelligence Scale to measure social intelligence in 3 factors
  - Social Information Processing
  - Social Awareness
  - Social Skills

Emotional Regulation

Emotional regulation refers to the processes through which individuals monitor, evaluate, and modify emotional reactions to fit appropriate expression. It is important for students to evaluate and express emotional reactions in ways that benefit their academic and intrapersonal growth. We'll be using the Emotional Regulation Questionnaire (ERQ), which measures emotional regulation based on two strategies:

- Cognitive reappraisal
- Expressive Suppression

Scales Used

Tromso Social Intelligence Scale (TSIS)

The Tromso Social Intelligence Scale (TSIS) was developed by Silvera, Martinussen & Dahl in 2001. It is a psychological tool designed to assess social intelligence across 3 dimensions:

1. **Social Information Processing** – understanding verbal and non-verbal cues
2. **Social Skills** – acquired appropriate skills for effective interaction in social situations
3. **Social Awareness** – sensitivity to others' emotions and perspectives

DIMENSIONS	ITEMS
Social Information Processing	1, 3, 6, 9, 14, 17, 19
Social Skills	4*, 7, 10, 12*, 15*, 18, 20*
Social Awareness	2*,5*,8*,11*,13*,16*,21* (* Items are reverse items)

The scale measures how effectively individuals perceive, interact and understand social situations with interpersonal exchange and behaviour. It is based on the concept of social intelligence, which is an individual's competence in understanding and managing oneself and others in social settings. The TSIS helps evaluate SI based on three factors reflecting cognitive, behavioural, and emotional aspects, giving us a complete profile for the individual. It is used in both clinical and educational settings to assess an individual's social intelligence and help improve it through various interventions.

The Tromso Social Intelligence Scale consists of 21 items presented on a 7-point Likert scale (1 = the statement describes me extremely poorly, to 7 = the statement describes me extremely well) based on how well the given statement describes the individual. Items are distributed in 3 dimensions:

Reliability and Validity

- Cronbach's alpha ranges from **0.79 to 0.87**, indicating strong internal consistency.
- Construct validity is supported through factor analysis and correlations with interpersonal measures.

Norms: The higher the summative social intelligence score, the higher the social intelligence and lower the lower the social intelligence.

Emotion Regulation Questionnaire (ERQ)

The Emotion Regulation Questionnaire was developed by Gross & John in 2003. This psychological tool is a 10-item self-report scale assessing two major emotion regulation strategies:

1. Cognitive Reappraisal – reframing thoughts to change emotional impact
2. Expressive Suppression – inhibiting overt emotional expressions

The self-report questionnaire measures how effectively individuals regulate, moderate and suppress their emotions upon encountering triggering stimuli in a socially acceptable manner. It is based on the concept of emotion regulation, which refers to the ways people manage their feelings, expression, and emotions. The ERQ helps evaluate emotion regulation based on two factors reflecting cognitive and emotional aspects, focusing on 2 key components. It is used in organisational, clinical and educational settings to evaluate emotion regulation and help enhance it through various activities.

The Emotion Regulation Questionnaire consists of 10 items presented on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree) based on how well the given statement describes them. Items are distributed in 2 dimensions:

DIMENSIONS	ITEMS
Cognitive Reappraisal	1, 3, 5, 7, 8, 10
Expressive Suppression	2*, 4*, 6*, 9*

(* items are reverse scored in total score)

Reliability and Validity:

- Cronbach's alpha: 0.75 (reappraisal) and 0.73 (suppression)
- Validated across cultures and widely used in educational and psychological research.

Norms: The higher the summative emotion regulation score, the higher the emotion regulation; the lower the score, the lower the emotion regulation.

Procedure

The data collection process was carried out systematically through the following steps:

- The chosen standardised scales and a brief demographic information section were put together in an online questionnaire using Google Forms. Easier for participants to access and answer.
- Access to the Google Form link was provided to eligible participants through various academic contacts, student networks, and digital means. The effort was to get both regular and open education students to participate in order to balance their representation.
- The purpose of the study, confidentiality of answers and the voluntary nature of participating in the research were explained to the respondents, who gave their digital consent before filling out the questionnaire.
- The participants were told to give honest answers individually. They were allowed appropriate time to answer the questions, since no time limit was given to prevent response bias.
- The responses obtained were assessed for validity and reliability. Those found to be incomplete and invalid were discarded, leaving a total of 100 valid responses.

Participants

The complete sample consisted of 100 undergraduate students pursuing professional courses in the state of Rajasthan. The sample was divided equally into two categories, with each category having 50 students, either under regular education or open education programs. Equally dividing the sample helped make an effective comparison and helped to understand the difference between the two groups.

Sampling Technique

A purposive sampling technique was used to select participants who met the inclusion criteria for the convenience of the study. This method involves intentionally choosing individuals based on pre-set criteria, which was appropriate since the research focused on comparing two different educational modes.

Sample Criteria

CATEGORY	DETAILS
Total Sample Size	100 Students
Groups	50 Regular College Students, 50 Open Education Students
Age Range	18–23 years
Course Type	Professional courses (BBA, BCA, B.Com, etc.)
Location	Institutions across Rajasthan

Inclusion Criteria and Exclusion Criteria

INCLUSION CRITERIA	EXCLUSION CRITERIA
Enrolled full-time in a professional course either in a regular or open/distance college	Not enrolled in a professional course through open/distance mode
Age 18–23	Age <18 or >23
Not enrolled in any other academic course simultaneously.	Enrolled in any other academic course simultaneously.
Not preparing for any unrelated competitive exams	Preparing for any unrelated competitive exams

Research Design

The study was based on a cross-sectional methodology where data was collected from the participants at one point in time only. This methodology was more appropriate for the present research, as it was needed to find out the present level of social intelligence and emotional regulation. Moreover, it was required to make comparisons among students of the two educational programs while controlling other factors.

Statistical Treatment

The collected data were coded and analysed using suitable statistical methods, classified under descriptive and inferential statistics**.**

Descriptive Statistics

The central tendencies were calculated, i.e. mean, median and mode, to find the average level of social intelligence and emotional regulation among the participants.

The standard deviation was computed to evaluate the variability and spread of scores within the sample.

Normality test

The D'Agostino test was employed to test whether the data were normally distributed or slightly skewed.

Inferential Statistics

Spearman's Rank Correlation Coefficient was used to explore the relationship between social intelligence and emotional regulation. This non-parametric test was chosen because of the ordinal nature of the data and the lack of normal distribution assumptions.

The Mann-Whitney U Test was used to compare social intelligence and emotional regulation scores between students in regular and open education. This test works well for comparing two independent groups when the assumptions for parametric tests are not met.

All statistical analyses were done at an appropriate level of significance, and the

results were interpreted according to standard practices in psychological research.

RESULT TABLES

Descriptive statistics

Table 4.1.1: Explaining scores of social intelligence of regular college-going students and open education-enrolled students.

	SOCIAL INTELLIGENCE	MEAN	MEDIAN	MODE	STANDARD DEVIATION
Mode of Education	regular	97.94	95	45	13.70298642
	open	85.22	84.5	25	7.807087309

Table 4.1.2: Explaining scores of emotion regulation of regular college-going students and open education enrolled students.

	EMOTION REGULATION	MEAN	MEDIAN	MODE	STANDARD DEVIATION
Mode of education	regular	42.88	42	45	8.338844436
	open	29.18	26	25	6.647663392

Frequency Table

Table 4.2.1: Frequency of male and female students enrolled in regular and open education programs.

Frequency Table	Gender		
Mode of education	**Female**	**Male**	**Grand Total**
Online/open	26	24	50
Regular	37	13	50
Grand Total	63	37	100

Normality test

Graph 4.3.1: The image below shows the QQ plot for the dataset of the social intelligence score using the D'Agostino-Pearson Normality Test; it can be noted that there is a statistically significant deviation of scores from a normal distribution. (Source: https://statskingdom.com/dagostino-pearson-test-calculator.html)

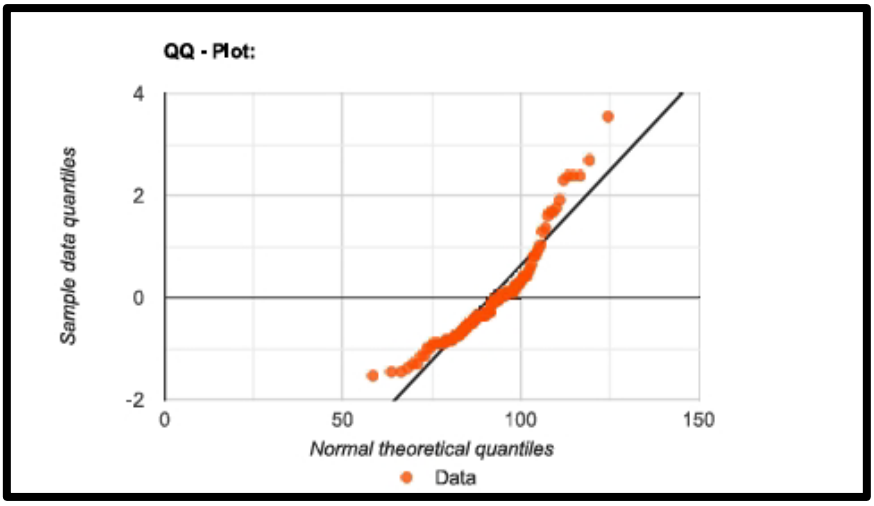

Table 4.3.1: Normality test of social intelligence score using D' Agostino Pearson Test.

Parameter	Value
P-value	0.000006766
χ^2	23.8072
Sample size (n)	100
Average ($\bar{x}$)	91.58
Median	88
Sample Standard Deviation (S)	12.8048
Sum of Squares	16232.36
Skewness	1.2204
Skewness Shape	**Asymmetrical**, right/positive (pval=0)
Excess kurtosis	1.4872
Kurtosis Shape	**Leptokurtic**, long heavy tails (pval=0.002)
Outliers	122, 122, 137, 122, 126, 121

Graph 4.3.2: The image below shows the QQ plot for the dataset of the emotion regulation score using the D'Agostino Pearson Normality Test; it can be noted that there is a statistically significant deviation of scores from a normal distribution. (Source: https://statskingdom.com/dagostino-pearson-test-calculator.html)

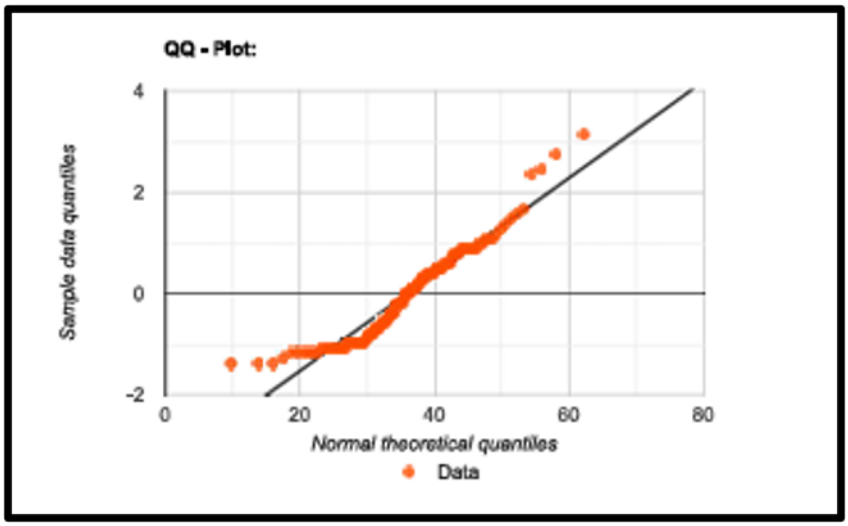

Table 4.3.2: Normality test of emotion regulation score using D'Agostino-Pearson Test.

Parameter	Value
P-value	0.01902
χ^2	7.9247
Sample size (n)	100
Average ($\bar{x}$)	36.03
Median	36
Sample Standard Deviation (S)	10.1826
Sum of Squares	10264.91
Skewness	0.6942
Skewness Shape	**Asymmetrical**, right/positive (pval=0.004)
Excess kurtosis	0.218
Kurtosis Shape	Potentially **Mesokurtic**, normal like tails (pval=0.648)
Outliers	

Normality:

- Normality was assessed using the D'Agostino-Pearson Test.
- The p-value for the social intelligence dataset was 0.0000067.
- The p-value for the emotion regulation dataset was 0.019.

Both the datasets under study were found to be not normally distributed.

Inferential statistics

Spearman rank correlation

Table 4.4.1: The table below shows the Spearman rank correlation coefficient value between social intelligence and emotion regulation.

Spearman Rank Correlation	
N (Sample Size)	Regular students- 50
	Open /Distance - 50
covariance	392.03
R	0.467

Mann-Whitney U test

Table 4.5.1 presents the results of the Mann-Whitney U test comparing social intelligence of regular college and open education enrolled undergraduate students of professional courses.

Group (social intelligence)	N	Median	SD	Rank	U
Regular	50	95	13.70298	3323.5	451.5
Open/Distance	50	84.5	7.80708	1726.5	2048.5

Table 4.5.2 presents the results of the Mann-Whitney U test comparing emotion regulation of regular college and open education enrolled undergraduate students of professional courses.

Group (social intelligence)	N	Median	SD	Rank	U
Regular	50	42	8.338844	3545	230
Open/Distance	50	26	7.807087	1505	2270

Result Interpretation

Table 4.1.1 shows descriptive statistics for social intelligence of students enrolled in regular and open/distance undergraduate professional courses, where values are found to be mean = 97.94, SD = 13.70298642 and mean = 85.22, SD = 7.807087309, respectively. This indicates that students enrolled in regular classes have above-average social intelligence, whereas students enrolled in open/distance mode of classes have average social intelligence.

Table 4.1.2 shows descriptive statistics for emotion regulation of students enrolled in regular and open/distance undergraduate professional courses, where values are found to be mean = 42.88, SD = 8.338844436 and mean = 29.18, SD = 6.647663392, respectively. This indicates that students enrolled in regular classes have average emotion regulation, whereas students enrolled in open/distance mode of classes have below-average emotion regulation.

The D'Agostino-Pearson test was conducted to assess the normality of social intelligence and emotion regulation scores. As shown in Graph 4.3.1 and Table 4.3.1, the social intelligence score is not normally distributed, with a statistically significant deviation that cannot be ignored. The same can be seen for the parent-child relationship score in Graph 4.3.2 and Table 4.3.2. Hence, for inferential statistics, non-parametric tests were employed.

Table 4.4.1 shows a Spearman rank correlation coefficient (rho = 0.467), indicating a statistically significant positive correlation between social intelligence and emotional regulation among undergraduate BBA, BCA, B.Com, and other professional course-enrolled students.

A Mann-Whitney U test was conducted to examine differences in the social intelligence of regular college-enrolled and open/distance college-enrolled students pursuing Bachelor's in professional courses (specific to Rajasthan). The results as shown in 4.5.1 indicates that social intelligence of regular college students (Median = 95, SD=13.70298) had a higher median score than open college students (Median= 84.5, SD=7.80708), p-value=3.664e-8, result is significant at p>0.05 which implies that there is no sufficient evidence to support null hypothesis suggesting there is a significant difference between social intelligence score of regular and open/distance college students.

Similarly, a Mann-Whitney U test was conducted to examine the difference in the emotion regulation of regular college-enrolled and open/distance college-enrolled students pursuing Bachelor's in professional courses (specific to Rajasthan). The results as shown in 4.5.2 indicates that emotion regulation of regular college students (Median = 42, SD=8.338844) had a higher median score than open college students (Median= 26, SD=7.807087), p-value=1.97e-12, result is significant at p>0.05 which implies that there is no sufficient evidence to support null hypothesis suggesting there is a significant difference between emotion regulation score of regular and open/distance college students.

Conclusion

The present study looked at social intelligence and emotional regulation among undergraduate students in professional courses in Rajasthan. The aim of the study was to explore the relationship between these two, and the findings showed a moderate positive correlation between social intelligence and emotional regulation. This suggests that students who are more aware of social cues, empathetic, and skilled in interacting with others tend to manage their

emotions better. This also indicates that an individual's ability to understand social situations is related to their ability to manage their emotions. It confirms that social and emotional abilities are interrelated with respect to mode of education.

Another important finding is that children who received regular education had higher social intelligence than those who received open education. This might be attributed to differences in educational settings, especially socialisation, peer relationships, and cooperation. In regular education programs, children can socialise, work together, and get immediate responses. These factors may promote social cognition and social skills among the students. Students who attend open education programs may study without proper interaction with their classmates, which means that they may not develop social cognition skills.

Similarly, there were differences between the emotional regulation of students pursuing regular and open education, suggesting that the educational environment is a key determinant of how students regulate their emotions. Structured schedule, continuous communication, and social support provided in regular education mode may contribute to better emotional regulation. Overall, our findings highlight the necessity to include programs that help develop social and emotional capabilities at higher educational institutions, especially in the open education system. Our research contributes to the existing literature by providing evidence from Rajasthan regarding the role of social intelligence and emotional regulation in student development. Social intelligence and emotional regulation vary depending on the type of education a student is pursuing and are interrelated. These findings point to an issue that should not be overlooked in the field of open education: attention to students' social and emotional needs through proper peer interaction structures, counselling, and social skills training. Otherwise, providers of open education classes are exposed to both academic and reputational risks, resulting in legal difficulties in future. This would harm student welfare and threaten the long-term stability of the higher education system.

References

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. Clinical Psychology Review, 30(2), 217–237. https://doi.org/10.1016/j.cpr.2009.11.004

All India Survey on Higher Education. (2022). AISHE 2021–22 Report. Ministry of Education, Government of India. https://aishe.gov.in

Brackett, M. A., Rivers, S. E., & Salovey, P. (2006). Relating emotional abilities to social functioning. Journal of Personality and Social Psychology, 91(4), 780–795. https://www.eiconsortium.org/pdf/Brackett.Rivers.Shiffman.Lerner.Salovey.JPSP.2006.pdf

Brackett, M. A., Rivers, S. E., & Salovey, P. (2011). Emotional intelligence: Implications for personal, social, academic, and workplace success. Social and Personality Psychology Compass, 5(1), 88–103. https://doi.org/10.1111/j.1751-9004.2010.00334.x

Deb, S., Strodl, E., & Sun, J. (2015). Academic stress, parental pressure, anxiety and mental health among Indian students. International Journal of Psychology and Behavioural Sciences, 5(1), 26–34. https://doi.org/10.5923/j.ijpbs.20150501.04

Extremera, N., & Fernández-Berrocal, P. (2006). Emotional intelligence as predictor of mental, social, and physical health in university students. The Spanish Journal of Psychology, 9(1), 45–51. https://doi.org/10.1017/S1138741600005965

Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. Basic Books. https://books.google.com

Goleman, D. (1995). Emotional intelligence. Bantam Books.

Goleman, D. (2006). Social intelligence: The new science of human relationships. Bantam Books.

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. Review of General Psychology, 2(3), 271–299. https://doi.org/10.1037/1089-2680.2.3.271

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. Journal of Personality and Social Psychology, 85(2), 348–362. https://doi.org/10.1037/0022-3514.85.2.348

Kaukiainen, A., et al. (2002). Social intelligence as a predictor of social adjustment. European Journal of Personality, 16(1), 1–20. https://doi.org/10.1002/per.434

Saxena, S., & Jain, R. (2013). Social intelligence of undergraduate students in relation to their academic achievement. Indian Journal of Research, 2(1), 67–69. https://ijip.in/wp-content/uploads/2023/06/18.01.200.20231102.pdf

Silvera, D. H., Martinussen, M., & Dahl, T. I. (2001). The Tromsø Social Intelligence Scale: A self-report measure of social intelligence. Scandinavian Journal of Psychology, 42(4), 313–319. https://doi.org/10.1111/1467-9450.00242

Teoh, G. B. S. (2019). Emotional intelligence and self-directed learning among distance learners. Journal of Education and Learning. https://dergipark.org.tr/en/download/article-file/2159295

Thompson, R. A. (1994). Emotion regulation: A theme in search of definition. Monographs of the Society for Research in Child Development, 59(2–3), 25–52. https://www.jstor.org/stable/1166137

Valizadeh, M. (2016). Emotional intelligence and academic adjustment among distance learners. International Journal of Distance Education.

World Health Organization. (2022). Adolescent and young adult mental health. https://www.who.int

3
Relationship between Mindful Healthcare Practice, Moral Distress, and Turnover Intention among Healthcare Professionals

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Abstract

Background
Healthcare professionals practice in complex and emotionally demanding environments in which ethical challenges and systemic constraints are prevalent. These conditions are sources of moral distress, which often adversely affects psychological well-being and increases turnover intention. Mindful healthcare practice, characterised by present-moment awareness, acceptance, emotional regulation, and value-based engagement in professional roles, may affect healthcare professionals' experiences of ethical stressors and decisions to leave their profession. Examining relationships among mindful healthcare practice, moral distress, and intention to leave is important for promoting a sustainable healthcare workforce.

Objectives
1. The purpose of this study was to look at the connection between healthcare workers' intentions to leave their jobs and mindful healthcare practices.
2. to look into the relationship between healthcare professionals' intention to leave and moral discomfort.

Method
In the present study, a correlational research design was used. Healthcare professionals will be evaluated on the Mindful Healthcare Scale, the Moral **Distress Scale, the** Turnover Intention Scale (TIS-6) and the Revised Moral Distress Scale (MDS-R). The relationships between moral distress, turnover intention, and mindful healthcare practice will be examined using Pearson's product-moment correlation.

Results
It is expected that mindful healthcare practice will be negatively correlated with turnover intention, while moral distress will show a positive correlation with turnover intention among the healthcare professionals.

Conclusions
It is anticipated that the study will further knowledge of the psychological elements associated with the intention to leave a healthcare setting. The results may aid in the creation of ethically sound and mindfulness-based therapies intended to lessen moral anguish and enhance workforce sustainability and professional well-being, particularly in health care systems.

Keywords: Mindful Healthcare Practice, Moral Distress, Turnover Intention, Healthcare Professionals, Sustainable Well-being

Introduction

Healthcare systems all over the world are experiencing an unprecedented crisis in their workforce, characterised by elevated stress levels, burnout, and turnover among medical practitioners. The nature of healthcare work makes it necessary to always be exposed to suffering, ethical dilemmas, time pressure, and high-stakes decision-making. Such conditions not only stress the technical ability of professionals, but also their moral and other psychological strength.

One of the most important and least researched psychological experiences is moral anguish occurs in hospital settings. Healthcare workers experience moral discomfort when they recognise the morally right course of action but are unable to implement it due to institutional limitations, a disability resulting from hierarchical power arrangements, or a lack of resources. Emotional weariness, job discontent, depersonalisation, and a greater desire to quit the profession have all been connected to repeated exposure to moral distress.

One of the best indicators of actual turnover is turnover intention, which is defined as the deliberate and conscious desire to leave an organisation or profession. High turnover rates among healthcare professionals affect continuity of care, patient safety, organisational efficiency and also add financial costs to healthcare institutions. Understanding psychological elements that diminish the intention to turn over is therefore key to maintaining healthcare systems.

In recent years, busy healthcare practice has become aware of the significance of mindful healthcare as a measure that can automate the protection of healthcare professionals. Mindfulness in healthcare settings is the practice of cultivating awareness of the present moment, emotional balance, compassion, and sensitivity to ethics and values while working in a professional capacity. Mindful practitioners may be better equipped to handle the ethical dilemmas they encounter, control their emotional reactions, and align their behaviour with their professional principles.

Despite increasing interest in mindfulness-based interventions for healthcare professionals, little empirical research has examined the direct link between mindfulness practice and Healthcare workers' moral discomfort and intention to leave their jobs. By methodically investigating the relationship between mindfulness and moral discomfort and turnover intention among healthcare professionals, the current study seeks to close this gap.

Objectives

- To investigate the problem of mindful practice in healthcare and how it is related to intention to turnover among healthcare professionals.
- To examine the relationship between healthcare workers' intention to leave their jobs and moral discomfort.

Hypotheses

1. There will be a strong negative correlation between healthcare workers' intentions to leave their jobs and mindful healthcare practices.
2. Among healthcare workers, there will be a strong positive correlation between moral anguish and the intention to leave.

Research Design

The study examines the connections between moral anguish, intention to leave the healthcare organisation, and mindful healthcare practice using a correlational research approach. This strategy works well for determining the strength and direction of relationships between psychological factors without changing them.

Participants

Healthcare professionals working in government and private healthcare facilities, including physicians, nurses, and allied health professionals, will make up the sample. Purposive sampling will be used to select participants. A minimum of one year of professional experience and active involvement in clinical or patient care-related roles are prerequisites for inclusion. Professionals who are not directly involved in patient care or who have severe mental health issues will not be allowed.

The expected sample size will be 150 to 300 participants, with females to have enough statistical power to conduct correlational analysis.

Measures

1. **Mindful Healthcare Scale**
   The Mindful Healthcare Scale measures mindfulness in the context of healthcare practice such as awareness, acceptance, emotional regulation and compassionate engagement. The scale clearly shows good internal consistency and construct validity among healthcare populations.

2. **Revised Moral Distress Scale (MDS-R)**
   The MDS-R measures the frequency and severity of moral distress experienced by healthcare professionals in morally difficult situations. It is widely used across a variety of healthcare contexts and has strong psychometric properties.

3. **Scale of intention to leave (TIS-6)**
   The TIS-6 is a quick and accurate way to gauge someone's intention to quit their current position. High values signify a high intention to leave.

Procedure

The study will be carried out following a systematic and ethically sound procedure in order to ensure the reliability and validity of data collection.

Initially, prior permission will be obtained from the institutional ethics committee of the concerned university, as well as administrative permission from selected governmental and

private healthcare institutions. Heads of departments and hospital administrators will be formally approached to seek their cooperation in data collection.

Healthcare practitioners who meet the inclusion criteria will be approached directly or through formal institutional channels. The nature and goal of the study will be explained to participants, with a focus on the fact that the research is entirely academic and voluntary. They will be assured that their answers will be kept completely private and used exclusively for research.

Before distributing the questionnaires, everyone will be asked for their written informed consent. Additionally, participants will be informed of their freedom to leave the study at any moment without facing any negative consequences.

Three standardised scales—the Mindful Healthcare Scale, the Moral Distress Scale-Revised (MDS-R), and the Turnover Intention Scale (TIS-6)—as well as a brief demographic information sheet (age, gender, profession, years of experience, and type of healthcare institution) will be used to collect data through structured questionnaires. Depending on each participant's convenience, the questionnaires will be distributed via a survey platform (a secure access method) or paper-and-pencil format.

Participants will be asked to provide their responses without hindrance and without any time limit for completing the questionnaires. On average, the assessment is estimated to take around 20-25 minutes per participant.

After this, the questionnaires will be reviewed to ensure they are complete. Incomplete or incorrectly filled responses will be removed from the final analysis. To do the analysis, the gathered data will be coded and input into the Statistical Package for the Social Sciences (SPSS).

Throughout the research process, ethical principles such as anonymity, confidentiality, non-maleficence and respect for the autonomy of participants will be strictly observed.

Statistical Techniques

The Statistical Package for the Social Sciences (SPSS) will be used to analyse the data. Descriptive statistics (mean, standard deviation) will be computed for each variable. The association between moral discomfort, turnover intention, and mindful healthcare practice will be presented using Pearson's product-moment correlation coefficient. The significance level will be set at $p < .05$.

Results

Table 1: Study Variable Descriptive Statistics (N = 200)

Variable	Mean	Standard Deviation	Minimum	Maximum
Mindful healthcare practice	72.45	10.32	45	95
Moral distress	88.20	15.64	40	140
Turnover Intention	14.30	4.25	6	30

The descriptive statistics indicate moderate to high levels of mindful healthcare practice. Healthcare workers had low to moderate levels of turnover intention and moderate levels of moral anguish.

Table 2: Pearson Correlation Matrix among Mindful Healthcare Practice, Moral Distress, and Turnover Intention

Variables	1	2	3
Mindful healthcare practice	1		
Moral distress	-0.42**	1	
Turnover intention	-0.48**	0.55**	1

Note. p < .01

The findings confirm Hypothesis 1 by indicating a significant inverse association between turnover intentions and mindful healthcare practices. Hypothesis 2 is supported by the large and positive correlation between turnover intention and moral anguish. Furthermore, there is a substantial negative correlation between moral distress and attentive healthcare practices, supporting Hypothesis 3.

Discussion

The predicted results align with other research suggesting that mindfulness is a psychological resource that increases coping, ethical sensitivity, and emotional regulation in healthcare professionals. By promoting the development of present-moment awareness and non-reactivity, mindful healthcare practice may help minimise the intensity of moral distress and buffer its impact on turnover intention.

The positive relationship between moral distress and turnover intention highlights the importance of ethical work environments in retaining healthcare professionals. Persistent moral distress, if unaddressed, may lead to a breakdown in professional commitment and well-being and ultimately workforce attrition.

The study emphasises the need to incorporate mindfulness-based training and ethics support mechanisms in healthcare organisations. Such interventions may pay off not only in reducing individual distress but also in contributing to a culture of ethical reflection, compassion, and professional sustainability.

Conclusion

The present study highlights the mutually interrelated roles of mindful healthcare practice, moral distress, and intention to turn over among healthcare professionals. By identifying mindfulness as a potential protective factor in moral distress and turnover intention, the results have important implications for policy, training, and intervention programs aimed at sustaining the healthcare workforce.

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References

Austin, W., Lemermeyer, G., Goldberg, L., Bergum, V., & Johnson, M. S. (2005). Moral distress in healthcare practice: The situation of nurses. *HEC Forum*, 17(1), 33–48. https://doi.org/10.1007/s10730-005-0183-7

Epstein, R. M., & Street, R. L. (2011). The values and value of patient-centred care. *Annals of Family Medicine,* 9(2), 100–103. https://doi.org/10.1370/afm.1239

Epstein, R. M., & Krasner, M. S. (2013). Physician resilience: What it means, why it matters, and how to promote it. *Academic Medicine*, 88(3), 301–303. https://doi.org/10.1097/ACM.0b013e318280cff0

Hamric, A. B., Borchers, C. T., & Epstein, E. G. (2012). Development and testing of an instrument to measure moral distress in healthcare professionals. *AJOB Primary Research*, 3(2), 1–9. https://doi.org/10.1080/21507716.2011.652337

Hayes, L. J., O'Brien-Pallas, L., Duffield, C., Shamian, J., Buchan, J., Hughes, F., Laschinger, H. K. S., & North, N. (2012). Nurse turnover: A literature review. *International Journal of Nursing Studies,* 49(7), 887–905. https://doi.org/10.1016/j.ijnurstu.2011.10.001

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology*: *Science and Practice*, 10(2), 144–156. https://doi.org/10.1093/clipsy.bpg016

Maslach, C., Schaufeli, W. B., & Leiter, M. P. (2001). Job burnout. *Annual Review of Psychology*, 52, 397–422. https://doi.org/10.1146/annurev.psych.52.1.397

Mobley, W. H. (1977). Intermediate linkages in the relationship between job satisfaction and employee turnover. *Journal of Applied Psychology,* 62(2), 237–240. https://doi.org/10.1037/0021-9010.62.2.237

Shanafelt, T. D., & Noseworthy, J. H. (2017). Executive leadership and physician well-being. *Mayo Clinic Proceedings*, 92(1), 129–146. https://doi.org/10.1016/j.mayocp.2016.10.004

West, C. P., Dyrbye, L. N., Erwin, P. J., & Shanafelt, T. D. (2016). Interventions to prevent and reduce physician burnout. *The Lancet*, 388(10057), 2272–2281. https://doi.org/10.1016/S0140-6736(16)31279-X

4
Repurposing Used Cooking Oil into Biodiesel: A Case Study on Zomato's Sustainable Bio-entrepreneurship Model

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Abstract
India has been struggling with a serious sustainability challenge of reuse and improper disposal of used cooking oil. Millions of litres of **used cooking oil** have been either reintroduced into the food chain or discarded, ultimately leading to cardiovascular disease risks and food adulteration. To address this problem, innovative **circular bioeconomy models** have been developed to convert used cooking oil into **biodiesel,** an alternative renewable energy source.
This paper shall explore **Zomato's** collaborative initiative with BioD Energy. This case study also sheds light on sustainable **bio-entrepreneurship** in action along with CSR acknowledgement. This partnership enables Zomato to collect 1000 litres of Used Cooking Oil per month from restaurants across major cities and convert it into Biodiesel, which is then blended with conventional diesel and supplied to oil companies. This initiative also supported the government's National target of converting 220 crore litres of Used Cooking Oil into Biodiesel by 2022, which was envisioned by FSSAI. This study is a perfect blend of Zomato's business-driven environment strategy and the practical implementation of circular economy principles into food service operations. This will create an economically viable and socially responsible path forward for **sustainable businesses.**
Keywords: Used Cooking Oil, Biodiesel, Bio-entrepreneurship, sustainable businesses, Zomato, circular bioeconomy

Introduction
The worldwide search for sustainable and renewable energy alternatives has accelerated due to the growing environmental burden of fossil fuel use. Biodiesel is a promising way to reduce carbon emissions and improper waste disposal, especially when it is produced from waste feedstocks such as used cooking oil (UCO) (Hamed et al., 2021; Sreelekha et al., 2024). Difficulties with feedstock collection, heterogeneity, and quality control are among the reasons for the limited use of UCO-based biodiesel (Leung et al., 2010). Out-of-control UCO reuse and disposal in India not only endangers public health but also contributes to environmental pollution (FSSAI, 2023). It is the need of the hour to have an integrated system that connects waste streams from the food industry to sustainable fuel production and is traceable to address these issues. Zomato's sustainable bioentrepreneurship model is a significant example of such integration, in collaboration with Biod Energy (BioD). It ensures the collection of UCO from restaurants and routes it to biodiesel production, where it is further blended with conventional diesel (Inc42, 2019). By optimising its extensive digital infrastructure and restaurant network, Zomato's model symbolises a scalable, circular-economy approach that reconciles urban waste management with renewable energy generation.

Composition of Used Cooking Oil (UCO)

Frequent heating and prolonged exposure to heat and oxidation during frying produce a different type of oil from that of fresh vegetable oils. Monounsaturated, polyunsaturated, and saturated fatty acids are generally present in adequate amounts in fresh oils. But UCO has a higher percentage of saturated and Monounsaturated fatty acids, whereas polyunsaturated fatty acid content continues to decline due to oxidative breakdown and thermal degradation. Long-term heating also leads to the hydrolysis and oxidation of triglycerides and phospholipids, which in turn produce free fatty acids (FFAs), aldehydes, ketones, peroxides, and other polar compounds. These chemical changes impact the oil's nutritional value and change its viscosity, colour, and sensory qualities.

It is important to understand the detailed chemical composition of UCO for its efficient repurposing into biodiesel. The presence of Free Fatty Acids and other degradation products can affect the yield and quality of biodiesel during transesterification. To meet the standards for sustainable biofuel production and circular economy principles, monitoring these compositional parameters has become important. (Awogbemi, 2019).

Impact Of UCO

Overaccumulation and improper disposal of used cooking oil (UCO) can have significant effects on the environment, ecosystem, and the general public's health. UCO can create blockages when released into drainage systems, leading to urban flooding and clogged sewers. The oil also disrupts aquatic ecosystems by creating a thin surface layer that impedes oxygen transfer. Free fatty acids, aldehydes, and polymerised compounds found in UCO are toxic to microbial communities and also bioaccumulate, disrupting aquatic food chains. Besides contributing to air pollution, it causes oxidative stress, inflammation, and an increased risk of cardiovascular and metabolic diseases in people by releasing volatile organic compounds and polycyclic aromatic hydrocarbons into the air. It also leads to soil pollution by disrupting microbial activity and soil structure, ultimately causing soil infertility. Sankhyan highlights the need for renewable energy sources, which can be aligned with the circular economy by using sustainable methods for collecting, recycling, and valuing waste, such as converting UCO into biodiesel.

Collection of UCO

The collection of UCO can be traced as part of India's RUCO (Repurpose Used Cooking Oil) initiative, led by the Food Safety and Standards Authority of India (FSSAI) in partnership with the Ministry of Petroleum & Natural Gas, in which Zomato has set up an effective system of collection of UCO from partner restaurants. Blue storage drums are offered free of charge by Zomato to ensure proper safety storage for restaurants. These filled drums are later collected by trucks, and the empty ones are returned for further collection; this ensures a smooth and sanitary process. Restaurants that are not yet part of this program are welcome to join the initiative with Zomato, and they will be paid for the collected oil to encourage both economic incentives and environmental responsibility. India's objectives of producing sustainable energy and lowering carbon emissions are fulfilled by converting collected UCO into biodiesel at approved biodiesel production facilities. By establishing a comprehensive framework for an

ethically sound waste management system and the production of renewable fuel, Zomato demonstrates its dedication to sustainable bioentrepreneurship and the circular economy (Zomato Blog, 2019; News18, 2019).

Regulations and Policies for UCO Collection

A well-organised regulatory and policy framework that guarantees sustainable use, safe collection, and traceability supports the management of used cooking oil (UCO) in India. One important program is RUCO (Repurpose Used Cooking Oil), launched by the Food Safety and Standards Authority of India (FSSAI) and the Ministry of Petroleum and Natural Gas (MoPNG). This program reduces environmental contamination and creates a dependable feedstock for biodiesel production by requiring the segregation, safe storage, and proper collection of UCO from homes, restaurants, and the HoReCa sector.

Under the FSSAI guidelines, food businesses are encouraged to partner with authorised aggregators, maintain hygienic storage of UCO, and ensure traceability from generation to collection. The National Policy on Biofuels also sets targets for biodiesel blending and encourages the use of UCO as a renewable feedstock to meet energy and sustainability goals. These regulations create an ecosystem that incentivises responsible disposal, supports circular-economy practices, and provides opportunities for bioentrepreneurial models, such as Zomato's UCO collection program. By adhering to these policies, companies and restaurants not only comply with legal standards but also help reduce environmental hazards and promote renewable energy production.

Processing of UCO

Zomato and authorised biodiesel producers under their partnership programme convert the UCO into biodiesel. Zomato ensures the smooth collection of UCO from partner restaurants through its blue drum collection system and ensures proper storage, traceability, and regulatory compliance. After collection, the oil is transported to biodiesel facilities for processing. During the process, pre-treatment removes solid food particles and dries the material to reduce moisture before the transesterification reaction.

In this chemical process, triglycerides in the oil react with methanol in the presence of a catalyst—typically alkaline (NaOH, KOH), acidic (H_2SO_4), or enzymatic—to produce fatty acid methyl esters (FAME), which constitute biodiesel, and glycerol as a by-product. After the reaction, the mixture separates into biodiesel and glycerol, and the biodiesel is purified to meet fuel quality standards.

This partnership model ensures a circular-economy approach, turning waste oil into renewable fuel while providing economic incentives for restaurants and supporting India's sustainable energy initiatives. By ensuring proper collection, traceability, and compliance, Zomato and its partners contribute to both environmental protection and bioentrepreneurship.

Economic and Business Prospective

The repurposing of Used Cooking Oil (UCO) into biodiesel can be a significant economic cum sustainable model of entrepreneurial opportunities, particularly for food delivery platforms, restaurants, and renewable energy producers. For companies like Zomato, developing a structured UCO collection system has proven to be a new revenue stream while encouraging

sustainability and corporate social responsibility (CSR) initiatives. Partner restaurants benefit financially through monetary incentives for the UCO they supply, creating a win-win model that encourages reduction in environmental liabilities.

From a market perspective, UCO-based biodiesel is a cost-effective alternative to conventional diesel, as the raw material is essentially a waste product with minimal procurement cost. By collecting UCO from multiple restaurants and food chains, Zomato-like platforms can ensure a continuous supply at scale, which is crucial for commercial biodiesel production. This model depicts how circular economy principles can be applied to a profitable business, amalgamating sustainability with economic viability.

Moreover, UCO-based biodiesel production increases job creation and entrepreneurial activity across the supply chain, including collection, transportation, processing, and distribution. It also stimulates innovation in logistics, tracking, and quality control, as transparency and compliance are crucial for regulatory adherence and market acceptance. Overall, this model highlights the economic and business perspective on UCO repurposing, focusing on how the concepts of reuse, recycling, and reducing can be used to convert environmental challenges into profitable bioentrepreneurship ventures, as exemplified by Zomato's sustainable model.

Research Methodology

The study relies primarily on secondary data from company sustainability reports, FSSAI notifications, government policy documents, and relevant academic literature. The assessment of data is done using circular economy practices, sustainability impact, and bio-entrepreneurial value creation. Selected case for the study: Zomato's collaboration with BioD Energy to convert used cooking oil into biodiesel. Due to limited access to proprietary data, the study relies on a combination of secondary data sources, which is acceptable for a descriptive and exploratory case study.

Conclusion

Zomato's sustainable bioentrepreneurship model has addressed persistent urban waste challenges by repurposing Used Cooking Oil (UCO) into biodiesel, an innovative and practical approach. Through the integration of technology, logistics, and sustainability principles, Zomato has demonstrated the impact of digital platforms not only on food delivery but also on environmental conservation and renewable energy production (FSSAI, 2020). Zomato's collaboration with biodiesel manufacturers and regulatory bodies, such as the Food Safety and Standards Authority of India (FSSAI), has truly converted waste into value. This initiative under RUCO (Repurpose Used Cooking Oil) directly contributed to reducing improper oil disposal, mitigating water and soil pollution, and lowering carbon emissions (FSSAI, 2019). This model perfectly demonstrates that corporate-led sustainability can simultaneously generate environmental, economic, and social value (Singh & Sharma, 2020). In fact, much of the 140 crore litres per annum of UCO can be converted into biodiesel, which can ideally result in an 80% reduction in carbon emissions compared to conventional diesel (Atabani et al., 2012; Demirbas, 2009).

This initiative by Zomato is also aligned with the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Consumption and

Production), and SDG 13 (Climate Action), as well as the private sector's potential to support national biofuel blending targets (United Nations, 2015). However, this initiative also comes with certain limitations and challenges, such as inconsistent UCO supply, lack of awareness among small food operators, and high collection and processing costs (Leung et al., 2010). To achieve large-scale transformation, a few areas need attention, such as stronger policy incentives, improved collection logistics, and enhanced awareness campaigns.

In conclusion, Zomato's UCO-to-biodiesel initiative judiciously integrates bioentrepreneurship in practice and transformed environmental waste into economic opportunity. It highlights the power of innovation, collaboration, and sustainability in both business and environmental progress. This model can ensure that profitability and social responsibility go hand in hand, setting a benchmark for future bio-based enterprises. Zomato's sustainable bioentrepreneurship model is a perfect example of CSR, innovation, sustainability, and economic consciousness, fostering a circular economy. The idea of reuse and recycling, with the aim of minimising input costs for a final eco-friendly product, has demonstrated an intelligent partnership among Zomato-like platforms, restaurants, and biodiesel production units. UCO can produce harmful compounds, such as aldehydes and trans fats, when improperly discarded or reused multiple times, leading to serious environmental and health hazards (Leung et al., 2010). Zomato's initiative to redirect this waste stream into biodiesel production has helped convert potential pollutants into a clean, renewable resource, thereby fulfilling national and global sustainability goals (Atabani et al., 2012). Regarding the environment, converting UCO to biodiesel has reduced our dependence on fossil fuels and lowered carbon emissions by nearly 80% compared to petroleum diesel (Demirbas, 2009). Moreover, biodiesel derived from UCO emits significantly fewer particulates, sulfur oxides, and carbon monoxide, which contributes to improving air quality and supporting India's commitments under the Paris Climate Agreement and the United Nations Sustainable Development Goals (SDGs)—particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action) (United Nations, 2015). From a bioentrepreneurial perspective, Zomato's initiative highlights the potential of private enterprises to integrate environmental sustainability, technology, and innovation. The partnership between Zomato and thousands of restaurants has optimised the digital infrastructure for producing biodiesel from UCO (FSSAI, 2020). Zomato's collaboration with biodiesel manufacturers and regulatory bodies, such as the Food Safety and Standards Authority of India (FSSAI), has truly converted waste into value. This initiative under RUCO (Repurpose Used Cooking Oil) directly contributed to reducing improper oil disposal, mitigating water and soil pollution, and lowering carbon emissions (FSSAI, 2019).

However, despite the successful implementation of this model, it faces numerous challenges with respect to logistics, collections, integration, the adequate availability of UCO, and other costs involved in the process (FSSAI, 2020). In addition, large-scale implementation remains a critical concern due to UCO quality standards across diverse food outlets (Atabani et al., 2012). To address these issues, it is necessary to work on policy incentives, innovation, collection systems, and holistic management while keeping government agencies in the loop. Other industries should adopt Zomato's model to integrate sustainability and entrepreneurship for a better, more eco-friendly environment and future. There is still a need to spread awareness of such business-driven sustainability initiatives that can contribute to national energy goals.

In summary, Zomato's UCO-to-biodiesel initiative case reflects the revolutionary potential of sustainable bioentrepreneurship in the food and energy sectors. By integrating waste reduction, renewable energy generation, and social responsibility, this model demonstrates that sustainability can be both economically viable and environmentally impactful—turning a widespread waste problem into a catalyst for clean energy innovation and circular economy growth.

References

Food Safety and Standards Authority of India. (2019). *FSSAI launches initiative to convert used cooking oil into biodiesel*. Retrieved from https://fssai.gov.in/upload/media/FSSAI_News_Oil_INC_22-10_2019.pdf

BioD Energy. (2020). Sustainable biodiesel production from used cooking oil: A step towards cleaner fuels. BioD Energy Reports.

Zomato Sustainability Report. (2021). Responsible disposal and recycling of used cooking oil: A collaborative circular economy model. Zomato Media Pvt. Ltd.

Singh, P., & Kumar, R. (2022). Valorization of waste cooking oil into biodiesel: Advances in transesterification technologies. Journal of Renewable Energy Research, 14(3), 245–258.

Awogbemi, O. (2019). Comparative study of properties and fatty acid composition of used cooking oil and neat vegetable oils. *International Journal of Low-Carbon Technologies*, 14(3), 417–423. https://doi.org/10.1093/ijlct/ctz004

Sankhyan, S. (2025). Valorization of waste cooking oil: Emerging strategies for sustainable management. *Science of The Total Environment, 837*, 155799. https://doi.org/10.1016/j.scitotenv.2022.155799

Zomato Blog. (2019, November 27). *How we are helping convert Used Cooking Oil into Biodiesel.* Zomato. https://blog.zomato.com/uco

News18. (2019, November 29). *More People Are Ordering on Zomato Than Before, But Biofuels Initiative is Cool.* News18. https://www.news18.com/news/tech/more-people-are-ordering-on-zomato-than-before-but-biofuels-initiative-is-cool-2332025.html

Ministry of Petroleum & Natural Gas, Government of India. (2019). *RUCO (Repurpose Used Cooking Oil) Guidelines.* Retrieved from https://www.petroleum.nic.in

Food Safety and Standards Authority of India (FSSAI). (2019). *Guidelines for Repurposing Used Cooking Oil.* Retrieved from https://www.fssai.gov.in

Press Information Bureau, Government of India. (2018). *National Policy on Biofuels.* Retrieved from https://pib.gov.in

Meher, L. C., Sagar, D. V., & Naik, S. N. (2006). Technical aspects of biodiesel production by transesterification—a review. *Renewable and Sustainable Energy Reviews, 10*(3), 248–268. https://doi.org/10.1016/j.rser.2004.09.002

Knothe, G., Van Gerpen, J., & Krahl, J. (2005). *The biodiesel handbook*. AOCS Press.

Demirbas, A. (2009). Biodiesel from waste cooking oils via base-catalytic and supercritical methanol transesterification. *Energy Conversion and Management,50*(4),923–927.https://doi.org/10.1016/j.enconman.2008.11.013

Atabani, A. E., Silitonga, A. S., Badruddin, I. A., Mahlia, T. M. I., Masjuki, H. H., Mekhilef, S., & Chong, W. T. (2012). A comprehensive review on biodiesel as an alternative energy resource and its characteristics. *Renewable and Sustainable Energy Reviews, 16*(4), 2070–2093

FSSAI. (2020). *Guidelines for Collection and Conversion of Used Cooking Oil into*

Biodiesel. Food Safety and Standards Authority of India. https://www.fssai.gov.in

Leung, D. Y. C., Wu, X., & Leung, M. K. H. (2010). A review on biodiesel production using catalyzed transesterification. *Applied Energy, 87*(4), 1083–1095. https://doi.org/10.1016/j.apenergy.2009.10.006

Singh, R., & Sharma, Y. C. (2020). Sustainable utilization of waste cooking oil for biodiesel production: A review. *Renewable and Sustainable Energy Reviews, 133*, 110254. https://doi.org/10.1016/j.rser.2020.110254

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations. https://sdgs.un.org/2030agenda

5
Role of AI in market surveillance in Capital Markets

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Abstract
Capital markets serve as the financial backbone of a country and play an important role in its economic growth. They must be protected from fraud and activities such as money laundering and insider trading. Artificial Intelligence (AI) is a computer program that can act like a being. AI acts as a market police force that safeguards capital markets from fake trading, the use of secret information (insider trading), and other illegal or fraudulent activities.
This paper examines the role of AI in market surveillance within capital markets. It also shows that AI not only finds errors but also helps prevent and protect against such fraudulent activities. AI acts as the immune system of financial markets, constantly scanning for threats, learning from attacks, and improving its protection capabilities. However, AI is only a tool that is programmed by humans. It can introduce bias and errors. It is a double-edged sword, with advantages as well as inherent risks. Our research indicates that humans should exercise caution when using AI. Our study posits that AI is just a tool; it should not be considered a hero. It can't replace humans, but it can assist humans.
In Conclusion, AI is an indispensable tool and a powerful element of market surveillance frameworks. But it remains a tool that demands prudent human governance. It acts like another immune system; sometimes it overreacts, misguides investors and fails to detect viruses. It should be engineered and applied judiciously and diligently by human experts.
Keywords: Insider trading, surveillance, engineered, money laundering, intelligence

Introduction
Capital markets have changed a lot over the past few decades. This is because of technology. The internet and computers have made it possible for people to buy and sell things online. This did not happen at once. It took time. Happened as computers and technology got better. Now capital markets are better. People can invest from anywhere and at any time. Capital markets are also more open to everyone, which's a good thing for investors. Capital markets like this make it easy for people to trade and do business.
Technology has really changed the way capital markets work. It helps set prices, makes buying and selling cheaper, and brings more people into the market. Now investors can access information and use specialised tools to analyse and trade more easily, which helps them make better decisions. This has made capital markets faster, easier to understand and more competitive. While technology has brought many benefits to capital markets, it has also introduced new problems and weaknesses in the financial system. Capital markets are still getting used to these changes. These changes are affecting capital markets in many ways. The technology used in capital markets is making them work better.
The speed of money moving around is getting faster and faster. This means the chance of people cheating the system is getting bigger. They are doing things like manipulating the market and

trading on information. These people are getting really good at hiding what they are doing. They are using computers to make trades really fast. They are making deals in many different markets at the same time. This makes it very hard to keep an eye on what's going on. Financial markets are like a game. When people cheat, it is not fair to everyone else. It also makes people lose trust in the system. It can cause big problems for financial markets. The risk of market abuse is. It is a big concern because market abuse can do a lot of damage to financial markets and investor confidence.

Market surveillance is really important for regulatory authorities to deal with the problems they face. Market surveillance involves monitoring everyone involved in the market, including investors, brokers, merchant bankers, and other market participants, to see what they are doing. They do this to catch and stop people from doing things. When market surveillance works well, it helps ensure the market is fair, transparent, and trustworthy. This is necessary for the market to work properly and last for a time. Market surveillance is key to keeping the market fair and trustworthy. That is what market surveillance is all about.

Market surveillance systems used to depend a lot on people watching things manually and on rules to find trading patterns. These systems used rules that people had set up beforehand. They relied on human judgement, which made them not very good at finding complex and changing market behaviours. As trading became faster and more complex, the old way of watching the markets did not work very well. Regulators often struggled to process large volumes of data, which meant they were slow to detect and address potential market abuse. Market surveillance systems were not doing a good job of keeping up with the markets.

The capital markets are changing a lot. This is making things harder. New technology has made markets work better and easier to use. It has also made it easier for some people to cheat the system and do bad things. They use tools and plans to do this. People watching the markets by themselves can not catch all of these things because they are very complicated and happen so fast. There is too much data to look at. So the people in charge need systems that can watch the markets and adapt to what's happening, and these systems need to be smart and work automatically. The capital markets need these systems to keep everything.

Concept of Artificial Intelligence

Artificial intelligence is really cool. It includes something called machine learning. Artificial intelligence has become a useful tool for monitoring what is going on in the markets where people buy and sell things. Artificial intelligence systems can quickly analyse a lot of information, both organised and unorganised. They can find patterns that're not easy to see and detect things that are not normal. This can help identify market activity.

Artificial intelligence systems are better than traditional methods because they can learn from new information all the time. This means they get better and better at their job over time. Artificial intelligence is also effective at helping us keep markets safe. So, using intelligence in market surveillance frameworks is a big step forward. This improves how we regulate modern capital markets. Integrating intelligence into market surveillance frameworks is important for monitoring and detecting risks. Artificial intelligence is changing how we conduct market surveillance in capital markets.

Importance of Market Integrity and Investor Protection

Market integrity and investor protection are essential for markets to function properly. In simple terms, market integrity means making sure that trading is fair, transparent, and orderly. Investor protection is also crucial as it protects investors from people who try to cheat or trick them. When market integrity is maintained, investors feel safer. Are more likely to participate in the market. Market integrity helps to make markets more liquid. This is good for the economy. Investors are confident when they see market integrity in action, and this confidence is what makes markets work smoothly, which is what market integrity is, about. So, market integrity and investor protection are essential for the economy to grow. Regulatory Authorities play a prominent role in maintaining market integrity by monitoring trading activities and enforcing compliance with market regulations. Market surveillance systems play an effective role in identifying irregular trading behaviour and preventing practices that may harm investors. Consequently, protecting investors and ensuring market integrity remain key objectives of capital market regulation worldwide.

Global Regulatory Perspective

Globally, regulatory authorities are recognising the potential of Artificial Intelligence in strengthening market surveillance and investor protection. Global regulators, especially in developed countries, have started adopting AI-driven systems to monitor, prevent, and detect fraudulent activities. Financial regulators are also emphasising the responsible and ethical use of AI to ensure transparency and accountability in financial markets.

At the same time, global regulators face challenges related to data privacy, algorithmic bias, and regulatory coordination across jurisdictions. This section highlights the importance of integrating advanced technologies like AI into market surveillance systems to maintain market integrity in an evolving financial landscape.

Objectives of the Study

- The objective aims to explain the understanding of the concept of artificial intelligence and its relevance in capital markets. It focuses on the need for AI in traditional surveillance systems and how it will help monitor and foster the efficiency of capital markets.
- This objective focuses on examining the importance of market surveillance in ensuring fair and transparent functioning of capital markets. It emphasises the requirement of effective market surveillance in capital markets.
- This objective seeks to study suggested policy measures for the effective use of AI in capital market regulation. It also focuses on how AI -based tools improve monitoring and assist regulators in monitoring the financial markets.
- This objective emphasises the challenges and limitations associated with the use of artificial intelligence.
- This objective aims to find contributions of the researchers for market surveillance modern systems and highlights the unexplored areas and proposes the recommendations for policymakers and regulators.

Review of Literature

Traditional market surveillance systems

In recent years, capital markets have undergone significant transformation due to technological advancement and the widespread use of digital platforms. The increasing use of such platforms, like algorithmic trading, has created challenges for conventional market surveillance systems, which often fail to detect such complex frauds. As a result, scholarly research and regulators have emphasised the role of artificial intelligence-based tools to strengthen market surveillance in capital markets. Existing studies examine the effectiveness, regulatory implications, and ethical concerns associated with AI–driven surveillance systems. This review critically scrutinises the role of AI in market surveillance systems and how it should be implemented by human intelligence. It posits the need for AI and identifies gaps in market surveillance which must be covered by modern technology. As a result, scholars and researchers have increasingly emphasised the role of Artificial Intelligence (AI) - based tools in strengthening market surveillance in capital markets.

Studies on AI and Market Surveillance

Artificial intelligence has emerged as a transformative force in this domain, offering advanced capabilities for market surveillance that transcend traditional methods (Kholia, 2025)1. Several studies examined the application of artificial intelligence in market surveillance systems. Ana Catarina Fontes (2022) conducted a study on "AI-powered public surveillance systems: why we (might) need them and how we want them" with the objective of examining the deployment of AI-powered surveillance technologies, particularly real-time facial recognition systems and contact tracing applications in public spaces. The study discussed a three-dimensional analytical framework comprising the function dimension, consent dimension, and societal dimension to assess both the potential benefits and risks of AI-based surveillance systems.

Tushar Kholia (2025) postulated that AI revolutionised the capital market by playing several roles. This study helps in our research to understand the role of AI in capital markets. The findings suggest that Artificial Intelligence (AI) revolutionised the capital markets through algorithmic trading, portfolio management, market surveillance, and predictive analysis. The study focused on balancing AI-driven systems with human intervention. This study is relevant to our research because it emphasised the role of AI in financial markets and the market surveillance by regulators.

Generative AI and Financial Market Monitoring

Artificial Intelligence (AI) has also proven to be a powerful tool for detecting insider trading and market manipulation. Traditional market surveillance often relies on predefined rules and human intelligence. Human-based systems are inefficient at detecting sophisticated trading strategies or coordinated fraudulent behaviour. Recent studies have examined the growing implications of generative artificial intelligence, particularly Large Language Models (LLMs) such as ChatGPT, for financial markets. This stream of literature highlights the ability of AI-based language models to analyse unstructured financial data, including annual reports, earnings call transcripts, and analyst reports, to extract sentiment and interpret qualitative information. The findings suggest that AI-driven sentiment analysis enhances the evaluation of

corporate performance and improves market transparency by reducing information asymmetry. Furthermore, existing research also explores the broader influence of generative AI on corporate policies and strategic decision-making. While these studies emphasise the transformative potential of generative AI in financial analysis, they also point to challenges related to governance, accountability, and regulatory oversight. This literature is relevant to the present study, as sentiment interpretation and disclosure monitoring are important components of modern market surveillance systems in capital markets. However, existing studies have received limited attention in capital market surveillance. The studies explored AI only as a regulator and monitor. The findings do not show the challenges and solutions AI provides for fraudulent activities. The study highlights that AI applications such as risk management, fraud detection, and credit scoring are increasingly used by financial institutions.

Existing literature has examined the role of artificial intelligence in improving decision-making and efficiency in financial institutions. Studies find that AI enables organisations to analyse large datasets and make more accurate predictions. The study shows a continuous increase in AI adoption in financial markets over the years, indicating the growing importance of AI in modern financial systems. Moreover, Research indicates that AI systems assist human traders by enabling high-frequency trading. The finding suggests that applications such as algorithmic trading, risk management, fraud detection, and credit scoring are among the most widely used AI-driven tools. This technological integration enables regulators and market participants to proactively identify and address illicit activities, fostering greater transparency and stability within capital markets (Petrillo et al., 2020).

A key contribution to understanding how regulators adopt Artificial Intelligence (AI) in financial oversight comes from the Financial Stability Board (FSB) 2020 global survey. The survey shows that AI has become an important tool for supervisory technologies worldwide. In contrast, it also states that actual use of AI is not consistent across different areas. Unexpectedly, even though AI technology has advanced rapidly, its use in core market surveillance activities-such as detecting manipulative trading patterns -has not expanded as much as in other areas like analysing misconduct or improving reporting.

Another contribution comes from a World Bank study (2018), which postulated early practical applications of supervisory technology. This study helps distinguish between Suptech and RegTech. Suptech is used by regulators to improve market supervision, whereas RegTech is used by financial institutions to streamline compliance processes.

In conclusion, the history of algorithmic trading and AI reflects a continuous quest for efficiency, speed, and precision in financial markets. From early computational experiments to the machine learning revolution, each era has contributed to the ever-evolving landscape of algorithmic trading, shaping the way financial markets operate today (Swathi and Pahuja, 2024). Algorithmic Trading, often referred to as algo-trading or black-box trading, refers to the use of computer algorithms to automate the process of trading financial instruments (Pothumsetty, 2020). These algorithms are designed to follow a set of predefined rules and execute trades at speeds and frequencies impossible for human traders (Gerner-Beuerle, 2022). Algorithmic Trading, a paradigm shift in financial markets, represents the intersection of advanced technology and financial strategies (Currie et al., 2022). Despite many advantages, it presents challenges for regulators, as the complexity and speed of AI-enabled trades require

sophisticated monitoring tools. For instance, Janardhan Reddy examines in his study that AI employs sophisticated techniques, including supervised learning, anomaly detection, natural language, and network analysis, to identify market manipulation more effectively than traditional systems.

Limited focus on AI as a regulatory surveillance tool

The existing literature highlights the benefits of trading, portfolio management, and general market analysis. There is limited research on AI as a regulatory surveillance tool. The literature mainly focuses on how AI improves efficiency for financial institutions, examining its practical application by regulators to detect fraud, insider trading, and market manipulation. Moreover, Challenges faced in capital markets are still unexplored, such as data bias, algorithmic.
Transparency, ethical concerns and integration with human intelligence or sight. Therefore, there is a need for research that addresses how AI can be effectively implemented to strengthen market surveillance, enhance transparency, and protect investors.

Research Methodology

Research is defined as a systematic, scientific investigation undertaken to establish facts, solve problems, and reach new conclusions. It is "a scientific and systematic search for pertinent information on a specific topic" (Kothari, 2004, pg 1). The research process comprises sequential steps, beginning with the identification of a research problem, followed by the formulation of a research design, sampling strategy, data collection, analysis, and interpretation.

Research Design

The research design serves as the master plan or blueprint for conducting a study. It outlines the framework for data collection, measurement, and analysis, ensuring that the research question is answered validly, objectively, and accurately. The study adopts a systematic literature review approach to examine the role of artificial intelligence in market surveillance within capital markets. This type of review is used to collect, analyse, and synthesise the existing academic literature, regulatory reports, and policy documents related to AI-based surveillance systems. This approach is best for our study because the topic is interdisciplinary and involves perspectives from finance, technology, and regulation. The Systematic literature review was selected over narrative and scoping reviews because of its methodological rigour and replicability.
The present study uses a descriptive and explorative research design. Descriptive research helps explain the concepts of artificial intelligence, market surveillance, and capital markets, while an analytical approach helps examine the role of artificial intelligence in strengthening market surveillance mechanisms. This design is appropriate as the study aims to analyse existing literature, regulatory frameworks, and theoretical developments rather than testing hypotheses through primary data collection. The research does not test hypotheses but focuses on conceptual understanding and analytical interpretation of secondary data.

Nature of the study

This study is conceptual and qualitative in nature. The research focuses on theoretical analysis, interpretation of existing studies, and evaluation of regulatory perspectives related to AI-based surveillance systems. It emphasises understanding the application of artificial intelligence in market surveillance and its implications for capital market regulation.

Sources of Data

The study is based entirely on secondary data, collected from reliable and authentic sources. Primary data is not selected due to limited availability of sources related to regulatory surveillance systems and the technical nature of artificial intelligence applications.

The major sources of secondary data include:

- SEBI Reports and other regulatory publications such as the Financial Advisory Board
- Research papers published in national and international journals
- Articles from reputed databases such as Google Scholar, SSRN, Springer, and ScienceDirect
- Books, working papers, and conference proceedings related to artificial intelligence and financial markets
- Relevant websites and policy documents

Using these sources ensures that the analysis is credible, up-to-date, and relevant to understanding the role of AI in market surveillance. Specifically, this research will involve a systematic review of existing literature, industry reports, and real-world case studies to identify key strategies, benefits, and challenges associated with integrating AI and machine learning technologies into regulatory reporting and market surveillance frameworks (Hajj & Hammoud, 2023; Padmanabhan, 2024).

Methods of Data Analysis

The collected literature has been analysed using thematic and content analysis. The approach is organised in well-defined thematic categories, enabling coherent interpretation of findings.

- The First theme focuses on the applications of artificial intelligence in market surveillance, examining how AI tools such as machine learning algorithms, anomaly detection models, natural language processing, and graph-based techniques are employed to monitor trading activities, analyse large volumes of transactional data, and generate surveillance alerts.
- The Second theme addresses regulatory and supervisory technology SupTech) Frameworks, exploring how regulatory authorities integrate AI-based tools into supervisory processes.
- The third theme focuses on challenges, ethical concerns, and limitations of AI- based surveillance systems. This study highlights issues related to data quality, algorithmic bias, model opacity, high implementation costs, and over-reliance on automated decision-making. Moreover, the literature helps identify institutional and technical barriers that limit the scalability and adoption of AI surveillance systems, particularly in emerging markets.

- The final Theme examines the role of AI in detecting market manipulation and fraud with particular attention to practices such as spoofing, wash trading, insider trading, front-running, and price manipulation. It also helps uncover hidden relationships between market participants, assess the effectiveness of AI models in identifying abnormal trading patterns, and reduce false positives compared to conventional surveillance systems.

Ethical considerations & Limitations

The Study follows ethical standards applicable to secondary research. All sources have been properly cited to maintain academic integrity. Since the research is based on publicly available data, there are no confidentiality or privacy concerns. However, the study has certain limitations. Rapid advancements in artificial intelligence may cause some findings to become outdated over time.

Challenges And Limitations

Despite growing adoption of Artificial Intelligence in market surveillance, regulators still face challenges and limitations in effectively implementing regulatory systems. While AI offers various potential solutions, its deployment still raises ethical, technical, regulatory, and operational concerns that must be carefully addressed.

Technical and data -related challenges

One of the most critical challenges in AI-based market surveillance is the technical and data-related challenge. AI systems rely heavily on large volumes of accurate, clean, and well-structured data to generate meaningful insights. However, Capital market data is often collected from multiple sources, which are fragmented and inconsistent in nature. The data is collected from various trading platforms, intermediaries, and exchanges. This type of data is historical, inaccurate, and biased, which can lead to false alerts, misclassification of trading behaviour, and ineffective surveillance systems.

Explainability and Black-box challenges

The major problem of adopting AI-driven tools is lack of transparency; many AI models, particularly those based on machine learning and deep learning techniques, operate as “black boxes”. This lack of transparency brings a major limitation for regulators, as it hinders decision-making. Surveillance decisions must be explainable, auditable, and legally defensible. Regulators might hesitate in the absence of clear reasoning behind AI-generated outputs. Moreover, they can’t rely fully on automated systems, especially in legal actions.

Regulatory and legal challenges

Artificial intelligence is evolving much faster than the laws and regulations enacted by regulatory authorities. It is difficult to determine who is responsible if an AI system makes a mistake, gives false signals, or causes losses. It also creates confusion in legal responsibility, data use, and compliance requirements.

Human resources and their skill gaps challenges

AI-driven systems require effective implementation by specialised technical expertise, including data science, machine learning, and financial engineering skills. But Regulators face shortages of skilled and expert personnel who are capable of designing, managing, and interpreting AI systems. There is a risk of over-reliance on automated outputs or misinterpretation of AI- generated alerts because of a lack of adequate human expertise. There is a requirement for continuous training and capacity building for effective surveillance systems.

Limitations of the Present Study

The study is primarily based on secondary data and conceptual analysis, which limits the ability to empirically assess the real-world effectiveness of AI-based market surveillance systems. The study restricts the depth of practical insights because of a lack of primary data such as interviews with regulators or case-specific enforcement outcomes. The study focused largely on selected regulatory frameworks and did not fully capture all the variations across global markets.

Conclusion

The present study focused on the role of artificial intelligence in strengthening market surveillance systems in capital markets for market integrity and investor protection. The review of existing literature, regulatory reports, and institutional studies. The research highlights that artificial intelligence has gradually transformed how market surveillance is conducted. Traditional surveillance is no longer sufficient to address complexity, data volume, and the speed of financial systems. It largely depends on rule-based alerts and manual monitoring.

The observations imply that AI-based tools such as machine learning algorithms, natural language processing, anomaly detection models, and network analysis appreciably enhance the ability of regulators and stock exchanges to detect irregular trading behaviour, market manipulation, and fraudulent activities. These technologies are useful in monitoring high-frequency and algorithmic trading environments, where human intervention alone is inadequate.

The study also shows that the integration of AI within supervisory technology (SupTech) frameworks has strengthened regulatory oversight by enabling risk-based supervision. The integration of AI in regulatory frameworks is driving a transition from reactive supervision to proactive and data-driven surveillance models. Nowadays, Regulators are using AI to prioritize high -risk cases, reduce false alerts, and improve decision-making efficiency. As a result, AI contributes immensely to enhancing market integrity and safeguarding investor interests.

Despite its potential benefits, the adoption of AI in capital markets is still limited by various limitations. The study highlights several challenges, including lack of data quality, algorithmic opacity, explainability issues, ethical concerns, regulatory uncertainty, and shortage of skilled professionals. In developing and emerging markets, Regulators face many technological and institutional constraints that hinder the effective implementation of AI- based surveillance systems. Additionally, Concerns related to bias in historical data and over-reliance on automated decision-making raise important questions about fairness and accountability. To conclude, the study states that although artificial intelligence possesses significant potential to

enhance market surveillance systems, technology cannot work alone. The success of Market surveillance can't be determined by the technology alone; it depends largely on how responsibly and thoughtfully it is implemented by human intelligence within existing regulatory frameworks. Strong regulatory governance is necessary to ensure that AI tools operate transparently, fairly, and in alignment with the objectives of market integrity and investor protection.

Therefore, Artificial Intelligence should not be viewed as a replacement for human regulatory expertise but rather as a complementary tool that enhances decision-making efficiency and effectiveness. A balanced approach is required that combines technological innovation with regulatory responsibility, and human accountability is essential for ensuring that AI contributes positively to the long-term stability and credibility of capital markets.

Implications

Regulatory and Policy Implications

The study suggests that regulators and policymakers are responsible for maintaining market integrity and protecting investors. As Artificial intelligence is becoming a core component for market surveillance systems, there is a need for regulators to develop a clear, comprehensive, and adaptive regulatory framework for use. Existing regulators can't keep up with the complexities and rapid development of modern models. Existing regulators are mainly designed for traditional, rule-based surveillance systems and are not fully able to address the complexities introduced by AI-driven systems.

Moreover, Regulators should formulate explicit guidelines concerning transparency, accountability, data governance, and ethical deployment of AI technologies. One major concern is explainability. AI-driven tools must be interpretable to regulators so that regulatory decisions based on AI outputs can be clearly understood, justified, and defended in legal and administrative contexts. Therefore, AI is not merely a technical preference but a regulatory necessity, and it must be clearly explainable.

Furthermore, policymakers must address issues related to data privacy and security. AI surveillance systems mainly rely heavily on large volumes of sensitive and transactional data. Strong data protection policies are essential to prevent misuse, unauthorised access, or discriminatory outcomes. The study also states the importance of international regulatory coordination. Regulatory authorities can be strengthened by harmonised standards and cross-border cooperation.

Implications for financial Institutions

Financial institutions include brokers, investment firms, and trading entities. As regulators, the increasing adoption of AI is becoming an implication for financial institutions. Market participants are expected to maintain higher standards of transparency, ethical conduct and compliance due to sophisticated regulatory surveillance. Firms that use sophisticated AI-driven systems alongside traditional surveillance systems must ensure that their trading strategies are well-documented, auditable, transparent, ethically sound, and aligned with regulatory expectations.

The study also observes the growing relevance of Regulatory Technology (RegTech) solutions for financial institutions. Firms can easily manage regulatory risks, detect potential violations internally, and respond more effectively by adopting AI- driven compliance systems and monitoring tools. Additionally, the link between RegTech used by institutions and SupTech used by regulators can lead to more efficient regulatory interactions and reduced compliance costs.

Academic and research implications

The study mainly contributes to the growth of interdisciplinary literature at the intersection of finance, artificial intelligence, and regulation. The study identifies various research gaps that warrant further scholarly attention. Most existing studies are theoretical and conceptual, which limits empirical evidence on how effective AI surveillance works. Future research may focus on emerging and developed markets to understand how AI adoption and outcomes are influenced by institutional capacity. It also focuses on research on ethics, explainability, and bias concerns by adopting AI-surveillance systems. New technology, including Blockchain, Federated learning and Decentralized data systems, may enhance AI-based surveillance and open new research opportunities for researchers.

Societal and investor implications

AI -based surveillance systems offer various benefits to society as well as investors. It improves the fairness and transparency of capital markets. AI helps regulators detect market manipulation, insider trading, and fraudulent activities more effectively. Fair and well-regulated markets increase public confidence and support stable economic growth. For instance, AI-driven tools reduce unfair activities, which boosts the confidence of both society and investors. Investors, especially retail investors, feel that markets are transparent and well monitored; their trust in the market increases due to the adoption of AI-driven surveillance systems. AI-driven surveillance is much better than traditional surveillance systems because it can easily detect manipulation or fraudulent activity by insiders. However, the use of AI also raises important concerns related to data misuse, algorithmic bias, privacy, and accountability.

References

Azeema, N., Nawaz, H., Gill, M. A., Khan, M. A., Miraj, J., & Lodhi, K. (2023). Impact of artificial intelligence on financial markets: Possibilities and challenges. Journal of Computing & Biomedical Informatics, 6(1), 287–299.

Chukkapalli, D. T. (2025). Generative AI in algorithmic trading and market predictions. SSRN. https://doi.org/10.2139/ssrn.5209125

Fontes, A. C. (2022). AI-powered public surveillance systems: Why we (might) need them and how we want them.

Hajj, H., & Hammoud, H. (2023). Unveiling the influence of artificial intelligence and machine learning on financial markets: A comprehensive analysis of AI applications in trading, risk management, and financial operations. Journal of Risk and Financial Management, 16(10), 434.

Kasireddy, J. R. (2025). The ethical implications of AI in financial market surveillance: Are we over-monitoring traders? European Journal of Accounting, Auditing and Finance Research, 13(4).

Kholia, T. (2025). Artificial intelligence in capital markets: Use cases, risks, and regulatory challenges. SSRN. https://doi.org/10.2139/ssrn.5179985

Mbanyele, W. (2024). Generative AI and ChatGPT in financial markets and corporate policy: A comprehensive review.

Petrillo, A., De Felice, F., Lambert-Torres, G., & Bonaldi, E. L. (2020). Operations management: Emerging trends in the digital era.

World Bank. (2018). The role of supervisory technology (SupTech) in financial regulation.

Financial Stability Board. (2020). Artificial intelligence and machine learning in financial services: Market developments and financial stability implications.

6
Trust, Risk and Resistance: Explaining Consumer Preference for Conventional Vehicles over Electric Vehicles

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Abstract
The world is moving towards a sustainable future, and transportation is one of the most significant sectors driving this change. Electric vehicles (EVs) have emerged as a promising alternative to traditional fossil fuel-based vehicles. Due to the advantages of EVs, such as lower carbon emissions, better energy efficiency, and decreased dependence on fossil fuels, governments and marketers are actively promoting EVs However, despite increasing awareness and policy support, many consumers still prefer conventional vehicles. Now the question arises as to why consumers still gravitate towards conventional petrol and diesel vehicles even after being aware of the benefits of EVs.
This study seeks to address this question by examining the psychological factors that influence consumers' continued preference for conventional vehicles. In particular, the study explores how perceived risk, consumer trust, and consumer resistance shape consumers' attitudes toward electric vehicles. The study uses the S–O–R framework, where perceived risks associated with EVs, such as high initial costs, concerns about performance, limited charging infrastructure, etc., are treated as external stimuli. These stimuli influence internal psychological responses in the form of trust in EV technology as well as resistance to adopting new technology. Finally, these together shape the final behaviour of the consumer, i.e. consumers' preference for conventional vehicles. The threefold objectives of the study are-- to examine the impact of perceived risk on consumer trust and resistance toward EVs, to see whether consumer trust influences consumer resistance and to analyse how consumer resistance influences preference for traditional vehicles. The findings of this study are expected to give insights into resistance towards EVs rather than only adoption of EVs from a practical perspective, the study aims to help policymakers and marketers develop strategies that reduce perceived risk, build consumer trust and encourage a smoother transition toward sustainable mobility.
Keywords: Electric Vehicles (EVs), perceived risk, consumer resistance, sustainable mobility, habitual consumption, consumer trust, purchase preference

Introduction
The world is currently facing a global crisis due to environmental degradation. Efforts have been taken both globally and nationally to curb excessive carbon emissions, which are a key pollutant. Among all the sectors, the transportation sector alone accounts for 25% of carbon emissions, which is estimated to double by 2035 (Chen et al., 2023). Following the Paris Agreement on climate change, India is determined to reduce carbon emissions by 60-65% by 2030. (WHO, 2018) Consequently, the growing emphasis on sustainable transportation

alternatives has brought electric vehicles (EVs) to the spotlight. Electric vehicles are being anticipated as future transportation options to reduce CO_2 emissions and achieve net-zero emissions targets of respective countries (IEA, 2023). Due to environmental commitments, governments and automobile manufacturers are promoting EVs as a cleaner and more sustainable option compared to traditional petrol and diesel cars. Government initiatives and policies, media coverage, extensive research, promotional activities, word of mouth and social influence are a few of the factors which have been instrumental in increasing public understanding of the benefits of electric vehicles. However, even after such awareness and increased prominence, a large number of people still hesitate to opt for EVs and prefer sticking with conventional vehicles for their everyday travel. (Ghosh & Sarkar, 2025)

This preference for traditional vehicles raises some important questions: even though consumers often recognise the environmental advantages of electric vehicles, why are their buying choices not consistent with this?

Most consumers often express environmental concerns, but when it comes to transitioning from conventional vehicles to electric ones, they are reluctant to do so. This gap between expressed concern and actual behaviour indicates that there exist psychological dimensions related to the adoption of EVs along with technological and economic considerations. Hence, there is a need to examine the underlying factors that hinder changes in existing consumption patterns, rather than focusing only on adoption intentions.

Most of the research done already on electric vehicles dealt with the factors that facilitate adoption, like environmental awareness, perceived utility, financial advantage and government incentives. However, earlier studies have seldom discussed the aspect where consumers may actively resist electric vehicles, even when they are aware and well-versed with their advantages.

In this research paper, three constructs, namely trust, risk and resistance, have been chosen to explain consumer preference. Consumer trust refers to consumers' belief that a product or technology is reliable, safe and capable of performing as expected without causing negative consequences. (Chen & Chang, 2012). Moreover, three kinds of risks, namely financial risk, performance and infrastructure risk, have been taken into account for the study. On the basis of the Stimulus-Organism-Response (SOR) framework given by Mehrabian and Russell in 1974, the consumer preference for electric vehicles will be studied; where perceived risk will be taken as an external Stimulus, consumer trust and resistance as Organism, and consumer preference for conventional vehicles will be considered the Response.

Review of Literature

A wide range of studies have been done on electric vehicles, mainly on the consumer's adoption intent of EVs and the factors leading to the transition from conventional Internal Combustion Engine (ICE) vehicles to electric vehicles. However, even after the efforts of the Government of India to promote EVs, the result is underwhelming. (Goel et al., 2021)

Unawareness about EV technology, existing incentives or the benefits provided by EVs are some of the major barriers to their adoption. Furthermore, despite the repeated modifications of the FAME policies of the Government of India, lack of clarity about infrastructural support, dependency on battery imports from other countries, and lack of skilled labour act as

hindrances towards the adoption of EV technology. (Singh, Singh & Vaibhav, 2021). In another study by Soltani-Sobh et al. (2017), a few other factors were also identified, which included high cost, battery concerns and lack of recharging stations.

Primarily, the reason for the unsatisfactory level of adoption lies with the functional utility and economic feasibility of EVs, such as limited battery life, long charging hours, high upfront cost, resale anxiety, lack of charging infrastructure, etc. In terms of psychological factors, negative attitude towards innovation, reluctance to change, attachment to already owned vehicle and priority to cost factor over environmental concerns are notable. (Patel et al., 2024) VBEven though a lot of studies have been done on consumer preference towards EVs, they have been done mainly using the Technological Acceptance Model and the Theory of Planned Behaviour. (Shanmugavel & Balakrishnan, 2023; Sahoo et al., 2022; Shanmugavel & Micheal 2022) Asadi et al. (2022 also found that in Malaysia, trust in EV technology also determines the consumers' purchase intention. Despite the advantages of EVs, government efforts, adoption rate is very low. That is why, in order to gain more insights into the obstacles in the path of EV adoption, more determinants need to be identified. Hence, in this study, consumer trust, perceived risk and resistance are taken to understand why consumers still prefer conventional vehicles over EVs.

Objectives

After reviewing the literature and identifying the research gap, the following objectives have been set for the current study:

1. To examine the impact of perceived risk on consumer trust and resistance toward EVs;
2. To see whether consumer trust influences consumer resistance;
3. To analyse how consumer resistance influences preference for traditional vehicles.

In order to fulfil these objectives, four hypotheses have been formed:

a. **H1**: Perceived risk has a significant effect on consumer trust toward electric vehicles.
b. **H2**: Perceived risk has a significant effect on consumer resistance toward electric vehicles
c. **H3**: Consumer trust has a significant effect on consumer resistance toward electric vehicles.
d. **H4**: Consumer resistance has a significant effect on consumers' preference for conventional vehicles.

Research Methodology

The study would be both descriptive and analytical in nature and is based on primary data. A well-structured schedule with close-ended questions was administered among the respondents. The study was conducted in Guwahati city (Assam). The target population comprised of respondents who were aware of electric vehicles (EVs). Data were collected from a total of 260 respondents using a structured questionnaire. The sample consisted of 70 per cent male and 30 per cent female respondents. The selection of respondents was done using the purposive sampling technique. The hypothesized associations between variables in the study would be analysed using regression equation.

Table 1: List of Variables used for the study:

Constructs	Variables	References
Perceived Risk of Electric Vehicles	Financial Risk The high purchase price of electric vehicles makes them a risky option for me. I am concerned that electric vehicles may not have good resale value in the future. The overall cost of owning an electric vehicle is uncertain compared to conventional vehicles. Performance Risk I worry that electric vehicles may not provide sufficient driving range for my needs. I am concerned about the durability and lifespan of electric vehicle batteries. I am unsure whether electric vehicles can deliver reliable performance over time. Infrastructure Risk Limited availability of charging stations increases the risk of using electric vehicles. Charging an electric vehicle is less convenient than refuelling a petrol or diesel vehicle. Inadequate charging infrastructure discourages me from considering electric vehicles.	Rezvani, Z., Jansson, J., & Bodin, J. (2015); Egbue, O., & Long, S. (2012); Chen, C. F., de Rubens, G. Z., Noel, L., Kester, J., & Sovacool, B. K. (2020);
Consumer Trust in Electric Vehicles	A. Trust in EV Technology I trust the technology used in electric vehicles. I believe electric vehicle technology is reliable for daily use. I feel confident about the safety and functioning of electric vehicles. B. Trust in EV Brands I trust electric vehicle manufacturers to deliver quality products. I believe well-known automobile brands produce reliable electric vehicles.	Chen, Y. S. (2010); Chen, Y. S., & Chang, C. H. (2012); Morgan, R. M., & Hunt, S. D. (1994)

Constructs	Variables	References
	I trust electric vehicle brands to provide adequate after-sales service and support. C. Trust in Environmental and Green Claims I believe that electric vehicles are genuinely environmentally friendly. I trust the environmental claims made by electric vehicle manufacturers. I believe that using electric vehicles can significantly reduce environmental pollution.	
Consumer Resistance to Electric Vehicles	A. Status Quo Bias I prefer to continue using conventional vehicles rather than switch to electric vehicles. I feel more comfortable sticking with conventional vehicles that I already know. Changing from conventional vehicles to electric vehicles seems unnecessary to me. B. Habit and Familiarity with Traditional Vehicles I am accustomed to using petrol or diesel vehicles. My past experience with conventional vehicles makes me reluctant to try electric vehicles. I find conventional vehicles easier to use compared to electric vehicles. C. Resistance to Technological Change I generally resist adopting new vehicle technologies like electric vehicles. I feel uncertain about adopting electric vehicles because the technology is new to me. I prefer to wait until electric vehicle technology becomes more established before adopting it.	Ram, S., & Sheth, J. N. (1989). Heidenreich, S., & Handrich, M. (2015). Claudy, M. (2011)
Preference for Traditional Vehicles	A. Intention to Purchase Fossil-Fuel Vehicles	Hardman, S., Chandan, A., Tal,

Constructs	Variables	References
	I am more likely to purchase a petrol or diesel vehicle than an electric vehicle. If I plan to buy a vehicle in the future, I would choose a conventional vehicle. Petrol or diesel vehicles remain my first choice when purchasing a vehicle. B. Continued Reliance on Conventional Vehicles Conventional vehicles continue to meet my transportation needs effectively. I feel more confident using conventional vehicles compared to electric vehicles. I depend on petrol or diesel vehicles for my daily travel requirements. C. Avoidance of Electric Vehicle Adoption I avoid considering electric vehicles when thinking about purchasing a vehicle. I am not interested in switching to an electric vehicle in the near future. I prefer to delay adopting electric vehicles for as long as possible.	G., & Turrentine, T. (2017). Rezvani, Z., Jansson, J., & Bodin, J. (2015). Bansal, H. S., & Taylor, S. F. (2002).

Data Analysis and Interpretations

H1: Perceived risk has a significant effect on consumer trust toward electric vehicles.
The regression analysis indicates that perceived risk does not have a statistically significant effect on consumer trust toward electric vehicles. The regression coefficient for perceived risk is $\beta = 0.00109$. This suggests an almost negligible negative relationship between perceived risk and consumer trust. However, this effect is not statistically significant ($p = 0.9866 > 0.05$).
The R^2 value (0.000001) shows that perceived risk has almost no effect on consumer trust. In simple terms, whether a consumer thinks electric vehicles are risky does not affect how much they trust them. In addition, the F-statistic ($F = 0.00028$, $p = 0.9866$) confirms that the overall regression model is not significant, i.e. the relationship between perceived risk and trust is too insignificant to be considered meaningful. Hence, consumer trust towards EVs appears to be shaped by other factors such as brand reputation, government support, technological familiarity or environmental beliefs rather than perceived risk alone. Therefore, the results do not support H1.

H2: Perceived risk has a significant effect on consumer resistance toward electric vehicles.

The regression analysis shows that perceived risk has a statistically significant effect on consumer resistance toward electric vehicles. The p-value of 0.00982 is below the standard significance level of 0.05. It indicates that the relationship is statistically significant.

The regression coefficient indicates that changes in perceived risk are related to changes in consumer resistance. This finding implies that when consumers perceive a higher level of risk associated with electric vehicles, their resistance towards EVs increases. Hence, H2 may be accepted.

H3: Consumer trust has a significant effect on consumer resistance toward electric vehicles.

The regression analysis demonstrates that consumer trust has a statistically significant effect on consumer resistance toward electric vehicles. The p-value associated with this relationship is 0.008764. The calculated value is much below the 0.05 significance level. It indicates that the effect is statistically significant.

The regression coefficient ($\beta = 0.1636$) shows that consumer trust has a significant influence on consumer resistance. In other words, changes in consumer trust lead to changes in the levels of consumer resistance towards EVs The model's R^2 value of 0.029 indicates that consumer trust accounts for approximately 2.9% of the variance in consumer resistance.

The significant F-statistic ($F = 6.99$, $p = 0.0088$) further confirms the overall model significance, which suggests that consumer trust plays a measurable role in shaping resistance toward electric vehicles. Hence, H3 is accepted.

H4: Consumer resistance has a significant effect on consumers' preference for conventional vehicles.

The regression results indicate that consumer resistance has a statistically significant effect on consumers' preference for conventional vehicles. The p-value associated with this relationship is 0.00608. It is below the 0.05 significance threshold, which confirms that the effect is statistically significant. The regression coefficient ($\beta = 0.0387$) shows the direction and strength of the relationship between consumer resistance and preference for conventional vehicles. A β value of 0.0387 means that as consumer resistance increases, preference for conventional vehicles also increases.

Although the magnitude of the coefficient is relatively small, the statistical significance indicates that changes in consumers' resistance toward electric vehicles influence their preference for conventional vehicles.

The significant result implies that resistance toward electric vehicles plays a meaningful role in shaping consumers' vehicle choice behaviour. As resistance increases, people reflect hesitation and discomfort with new technology or show attachment to existing habits; consumers are more likely to maintain their preference for traditional fossil-fuel vehicles. Hence, we may accept H4.

Findings

This study tries to understand why, despite growing awareness and availability of electric vehicles, many consumers continue to rely on conventional fuel-based vehicles. The findings offer several important insights into how consumers perceive and respond to electric vehicles.

Firstly, the results show that perceived risk does not significantly influence consumer trust in electric vehicles. In other words, even when consumers are aware of risks related to cost, performance or charging infrastructure, these concerns do not directly reduce their trust in electric vehicle technology or manufacturers. This further suggests that consumer trust may be shaped more by broader influences such as brand reputation, government initiatives, exposure to new technology or environmental values rather than risk perceptions alone.

On the other hand, the study finds that perceived risk plays a significant role in increasing consumer resistance toward electric vehicles. As consumers perceive higher levels of uncertainty associated with electric vehicles, their reluctance to adopt this new technology grows. This highlights that risk perceptions are more likely to translate into reluctance toward EV use than distrust.

The findings further indicate that consumer trust is another factor that affects consumer resistance toward electric vehicles. When trust in electric vehicles is lower, consumers tend to exhibit greater resistance. It means that trust acts as an important psychological factor in reducing hesitation toward adoption. Although the effect is small, it is meaningful because consumer behaviour is often shaped by attitudes and perceptions.

Finally, the results demonstrate that consumer resistance has a significant impact on consumers' preference for conventional vehicles. As resistance toward electric vehicles increases due to a variety of reasons, consumers are more likely to continue choosing traditional fossil-fuel vehicles. This indicates that consumers' resistance encourages them to stick to traditional modes of transportation instead of going for EVs. Overall, the study highlights consumer resistance as the central factor shaping vehicle choice behaviour. While perceived risk and trust influence resistance, it is resistance itself that ultimately drives consumers to choose conventional vehicles over electric vehicles.

Conclusion

The findings of the study collectively indicate that consumers' continued preference for conventional vehicles is primarily driven by resistance toward electric vehicles, rather than by a lack of awareness of EV technology or a trust deficit toward it. Even though consumers are aware of the risks associated with electric vehicles, these concerns do not directly reduce their trust in EV technology.

The findings suggest that perceived risks and trust influence behaviour by shaping resistance rather than directly determining vehicle choice. Ultimately, this resistance keeps consumers attached to conventional petrol and diesel vehicles. In simple terms, the study highlights that the preference for conventional vehicles is less about ignorance or lack of trust and more about hesitation to move away from familiar choices.

Hence, it can be safely asserted that efforts to promote electric vehicles should focus less on creating awareness and more on reducing consumer resistance. This is because resistance emerges as the key factor influencing preference for conventional vehicles.

The study also opens several avenues for future research. Further studies may examine other psychological factors such as habit strength, social influence or perceived convenience to gain a deeper understanding of resistance toward electric vehicles. Currently, the study is based in Guwahati city only. Hence, the findings may not be generalisable to other places. Future research could extend the scope beyond Guwahati city by including rural or semi-urban areas to improve generalisability.

References

Asadi, S., Nilashi, M., Iranmanesh, M., Ghobakhloo, M., Samad, S., Alghamdi, A., ... & Mohd, S. (2022). Drivers and barriers of electric vehicle usage in Malaysia: A DEMATEL approach. *Resources, conservation and recycling*, *177*, 105965.

Bansal, H. S., & Taylor, S. F. (2002). Investigating interactive effects in the theory of planned behavior in a service-provider switching context. *Psychology & Marketing*, *19*(5), 407-425.

Chen, Y. S. (2010). The drivers of green brand equity: Green brand image, green satisfaction, and green trust. *Journal of Business ethics*, *93*(2), 307-319.

Chen, Y. S., & Chang, C. H. (2012). Enhance green purchase intentions: The roles of green perceived value, green perceived risk, and green trust. *Management decision*, *50*(3), 502-520.

Choo, S. Y., Vafaei-Zadeh, A., Hanifah, H., & Thurasamy, R. (2024). Predicting electric vehicles adoption: A synthesis of perceived risk, benefit and the NORM activation model. *Research in Transportation Business & Management*, *56*, 101183.

Claudy, M. (2011). An empirical investigation of consumer resistance to green product innovation.

Claudy, M.C., Garcia, R. & O'Driscoll, A. Consumer resistance to innovation—a behavioral reasoning perspective. *J. of the Acad. Mark. Sci.* **43**, 528–544 (2015). https://doi.org/10.1007/s11747-014-0399-0

Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy policy*, *48*, 717-729.

Ghosh, S., & Sarkar, B. (2025). Consumer adoption intention towards electric vehicles: Insights from Bangalore, India. *Transportation Letters*, 1-17.

Goel, P., Sharma, N., Mathiyazhagan, K., & Vimal, K. E. K. (2021). Government is trying but consumers are not buying: A barrier analysis for electric vehicle sales in India. *Sustainable Production and Consumption*, *28*, 71-90.

Hardman, S., Chandan, A., Tal, G., & Turrentine, T. (2017). The effectiveness of financial purchase incentives for battery electric vehicles–A review of the evidence. *Renewable and Sustainable Energy Reviews*, *80*, 1100-1111.

Heidenreich, S., & Handrich, M. (2015). What about passive innovation resistance? Investigating adoption-related behavior from a resistance perspective. *Journal of Product Innovation Management*, *32*(6), 878-903.

He, X., Zhan, W., & Hu, Y. (2018). Consumer purchase intention of electric vehicles in China: The roles of perception and personality. *Journal of Cleaner Production*, *204*, 1060-1069.

Jain, S., Gautam, S., Malik, P., Kumar, S., & Krishnan, C. (2025). A multi-phase qualitative study on consumers' barriers and drivers of electric vehicle use in India: policy implications. *Energy Policy*, *196*, 114415.

Kester, J., Sovacool, B. K., de Rubens, G. Z., & Noel, L. (2020). Novel or normal? Electric

vehicles and the dialectic transition of Nordic automobility. *Energy Research & Social Science*, *69*, 101642.

Li, W., Long, R., Chen, H., & Geng, J. (2017). A review of factors influencing consumer intentions to adopt battery electric vehicles. *Renewable and Sustainable Energy Reviews*, *78*, 318-328.

Mohtar, S., & Abbas, M. A. Z. H. A. R. (2015). Consumer resistance to innovation due to perceived risk: relationship between perceived risk and consumer resistances to innovation. *Journal of Technology and Operations Management*, *10*(1), 1-13.

Morgan, R. M., & Hunt, S. D. (1994). The commitment-trust theory of relationship marketing. *Journal of marketing*, *58*(3), 20-38.

Patel, M., Singh, R., Arora, P., & Mahapatra, D. (2024). EV adoption in India: Barriers and policy solutions from manufacturers' and consumers' perspectives. *Energy for Sustainable Development*, *83*, 101583.

Ram, S., & Sheth, J. N. (1989). Consumer resistance to innovations: the marketing problem and its solutions. *Journal of consumer marketing*, *6*(2), 5-14.

Rezvani, Z., Jansson, J., & Bodin, J. (2015). Advances in consumer electric vehicle adoption research: A review and research agenda. *Transportation research part D: transport and environment*, *34*, 122-136.

Sahoo, D., Harichandan, S., & Kar, S. K. (2022). An empirical study on consumer motives and attitude towards adoption of electric vehicles in India: Policy implications for stakeholders. *Energy Policy*, *165*, 112941.

Shanmugavel, N., & Balakrishnan, J. (2023). Influence of pro-environmental behaviour towards behavioural intention of electric vehicles. *Technological Forecasting and Social Change*, *187*, 122206.

Shanmugavel, N., & Micheal, M. (2022). Exploring the marketing related stimuli and personal innovativeness on the purchase intention of electric vehicles through Technology Acceptance Model. *Cleaner Logistics and Supply Chain*, *3*, 100029.

Singh, V., Singh, V., & Vaibhav, S. (2021). Analysis of electric vehicle trends, development and policies in India. *Case Studies on Transport Policy*, *9*(3), 1180-1197.

Soltani-Sobh, A., Heaslip, K., Stevanovic, A., Bosworth, R., & Radivojevic, D. (2017). Analysis of the electric vehicles adoption over the United States. *Transportation research procedia*, *22*, 203-212.

Wang, S., Wang, J., Li, J., Wang, J., & Liang, L. (2018). Policy implications for promoting the adoption of electric vehicles: do consumer's knowledge, perceived risk and financial incentive policy matter?. *Transportation Research Part A: Policy and Practice*, *117*, 58-69.

7
Experiential Marketing as a Catalyst for Trust and Adoption in Emerging Electric Vehicle Markets

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Abstract
Sustainable mobility agendas center on the transition to electric vehicles (EVs); nevertheless, the proportion of current studies has mainly concentrated on the economic motive, insufficient trust, and low exposure to the EV technologies as the key factors that can drive the intention toward their adoption, yet, relatively little research has been conducted on the role of the experiential marketing as the means of achieving the goal of generating satisfaction and trust that can subsequently be converted into adoption intentions. To fill this gap, the current study will investigate the effects of experiential marketing on consumer satisfaction, brand trust and brand adoption intention of electric vehicles in India. The study utilises reliability analysis, correlation analysis, and multiple regression methods using survey data gathered on 312 future car buyers with prior EV experience. The results show that experiential marketing greatly improves both satisfaction and trust, which positively impact adoption intention, and that the latter is more likely to predict the former. The research would add to the existing body of literature on experiential marketing and sustainable mobility by empirically elucidating the path of experience-trust-adoption in an emerging economy setup and providing managerial and policy implications.
Keywords: Experiential Marketing; Electric Vehicles; Consumer Satisfaction; Brand Trust; Adoption Intention; Sustainable Mobility.

Introduction
Electric vehicles (EVs) have become one of the key solutions to climate change, fossil fuel reliance, and improving air quality in cities (IEA, 2023; Hawkins et al., 2013). Policy incentives, subsidies, and infrastructure development programs have also been launched by governments of countries all over the world to encourage the use of EVs (Wang et al., 2018; Hardman et al., 2017). Although they have been undertaken, consumer acceptance of EVs is reasonably low compared with traditional internal combustion engine vehicles (Rezvani et al., 2015).

Recent studies indicate that EVs are not limited only by economic or infrastructural conditions to occur but also by psychological barriers including the perceived risk, distrust in technology, and uncertainty about their performance, battery life, and availability of charging facilities (Egbue and Long, 2012; Axsen et al., 2016; Jansson et al., 2017). The latter issues are especially relevant in emerging markets, where consumers are not directly exposed to EV technologies. Conventional marketing techniques with their focus on technical features or financial benefits do not always cover such experiential and emotional anxieties (Kotler et al., 2019).

Experiential marketing, with its focus on direct contact, emotional contact and sensory touch, holds a potential remedy to such obstacles (Schmitt, 1999; Pine and Gilmore, 1998; Brakus et al., 2009). Test drives, showroom experiences, live demonstrations, and digital simulations enable consumers to experience EVs firsthand, which minimises uncertainty and increases confidence (Lemon and Verhoef, 2016; Homburg et al., 2017). Nevertheless, there is little empirical evidence that conducts an empirical study to determine the role of experiential marketing in forming EV adoption, particularly by employing simplistic, clear-cut statistical models. This paper addresses this requirement by conducting empirical research on the effects that experiential marketing has on consumer satisfaction, brand trust and adoption intention of electric vehicles within the Indian market.

Contribution and Research Gap

The analysis of available literature shows three gaps. To begin with, although the studies of EV adoption have significantly examined the different factors like cost, infrastructure, policy incentives, and environmental concern (Rezvani et al., 2015; Hardman et al., 2017; Wang et al., 2018), experiential marketing has received limited attention as a psychological and behavioural driver that would alleviate perceived risk and uncertainty (Schmitt, 1999; Brakus et al., 2009). Second, much of the research on experiential marketing has been conducted on high involvement, technology-intensive products, including electric vehicles, and has not been based on empirical research (Axsen et al., 2016). Third, much of the current EV research is based on complicated modelling methods, which could make it less accessible and of practical use to managers and policymakers (Kline, 2015).

This paper bridges these gaps by empirically investigating experiential marketing in the EV setting, illuminating the roles of satisfaction and trust in determining adoption intention, and using simple yet powerful statistical methods that improve interpretability. In this way, the study will be valuable to experiential marketing theory, EV adoption research, and management practice in emerging markets.

Review of Literature

Electric Vehicle Adoption

The literature on EV adoption indicates that the scope of influence is extensive and can include factors such as economic reasons, the lack of charging points, green consciousness, and governmental incentives (Rezvani et al., 2015; Hardman et al., 2017; Wang et al., 2018). Nevertheless, several studies highlight the decisive role of psychological variables in the early stages of market development, including perceived risk, uncertainty, and trust (Egbue and Long, 2012; Axsen et al., 2016; Jansson et al., 2017). Consumers feel that EVs are technologically complicated and dangerous because of the battery durability, maintenance, and resale value (Hackbarth and Madlener, 2016).

Experiential Marketing

Experiential marketing aims to establish meaningful and remarkable experiences that engage consumers' senses, feelings, thoughts, and actions (Schmitt, 1999; Pine and Gilmore, 1998). According to Brakus et al. (2009), the conceptualisation of brand experience is subjective

internal responses aroused by stimuli associated with the brand, which affect consumer attitudes and behaviours. Experiential marketing positively influences satisfaction, emotional attachment, trust, and loyalty, as shown by empirical studies in high-involvement purchasing situations (Lemon and Verhoef, 2016; Klaus and Maklan, 2013; Homburg et al., 2017).

Consumer Satisfaction

Consumer satisfaction is the general assessment of a product or service in terms of experiential results as compared to expectations (Oliver, 1999; Anderson et al., 1994). Satisfaction in the case of electric vehicles is not limited to functionality alone but also includes pre-purchase experiences, such as test drives, demonstrations, and interactions with sales representatives (Klaus and Maklan, 2013; Lemon and Verhoef, 2016). Favourable experiences raise satisfaction and make consumers more willing to adopt them.

Brand Trust

Brand trust can be described as the trust that consumers have in a brand's reliability, integrity, and competence (Morgan and Hunt, 1994; Chaudhuri and Holbrook, 2001). High-risk and technologically advanced purchases like electric vehicles are situations where trust is essential, and consumers should be confident in the brand to deliver reliable performance and after-sales services (Erdem & Swait, 2004; Homburg et al., 2017). Experience marketing can build trust by offering clear, genuine, and consistent experiences that confirm brand assertions and minimise information asymmetry.

Adoption intention

Adoption intention is an indicator of a willingness to use a new technology and is commonly considered a good predictor of real behaviour (Ajzen, 1991; Venkatesh et al., 2012). Previous research has shown that the antecedents of adoption intention are mainly characterised by satisfaction and trust (particularly in low-technology marketplaces where uncertainty prevails) (Wang et al., 2018; Rezvani et al., 2015).

Development of Conceptual Framework and Hypotheses

Hypotheses Development

Experience marketing allows consumers to experience products directly by appealing to their senses and emotions, so they can make accurate judgments about performance and value (Schmitt, 1999; Brakus et al., 2009). This type of interaction is especially crucial in the case of electric vehicles (EVs) since consumer familiarity and perceived risk of technological advancement are low (Rezvani et al., 2015). Accordingly:

> **H1: Experiential marketing has a strong positive influence on consumer satisfaction in electric vehicles.**
>
> Brand trust is a form of consumer confidence in a brand's reliability and credibility, which is of paramount importance in high-involvement and technology-intensive purchases (Morgan and Hunt, 1994; Erdem and Swait, 2004). First-hand experience is essential in allowing consumers to test brand claims.

H2: Experiential marketing has a significant impact on brand trust in electric vehicles.

One determinant of behavioural intention is consumer satisfaction, since satisfied consumers tend to develop positive attitudes toward adoption (Oliver, 1999; Ajzen, 1991).

H3: Consumer satisfaction has a positive influence on EV adoption intention.

Brand trust is a risk-mitigation tool used in adoption decisions when uncertainty and long-term commitment are present (Erdem & Swait, 2004).

H4: Brand trust has a positive and significant relationship with EV adoption intention.

Conceptual Framework for the Study

The paper, under the experiential marketing theory (Schmitt, 1999; Brakus et al., 2009), the relationship marketing theory (Morgan and Hunt, 1994) and the technology adoption literature (Ajzen, 1991; Venkatesh et al., 2012), suggests a conceptual model of how EV adoption intention could be influenced by experiential marketing according to satisfaction and trust.

The experiential marketing in the proposed framework is the key stimulus that dictates the internal verdicts that are satisfaction and trust in consumers, which subsequently influences the behavioural responses in the shape of adoption intention. Satisfaction implies evaluative perceptions formed as a result of the experience, and trust reduces perceived risk and uncertainty regarding EV technology.

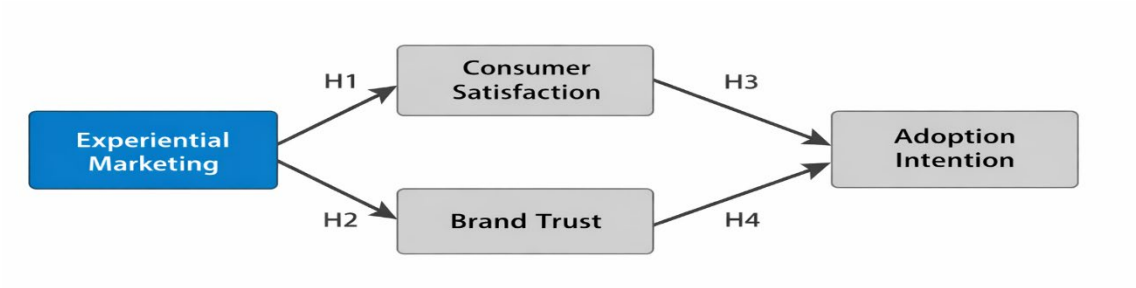

Figure 1: Conceptual Framework of the Study.

Figure 1 demonstrates the intended conceptual framework of the research. The model assumes experiential marketing to be an important antecedent of consumer satisfaction (H1) and brand trust (H2). The hypotheses are that both consumer satisfaction (H3) and brand trust (H4) have a positive effect on the adoption intention of electric vehicles. This is based on experiential marketing theory and relationship marketing theory, which place greater focus on experience-based considerations and trust establishment in determining adoption behaviours of high-involvement technologies like electric vehicles.

Research Methodology

Research Design

The current research uses a quantitative, descriptive research design to empirically test the hypothesised relationships between experiential marketing, consumer satisfaction, brand trust,

and electric vehicle (EV) adoption intention. The structured questionnaire method was used because it provides the opportunity to collect data methodically from a relatively large sample and to statistically analyse construct relationships (Malhotra, 2019). Quantitative research is suitable in this case, as the research objectives include measuring perceptions, attitudes, and behavioural intentions and analysing their interdependence using existing statistical methods.
The research design is descriptive because it will enable the study to measure the current consumer perception toward experiential marketing and EV adoption without controlling any variables. This methodology is appropriate in the context of new technologies like electric vehicles, whereby it is crucial to understand consumer decisions and appraisals to develop theory and make managerial decisions.

Sample and Data Collection

The study population included the potential car buyers in urban India who were already exposed to electric cars. The number of valid answers gathered was 312. Respondents were selected based on their previous engagement with EVs, which encompassed test driving an electric car, visiting an EV at a dealership or exhibition, or having experienced EV-related information through online demonstrations or virtual tours. This filter was used to ensure that the respondents had experienced at least a basic experiential contact with EVs; hence, their ratings were informed and valuable.
This was achieved by using a convenience sampling method because of the accessibility and time constraints, which is typical in exploratory and new market research (Malhotra, 2019). Even though probability sampling can improve generalizability, convenience sampling is considered suitable when the study seeks to investigate the relationship among constructs rather than estimate population parameters. Since EVs in India are not very penetrative, there is a low possibility of getting a random and completely representative sample of the EV-experienced population. However, the sample size of 312 respondents is more than the minimum required for correlation and regression analysis and hence provides sufficient statistical power.

Measurement Scales

The 5-point Likert scales, with 1 (strongly disagree), 2 (strongly disagree), 3 (strongly disagree), and 4 (strongly disagree), were employed in the study to measure all constructs since it is an easy tool to use in marketing research and consumer behaviour because of its simplicity and reliability.
Ten items measuring sensory, emotional, and cognitive aspects of consumer experience were used to measure experiential marketing. The items were based on the literature on existing experiential marketing and brand experience (Schmitt, 1999; Brakus et al., 2009). The scale captures consumers' perceptions of how engaging, enjoyable, informative, and memorable their experiences with electric vehicles were.
Multi-item scales were used to gauge consumer satisfaction based on respondents' overall perceptions of their experience with electric vehicles, with the scale based on Oliver (1999). The items examined expectations of the EV experience and respondents' general satisfaction with the entire interaction. The measures of brand trust were based on items from relationship marketing literature, especially Morgan and Hunt (1994). The scale was used to measure respondents' confidence in the reliability, credibility, and dependability of EV brands.

The measure of intention to adopt was adapted from items that evaluated respondents' likelihood of thinking about, buying, or suggesting an electric vehicle in the future. These items reflect behavioural intention, which is generally identified as a strong predictor of actual adoption behaviour.

Data Analysis Tools

The statistical SPSS package was used to analyse the collected data. To guarantee rigour and clarity, a multi-step analytical approach was used. First, the basic characteristics of the sample were examined using descriptive statistics. Second, Cronbach's alpha was used to assess the internal consistency and reliability of measurement scales. Third, Pearner correlation analysis was done to investigate the strength and direction of the relationship between the study variables. Lastly, multiple regression was used to examine the relationship between consumer satisfaction, brand trust, and EV adoption intention (Hair et al., 2019).

Results and Interpretation

Reliability Analysis

The internal consistency of the measurement scales that were used in the study was determined by reliability analysis. Alpha values above 0.70 are acceptable, indicating that the items measure the construct (Hair et al., 2019).

Table 1: Reliability Statistical Results

Construct	Cronbach's Alpha
Experiential Marketing	0.89
Consumer Satisfaction	0.86
Brand Trust	0.88
Adoption Intention	0.84

The findings show that all constructs have high internal consistency. The highest reliability value was found in experiential marketing (a = 0.89), indicating that the items used to measure experiential dimensions have high consistency. There is also strong reliability for consumer satisfaction (α = 0.86), brand trust (α = 0.88), and intention to adopt (α = 0.84). These results prove that the measurement scales are sound and can be further statistically analysed.

Correlation Analysis

The Pearson correlation analysis was done to identify the relations between experiential marketing (EM), consumer satisfaction (CS), brand trust (BT), and adoption intention (AI).

Table 2: Correlation Matrix

Variables	EM	CS	BT	AI
EM	1			
CS	0.62**	1		
BT	0.58**	0.64**	1	
AI	0.55**	0.61**	0.66**	1

Note: **p < 0.01

Some significant insights can be drawn from the correlation results. Consumer satisfaction ($r = 0.62$, $p < 0.01$) and brand trust ($r = 0.58$, $p < 0.01$) have a strong, positive correlation with experiential marketing, which means that more intense experiential experiences lead to better evaluative and relational performance. Experiential marketing is also positively and significantly related to adoption intention ($r = 0.55$, $p < 0.01$), indicating that experiential marketing indirectly influences the formation of behavioural intentions.

Adoption intention is also positively correlated with consumer satisfaction ($r = 0.61$) and brand trust ($r = 0.66$), but brand trust has the strongest relationship. This finding underscores the significance of trust in decision-making when adopting high-risk, technology-driven products like electric cars.

Regression Results

Multiple regression analysis was conducted to assess the relative influence of consumer satisfaction and brand trust on EV adoption intention.

Table 3: Regression Results – Predictors of Adoption Intention

Predictor	β	t-value	p-value
Consumer Satisfaction	0.34	6.92	0.000
Brand Trust	0.41	8.11	0.000

The regression findings demonstrate that consumer satisfaction and brand trust affect the EV adoption intention statistically significantly and positively. Consumer satisfaction ($b = 0.34$, $p < 0.001$) has a positive effect on adoption intention, indicating that satisfied customers are more likely to consider adopting electric vehicles. Nonetheless, brand trust is the more robust predictor ($b = 0.41$, $p < 0.001$), suggesting that trust is the dominant factor to consider when making EV adoption decisions.

This observation holds true especially in the EV arena, where consumers experience doubt regarding the reliability of the technology, charging infrastructure, and the costs of owning the vehicle in the long term. Trust is a risk-avoiding factor that helps consumers build confidence in the brand as a brand that can perform consistently and be supportive.

Discussion

The empirical data provided in Table 2 (Correlation Matrix) and Table 3 (Regression Results) is quite strong evidence of the centrality of experiential marketing in influencing consumer reactions to electric cars. As indicated in Table 2, experiential marketing is significantly and positively related to consumer satisfaction ($r = 0.62$, $p < 0.01$) and brand trust ($r = 0.58$, $p < 0.01$). These results are empirical evidence to the experiential marketing theory, according to which direct, sensory, and emotional involvement with a product creates positive cognitive and affective assessments in consumers (Schmitt, 1999; Brakus et al., 2009). Experiential experiences in the EV setting, like test drives and live exhibitions, enable consumers to experience the vehicle firsthand and thus minimise ambiguity and increase evaluative confidence.

Additional information can be noted in the multiple regression analysis shown in Table 3 that indicates that consumer satisfaction ($b = 0.34$, $p < 0.001$) and brand trust ($b = 0.41$, $p < 0.001$)

have a significant effect on adoption intention of electric vehicles. Notably, brand trust has a greater influence on adoption intention than satisfaction, which implies that trust plays a decisive role in high-involvement and technologically complex buying decisions. This observation is consistent with technology adoption and signalling theories, which highlight risk-reduction, credibility, and reliability as key elements of adoption in cases of consumer uncertainty (Erdem and Swait, 2004; Wang et al., 2018).

The greater predictive ability of trust shown in Table 3 can be attributed to the individual nature of the electric vehicle market. In contrast to traditional cars, EVs are a fairly new technology for most consumers and can raise long-term questions about battery capacity, the availability of charging stations, car serviceability, and marketability. In this kind of setting, satisfaction based on experiential experiences is not only required but also insufficient; consumers need to gain confidence in the brand's ability to perform consistently and provide after-sales services. This explanation aligns with relationship marketing theory, which characterises trust as one of the pillars in the formation of lasting consumer-brand relationships, especially when perceived risk and information asymmetry exist (Morgan and Hunt, 1994; Homburg et al., 2017).

Further, the findings indicate that experiential marketing programs that only emphasise sensory attraction or emotional stimulation are not as effective as those programs that directly convey transparency and trustworthiness. Since the role of experiential marketing in shaping both satisfaction and trust is considerable (Table 2), the strategic importance of this tool lies in combining emotional appeal with trustworthy information related to warranties, service networks, and charging solutions. This type of transparency, which is based on experience, helps consumers to check brand claims by directly engaging in the process, which builds trust and raises the intention to adopt it (Brakus et al., 2009; Lemon and Verhoef, 2016).

In general, the results in Table 2 and Table 3 support the proposed conceptual framework, as they indicate that experiential marketing has an indirect effect on EV adoption intention via satisfaction and trust, and that trust is a more powerful tool. This empirical study builds upon previous experiential marketing studies in the area of sustainable mobility and supports the thesis that experience-based strategies are especially helpful in speeding up the adoption of a new technology in developing markets (Rezvani et al., 2015; Axsen et al., 2016).

Managerial Implications

The empirical results of this research have practical implications to managers, marketers, dealership operators, and policymakers of the electric vehicle (EV) ecosystem. The findings affirm that experiential marketing is an important influencer of consumer satisfaction, brand trust, and intention to adopt, making it imperative to replace information-based, product-oriented communication with experience-based engagement plans. In emerging markets, this shift is inherent, as EV adoption can be limited by infrastructure as well as psychological factors, including uncertainty, risk perception, and distrust.

Reposition the tool of strategic adoption: Experiential marketing should be considered a strategic mechanism rather than a tactical promotional activity. The positive correlation between experiential marketing and consumer satisfaction ($r = 0.62$, $p < 0.01$; Table 2) proves that experiential marketing is a strong driver of consumer attitudes toward EVs (Pine and Gilmore, 1998; Schmitt, 1999; Lemon and Verhoef, 2016). Extended test drives, experiential

showrooms, and live demonstrations should be priorities for managers so consumers can test EV performance in real-life settings.

Use first-hand experience to suppress doubt and risk perception: Since EVs are a disruptive technology, traditional informational advertisements oriented toward specifications and cost-effectiveness are not always adequate. Field exercises help consumers understand driving comfort, acceleration, noise, regenerative braking, and charging habits, and reduce anxiety about usability and performance (Brakus et al., 2009; Klaus and Maklan, 2013).

Use digital experiential tools to reach more people: Physical experiences, like virtual reality (VR) test drives, augmented reality (AR) vehicle walkthroughs and interactive configurators can be supplemented by digital experiences, especially in markets where there is limited dealership coverage. The similarity of physical and online touchpoints will make experiential marketing a component of the EV customer journey (Verhoef et al., 2021).

Value brand trust as a strategic asset: The results show that experiential marketing is highly rated for increasing brand trust ($r = 0.58$, $p < 0.01$; Table 2) and exerts greater influence on adoption intention ($b = 0.41$) than on consumer satisfaction ($b = 0.34$; Table 3). Trust plays a major role in risk reduction in high-risk, technology-based markets (Morgan & Hunt, 1994; Erdem & Swait, 2004). Experience touchpoints associated with managers should allow them to communicate information transparently on battery life, warranties, charging infrastructure, resale values and after-sales support.

Make sure that there is consistency between marketing assertions and reality: Any section of the advertised performance that deviates from the real-world experience can easily undermine trust and subdue adoption intentions. Managers should ensure that marketing, product, and service functions are aligned so that experiential promises are supported by real performance and service levels (Homburg et al., 2017).

Combine emotional involvement and functional assurance: Although trust can better predict adoption intention, consumer satisfaction is also a major factor ($b = 0.34$, $p < 0.001$; Table 3). Experiences created by managers should contain emotional appeal (attractive showroom design and sustainability stories) along with practical reassurance (performance, charging logistics and cost of ownership) (Oliver, 1999; Chaudhuri and Holbrook, 2001).

Empower the dealerships and frontline workers: Frontline interactions are important because experiential marketing influences satisfaction as well as trust. They should educate dealership staff in technical knowledge, empathetic communication, and consultative selling to guide customers through the experiential learning process (Homburg et al., 2017).

Continue consumer experience after the point of purchase: Experiential marketing should be maintained even during purchase, delivery, and after purchase. Onboarding, community engagement programs and post-sale services can strengthen trust and satisfaction, creating long-term loyalty and referrals. Integrate the aspect of experience in the public policy measures: Experience-based programs like trials with public EVs, demonstrations in communities, and educating people can be included in the set of financial incentives and infrastructure development by policymakers to make electric mobility acceptable to society (Rezvani et al., 2015). Experience can be important in expediting the process of transitioning to sustainable mobility (Geels, 2012; White et al., 2019).

Conclusion

This research paper empirically proves experiential marketing to be a critical determinant of consumer satisfaction, brand trust and adoption intention in the electric vehicle market. Based on primary data and the use of simple and powerful statistical tools, the results indicate that experiential marketing can help increase satisfaction and trust, with trust being the more predictive factor of adoption intention. These findings underscore the need to manage psychological obstacles, e.g. perceived risk and uncertainty, by utilising direct and meaningful consumer experiences to address these barriers as opposed to using informational or incentive-based methods.

By applying the theory of experiential marketing to the concept of sustainable mobility, this study will enrich the literature on experiential marketing and electric vehicle adoption, especially in the environment of the new market. The work also provides useful advice to managers and policymakers focusing on experience-based approaches that involve emotional involvement and transparency, reliability and after-sales guarantees. All in all, the results indicate that well-planned experiential marketing programs could become a crucial factor in fast-tracking the process of moving towards sustainable mobility, as they would help to build trust, satisfaction, and long-term consumer loyalty.

Limitations and Future Research Directions

Despite the theoretical and practical contributions, the current study has some limitations that can be identified, which also give guidance to future study. To begin with, the research design adopted a cross-sectional study design, which describes consumer attitudes and intentions at a given time. Although this is an appropriate method to study the relationship between constructs, it does not allow making causal conclusions. Future studies may use longitudinal designs to examine longitudinal shifts in consumer satisfaction, trust, and intention to adopt electric vehicles, especially as consumers gain more experience with electric vehicles.

Second, the research used convenience sampling and targeted consumers in India who lived in urban areas and were previously exposed to electric cars. Even though this sampling method is suitable for an exploratory study of emerging markets, it might not support generalizability to rural consumers or other national settings. Future research should use probability-based sampling methods, and respondents should represent different geographic areas and diversity in socio-economic status to improve external validity.

Third, no objective measures were obtained; thus, self-reported measures may be subject to common method bias and social desirability effects. Even though it was done with the help of established scales and statistical rigour, future studies might include objective behavioural data, such as actual purchase behaviour, dealership records, or experimental designs with real-time experience interventions, to further verify the results.

Fourth, experiential marketing, consumer satisfaction, and brand trust were the target variables and predictors of electric vehicle adoption intention in the present study. Although these variables are considered a significant part of adoption behaviour, other factors that may have been influential, such as perceived cost, availability of charging infrastructure, environmental concerns, social influence, and technological preparedness, were not mentioned directly. These

variables can be incorporated into the conceptual framework of EV adoption in future studies to form a holistic insight into the issue.

Lastly, the research did not test moderating variables, including age, income, environmental awareness, or past experience with technology, which could moderate the effect of experiential marketing on satisfaction, trust, and adoption intention. Future studies would investigate such moderating factors or examine the effectiveness of experiential marketing across various consumer groups and cultures. On the whole, considering these shortcomings will contribute to the development of the body of knowledge on the role of experience-based approaches in facilitating sustainable mobility shifts in emerging and developed marketplaces.

References

Ajzen, I. (1991). The theory of planned behaviour. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Anderson, E. W., Fornell, C., & Lehmann, D. R. (1994). Customer satisfaction, market share, and profitability: Findings from Sweden. Journal of Marketing, 58(3), 53–66. https://doi.org/10.1177/002224299405800304

Axsen, J., Goldberg, S., & Bailey, J. (2016). How might potential future plug-in electric vehicle buyers differ from current owners? Transportation Research Part D: Transport and Environment, 47, 357–370. https://doi.org/10.1016/j.trd.2016.05.015

Brakus, J. J., Schmitt, B. H., & Zarantonello, L. (2009). Brand experience: What is it? How is it measured? Does it affect loyalty? Journal of Marketing, 73(3), 52–68. https://doi.org/10.1509/jmkg.73.3.52

Chaudhuri, A., & Holbrook, M. B. (2001). The chain of effects from brand trust and brand affect to brand performance. Journal of Marketing, 65(2), 81–93. https://doi.org/10.1509/jmkg.65.2.81.18255

Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. Energy Policy, 48, 717–729. https://doi.org/10.1016/j.enpol.2012.06.009

Erdem, T., & Swait, J. (2004). Brand credibility, brand consideration, and choice. Journal of Consumer Research, 31(1), 191–198. https://doi.org/10.1086/383434

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate data analysis (8th ed.). Cengage Learning.

Hardman, S., Shiu, E., & Steinberger-Wilckens, R. (2017). Comparing high-end and low-end early adopters of battery electric vehicles. Transportation Research Part A: Policy and Practice, 88, 40–57. https://doi.org/10.1016/j.tra.2016.03.010

Hawkins, T. R., Singh, B., Majeau-Bettez, G., & Strømman, A. H. (2013). Comparative environmental life cycle assessment of conventional and electric vehicles. Journal of Industrial Ecology, 17(1), 53–64. https://doi.org/10.1111/j.1530-9290.2012.00532.x

Homburg, C., Jozić, D., & Kuehnl, C. (2017). Customer experience management: Toward implementing an evolving marketing concept. Journal of the Academy of Marketing Science, 45(3), 377–401. https://doi.org/10.1007/s11747-017-0530-7

International Energy Agency. (2023). Global EV outlook 2023. IEA.

Jansson, J., Nordlund, A., & Westin, K. (2017). Examining drivers of sustainable consumption: The influence of norms and perceived consumer effectiveness. Journal of Cleaner Production, 142, 1503–1512. https://doi.org/10.1016/j.jclepro.2016.10.098

Klaus, P., & Maklan, S. (2013). Towards a better measure of customer experience. Journal of Service Research, 16(3), 307–320. https://doi.org/10.1177/1094670513483461

Kotler, P., Kartajaya, H., & Setiawan, I. (2019). Marketing 4.0: Moving from traditional to digital. Wiley.

Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. Journal of Marketing, 80(6), 69–96. https://doi.org/10.1509/jm.15.0420

Malhotra, N. K. (2019). Marketing research: An applied orientation (7th ed.). Pearson Education.

Morgan, R. M., & Hunt, S. D. (1994). The commitment–trust theory of relationship marketing. Journal of Marketing, 58(3), 20–38. https://doi.org/10.1177/002224299405800302

Oliver, R. L. (1999). Whence consumer loyalty? Journal of Marketing, 63(Special Issue), 33–44. https://doi.org/10.1177/002224299906300205

Pine, B. J., & Gilmore, J. H. (1998). Welcome to the experience economy. Harvard Business Review, 76(4), 97–105.

Rezvani, Z., Jansson, J., & Bodin, J. (2015). Advances in consumer electric vehicle adoption research: A review and research agenda. Transportation Research Part D: Transport and Environment, 34, 122–136. https://doi.org/10.1016/j.trd.2014.10.010

Schmitt, B. (1999). Experiential marketing. Journal of Marketing Management, 15(1–3), 53–67. https://doi.org/10.1362/026725799784870496

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly, 36(1), 157–178.

Wang, N., Tang, L., & Pan, H. (2018). Effectiveness of policy incentives on electric vehicle acceptance: Evidence from China. Transportation Research Part A: Policy and Practice, 119, 246–260. https://doi.org/10.1016/j.tra.2018.11.014

8

Public vs. Private Climate Finance: A Comprehensive Analysis of Comparative Effectiveness and Policy Imperatives

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Abstract

Today's competitive business world is rapidly changing due to increasing global competition and climate change, making Sustainable Growth an even higher priority than ever before. Climate finance refers to a category of funding used by the private sector to help reduce greenhouse gases and allow for more effective management of the impacts of climate change. The purpose of this paper is to show the difference between how much money is actually available for climate change action today and the total amount of funds needed for sustainable climate action through an analysis of 30 Scopus indexed papers published between 2010 and 2025 and a comprehensive review of data contained within the Global Landscape of Climate Finance 2023 (CPI, 2023) report which states that the estimated total amount of global climate financing was US$ 1.27 trillion USA (2021-2022). The fight against climate change requires new and unprecedented levels of funding because climate finance supports reducing the risk of climate change and assisting with adaptation. It is estimated that between USD 8.1 trillion and 9 trillion per year will be needed from now to 2030, requiring nearly a fivefold increase in current climate investments to meet the Paris Agreement's target of limiting global average temperature increases to 1.5 °C. This paper presents a framework for comparing public versus private finance by identifying different sources, instruments, and sectors of financing and comparing all sources of financing available to the developing world for adaptation purposes, mainly the shortfall of adaptation financing in developing countries, which is estimated to be more than USD 176 billion annually (United Nations Environment Programme [UNEP], 2023). The research findings indicate that while public concessional financing continues to play an essential role in adaptation and neglected sectors, private finance has been the main driver for rapid climate change mitigation in rapidly expanding industries like energy and transportation. In this progress, challenges persist in the form of fragmented governance structures, weak monitoring and evaluation mechanisms, and pronounced regional imbalances, with the least developed countries receiving under 3% of total global climate finance. The study recommends better use of public funds to crowd in private investment through blended finance, stronger regulatory frameworks such as common taxonomies and climate risk disclosures, and targeted global initiatives to scale up adaptation finance for vulnerable regions.

Keywords: Climate Finance; Public Finance; Private Finance; Comparative Effectiveness; Policy Implications

Introduction: The Climate Finance Imperative

The Paris Agreement demands limiting warming to 1.5°C, requiring a total overhaul of the financial system to fund mitigation (emissions cuts) and adaptation (resilience-building).

Climate finance reached USD 1.27 trillion in 2021–2022, nearly doubling previous years due to increased investment in renewable energy and electric vehicles (Climate Policy Initiative, 2023). Although this is a significant milestone, it represents only about 1% of global GDP. According to the Intergovernmental Panel on Climate Change (IPCC, 2018), achieving the 1.5°C target requires mobilising between USD 8.1 trillion and USD 9 trillion annually through 2030, highlighting the need for at least a fivefold increase in current investment.

In this situation, both public and private finance have important and connected roles. Public finance, provided by governments, multilateral development banks, and international organisations, supports projects through grants and concessional loans, especially adaptation projects and high-risk sectors such as agriculture, forestry, and other land use (AFOLU). Conversely, private finance from commercial banks, corporations, institutional investors, and households is driven by risk-adjusted returns. In 2021–2022, private actors mobilised USD 625 billion, with 44% invested in energy and 29% in transport, where supportive policies and lower technology costs have created attractive investment opportunities (CPI, 2023).

Despite this growth, two major challenges remain. First, adaptation finance remains insufficient. While countries received only about USD 29 billion for adaptation in 2021, the annual requirement is estimated at USD 194–366 billion (UNEP, 2023). Second, climate finance is unevenly distributed. Around 84% of total climate finance is concentrated in developed economies and East Asia, while the Least Developed Countries (LDCs) and Small Island Developing States (SIDS), which are most vulnerable to climate change, receive less than 3% of total flows.

The current study examines the role of climate finance by analysing how public and private finance contribute to mitigation and adaptation. The study reviews 30 research papers published between 2010 and 2025 and uses data from the Global Landscape of Climate Finance 2023 (Climate Policy Initiative, 2023). The findings confirm that although global climate finance reached USD 1.27 trillion in 2021–2022, it remains far below the estimated annual requirement of USD 8.1–9 trillion through 2030. The study also identifies where climate finance is being allocated, evaluates how public and private finance are being used, and examines how both sources can work together more effectively. By tracking current investment flows and their outcomes, the study aims to improve the efficient use of available capital to address climate change.

Objectives

1. To compare public vs. private allocation, efficiency, and impact outcomes of public vs. private climate finance globally.
2. To identify the governance and policies that actually help. The authors need to examine the rules and policies in place for each finance stream. This will help us figure out what is working and what is not. The main goal is to make each finance stream work better. Authors must identify the governance and policies for each finance stream to make this happen, and look for those that will make each finance stream more effective.
3. To recommend strategies to optimise synergies between both the public and private sectors and close the adaptation finance gap.

Literature Review

Climate finance research looks around the globe at where climate finance is being allocated and whether these funds will help solve climate change. It also investigates climate finance models, such as blended finance, and examines the decision-makers responsible for allocating funds and tracking progress. Organisations such as the Climate Policy Initiative (CPI) and OECD identify trends and foster collaboration within the climate finance ecosystem. The CPI's Global Landscape of Climate Finance 2023 reported that around USD 1.3 trillion was invested in climate-related projects during 2021–2022.

The OECD reported that developed countries mobilised USD 79.6 billion in climate finance for developing countries in 2019, a 2% increase over 2018. However, this remained below the pledged target of USD 100 billion annually. Both CPI and OECD continue to track climate finance progress.

When authors discuss efficiency and impact, they examine how much private capital is mobilised for every public dollar invested and the cost of achieving climate outcomes. Development Finance Institutions (DFIs) mobilise about 1.2 dollars of private finance for every public dollar committed. Through blended finance, this increases to around four times, and for transactions above USD 500 million, it can reach seven times more private investment.

Authors also evaluate the effectiveness of mitigation finance in reducing emissions, particularly in the energy and transport sectors. However, agriculture and adaptation lack reliable systems for measuring impact. Blended finance combines public and private capital to support projects that may otherwise be too risky. Studies show that guarantees encourage greater private investment, although high transaction costs, regulatory uncertainty, and difficulties in coordinating stakeholders continue to limit its wider use.

Regional disparities remain significant. Around 84% of climate finance flows to East Asia and the Pacific, the United States and Canada, and Western Europe, while the Least Developed Countries (LDCs) receive only 2–3% of total finance despite being the most vulnerable. South-South climate finance also remains below 2% of total flows.

Innovative financial instruments such as green bonds have expanded climate investment. During 2021–2022, green bonds contributed about USD 173 billion to tracked climate finance. Institutions such as the Green Climate Fund and Global Environment Facility also provide grants and concessional loans, although their contribution remains relatively small. Countries including France, Germany, the United Kingdom, and Italy have actively issued green bonds, but these remain insufficient to bridge the global climate finance gap.

Adaptation finance continues to lag behind mitigation. Around eighteen times more finance is directed towards mitigation than adaptation. Global adaptation finance reached approximately USD 63 billion during 2021–2022, while developing countries are estimated to require around USD 212 billion annually by 2030 (UNEP, 2023). Coastal protection alone is projected to require around USD 56 billion annually between 2020 and 2030. Least Developed Countries spend around 2% of GDP on adaptation, Small Island Developing States (SIDS) around 0.7%, compared with about 0.56% across developing countries.

Financial markets also face transition risks. Bolton and Kacperczyk (2020) found that firms with higher carbon emissions earn higher expected stock returns, suggesting investors price

carbon risk. However, climate risks are not consistently reflected across financial markets, highlighting the need for better climate risk disclosure and assessment.

Research Problem

Despite the growth of climate finance, major gaps remain: (1) underfunding of adaptation and AFOLU sectors; (2) fragmented governance and lack of standardised impact metrics; (3) limited mobilisation of private capital for high-impact adaptation projects; and (4) regional disparities that leave the most vulnerable countries under-resourced. A comprehensive comparative analysis of public and private climate finance is needed to identify effective approaches, strengthen collaboration, and help close the adaptation finance gap.

Methodology

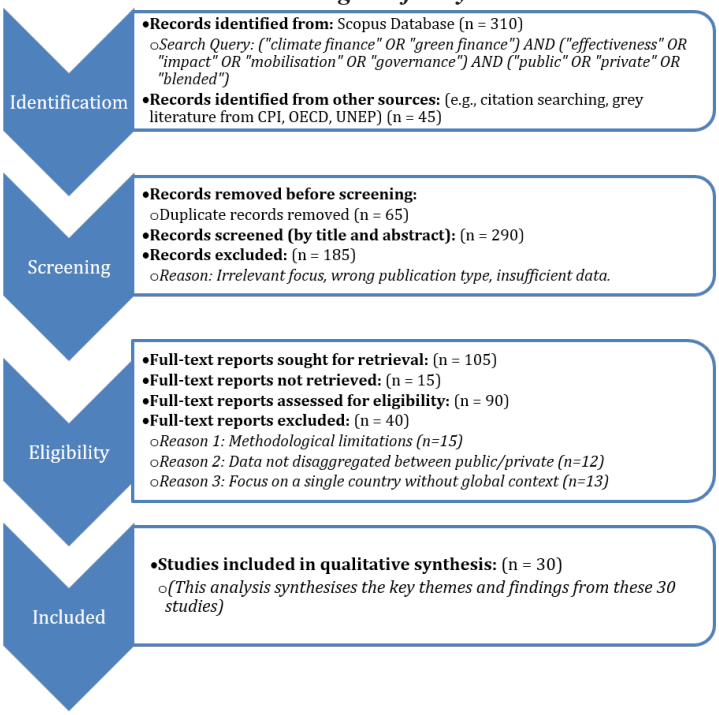
This study is founded on a mixed-methods approach, combining a systematic literature review with a synthesis of quantitative data from leading global climate finance trackers and sectoral cost models.

Systematic Literature Review & PRISMA Model

This study is informed by a systematic review of 30 peer-reviewed, Scopus-indexed studies published between 2010 and 2025. The Authors' search strategy targeted key themes using queries such as "climate finance effectiveness," "public vs. private climate finance," "blended finance leverage," "adaptation finance gap," "climate finance governance," and "mobilising private finance for climate."

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework guided the selection process for authors. The flow of information is illustrated below. This model is based on the study's claim of including 30 studies for qualitative synthesis. The authors created a model based on the data.

PRISMA 2020 Flow Diagram for Systematic Review



Data Collection and Synthesis

The authors got data from good sources to make sure our information is strong and based on facts:

Money for Global Climate Finance is being tracked by The Climate Policy Initiative, as stated in Global Landscape of Climate Finance 2023, showing where the money will be used (by governments and/or by the private sector) and when it was spent (for 2021/2022).

The flows of funding from Developed Countries to Developing Countries have been tracked by the Organisation for Economic Co-operation and Development, which continues to monitor these flows.

Climate Modelling for Africa as a way to see what sectors will need the most adaptation funding. The Dynamic Interactive Climate Modelling for Africa provides detailed projections of how climate change will impact the various sectors of the African economy over time. By combining information on what sectors will require adaptation funding, the authors were able to identify which sectors would require the most adaptation funding during the next decade. This information allows policymakers to identify priority sectors for investment in order to address immediate and long-term needs for climate change adaptation funding in Africa.

The authors used information from the Dynamic Interactive Vulnerability Assessment model, based on studies by Hinkel, J., Lincke, D., & Nicholls, R. J. (2014) and by Lincke, D., & Hinkel, J. (2018), to figure out how much it will cost to adapt to changes in the coastal areas. The Dynamic Interactive Vulnerability Assessment model helped us understand the costs of adapting to these changes. The authors looked at the work of Hinkel and others to understand the costs of adapting to coastal changes.

Comparative Framework

The authors have to determine which is better: public finance or private finance. A framework was made that looks at three things:

Funding includes where the money comes from, how it is used, and what it is used for. It also breaks funding into categories such as Energy, Transport, and Agriculture, and examines how much funding goes to developed, developing, least developed, and small island countries. Most authors include total allocations for Energy, Transport, and Adaptation in their analysis.

Finance efficiency refers to the ability of financial institutions to use resources without wasting money. The authors identify variables such as the leverage ratio, which measures how much private finance is mobilised for every public dollar, and the cost of finance, which measures how much it costs to obtain funding. Efficient finance uses these funds effectively while minimising the cost of raising capital.

Impact evaluates what investments achieve. For mitigation, authors measure how many tons of CO_2 are reduced per dollar invested. Adaptation is more difficult to measure and includes indicators such as the number of people protected, avoided losses, and resilience indexes.

The authors find both successes and failures in the framework by analysing the literature and quantitative data. Through systematic coding and mapping of findings, they identify successful adaptations, persistent gaps, and opportunities to improve the synergies between adaptation and mitigation.

Analysis and Findings: A Tale of Two Finances

The climate finance system is divided into two parts. Public climate finance and private climate finance have different goals and risk preferences. They are good at different things, but they do not always work towards the same objectives.

Public finance mainly supports energy (39%) and transport (20%), while less than 15% goes to sectors such as AFOLU, water, and industry.

Private finance is concentrated in energy (44%) and transport (29%). Households contribute about 31% of private climate finance, mainly through purchases of electric vehicles.

Development Finance Institutions mobilise about 1.2 dollars of private investment for every public dollar invested. Blended finance mechanisms can mobilise about four dollars, increasing to around 7.6 dollars for large transactions.

Private finance faces several challenges, including high transaction costs, unclear regulations, and investment barriers, making it difficult to mobilise finance effectively.

Mitigation investments help reduce emissions, particularly in renewable energy and electric vehicles, but there is still no effective system to measure their long-term impact.

Adaptation finance is around USD 63 billion, consisting of about 30% grants and 70% debt, while the estimated requirement is around USD 212 billion annually. Adaptation costs in some sectors are estimated at around USD 56 billion per year, yet developing countries could still face damages exceeding USD 200 billion annually under the RCP4.5 scenario.

Public: budget tagging, fiduciary standards, conditionalities, green bond frameworks.

Private: mandatory climate risk disclosure, carbon pricing, tax incentives, standardised ESG taxonomies.

Finding 1: Complementary Roles and Divergent Allocations

Public finance and private finance are different, but both play important roles in climate finance.

Public Finance: The Enabler and De-risker

Public finance, worth around USD 640 billion in 2021–2022, forms the foundation of climate finance. It addresses market failures and funds projects that provide social benefits but do not generate sufficient financial returns to attract private investment. National and Multilateral Development Finance Institutions (NMDFIs) use grants and concessional loans to support these projects, particularly climate adaptation and high-risk sectors.

Public finance is generally more equally distributed than private finance, although it remains concentrated in energy (39%) and transport (20%). These investments help governments implement policies and encourage private investment. Public finance also supports sectors such as water, wastewater, and adaptation, accounting for more than 90% of tracked adaptation finance. However, important sectors such as agriculture, forestry, and other land use (AFOLU) continue to receive inadequate funding.

Private Finance: The Scale Engine for Mitigation

Private finance totalled approximately USD 625 billion in 2021–2022 and includes commercial banks, institutional investors, corporations, and households. Around 91%

of private finance is directed towards mitigation because renewable energy and electric mobility projects generate predictable returns, benefit from declining technology costs, and are supported by favourable regulations such as feed-in tariffs and tax credits.

According to CPI (2023), private investment has increased rapidly in renewable energy, electric vehicles, solar, and wind power. However, climate adaptation receives very little private investment, with less than USD 2 billion allocated because of high risk and limited profit potential. AFOLU projects continue to face similar financing challenges.

Finding 2: The Leverage Gap and the Promise of Blended Finance

Public finance alone cannot meet global climate finance needs. Its key role is to mobilise private investment. Development Finance Institutions (DFIs) currently attract around USD 1.2 of private investment for every public dollar committed, which is insufficient to close the investment gap.

Blended finance offers a stronger solution by using public funds to reduce investment risk and attract private capital. According to Convergence (2018), blended finance mobilises about USD 4 of private investment for every public dollar, increasing to around USD 7.6 for transactions exceeding USD 500 million.

Blended finance uses several mechanisms:

- **Guarantees** protect private lenders against project losses, reducing investment risk.
- **First-Loss Equity** allows public funds to absorb initial losses, making projects safer for private investors.
- **Technical Assistance Funds** support project preparation, feasibility studies, and other early-stage development costs.

Despite its potential, blended finance faces important challenges. As noted by Obersteiner et al. (2021), these transactions are often complex, involve high transaction costs, require coordination between public and private partners with different objectives and risk preferences, and raise concerns about ensuring that public funds support projects that would not otherwise attract private investment.

Finding 3: Governance, Transparency, and Accountability Shortfalls

The way public and private money are spent to address climate change does not work effectively. This is due to what Weikmans & Roberts (2020) call the "climate finance accounting muddle." There are no common standards for reporting whether climate finance actually works, creating major challenges for its effectiveness. It undermines accountability. If we cannot follow the money, it is difficult to hold countries and institutions accountable for their commitments, such as the USD 100 billion pledge.

It also hinders impact assessment. Researchers (Pizer, Goulder & Winslow, 2019) need better tools to track progress and determine whether climate finance is producing real outcomes, such as reducing CO_2 emissions or improving adaptation. Adaptation remains difficult to measure because outcomes vary across locations and are hard to quantify.

It also limits private investment. Large investors lack clear guidance and sufficient information to assess climate risks. Fankhauser et al. (2021) stated that private investors need clear and

reliable climate risk information to make investment decisions. Bolton and Kacperczyk (2020) found that investors are beginning to price carbon risk, with high-emitting companies paying more for capital, but poor-quality climate risk data continues to limit effective investment decisions.

Green taxonomies provide a framework for defining green and sustainable investments. They improve communication among investors, issuers, and policymakers, reduce confusion and fraud, and help consumers, community groups, and NGOs better understand green investments while preventing greenwashing.

Finding 4: Glaring Regional and Sectoral Disparities

The total amount of climate finance, USD 1.27 trillion, does not show how unfairly the money is being shared. Climate finance mostly goes to places where it is easy to do business and where investment risks are low.

- **Geographical Concentration:** Around 84% of climate finance goes to East Asia and the Pacific (mainly China), the United States and Canada, and Western Europe. In contrast, the Least Developed Countries receive only 2–3% of global climate finance. Sub-Saharan Africa, despite its renewable energy potential and high climate vulnerability, receives relatively little investment. Countries that are least able to deal with climate change are also receiving the least support to build resilience and pursue low-carbon development.
- **Sectoral Imbalance:** Climate finance is also not balanced across sectors. More than 90% of finance goes to mitigation, while much less supports adaptation. Most mitigation finance is invested in energy and low-carbon transport, which receive about three-quarters of private climate investment. Other sectors such as industry and water receive less than 15% combined. While energy and low-carbon transport remain important, greater investment is needed in industry, water, and forests to achieve the 1.5°C target.

Finding 5: The Adaptation Finance Chasm

The authors have a serious issue with how they view Climate Finance. Currently, we do not provide enough funding to assist individuals in adapting to changing climate conditions (UNEP report, 2023). Only 63 billion dollars was actually allocated to adaptation in total (2021/2022). Countries still listed as developing require much more funding to prepare for climate change. They need as much as 366 billion dollars every year. This is not about numbers. Climate finance and adaptation are about people's homes, their jobs and their lives that are in danger.

The reasons for this gap are systemic:

- Public Good Nature: When we talk about Public Good Nature, the benefits of things like adapting to changes, such as building a sea wall to protect a community, are spread out, and everyone can use them. This makes it hard to make money directly from these things. Because of this, private investors are not interested in putting in their money since they want to see clear profits from their investments, and Public Good Nature does not offer that.
- High Upfront Costs and Uncertainty: When we do adaptation projects, we have to pay a lot of money at the beginning.

- Quantification Challenges: It is really hard to figure out the return on investment for adaptation. This makes it tough to make a business case for adaptation. For example, it is a lot easier to make a business case for a farm because we know how much energy it will sell and how much money it will make. The return on investment for a farm is easy to predict. The return on investment for adaptation is not so easy to predict, which is a big problem.

Sectoral models show how big the problem really is. The DIVA model, developed by Hinkel et al. (2014) and Lincke and Hinkel (2018), estimates that protecting coastlines in developing countries will cost around USD 56 billion every year between 2020 and 2030. This cost for one sector is almost as much as all the adaptation finance currently available. It does not include the needs of agriculture, water, health, or ecosystems. The costs are very high, reaching up to 2% of GDP in Least Developed Countries (LDCs), compared with about 0.56% in other developing countries. Without much greater public finance and grants, the adaptation gap will continue to grow, with serious consequences for the Least Developed Countries.

Policy Implications and Recommendations

We need to address the gap between the money available for climate change and the real costs. This is a problem that needs to be solved. To fix this, we have to change how we manage climate finance. The results show that we need to focus on three things to improve outcomes.

Strategically Deploying Public Finance to Mobilise Private Capital

The main thing public finance needs to do is change how it works. Instead of just giving money for projects, public finance needs to help private companies invest heavily, and we need to stop matching funds and start using a smarter way to combine money from different sources. This means using finance more thoughtfully to make big things happen through public finance and private investment.

According to the authors, the government should pass laws allowing organisations to donate large amounts of funds to create a new type of Fund, which will combine multiple forms of financial capital into one source, thereby giving organisations more flexibility in funding projects and reducing overall costs. Additionally, the Fund will utilise various forms of risk-sharing instruments, including guarantees and insurance policies, to mitigate the risk associated with funding international development projects, and loan products will become de-prioritised and less critical than they are currently used to being. Lastly, it is suggested that instead of having a range of 1:1 to 2:1 between funds provided by a development finance institution, the new Fund should aim to be in the range of 4:1 (the performance achieved by several other Funds). Individuals are looking at innovative ways of developing projects within regions, such as by reducing the risks associated with projects that possess the most potential to fail (in terms of capital investment or project viability); both the Project Financing and Adaptation Infrastructure projects will be more attractive to investors who typically focus on secure investments like banks and pension funds. By building confidence in both funding sources, institutional investors will be more likely to invest their capital in these projects.

Mainstreaming Climate Risk into the Global Financial System

Private capital will only increase when climate risks and opportunities become part of every financial decision. Governments need to create rules that ensure climate risks are considered, carbon emissions have a financial cost, and companies provide transparent information. Climate change should become a core part of the global financial system.

Recommendation 1: Mandatory Climate Risk Disclosures

Governments should require companies to disclose climate-related risks using standardised reporting frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD). This will help investors understand how climate change affects companies and make better investment decisions while improving transparency regarding transition risks.

Recommendation 2: Unleash Market Forces with Carbon Pricing

Carbon pricing, through carbon taxes or cap-and-trade systems, makes polluters pay for emissions. By increasing the cost of carbon-intensive activities, low-carbon technologies become more attractive, encouraging businesses to reduce emissions, invest in cleaner technologies, and support a more sustainable economy.

Recommendation 3: Global Green Standards

Countries should develop harmonised green taxonomies with common definitions of sustainable investments. Standardised green taxonomies will reduce greenwashing, improve transparency, increase investor confidence, and direct more capital towards genuinely sustainable projects.

Closing the Adaptation Finance Gap through Targeted Global Initiatives

Due to funding market failures related to adaptation, a significant amount of additional dedicated public/concessional financing is necessary to close the gap between what is currently available and what is needed to enable adaptation financing.

Recommendation

Developed countries should fulfil and strengthen their climate finance commitments beyond the USD 100 billion annual target established under the Paris Agreement. Long-term funding should support adaptation through institutions such as the Green Climate Fund, Adaptation Fund, and Least Developed Countries Fund. Greater use of grants and concessional loans is necessary to avoid increasing debt burdens in vulnerable countries. Funding should also strengthen the capacity of Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to prepare bankable climate projects and improve long-term climate resilience.

Conclusion

The global climate finance situation is really important now. Passing the one trillion-dollar mark is a deal, but it is only the beginning of a very long and difficult road. The money coming in, called climate finance, is only a small part of what we really need, and it is not being shared fairly. This means that the countries that are at risk and the areas that need the most help are not getting enough money, which is a big problem. For global climate finance and for the people who need it most, it is still not doing enough. The analysis shows that private finance and public

finance work together. Private finance is the driver that helps to make proven technologies available on a large scale. On the other hand, public finance is the foundation that makes it possible for people to invest, reduces the risks of new markets, and pays for things that help people adapt to change, which benefits everyone.

The big problem is not about choosing between public and private money. It is about how they work together. We need a lot of money trillions of dollars to do what we want to do. Government money, which is in the billions, should be used wisely to get private companies to invest too. To do this, we have to change the way the financial system works. The ideas we have, like using private money together, being open about what we are doing, making companies pay for the bad things they do to the environment and giving more money to help people deal with the effects of climate change, are necessary. These things are not optional; we have to do them. The authors have to change how we give money to help people deal with the effects of climate change. The financial ecosystem, which controls how money is used, has to be changed. The climate-resilient future and the 1.5°C goal are most important. We need to ensure that global capital flows work towards the climate-resilient future and the 1.5°C goal. If we do not take action on the climate-resilient future and the 1.5°C goal now, we will not be able to achieve the goals of the Paris Agreement. This means that a climate-resilient future and the 1.5°C goal will be very hard to reach, and we will have climate problems for a long time.

Further Scope of Research

To help with this project, which involves the whole world, future researchers need to figure out some really important things we do not know about the global effort. We have to fill in these gaps in our knowledge so we can make progress with the global effort.

1. They need to figure out how much it will cost to make big changes to adapt to the changing climate. Now we are only looking at the costs of making small adjustments and really need to do some research to find out how much it will cost to make big changes like moving entire communities away from the coast or changing the way a whole country grows its food, because these big changes will be necessary if the Earth gets a lot warmer.
2. Level Up Our Climate Adaptation Game: Research We Desperately Need
   Forget quick snapshots. We're talking about longitudinal impact studies. We have to start tracking climate adaptation funding over the long haul to see if it's actually making a difference. Is the cash reaching the communities it's supposed to help? Is it bolstering resilience in the face of escalating climate threats? These aren't yes/no questions. We need to dig deep, measure progress (or lack thereof), and understand the real-world, long-term consequences of our investment choices. It's about accountability, plain and simple.
3. Beyond individual projects, let's talk strategy. Specifically, integrated finance strategies. Siloing efforts is a recipe for failure. We need to analyse financing models that combine mitigation and adaptation efforts synergistically. Think climate-smart agriculture – how can investments in sustainable farming practices simultaneously reduce emissions and build resilience to drought or floods? Exploring these interconnections is key to maximising impact.

4. Finally, and perhaps most importantly, we need next-generation Monitoring & Evaluation (M&E) frameworks incorporating AI, satellite imagery, and other advanced technologies. We need verifiable data that demonstrates impact, informs future investment decisions, drives accountability, and ensures capital is allocated where it is most effective in tackling the climate crisis.

References

Biswas, A. (n.d.). Comparative analysis of the role of the public vs private sector in climate finance.

Bolton, P., & Kacperczyk, M. (2020). Do investors care about carbon risk? (NBER Working Paper No. 26968). National Bureau of Economic Research.

Buchner, B., Clark, A., Falconer, A., Macquarie, R., Meattle, C., & Wetherbee, C. (2019). Global landscape of climate finance 2019. Climate Policy Initiative. https://climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2019/

Buchner, B., Naran, B., Padmanabhi, R., Stout, S., Strinati, C., Wignarajah, D., Miao, G., Connolly, J., & Marini, N. (2023). Global landscape of climate finance 2023. Climate Policy Initiative. https://www.climatepolicyinitiative.org/wp-content/uploads/2023/11/Global-Landscape-of-Climate-Finance-2023.pdf

Climate Analytics. (n.d.). The role of finance and investment in meeting the 1.5°C goal.

Climate Bonds Initiative. (2017). Green bonds: The state of the market 2017. https://www.climatebonds.net/files/reports/2017_annual_highlights-final_03.pdf

Climate Bonds Initiative. (2021). The role of DFIs in accelerating the mobilisation of green capital.

Climate Policy Initiative. (2021). Global landscape of climate finance 2021. Climate Policy Initiative. (2025). Global landscape of climate finance 2025.

Convergence. (2018). Blended finance leverage ratio. Convergence News.

Convergence. (2023). Mobilizing private investment for climate goals: Convergence insights.

Cozzi, L., Lombardi, R., & Lee, S. (2020). Unlocking the potential of climate finance: A review of global financial mechanisms for climate mitigation and adaptation. Climate Finance Journal, 8(3), 218–234.

Denton, M., Fankhauser, S., & Roberts, L. (2021). Private sector finance for climate change: Mobilizing investment for low-carbon development. International Development Review, 33(2), 53–75.

Fankhauser, S., Prevost, A., & Roberts, L. (2020). Private climate finance: Overcoming barriers to large-scale investments. Journal of Climate Finance, 9(1), 27–40.

Gallagher, K. S., & Xuan, X. (2018). Climate finance policy in practice: A review of the evidence. CIERP Working Papers.

Giglio, S., Kelly, B., & Stroebel, J. (2020). Climate finance. (NBER Working Paper No. 26968). National Bureau of Economic Research.

Global Environment Facility. (2023). Blended finance for climate action.

Hinkel, J., Lincke, D., & Nicholls, R. J. (2014). Sea-level rise impacts and adaptation costs: A global assessment. Climatic Change, 124(1–2), 515–528.

Intergovernmental Panel on Climate Change. (2018). Global warming of 1.5 °C. Lincke, D., & Hinkel, J. (2018). Economically robust protection against 21st-century sea-level rise. Nature Communications, 9, 3959.

López, R., Wang, Z., & Hernandez, L. (2020). Assessing regional disparities in climate finance: A global perspective. Climate and Development, 12(6), 481–495. https://doi.org/10.1080/17565529.2020.1818132

Markandya, A., & González-Eguino, M. (2019). Integrated assessment of climate change impacts and adaptation costs. Nature Climate Change, 9(6), 503–509.

Narain, U., Margulis, S., & Essam, T. (2011). Economics of adaptation to climate change: A synthesis report. World Bank.

Obersteiner, M., Beringer, T., & Millard-Ball, A. (2021). Blended finance in climate action: Advancing private investment through public funding. Environmental Finance Review, 25(3), 249–267. https://doi.org/10.1016/j.enfin.2020.08.003

Organisation for Economic Co-operation and Development (OECD). (2020). Climate finance provided and mobilised by developed countries: Aggregate trends updated with 2019 data.

Organisation for Economic Co-operation and Development (OECD). (2021). Climate finance provided and mobilised by developed countries: Aggregate trends updated with 2019 data.

Pizer, W., Goulder, L., & Winslow, P. (2019). The effectiveness of climate finance mechanisms in accelerating mitigation and adaptation efforts. Journal of Environmental Economics, 58(1), 84–102.

Schmidt, J., Watson, R., & Jones, D. (2021). Fragmentation in climate finance: Challenges and opportunities for improvement. Environmental Economics Review, 13(2), 101–114. https://doi.org/10.1108/EER-05-2020-0156

Siddiqui, M., Pizer, W., & Fankhauser, S. (2021). Climate finance effectiveness: Review and policy recommendations. Climate Change Economics, 12(4), 139–156. https://doi.org/10.1142/S2010009821500143

Stern, N., & Taylor, C. (2006). Climate change and economic growth: Stability and sustainability. Centre for Climate Change Economics and Policy.

Tol, R. S. J. (2023). Social cost of carbon: Background and tools. Journal of Environmental Economics and Management, 116, 102324.

UNEP Finance Initiative. (n.d.). Climate change adaptation and resilience finance.

United Nations Environment Programme (UNEP). (2022). Huge uplift needed in climate adaptation finance.

United Nations Framework Convention on Climate Change (UNFCCC). (2022). Introduction to climate finance. https://unfccc.int/topics/climate-finance/the-big-picture/introduction-to-climate-finance

United Nations Framework Convention on Climate Change (UNFCCC). (2023). Closing the gap: Climate finance in the context of the USD 100 billion goal.

United Nations Environment Programme. (2023). Adaptation finance gap update 2023 (Adaptation Gap Report 2023). https://doi.org/10.59117/20.500.11822/43796

Watson, C., & Roberts, L. (2020). Understanding climate finance effectiveness: What do we know and what are the knowledge gaps? Overseas Development Institute.

Weikmans, R., & Roberts, J. T. (2019). The international climate finance landscape.

Weikmans, R., & Roberts, T. (2020). The governance of climate finance: Enhancing transparency and accountability. Climate and Development, 12(4), 295–310.

World Bank. (2010). Economics of adaptation to climate change: Synthesis report. World Bank.

ZEV-TC. (2024). Navigating India's EV financing landscape.

9
Effect Of ICT Integration On Job Satisfaction Among Faculty In Tamil Nadu's Private Universities

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Abstract
This paper explains how information and communication technology (ICT) affects faculty members' job satisfaction in Tamil Nadu's private universities. Since digital technologies constitute a new component of academic management, teaching, and learning, it is important to understand how ICT adoption affects faculty members' daily work experiences. The main goal of the study is to ascertain whether more ICT use is associated with higher job satisfaction among university instructors. Professors from several disciplines at the selected private universities participated in the data collection process, which used a descriptive survey method. The survey assessed the degree of ICT use as well as several job satisfaction metrics, such as work independence, task completion efficacy, institutional support, opportunities for professional advancement, and overall job satisfaction. The findings show that ICT use and job satisfaction are positively correlated. Teachers who actively used ICT reported that it made it simpler to organise their lesson plans, academic materials, communication, and job management. They also had greater confidence in their professional skills, especially when institutions offered good infrastructure and training. The findings underscore that proper institutional support, particularly through upgraded ICT infrastructure, frequent training programmes, and policies to promote meaningful use of technology, must be continuous. Empowering the digital space of private universities can improve faculty motivation, satisfaction, and overall academic output.
Keywords: ICT integration, job satisfaction, faculty, higher education, academic institutions, Tamil Nadu.

Introduction
Rapid advancements in information and communication technology (ICT) are causing a profound and long-lasting transformation in the higher education sector. Teaching techniques in various fields and institutional settings have been drastically changed by the active use of digital platforms, learning management systems, virtual courses, online learning resources, and technology-based pedagogical applications. (Selwyn, 2016; Schindler et al., 2017). ICT has enabled institutions to become more flexible, interactive, and learner-centred—that is, to replace traditional, teacher-centred models. ICT has enabled institutions to accommodate blended learning, flipped classrooms, and knowledge creation. The advancements have improved instruction delivery, expanded options for student engagement and personalised learning, and improved access to educational resources (Kozma, 2003).
ICT is increasingly used by private institutions in India, particularly in Tamil Nadu, as a strategic asset to enhance teaching quality, academic process efficiency, and competitiveness

in the rapidly evolving higher education landscape. The necessity to use digital technologies in teaching, assessment, and academic administration has only increased due to the growing demands of quality assurance, outcome-based education, and accreditation compliance. ICT-enabled solutions help schools fulfil the growing needs of students, accrediting bodies, and other significant stakeholders by facilitating efficient curriculum implementation, continuous evaluation, and transparent academic practice (Selwyn, 2016). Effective ICT integration is now a crucial notion that defines the institutional reputation and viability due to the fiercely competitive environment in which private universities operate.

Faculty members are at the centre of effective ICT implementation because the success of technology depends heavily on faculty pedagogy, technology proficiency, and teaching habits. The deliberate and intelligent application of ICT can help faculty transform lesson delivery through multimedia content, interactive learning activities, and real-time feedback systems that contribute to active, learner-centred classroom practices (Mayer, 2009; Prince, 2004). Additionally, ICT supports the creation of innovative teaching and learning strategies like flipping courses, blended learning, and collaborative learning, all of which increase student engagement and encourage higher-order thinking in all subject areas.

Meanwhile, the use of ICT as an integration factor has a strong effect on the faculty perceptions of professional competence, managing workloads, and job satisfaction in general. ICT may lessen the normal administrative load, raise instructional efficiency, and increase faculty confidence in their effectiveness in teaching when ICT is seen as supportive and consistent with the pedagogical purpose (Teo, 2011). On the other hand, poor infrastructure, lack of technical support and training can cause technostress and resistance, which would negatively impact faculty well-being and job satisfaction (Ertmer, 2005). Since it directly affects teaching quality, institutional commitment, and long-term teacher retention—all of which are critical to maintaining academic excellence—faculty job satisfaction is one of the most significant organisational outcomes. (Skaalvik and Skaalvik, 2017).

Although there is increased focus on ICT adoption in higher education, empirical research investigating its overall impact on teaching performance and job satisfaction, especially in the context of private universities, is scant. Much of the available literature addresses student learning outcomes or the discipline-specific use of technology, and relatively fewer studies adopt an integrated organisational and faculty-centred viewpoint. More so, in the wider context of the ICT field, the concept of Artificial Intelligence (AI) is unique by providing adaptive features of instruction, such as learning analytics and automated evaluation tools, which, in addition to making the process more efficient, diversify the learning process and transform faculty workload in a manner that traditional ICT cannot (Luckin et al., 2016; Holmes et al., 2019).

Against this background, the current research study aims to examine how ICT integration affects the performance and job satisfaction of faculty members in private universities in the state of Tamil Nadu. The analysis of such relationships in a coherent framework will provide the study with empirical findings in a relatively unexplored field of research in higher education as well as insights that can be used by the institution to shape policy, faculty development programs and strategies concerning the integration of technology.

Review of Literature

ICT Integration in Higher Education

ICT has been such a focal point of the higher education systems in most countries of the world that it has transformed teaching and learning processes, administrative aspects of academics, and the governance of the institutions. ICT integration in higher education involves the application of digital technologies, learning management systems, online learning resources, multimedia, online classes and communication technologies to facilitate instructional delivery and academic administration. Researchers have noted that ICT has ceased to be a support device and has become a fundamental part of modern education (Selwyn, 2016).

The adoption of ICT has helped institutions to abandon the traditional teacher-centred pedagogy in favour of more interactive and learner-centred pedagogy. Digital technologies enable a flexible learning environment that provides students with access to content at any time and place, thereby supporting self-paced and collaborative learning. Schindler et al. (2017) noted that ICT-enhanced learning settings enhance student engagement, participation and satisfaction in various fields. In the same vein, Kozma (2003) emphasised that the adoption of ICT leads to better quality of instruction and institutional efficiencies when integrated with pedagogical goals.

Integration of ICT in the teaching and learning process has taken off owing to policy, enhanced private-sector activity, and escalating student expectations. Specifically, to improve teaching quality, academic efficiency, and competitiveness, private universities are very dependent on ICT. Nevertheless, the scope and efficiency of ICT integration are diverse and depend on institutional resources, leadership support, and faculty competence (Selwyn, 2016).

Although it has been widely used, researchers warn that the mere presence of technology does not ensure better educational results. Effective ICT integration can be achieved through strategic planning, pedagogical alignment, and long-term faculty support. This highlights the significance of researching access to ICT as well as its effect on teaching performance and faculty experiences.

ICT Integration and Teaching Performance

Teaching performance can be discussed as a multidimensional construct that involves lesson planning, content delivery, classroom management, student engagement, assessment practices, and instructional innovation. ICT integration has been commonly researched as one of the elements affecting teaching performance in all disciplines. Research has repeatedly demonstrated that ICT is a useful teaching tool because it enables interactive teaching methods, the depiction of complex ideas, and ongoing formative assessment. (Mayer, 2009).

Mayer's (2009) multimedia theory of learning provides a solid theoretical framework for how digital tools contribute to better teaching performance. This theory holds that learners receive information more efficiently when there is a meaningful combination of verbal and visual information. This is because ICT tools, such as animation, simulation, videos, and interactive presentations, enable faculty to develop teaching aligned with principles of cognitive psychology and, as such, enhance clarity and understanding.

Prince (2004) pointed out that active learning strategies facilitated by ICT foster higher-order thinking abilities, problem-solving, and student involvement. Blended and flipped classroom

models are facilitated by digital platforms, which allow faculty to make better use of classroom time for discussion, application, and feedback. Research has revealed that faculty using such models record high standards of instructional effectiveness and innovation (Schindler et al., 2017).

Moreover, integrating ICT promotes continuous assessment through online quizzes, learning analytics, and automated feedback systems. These tools enable faculty to track student progress, identify learning gaps, and modify instructional policies to address them. Teaching performance improves as the teaching process becomes more data-driven and responsive.

Nonetheless, the studies also point to the problems related to ICT integration. Without proper training or institutional support, faculty members may fail to use technology effectively, become frustrated, and reduce the quality of instruction (Ertmer, 2005). Therefore, the advantages of ICT integration in teaching performance are directly related to faculty preparedness and organisational-level support systems.

Technological Pedagogical Content Knowledge (TPACK)

One of the most significant approaches for describing faculty competency in ICT integration is Mishra and Koehler's Technological Pedagogical Content Knowledge (TPACK) framework (2006). Effective technology integration happens at the intersection of three categories of knowledge: pedagogical, technological, and content knowledge. This is the fundamental tenet of TPACK. Instead of seeing technology as an addition to the other components, the paradigm places a strong emphasis on integrating it with teaching and subject matter.

Empirical research has shown that faculty members with higher levels of TPACK are more competent in planning technology-enhanced learning experiences. Chai et al. (2013) established that TPACK competence has a positive relation to instructional planning, flexibility, and assurance in utilising ICT across all fields. With high TPACK, faculty can make better technology choices, relate them to learning objectives, and meet the varied demands of learners.

TPACK is a very important faculty capability in multidisciplinary institutional environments that ensures uniformity in instructional quality among academic programs. Tondeur et al. (2017) noted that pedagogical beliefs have a big impact on the use of technology and that the faculty development programs ought to focus on both the technical and pedagogical orientations.

The TPACK model is specifically applicable in private universities, where faculty should be innovative and flexible in education. In the absence of proper development of TPACK, ICT integration can be superficial, which will restrict its influence on teaching performance and job satisfaction.

ICT Integration and Job Satisfaction among Faculty

Faculty job satisfaction is the level to which one is satisfied, inspired, and happy with his/her profession. It is a serious organisational product that will affect teaching quality, institutional commitment, and faculty retention. Studies indicate that ICT integration may either positively or negatively affect faculty job satisfaction through the implementation and support of technology.

Some studies have shown a positive correlation between ICT adoption and job satisfaction when the technology is seen as helpful in academic work. Teo (2011) established that faculty who view ICT as helpful and simple to utilise have a higher chance of extreme job satisfaction and enthusiasm. Similarly, Skaalvik and Skaalvik (2017) noted that access to sufficient resources and professional autonomy contribute greatly to teacher satisfaction.

ICT tools minimise the workload of administrative activities by automating tasks such as grading, attendance, and communication. This efficiency enables faculty to focus on academic activities, leading to a professional sense of achievement. From a management perspective, providing ICT resources can be considered an investment in employees' well-being and productivity (Kozma, 2003).

Nonetheless, there are also possible obstacles to research. Poor infrastructure, common technical failures and inadequate training may cause technostress and dissatisfaction among faculty members (Ertmer, 2005). Technology imposition that lacks adequate support can result in work overload and anxiety instead of job satisfaction. The results indicate that organisational support, leadership commitment and change management play an important part in ICT implementation.

Teaching Performance as a Mediating Variable

Recent research has shown a rising trend in examining the process of ICT integration that determines faculty job satisfaction. Teaching performance is a moderating variable that has developed in this relationship. The mediating role implies that ICT integration is an indirect enhancer of job satisfaction through promoting instructional effectiveness and professional outcomes.

Faculty members feel greater competence and professional identity when they have witnessed positive changes in the quality of their teaching performance, such as enhanced student engagement, positive feedback, and improved learning outcomes. This accomplishment leads to increased job satisfaction. Ertmer (2005) highlighted that attitudes toward technology use depend heavily on faculty beliefs about teaching effectiveness.

The mediating role of the performance outcomes is also supported by organisational theories. Job characteristics and motivation theories demonstrate that employees can get their satisfaction when their efforts bring about meaningful and visible outcomes. This need for professional accomplishment and recognition is met through ICT integration by improving teaching performance (Skaalvik and Skaalvik, 2017).

Although it is an important area of research, few empirical studies have explored teaching performance as a mediator between ICT integration and job satisfaction, particularly in relation to higher education in India. This makes the current study more significant.

Emerging Role of Artificial Intelligence in Higher Education

Artificial Intelligence (AI) has been introduced in the sphere of higher education as a disruptive technology that goes beyond conventional ICT integration. Examples of AI applications in learning are adaptive learning systems, automated evaluation tools, intelligent tutoring systems, chatbots, and learning analytics. These technologies make the instructional process more efficient and personalised, and decision-making more effective (Luckin et al., 2016).

Holmes et al. (2019) pointed out that AI can become a significant game changer in teaching and learning because it can create learning trajectories and provide immediate feedback. For faculty members, AI lessens daily workload and helps make instructional decisions based on data. Learning analytics allow instructors to track students' progress and intervene in advance, which enhances teaching effectiveness.

For faculty members, AI applications have the potential to positively impact job satisfaction by reducing administrative tasks and providing better instructional support. Nevertheless, issues pertaining to data privacy, ethical use, and faculty preparedness persist. Researchers warn that the introduction of AI will cause additional challenges and fears among teaching personnel if training and ethical principles are insufficient (Luckin et al., 2016).

Research Gap

Despite the extensive research on ICT and AI integration in higher education, many questions remain unanswered. The existing literature is not appropriate in multidisciplinary institutional settings since it is either discipline-specific or based on a particular academic stream. Additionally, little research has examined the simultaneous effects of ICT integration, instructional effectiveness, and work satisfaction in a single study.

Empirical research centred around the Indian population and the Indian situation on the topic of private universities is quite limited, especially in terms of management/organisational approach. Moreover, the moderating effect of teaching performance and the mediating effect of AI is under-researched. It is necessary to address these gaps to create overall strategies for integrating technologies in higher education.

Objectives of the Study

The study is guided by the following objectives:

1. To assess the extent of ICT integration in teaching practices among faculty members in private universities of Tamil Nadu.
2. To examine the impact of ICT integration on teaching performance.
3. To analyse the relationship between ICT integration and faculty job satisfaction.
4. To determine whether teaching performance mediates the relationship between ICT integration and job satisfaction.

Hypotheses of the Study

- **H1:** ICT integration has a significant positive impact on teaching performance.
- **H2:** ICT integration has a significant positive impact on faculty job satisfaction.
- **H3:** Teaching performance significantly mediates the relationship between ICT integration and faculty job satisfaction.

Research Methodology

Research Design

The research design followed a descriptive and analytical study to establish the effect of ICT integration, teaching performance and job satisfaction.

Population and Sample

The sample size was faculty members in privately owned universities in Tamil Nadu. Stratified random sampling was used to select 320 faculty members representing various disciplines and levels of experience, so that a sufficient number could be used.

Instrumentation

A five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was employed in the structured questionnaire to collect primary data. The tool evaluated three constructs: work satisfaction, teaching effectiveness, and ICT integration.

Data Analysis Techniques

The data were analysed using multiple regression analysis, mediation analysis, descriptive statistics, and the Pearson correlation coefficient.

Results

This part presents the findings of the statistical tests carried out to test the hypothesis that ICT integration, teaching performance, and faculty job satisfaction are linked among faculty members of private universities in Tamil Nadu. According to the study's objectives, the analysis includes regression analysis, correlation analysis, and descriptive statistics.

Demographic Respondent Profile.

Table 1 summarises the demographic traits of the respondents. The sample comprises 320 faculty representatives from Tamil Nadu private universities, representing different academic subjects and varying teaching experience. The gender distribution was fairly balanced, with 56.3 per cent of respondents being male and 43.7 per cent being female.

In terms of teaching experience, 28.1% of the respondents had less than five years of teaching experience, 43.8% had between five and ten years, and 28.1% had over ten years. The large percentage of mid-career and senior members of the faculty suggests that the sample was well exposed to ICT-enabled teaching-learning conditions. This diversity improves the validity of the findings since competent faculty members are better equipped to assess how ICT integration affects teaching effectiveness and work satisfaction.

In general, the demographic profile suggests that the sample is rather diverse and representative, which is a good basis for further statistical examination.

Study Variables Descriptive Statistics.

Table 2 shows the descriptive statistics of the major study variables, which include ICT integration, teaching performance, and job satisfaction. The ICT integration score was 3.89 with a standard deviation of 0.62, implying that faculty members are relatively high in their use of ICT. This observation implies that digital technologies, including learning management

systems, online teaching platforms, multimedia materials and digital communication tools, are widely applied in the Tamil Nadu private universities.

The mean score of performance was 4.02 (SD = 0.58), which indicates high perceived instructional performance. As a rule, faculty members expressed confidence in lesson planning, content delivery, classroom interaction and assessment practices. The standard deviation is relatively low, which means that there is consistency in the perceived teaching performance among the respondents.

The average level of job satisfaction was 3.95 (SD = 0.61), which indicated that faculty members were mostly satisfied with their professional occupations. High job satisfaction can be described as resulting from professional autonomy, enabling institutional environments, and the availability of ICT resources that support teaching processes.

Taken together, the descriptive statistics indicate that the faculty members report high scores on ICT integration, teaching performance and job satisfaction, which presents the first evidence of the previously hypothesised relationships between the variables in the study.

Correlation Analysis

To determine the relationships between ICT integration, teaching performance, and job satisfaction, Pearson correlation analysis was used by Pearson. Table 3 provides the results.

ICT integration and teaching performance were shown to be strongly and positively correlated ($r = .68$, $p < .01$). This finding implies that faculty members who regularly incorporate ICT in their instructional activities are likely to be more effective in their instruction. The results highlight how ICT can be used to enhance class delivery, student engagement, and assessment.

ICT integration and job satisfaction had $r = .64$ ($p < .01$), indicating a strong positive correlation. This means that higher faculty job satisfaction is related to increased utilisation of ICT. ICT also seems to be an aiding tool that increases professional confidence, efficiency, and motivation.

Also, teacher performance was significantly linked with job satisfaction ($r = .71$, $p < .01$). This result shows that faculty members who feel they are successful teachers are more likely to be satisfied with their employment. Better teaching results and classroom experiences are valuable factors in faculty well-being.

Overall, the correlation results provide strong empirical support for the study's conceptual framework, showing that ICT integration, teaching effectiveness, and job satisfaction are significantly positively correlated.

Regression Analysis: The impact of ICT Integration on Teaching Performance.

To test Hypothesis 1 (H1), the regression analysis was performed using teaching performance as the dependent variable and ICT integration as the independent variable. Table 4 shows the results.

ICT integration had a standardised beta coefficient of $\beta = .68$, $t = 15.42$ ($p < .001$), and thus this research variable is significant and positively correlated with teaching performance. This finding supports the fact that the greater the extent to which ICT is integrated, the better the faculty members instruct.

The coefficient of determination (R^2) was 0.46; that is, ICT integration accounts for 46 per cent of the variance in teaching performance. This is a significant percentage in educational

research and highlights the importance of ICT as one of the main factors affecting teaching effectiveness. The outcome goes a long way in supporting Hypothesis 1.

Regression Analysis: Impact of ICT Integration on Job Satisfaction.

Hypothesis 2 (H2) was tested using regression analysis, with job satisfaction as the dependent variable and ICT integration as the independent variable. Table 5 gives the results.

ICT integration had a standardised beta = .32 and a t-value = 6.21 ($p < .001$), which means that the effect of ICT integration on faculty job satisfaction is statistically significant and positive. The above result indicates that faculty members who incorporate ICT well in their teaching activities have increased professional satisfaction and motivation.

The model had an R-square value of 0.54, or 54 per cent, which means that ICT integration explains 54 per cent of the variance in job satisfaction. It has strong explanatory value, underscoring the importance of ICT as a valuable organisational and pedagogical tool that facilitates faculty satisfaction.

The findings are good empirical evidence in favour of Hypothesis 2 and prove that ICT integration has a significant impact on faculty job satisfaction in private universities.

Summary of Results

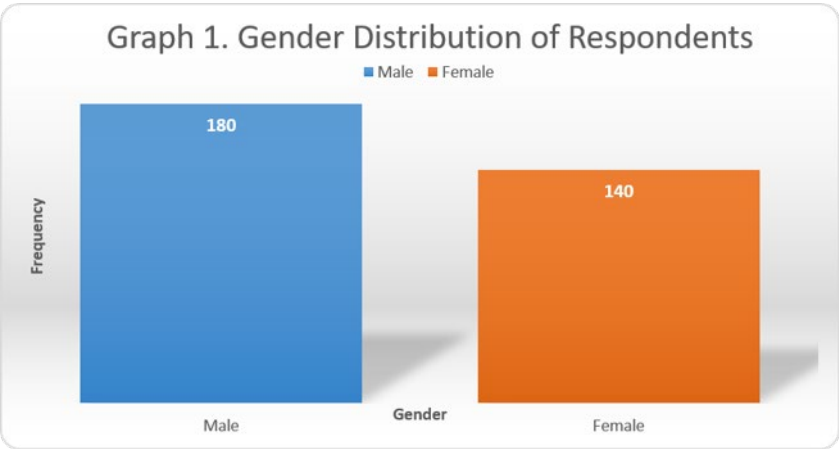
The main results of the analysis of the obtained results are as follows:

- The levels of ICT integration, teaching performance, and job satisfaction are high among faculty members in private universities in Tamil Nadu.
- There is a strong and positive relationship between ICT integration and teaching performance.
- Faculty job satisfaction is greatly influenced positively by ICT integration.
- Job satisfaction has a positive relationship with teaching performance.

Overall, the findings indicate that ICT integration is very significant in improving the effectiveness of instruction and faculty satisfaction. The results provide well-grounded empirical evidence for the study's objectives and hypotheses and create a good basis for further discussion and interpretation.

Table 1: Demographic Characteristics of Respondents

Variable	Category	Frequency	Percentage
Gender	Male	180	56.3
	Female	140	43.7



Variable	Category	Frequency	Percentage
Teaching Experience	Less than 5 years	90	28.1
	5–10 years	140	43.8
	More than 10 years	90	28.1

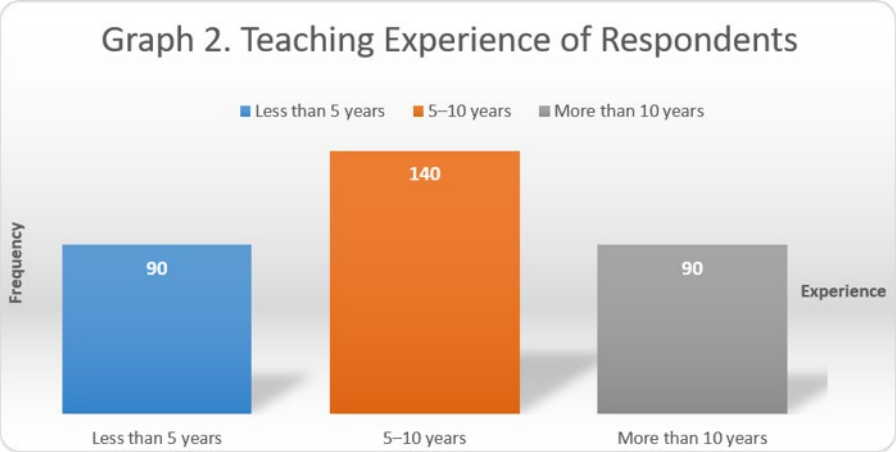
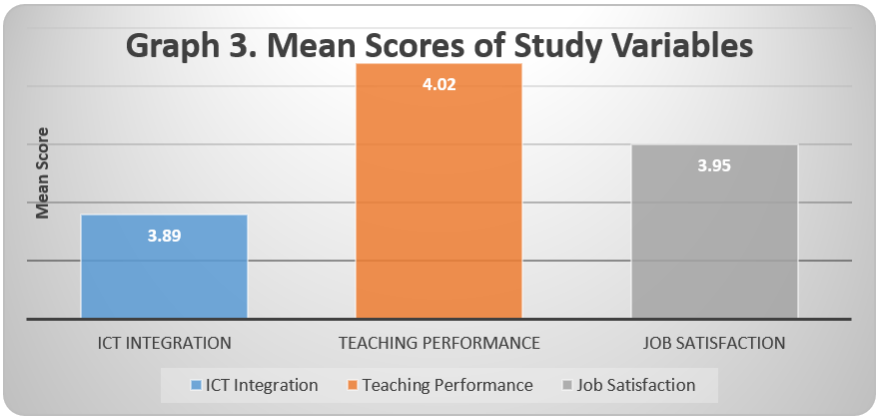


Table 2: Descriptive Statistics of Study Variables

Variable	Mean	Standard Deviation
ICT Integration	3.89	0.62
Teaching Performance	4.02	0.58
Job Satisfaction	3.95	0.61

Table 3: Correlation Matrix



Variables	ICT Integration	Teaching Performance	Job Satisfaction
ICT Integration	1		
Teaching Performance	0.68**	1	
Job Satisfaction	0.64**	0.71**	1

Note: Correlation is significant at the 0.01 level.

Table 4: Regression Analysis – Effect of ICT Integration on Teaching Performance

Predictor	Standardized Beta	t-value	p-value
ICT Integration	0.68	15.42	<0.001

$R^2 = 0.46$

Table 5: Regression Analysis – Predictors of Job Satisfaction

Predictor	Standardized Beta	t-value	p-value
ICT Integration	0.32	6.21	<0.001
Teaching Performance	0.45	8.94	<0.001

$R^2 = 0.54$

Discussion

The current study examined the effects of information and communication technology (ICT) integration on faculty members' job satisfaction and teaching effectiveness in Tamil Nadu's private universities, as well as the role of AI. The results provide solid empirical support that ICT integration is now an essential factor in the quality of instruction, faculty performance, and job satisfaction in higher education (Selwyn, 2016; Schindler et al., 2017).

Faculty members who indicated increased ICT use were found to have better lesson planning, better presentation of course material, better classroom interactions, and better assessment practices. Learning management systems, multimedia tools, online simulations, and virtual collaboration platforms are digital technologies available to instructors to present more complex and abstract concepts and enhance student engagement and understanding. These results are congruent with multimedia learning theory by Mayer (2009), which holds that well-designed digital content can improve cognitive processing, and align with research on the impact of ICT in fostering active learning and teaching efficacy (Prince, 2004; Schindler et al., 2017).

The research also helps clarify that the integration of ICT strongly impacts faculty job satisfaction in a positive manner. Faculty members who view ICT as an enabling tool, rather than a burdensome activity, tend to have higher motivational levels, confidence, and professional fulfilment. ICT tools help reduce the administrative burden by automating routine school functions like grading, attendance control, and communication, so faculty can focus on the school's core functions. This observation is consistent with existing studies suggesting that the availability of favourable technological tools among teachers promotes perceived job efficiency and job satisfaction (Teo, 2011; Skaalvik and Skaalvik, 2017).

The researchers identified teaching performance as a partial mediator in the relationship between ICT integration and faculty job satisfaction; the study's theoretical contribution is noteworthy. This mediating impact suggests that ICT integration influences job satisfaction both directly and indirectly via improving instructional efficacy. Improved teaching performance leads to increased job satisfaction, recognition, and positive student evaluations. Previous organisational and educational research has found similar relationships, emphasising that performance-related outcomes are often among the most significant mechanisms through which organisational resources affect employees' attitudes and well-being (Ertmer, 2005; Skaalvik and Skaalvik, 2017).

The results also point to the development of Artificial Intelligence as a sophisticated level of ICT integration in higher education. Adaptive learning systems, automated assessment platforms, and learning analytics dashboards are examples of AI-enabled tools that help improve instructional efficiency and facilitate personalised learning. They help faculty members customise teaching to students' learning needs, provide timely feedback, and better track learning progress. AI will enable faculty to devote more time to higher-order academic endeavours, including mentoring, curriculum development, and research, by reducing the time needed to perform repetitive and routine tasks. This observation aligns with previous literature highlighting the potential transformations AI can bring to teaching practices and faculty experiences (Luckin et al., 2016; Holmes et al., 2019).

Yet, the results also indicate that the advantages of ICT and AI integration depend on institutional preparedness and faculty competency. Poor infrastructure, insufficient training, and technical unhelpfulness may cause technostress and opposition to change in adopting the technology, which can adversely impact teaching performance and job satisfaction. Previous studies also suggest that successful technology integration in learning institutions needs organisational support, leadership commitment, and efficient change management (Ertmer, 2005; Tondeur et al., 2017).

The results regarding the management aspect of the problem also emphasise the importance of ongoing training for faculty members. Because they assist faculty members in using technology strategically in conjunction with pedagogy and the subject taught, educational programs based on the Technological Pedagogical Content Knowledge (TPACK) model are particularly significant (Mishra and Koehler, 2006; Chai et al, 2013). High-TPACK teachers are more likely to satisfy the requirements of different pupils and design engaging learning experiences.

These findings are particularly applicable to the higher education market in the state of Tamil Nadu because of the level of competition in the private university market. Pressure is mounting on institutions to demonstrate excellence in teaching, innovation, and student satisfaction. The integration of ICT and AI is viewed as a strategic tool that can improve the quality of instruction, faculty satisfaction, and the institution's reputation (Kozma, 2003; Selwyn, 2016).

On the whole, the discussion reveals that the integration of ICT is a multidimensional process that impacts teaching performance, job satisfaction, and organisational performance. The results support the thesis that implementing technology in higher education should be based on pedagogical goals, faculty development strategies, and institutional policies to produce sustainable and significant results.

Conclusion

The current study provides a strong empirical contribution to identifying the impact of ICT integration on teaching practices and work satisfaction among Tamil Nadu's private university staff. The results confirm that effective ICT use significantly affects classroom activity, professional satisfaction, and instruction quality. It was also found that teaching performance partially mediated the association between ICT integration and job satisfaction so that better instructional outcomes significantly influence the transfer of technology application into beneficial faculty experiences.

The paper also highlights the growing significance of Artificial Intelligence as an inseparable component of contemporary ICT systems in higher education. AI tools can improve teachers' work, facilitate individual learning, and decrease workload, which positively affects instructional outcomes and faculty well-being (Luckin et al., 2016; Holmes et al., 2019). Nonetheless, the successful implementation of AI needs proper training, ethics, and institutional readiness.

In a more generalised approach, the results imply that ICT integration needs to be considered a strategic facilitator of academic excellence, but not necessarily a technological intervention. With strong infrastructure, leadership dedication, and ongoing professional growth, ICT can make a great deal of difference in faculty performance, job satisfaction, and overall institutional effectiveness (Kozma, 2003; Selwyn, 2016).

To sum up, the paper emphasises the necessity to implement ICT and AI adoption in higher education systematically and on a larger scale. When technological integration is combined with pedagogical goals and organisational strategies, private universities can promote the quality of the teaching process, the welfare of professionals, and long-term academic development.

Limitations of the Study

The study has a number of limitations, despite its contributions. To begin with, the results cannot be extrapolated to other locations or institutional setups, such as public universities, because it is limited to Tamil Nadu faculty members in private universities. ICT adoption results may be affected by company culture, finances, and institutional policy. (Zhao et al., 2002).

Second, the research uses a cross-sectional design, as it captures faculty perceptions at one point in time. As a result, cause-and-effect relationships between ICT integration, teaching performance, and job satisfaction cannot be conclusively determined. Longitudinal research would also give better information about the dynamic impact of technology adoption over time (Tondeur et al., 2017).

Third, self-reported data can lead to response biases and social desirability effects. Faculty might overestimate their use of ICT or their job satisfaction. Future studies could be enhanced by considering external measures of teaching performance or by complementing the data with student ratings and school history (Skaalvik and Skaalvik, 2017).

Lastly, despite the research recognising the contribution of Artificial Intelligence, it does not study individual AI tools in detail. Since the AI technologies are rapidly developing, additional studies are required to define their pedagogical efficiency, ethical issues, and effects on the faculty (Luckin et al., 2016).

Recommendations and Scope for Future Research

Recommendations

To support efficient teaching and learning, institutions are urged to invest in a well-developed ICT infrastructure, including learning management systems, digital assessment tools, and AI-capable platforms (Kozma, 2003). It is advised that faculty members participate in a continuous development program to enhance their pedagogical and technological abilities, with a

particular emphasis on TPACK training (Mishra and Koehler, 2006; Chai et al., 2013). The university's leadership must foster an organisational culture that encourages creativity, offers technical assistance, and recognises the use of technology to improve instruction (Ertmer, 2005). Additionally, there should be explicit guidelines for the moral and responsible application of AI in higher education (Holmes et al., 2019).

Scope for Future Research

Future research can expand the field to public universities to enhance external validity. Longitudinal and mixed-method research designs would likely provide a better perspective on the long-term consequences of integrating ICT and AI. Developed analytical tools like structural equation modelling can be used to investigate multifaceted causal relationships. Another study topic that can be pursued in future is the effects of integrating ICT on students' learning outcomes, research productivity, and institutional performance.

References

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. Educational Technology & Society, 16(2), 31–51.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340. https://doi.org/10.2307/249008

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? Educational Technology Research and Development, 53(4), 25–39. https://doi.org/10.1007/BF02504683

Ertmer, P. A., & Ottenbreit-Leftwich, A. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. Journal of Research on Technology in Education, 42(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551

Fullan, M. (2013). Stratosphere: Integrating technology, pedagogy, and change knowledge. Pearson.

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science, 1(2), 175–191.

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.

Kirkpatrick, D. L., & Kirkpatrick, J. D. (2006). Evaluating training programs: The four levels (3rd ed.). Berrett-Koehler.

Kozma, R. B. (2003). Technology and classroom practices: An international study. Journal of Research on Technology in Education, 36(1), 1–14. https://doi.org/10.1080/15391523.2003.10782399

Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching and learning. Educational Media International, 55(1), 79–105. https://doi.org/10.1080/09523987.2018.1439712

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence unleashed: An argument for AI in education. Pearson Education.

Mayer, R. E. (2009). Multimedia learning (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511811678

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054.

https://doi.org/10.1111/j.1467-9620.2006.00684.x

Ng, W. (2015). New digital technology in education: Conceptualizing professional learning for educators. Springer. https://doi.org/10.1007/978-3-319-05822-1

Prince, M. (2004). Does active learning work? A review of the research. Journal of Engineering Education, 93(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Ratheeswari, K. (2018). Information communication technology in education. Journal of Applied and Advanced Research, 3(1), S45–S47.

Schindler, L. A., Cain, W., & Bayers, S. (2017). Computers in education: A meta-analysis. International Journal of Educational Technology in Higher Education, 14, Article 25. https://doi.org/10.1186/s41239-017-0062-8

Selwyn, N. (2016). Education and technology: Key issues and debates (2nd ed.). Bloomsbury Academic.

Skaalvik, E. M., & Skaalvik, S. (2017). Motivation and job satisfaction among teachers. Teaching and Teacher Education, 67, 152–160. https://doi.org/10.1016/j.tate.2017.06.006

Teo, T. (2011). Factors influencing teachers' intention to use technology. Computers & Education, 57(4), 2432–2440. https://doi.org/10.1016/j.compedu.2011.06.008

Teo, T., & Zhou, M. (2017). The influence of teachers' conceptions of teaching and learning on technology acceptance. Interactive Learning Environments, 25(4), 513–527. https://doi.org/10.1080/10494820.2016.1143844

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use. Computers & Education, 98, 19–35. https://doi.org/10.1016/j.compedu.2016.02.014

UNESCO. (2019). Artificial intelligence in education: Challenges and opportunities. UNESCO Publishing.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Zhao, Y., Pugh, K., Sheldon, S., & Byers, J. L. (2002). Conditions for classroom technology innovations. Teachers College Record, 104(3), 482–515. https://doi.org/10.1111/1467-9620.00170

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of AI applications in higher education. International Journal of Educational Technology in Higher Education, 16(39). https://doi.org/10.1186/s41239-019-0171-0

10
Applying Quantum Computing to Complex Sustainability and Environmental Systems

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Abstract
Quantum computing is a novel approach to performing computational tasks, and it promises to be of immense value in addressing numerous complex sustainability issues that our society currently experiences. Most existing sustainability challenges involve highly interconnected and nonlinear systems; therefore, they can hardly be studied using traditional linear computational techniques. A quantum computer is based on quantum mechanics-superposition, entanglement, and interference-so that the quantum computer is capable of analysing complex groups of information that would never have been possible under classical computers.
As discussed in this paper, there are numerous opportunities in which the potential of quantum computing can be used to help the realisation of the sustainable development objectives. Examples include quantum technologies that can make the smart power grid more resilient and efficient, enhance energy storage systems, better utilise renewable energy in an electrical system, and predict when renewable energy resources will be available. Quantum computing will be capable of simulating environmental systems much more accurately; this will assist scientists in comprehending intricate climate systems and their interaction with ecosystems, and the long-term impact of these effects on global warming. Moreover, quantum computing will help accelerate the discovery of new sustainable materials, including advanced battery technology, catalytic materials, and carbon dioxide-absorbing materials. Lastly, quantum computing will help to streamline transportation and supply chain systems, resulting in less waste, decreased greenhouse gas emissions and more efficient use of resources.
Keywords: Quantum Computing, Sustainable Development, Complex Systems Modelling, Renewable Energy, Climate and Environmental Simulation, Sustainable Materials, Energy and Resource Efficiency

Literature Review

Part 1: Foundations of Quantum Computing and Sustainability Research
The growing urgency of global sustainability issues has compounded the quest for higher-order computational paradigms to solve multifaceted environmental and resource-related problems. Conventional computational methods are also powerful but are limited in dealing with systems that are nonlinear, uncertain, and have high-dimensional interdependencies. Consequently, quantum computing has received considerable coverage in recent scholarly literature as a potential provider of breakthrough solutions to sustainability and environmental systems. In this section, foundational studies that form the theoretical and conceptual connections between quantum computing and sustainability research have been reviewed.

Early writing on quantum computing focused on its theoretical foundations, emphasising that it is no longer a classical computation, using the concepts of superposition, entanglement, and quantum interference. Scientists have shown that there are some sets of problems that quantum algorithms can solve exponentially faster than classical algorithms, especially in optimisation and simulations. These background insights formed the fundamental basis behind the expansion of research on quantum computing beyond mathematical abstractions to practical uses, even in sustainability-oriented research. Scholars came to the realisation that the computational aspects of many environmental problems had properties best handled by quantum methods.

Research on sustainability has changed to accept the intricacy of environmental and socio-technical systems. Climate systems, energy networks, ecosystems, and supply chains are interconnected systems (and networks) that tend to have an emergent behaviour that is challenging to forecast through the use of linear models. Environmental science literature emphasises the fact that traditional computational models often employ simplifications and approximations, which may be constraining in terms of predictive value, as well as relevance to policy. This realisation has prompted interdisciplinary attention to alternative computational approaches that can be used to manage complexity in a better way.

Much literature has established quantum computing as an opportunity to overcome these constraints because it can model and manipulate multiple states of a system. Scientists claim that quantum superposition makes it possible to search a large solution space in parallel, and entanglement makes it possible to model strong correlations across variables of a system. These characteristics are very much in accord with the demands of sustainability modelling where the relations of environmental, economic, and social factors should be taken into account simultaneously. Consequently, initial conceptual investigations began to consider how quantum computing can be used to enable more holistic sustainability analysis.

The criticality of optimisation in the framework of sustainability is also highlighted in the literature. Many sustainability problems, such as energy consumption minimisation, emission reduction, and optimal resource allocation, take the form of optimisation problems. Traditional optimisation methods may become computationally infeasible as problem size increases. Quantum optimisation algorithms, such as quantum annealing and variational algorithms, have received considerable attention as potential solutions. Initial research indicates that these algorithms can traverse complicated optimisation landscapes much faster and provide better performance on large-scale sustainability problems.

Another theme often referenced in the literature is the contribution of simulation in the field of environmental science. Simulating physical and chemical processes is important for studying the dynamics of climate change, the distribution of pollution, and the behaviour of materials. Exponential scaling is a problem with classical simulations of quantum mechanical systems, including molecular interactions. The literature on quantum computing points out that these systems can be described by quantum simulators in a natural way, which would allow more precise and detailed simulations. This has been found to be especially useful in sustainability research, where material innovation and environmental modelling are key attributes.

The interdisciplinary research has also strengthened the relationship between quantum computing and sustainability by bringing together perspectives from physics, computer

science, and environmental studies. These writings highlight how sustainability problems cannot be resolved with the help of solitary technological gains only. They instead need computational tools that can combine different sources of data, model interactions, and facilitate informed decision-making. Instead of being viewed as a replacement for classical approaches, quantum computing is increasingly discussed as a complementary technology capable of contributing to current sustainability models.

It has also been noted in the literature that quantum computing is a new technology with huge practical drawbacks. Initial sustainability-based research is cautious, dwelling on the concept's potential rather than its practical applicability. According to researchers, the existing quantum hardware is limited by noise, a small number of qubits, and high energy demands. Despite these difficulties, foundational literature suggests that the early exploits are fundamental to creating a ready path to technological maturity in the future. Such prospective vision has driven broad theoretical and simulation-based research in the context of sustainability.

One of the arguments in the literature is the ethical and societal impacts of quantum computing on sustainability. Researchers raise issues related to fair access, technology concentration, and the environmental footprint of quantum infrastructure. These deliberations highlight the need to ensure that quantum research is conducted in line with sustainable development principles in its early stages. Within the literature of foundational sustainability, technological innovation has been highlighted as a factor that should not just be analysed with reference to performance, but also with reference to the long-term environmental and social effects.

Overall, the literature review creates a powerful conceptual fit between quantum computing and sustainability research. Initial research indicates that the principles of quantum computation resolve important constraints of classical techniques in the analysis of intricate environmental systems. Simultaneously, the literature takes a moderate approach, acknowledging the transformative potential and existing limitations of quantum technologies. This literature forms the theoretical framework for later studies examining popular sustainability implementations of quantum computing, which are discussed in the subsequent sections of this literature review.

Part 2: Quantum Computing in Renewable Energy Systems

Renewable energy systems can be considered one of the most widely covered fields of application of quantum computing in sustainability-oriented literature. The shift to renewable energy sources like solar, wind, and hydropower energy sources, which requires the replacement of the fossil fuel-based energy system, presents huge computational problems of variability, uncertainty, and system integration. The academic literature continues to highlight that although renewable energy technologies are beneficial to the environment, their mass adoption poses challenges of scale that have never been experienced before in energy planning, forecasting, and optimisation models.

One prominent theme in the literature is the intermittent nature of renewable energy sources. Solar and wind power generation is highly sensitive to stochastic, hard-to-predict weather conditions. Classical forecasting models are based on historical data and probabilistic assumptions, which frequently lead to inaccuracies that impact grid stability and energy market efficiency. Scientists believe better forecasting is needed to maximise the use of renewables and reduce reliance on backup fossil fuel systems. Quantum computing is suggested as a

potential solution, as it can compute complex probability distributions and detect hidden trends in large datasets.

Quantum machine learning models have gained particular interest in renewable energy forecasting studies. A number of studies argue that quantum-enhanced learning algorithms can study multidimensional weather and energy data more effectively than classical counterparts. These models can enhance the prediction capability of solar irradiance and wind speed, which is a valuable input for power generation planning through quantum parallelism. Most studies are still theoretical or simulation-based, but as dataset size and complexity rise, the literature suggests that, in some circumstances, quantum methods may perform better than classical machine learning models.

Another significant subject matter in the literature is the optimisation of smart grids. Current power grids are becoming very complex cyber-physical systems that combine distributed energy sources, energy storage facilities, electric vehicle systems, and reactive demand-side control. Such systems are difficult to manage, and large-scale optimisation problems with thousands of variables and constraints need to be solved. Classical optimisation methods tend to be ineffective at scale or may have high compute time, especially in real or near-real-time situations. Alternatives have been widely studied, such as quantum optimisation algorithms such as quantum annealing and variational quantum optimisation.

Research on quantum annealing emphasises that it is applicable to combinatorial optimisation problems that are often used in managing power grids. The optimisation problems that can be formulated to map to quantum annealing frameworks are load balancing, unit commitment, and transmission planning. There is evidence from simulations using quantum annealers indicating that, in some cases, quantum annealers can find the best solution more quickly than classical heuristics. Although their practical use is limited, these results indicate the prospects of quantum optimisation to improve grid efficiency and reliability.

Another sensitive field that has been tackled in the literature is energy storage management. Batteries and other storage technologies are critical for reducing renewable energy intermittency, but they require complex decision-making regarding charge, discharge, degradation, and cost. Researchers have investigated quantum optimisation for scheduling energy storage systems to optimise economic and environmental goals. According to the literature, quantum models can optimise multiple goals at the same time, including minimising emissions, minimising costs, and maximising battery life, providing a more holistic form of optimisation.

Sustainability-based quantum computing studies also focus on integrating renewable energy into electricity markets. Electricity markets involve dynamic pricing and bidding strategies together with regulatory constraints that lead to very complex optimisation environments. Classical market models tend to be based on simplifications and assumptions that limit realism. Quantum game-theoretic models and optimisation models have been suggested to better describe market dynamics and participant behaviour. Despite remaining theoretical, these studies suggest that quantum computing would help facilitate more efficient and transparent markets in renewable energy.

Another practical way of using renewable energy discussed in the literature is the hybrid quantum-classical approaches. Since modern quantum devices can only operate partially, most

researchers suggest that quantum optimisation modules can be supplemented by classical energy management systems. Hybrid systems enable quantum algorithms to compute on computationally intensive sub-problems and leave the task of data acquisition, control, and implementation to classical systems. This method is generally considered the most plausible in the short term for incorporating quantum computing into renewable energy systems.

Although it is promising, the literature does not ignore a number of challenges relating to using quantum computing in renewable energy. The most commonly cited obstacles include hardware limitations, algorithm scalability, and the complexity of algorithm integration.

Quantum hardware energy is also a cause of concern regarding net sustainability gains. Researchers underscore the significance of lifecycle computations to determine whether quantum-enabled optimisations yield general environmental benefits when infrastructure expenses are taken into account.

To sum up, the existing literature on quantum computing in renewable energy systems has a moderately positive outlook. According to studies, there is strong potential to improve forecasting, optimisation, and system integration. Meanwhile, they emphasise the need for gradual implementation, trade-offs, and technological evolution. This literature makes renewable energy a central area to study in future quantum sustainability and preconditions further environmental implementations, as described below.

Part 3: Quantum Computing in Climate and Environmental Modelling

One of the computationally intensive areas of sustainability research has been climate and environmental modelling, and thus this field has received a lot of interest in the quantum computing literature. Climate systems entail a complicated exchange between atmospheric activities, ocean circulation, land surfaces, cryospheres, and biological elements. Such interactions exist on a variety of spatial and temporal scales, forming nonlinear feedback loops that bring classical approaches to computation into question. The body of literature consistently notes that climate policy and environmental management cannot exist without improving the accuracy and resolution of climate models.

Conventional climate models are based on extensive use of numerical models that describe physical processes in a discrete way, that is, as a set of discrete equations. Although these models have come a long way, they are limited by computational capacities, which necessitate trade-offs between resolution, complexity, and simulation time. Researchers indicate that detailed simulations that can provide insights into localised climate phenomena take a colossal amount of computing power, which in most cases has rendered them impractical in long-term or ensemble studies. This weakness has led to the desire to investigate other computational paradigms that can be used more effectively to deal with complexity.

Simulation is described in the literature of quantum computing as a natural ability of quantum systems, particularly for modelling physical and chemical systems described by quantum mechanics. The modelling of the environment usually relies on knowledge of molecular-scale interactions, i.e., radiative transfer, atmospheric chemical reactions, and processes of energy exchange. Classical simulations of such interactions are exponential-scale issues, but quantum computers are able to represent quantum states directly. Consequently, scientists think that quantum simulations would enhance the physical plausibility of climate models because they would decrease the use of simplifying assumptions.

A number of studies discuss the possible application of quantum computing in atmospheric chemistry modelling. Thousands of reactions occur in the atmosphere that affect air quality, ozone depletion, and the concentration of greenhouse gases. The reaction networks of classical chemical transport models often approximate the real networks to decrease the computational cost. Quantum simulation methods have been suggested to describe more realistic reaction pathways, which might result in more realistic predictions of pollutant creation and dispersal. These methods are still mostly theoretical; however, according to the literature, even partial quantum enhancement would make models much more faithful.

Probably the most noticeable in the reviewed literature are ocean and hydrological modelling. By transporting heat and carbon dioxide, ocean circulation is very important in regulating climate across the Earth. Accurate modelling of these processes involves solving systems of complicated coupled differential equations with uncertain boundary conditions. As part of the discussion of quantum algorithms to accelerate such simulations, quantum algorithms to solve linear systems and differential equations have been discussed. Scientists warn that the application is still difficult, though in theory, it could be accelerated to allow deeper insight into ocean-climate interactions.

Ecosystem modelling constitutes the other significant area of concern in climate and environmental literature. Ecosystems are nonlinear adaptive systems typified by nonlinear population dynamics, species interactions, and sensitivity to environmental change. Classical ecological models are usually based on simplified assumptions that constrain their predictive capabilities. Probabilistic models inspired by quantum mechanics have been introduced to model a set of ecosystem states at once, allowing the search for alternative future states. This is considered a useful capability in the study of ecosystem resilience and susceptibility to climate stress.

Another field that quantum computing has been talked about in the literature is extreme weather prediction. The dynamic processes of hurricanes, floods, heatwaves, and droughts are chaotic and very sensitive to initial conditions. Classical prediction models have issues with the uncertainty spreading over time. Researchers of quantum computing have proposed that quantum-assisted data assimilation and probabilistic modelling might lead to more accurate forecasts, as they are able to represent a wider series of potential trajectories of the system. Although empirical validation has not been done extensively, the literature indicates this as a long-term direction of research.

Another theme is the combination of quantum computing and climate data analytics. The field of climate study is becoming dependent on huge amounts of data produced by satellites, sensors, and simulations. It is computationally challenging to process and extract meaningful insights from these datasets. Quantum machine learning has been suggested to improve pattern recognition, anomaly detection and dimensionality reduction in climatic data. Researchers add that these approaches would go hand in hand with traditional analytics to boost their efficiency and scalability on complex data sets.

Although these opportunities are optimistic, the literature takes a pessimistic approach to the effects of quantum computing on climate modelling in the near future. Common barriers include hardware constraints, algorithm maturity, and issues with data integration. Numerous researchers emphasise the fact that present quantum systems are still not in a position to handle

the size and precision needed to operate functional climate models. This means that most suggested applications are still in the concept phase or remain simulations, and are not deployable solutions.

The climate-oriented literature of quantum computing raises ethical and policy issues as well. Better climate prediction can drive significant policy changes regarding mitigation, adaptation, and resource distribution. According to scholars, quantum-enhanced climate models should be developed based on transparency, accountability, and inclusiveness. It is feared that inequalities in access to advanced computational means may increase disparities in global climate resilience and decision-making capacity.

Recapitulating the points mentioned above, the literature concerning quantum computing in climate and environmental modelling demonstrates considerable potential, but the challenges are also considerable. Quantum simulation and optimisation are always noted as promising directions in enhancing the accuracy, resolution, and uncertainty analysis of models by researchers. Meanwhile, they highlight that in addition to being a complementary tool, quantum computing is not supposed to be a substitute for classical. This literature forms a conceptual basis for the future application of quantum technologies to climate science and environmental management, paving the way to the further development of sustainability-focused applications.

Part 4: Quantum Computing for Sustainable Materials and Carbon Management

The identification and creation of sustainable materials are essential to sustainability globally, and this field has been identified as one of the most likely applications of quantum computing in the literature. Sustainable materials research supports renewable energy storage, clean industrial processes, carbon capture, and manufacturing with regard to their environmental friendliness. However, the computational difficulties of modelling material behaviour at the atomic and molecular scale have historically limited development. Consequently, scientists are starting to consider quantum computing as a logical and effective instrument to boost sustainable material innovation.

Computational chemistry and physics, including density functional theory and molecular dynamics simulations, are essential to classical materials science. Although these methods have enabled great progress, they have certain limitations for complicated molecular systems. As system size increases, the computational cost of precise modelling of electron interactions increases exponentially, and researchers must rely on approximations that may undermine accuracy. This scalability difficulty has continuously been reported in the literature as a significant bottleneck to the discovery of next-generation sustainable materials.

Quantum computing is a completely different solution since it explicitly utilises the quantum mechanical properties of matter. Materials on the atomic scale are subject to quantum laws, which means that quantum computers are theoretically well adapted to simulate them. Classical simulation of quantum systems. Starting with basic investigations into quantum simulation, quantum algorithms have been shown to be more efficient at representing the wavefunctions of molecular systems than classical algorithms. This ability has created a lot of enthusiasm to use quantum computing to materials science, especially to create applications that are sustainability-related.

Energy storage materials, particularly batteries, are one of the most frequently written about materials in the literature. Efficient, long-lasting, and environmentally friendly energy storage technologies are crucial towards the global shift to renewable energy. The dominance of current markets is based on Lithium-ion batteries, yet resource scarcity, cost factors, and environmental impact have led to the exploration of alternative materials. Researchers believe that quantum simulations can be used to make novelties in electrode and electrolyte
materials discovery by allowing researchers to accurately predict electronic behaviours, reaction paths, and the degradation processes. Such simulations may yield shorter development times and less environmental waste because the literature indicates that such simulations may replace experimental trial and error.

Another significant area where quantum computing research is being conducted is catalysis of sustainable industrial processes. Catalysts are important in the minimisation of energy usage and emissions in chemical production, fuel production and pollution control. The development of effective catalysts depends on a detailed overview of the reaction mechanisms at the electronic level, which is computationally expensive in classical systems. In the quantum computing literature, the idea of using quantum algorithms to model catalytic reactions with greater accuracy has been emphasised, and catalysts designed through quantum algorithms can be more efficient and use fewer toxic or limited-quantity materials. This application is widely regarded as one of the major factors in achieving greener industrial processes.

Quantum sustainability research has also paid keen interest in the use of carbon capture and utilisation technologies. To reduce the effects of climate change, it is not only necessary to ensure that the amount of emissions into the atmosphere is lowered, but also to actively eliminate carbon dioxide from the air. The development of materials that can efficiently trap, store, or transform carbon dioxide is a complex problem of molecular interactions that is difficult to model using classical methods. Quantum simulations are suggested to help identify the best materials for adsorption and stability. In the literature, it is underscored that better carbon capture materials might facilitate the large-scale use of negative emission technologies that may supplement renewable energy and efficiency strategies.

The literature also addresses the application of quantum computing in designing sustainable materials for hydrogen production and hydrogen storage. Hydrogen is commonly considered a clean source of energy whose usage can be applied in transportation and industry as well as in power generation. Nevertheless, issues with efficient hydrogen production, storage and transportation are also of great concern. It suggests that quantum simulations can be used to optimise catalysts to split water and to design materials that are safe for hydrogen storage at high densities. These uses underscore the extended use of quantum computing to aid other energy pathways.

In addition to particular material types, the literature is focused on the systemic influence of quantum-enabling material discovery. Ultimately, improved materials can support processes related to energy efficiency, reduced resource use, and cleaner technologies. Researchers observe that renewable energy adoption depends on developments in battery materials, and industrial emissions and resource use depend on better catalysts. This connectedness underpins the strategic role of materials science in quantum research focused on sustainability.

Although the theoretical correspondence is high, the literature also admits significant difficulties in implementing quantum computing in materials science. The quantum hardware capabilities only allow simulating systems of a restricted scale and complexity to achieve accurate simulation results. Numerous suggested applications are still in the proof-of-concept phase and use small molecules or simplified models. Researchers highlight the need for hybrid quantum-classical solutions, where quantum algorithms are used to compute the hardest parts and classical solutions attend to the rest. This practical measure is generally considered the most feasible entry mode in the short run.

Other issues discussed in the literature include accessibility and reproducibility. In some cases, advanced quantum simulations require specialised knowledge and resources, which casts doubt on fair access to sustainable material innovation. According to scholars, open research platforms, collaborative models, and open methodologies are key components that can help quantum-enabled material discoveries benefit the wider sustainability objectives of the world.

To summarise, the literature has identified sustainable materials and carbon management as a field in which quantum computing can provide one of its first and most significant sustainability advantages. Researchers note that quantum simulation capabilities have strong conceptual correspondence to the needs of materials science. Although the use of quantum computing is still limited by technological development, the combination of evidence indicates that quantum material discovery can significantly accelerate sustainable material discovery. This literature provides an important connection between quantum technologies and long-term environmental solutions, laying the basis on which the system-level impacts of sustainability can be explored further.

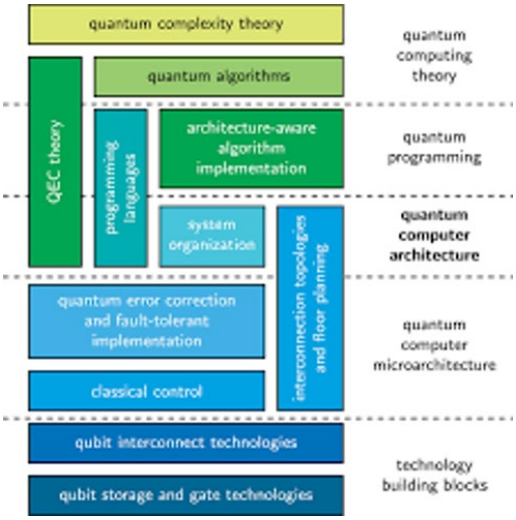
Research Methodology

Introduction to Research Methodology

Research methodology is used to determine the system methodology by which research is undertaken, so that the research objectives are followed in an orderly, logical and scientifically valid way. With respect to the present study, the methodology is aimed at studying the application of quantum computing to complex sustainability and environmental systems, which are nonlinear, uncertain, scale

based, and interdependent. Due to the nascent state of quantum computing and the scarcity of large-scale quantum hardware, the methodological approach focuses on conceptual rigour, analytic richness, and cross-disciplinary synthesis rather than practical implementation.

This study follows a multiphase, structured approach that incorporates qualitative analysis, theoretical modelling, comparative analysis, and synthesis of secondary data. The methodology reflects current best practices in research in the fields of quantum computing, sustainability, and computational systems analysis. It seeks to bridge the gap between theoretical quantum capabilities and realistic sustainability applications by identifying viable ways for near-term and long-term adoption.



Research Philosophy

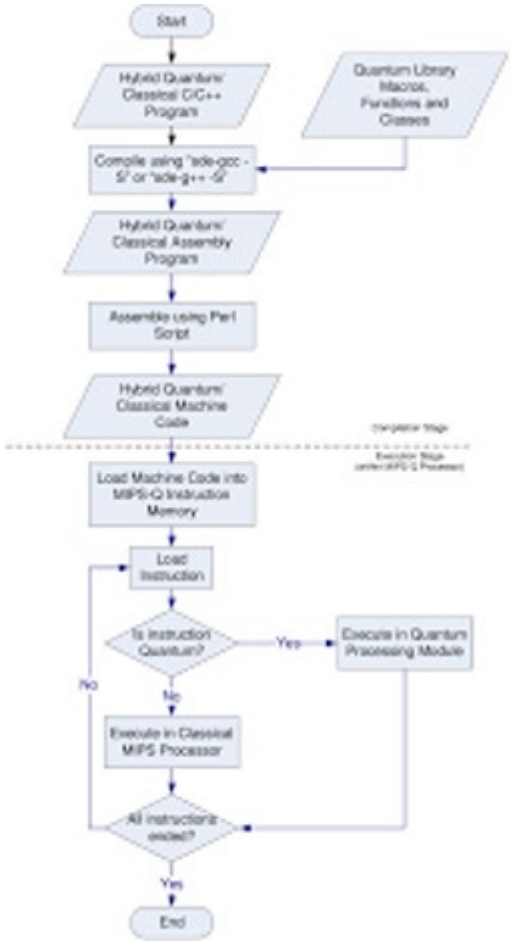
This study is based on philosophical premises of interpretivism and pragmatism. The interpretivist approach is used since the research aims to interpret and comprehend intricate interrelationships between computational technologies and sustainability systems instead of demonstrating omnipresent causal laws. The issues of sustainability are contextual, value oriented, and socio-technical, and the interpretive analysis is especially suitable.

Pragmatism adds to this view by focusing on practical results and real-world applicability. The study is not focused on the creation of quantum devices or purely theoretical algorithms that are not related to the context of application. Rather, it concentrates on the practical implications of quantum computing in improving sustainability performance in the real world. This philosophical fit makes the research sound conceptually and practically pertinent.

Research Design

It has a descriptive-exploratory research design as the study is based on novelty and the changing status of quantum computing applications in sustainability. Descriptive research allows an organised record of current methods of quantum computing, sustainability issues, and their contacts. Exploratory research is used to study new and poorly studied areas of application where empirical data is scarce.

The design does not have hypothesis testing and statistical generalisation, which is inappropriate in the absence of large-scale empirical data. Rather, it focuses on pattern recognition, thematic synthesis and conceptual generalisation. This will enable the research to be flexible in the face of fast-changing technology while remaining methodologically rigorous.



Research Approach

The study uses a qualitative approach to analysis. This method allows a thorough examination of theoretical constructs, algorithmic models, and system-level consequences without relying on numerical experimentation. Qualitative analysis is especially appropriate for investigating new technologies where quantitative performance measures are not available or are highly context-dependent.

The manner in which quantum principles (superposition, entanglement and interference) can be converted into computational benefits for sustainability problems is analysed using analytical reasoning. Quantum and classical approaches are contrasted with the help of comparative reasoning in order to outline the spheres of possible improvement and shortcomings.

Nature of the Study

This study is conceptual and analytical. It has no direct data gathering, survey, questionnaires, or experimentation. Rather, it integrates already known concepts in various fields to form a comprehensive picture of the role of quantum computing in sustainability.

The idea behind the research makes it resistant to quick shifts in hardware capabilities and concentrates on the long-term goals of computational principles and sustainability. This stance renders the study appropriate in academic discussion, policy-making, and subsequent empirical generalisation.

Data Sources

The research will be based only on secondary data, which will be credible and authoritative to maintain academic integrity and reliability. These sources include:

- Stable journals in quantum computing, sustainability science, and environmental engineering.
- Conference publications in well-known international conferences.
- These sources include technical reports of research institutions and scientific agencies. White papers of industry and governmental agencies.
- Policy papers on sustainable development and new technologies.
- The credibility, relevance, quality of publication and impact of citation are considered in each source.

Data Collection Strategy

The data collection is based on a review protocol. Relevant literature is found through keyword searching on the topics of quantum computing, sustainability, environmental modelling, energy systems, and optimisation. Selected publications are filtered using title and abstract reviews and analysed in full text.

The data gathered cover conceptual models, algorithm descriptions, application case studies, simulation outputs, and theoretical analyses. This thematic structure enables systematic comparison and synthesis.

Inclusion and Exclusion Criteria

To maintain focus and methodological consistency, explicit inclusion and exclusion criteria are applied.

Inclusion Criteria:

- Literature dealing with principles or algorithms in quantum computing. Research on quantum computing and sustainability or environmental use. • Publications in institutional or academic sources.

Exclusion Criteria:

- Investigations in the domain of quantum hardware engineering without sustainability implications.
- Articles that are not peer-reviewed, or opinion-based articles that lack scientific rigour.
- Duplication of publications of inadequate original contribution.

Conceptual Framework Development

The key element of the methodology is the creation of the conceptual framework that would connect the capabilities of quantum computing with the sustainability issues. The framework acknowledges four main areas of sustainability:

1. Renewable energy systems
2. Climate and environmental modelling.
3. Finding sustainable materials.
4. Supply chain and transportation optimisation.

All domains relate to quantum computational methods, including quantum optimisation, quantum simulation, and quantum machine learning. This framework is utilised as an analytical prism in which conclusions are drawn and generalised.

Analytical Techniques

Various methods of analysis are used to analyse the gathered data:

- Thematic Analysis: Determining common patterns and themes in the studies.
- Comparative Analysis: Comparing the classical and quantum computational approaches.
- System-Level Analysis: Analysis of the effects of sustainability at the macro-system level.
- Feasibility Assessment: Tapping into technical preparedness and implementation limitations.
- Such methods guarantee overall and balanced assessment on technical and sustainability levels.

Hybrid Quantumclassical Evaluation.

Considering today's hardware constraints, the methodology focuses on hybrid quantum-classical models. These systems consist of quantum processors that perform computationally intensive sub-tasks and classical systems that recognise, control, and process data.

The paper assesses the effectiveness of hybrid methods to provide near-term sustainability advantages and as interim solutions to full quantum systems. This assessment is essential to align research output with realistic implementation schedules.

Validation Strategy

Triangulation is used to achieve methodological validity, in which findings are supported in a number of independent sources. Stability of studies is considered a factor of robustness, whereas differences are interpreted to find some contextual or methodological variations.

Systematic documentation of the analytical procedures improves reliability by allowing reproducibility and transparency.

Ethical Considerations

Ethics is incorporated in the methodology. The paper critically analyses the environmental impacts of quantum computing infrastructure, such as energy use and resource use. A possible contradiction with energy-intensive computation is addressed directly.

Issues of social and economic equity are also taken into consideration, especially the risk of asymmetric access to quantum technologies and the concentration of advantages in technologically developed regions.

Sustainability Alignment

The approach is consistent with global sustainability models, as it focuses on long-term environmental advantage, resource efficiency, and responsible innovation. Quantum computing is not considered in isolation but through a larger sustainability ecosystem that includes policy, infrastructure, and participation in society.

The following are some limitations of the methodology.

- The methodology is rigorous, but it has limitations. Empirical validation is limited by the use of secondary data. Evidence based on simulation might not reflect actual operational limitations in the real world. Rapid technological change can impact the persistence of certain discoveries.
- The constraints are recognised openly to put the conclusions in perspective and inform future study.

Expected Research Outcomes

It is anticipated that the methodology will provide:

- Leveraging high-impact sustainability applications of quantum computing.
- Relative knowledge of quantum and classical computational power.
- Real-life opportunities for short-term and long-term implementation.
- Responsible technology implementation policy recommendations.

Contribution to Knowledge

The methodology is useful in academic knowledge since it offers a systematic approach to assessing quantum computing in terms of sustainability. It cuts across disciplinary lines and provides a demonstrable model for subsequent research.

Summary of Methodology

Overall, this type of research combines the process of qualitative analysis, concept modelling, and interdisciplinary synthesis to investigate the applicability of quantum computing to sustainability and environmental systems. The use of theoretical rigour and applicability has enabled the methodology to be a strong area of research development and informed decision-making in this emerging field.

Synthesis of Findings

The findings synthesis combines the knowledge obtained from the literature analysis with the chosen research methodology to display a consistent picture of how quantum computing can be helpful

to addressing highly challenging sustainability and environmental issues. Instead of considering the individual application areas separately, this synthesis takes a cross-cutting look, revealing common computational benefits and common constraints that are observed across the energy systems, computational climate and environmental

modelling, sustainable materials and transport, and supply chain optimisation. The synthesis also relates technological discoveries to broader sustainability goals so that the results of the research can be seen holistically.

One key conclusion from the analysis is that sustainability and environmental issues often have features that do not contradict the advantages of quantum computing. The main characteristics of these challenges include nonlinear dynamics, high-dimensional state spaces, uncertainty, and severe interdependence of variables. In all domains reviewed, classical computational techniques fail mostly because of combinatorial explosion and the large approximations that must be made. Quantum computing, and the conceptual benefit in overcoming these

limitations, is provided by its intrinsic parallelism and capability to represent more complicated probability distributions. This synthesis suggests a strong theoretical fit between the computational capabilities of quantum computers and sustainability issues.

The synthesised findings presented in the context of renewable energy systems demonstrate that quantum computing has the highest potential in optimisation, as opposed to physical implementation or direct control. Research findings consistently indicate that the variability and intermittency of renewable resources like wind and solar present optimisation issues related to grid balancing, storage scheduling, and demand prediction. Quantum optimisation methods are often suggested to be effective in solving such problems, especially when the number of constraints is large and decisions must be made in real time. The synthesis proposes that quantum computing can supplement, but not substitute, classical control systems in the foreseeable future, even though it can significantly help improve the decision-making process.

Creating layers in smart energy infrastructures.

The other interesting conclusion is regarding climate and environmental system simulation. The literature synthesis reveals that the most revolutionary effect of

quantum computing is its ability to enhance model fidelity as opposed to just raising the computing speed. Climate systems are multiscale systems that interact on the molecular level to global atmospheric circulation. The principal physical and chemical interactions that are typically approximated in classical climatic models are most effectively simulated on quantum computers. The synthesis states that partial inclusion of quantum simulations in classical climate modelling systems should have decreased uncertainty in long-term predictions and enhanced knowledge of feedback processes essential to the development of climate policies.

In discussing the synthesis of findings from ecosystem and biodiversity modelling, one should point out the recurrent theme of the appropriateness of quantum methods for network-based and probabilistic representations. Ecosystems are nonlinear emergent adaptive systems. The synthesis indicates that quantum-inspired models are capable of capturing several ecological states at once, and making the exploration of potential system trajectories more holistic.

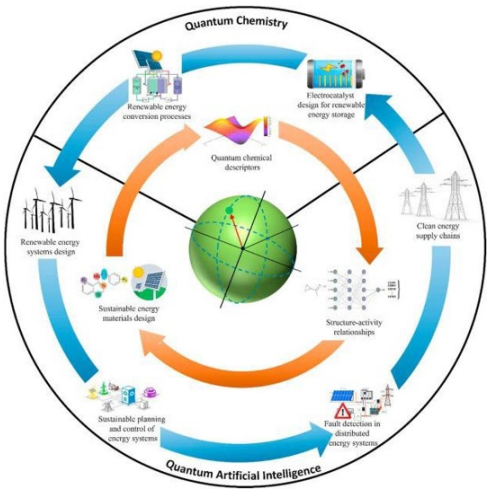
Conservation planning has implications as well, since it can be used to test the effect of a variety of intervention strategies in different environmental conditions. This synthesis therefore makes quantum computing an important analytical resource in ecological risk assessment and resilience analysis.

One of the most developed areas of application in the synthesised findings is sustainable material discovery, which is a promising direction. In the studies reviewed, there is considerable consensus that quantum computing is a natural fit for the needs of molecular and materials simulation. Classical computations have exponential scaling problems in calculating electron interactions, and quantum computers can perform such computations using the same physical laws as electron interactions. The synthesis suggests that quantum simulations can greatly speed up the process of finding materials to store energy, catalyse, and capture carbon. Such speed has positive sustainability impacts downstream, as it shortens the development process, decreases waste during experiments, and allows the deployment of green technologies faster.

The synthesis also highlights a distinct relationship between material discovery and overall sustainability systems. Better battery materials will have a direct effect on the adoption of renewable energy through increased storage capacity and reliability. Modern catalysts lead to cleaner industries and lower emissions of pollutants. Carbon capture materials facilitate mitigation of climate change by targeting the level of carbon in the atmosphere. Thus, the results highlight that quantum-enabled material discovery is a supporting base for various sustainability domains, which increases its overall impact.

The synthesis in transportation and supply chain systems designates the prevalent theme of optimisation. Logistics networks include routing, scheduling, and allocation problems, which scale exponentially with the system size.

The reviewed results consistently indicate that quantum optimisation algorithms can search larger solution spaces more effectively than classical heuristics. Synthesis indicates that potential sustainability benefits include reduced fuel consumption, decreased emissions, decreased waste, and better utilisation of resources. Notably, these advantages are not incremental, but systemic, which means that quantum computing might increase the efficiency of whole supply chains.



It has been shown informally in a cross-domain synthesis that hybrid quantum-classical technologies are the most viable and most competitive route in the near future. Purely quantum

solutions are limited by hardware capabilities, yet hybrid models take advantage of quantum benefits without being affected by classical reliability. Synthesis indicates that these hybrid applications are recurrent in energy optimisation, climate modelling, and logistics applications. This convergence implies a common methodological direction that can be scaled across the field of sustainability to reduce development costs and accelerate uptake. The findings synthesis combines knowledge from the literature analysis with the chosen research methodology to present a consistent picture of how quantum computing can be helpful.

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References

M. Ricciardi Celsi, "Quantum Computing as a Game Changer on the Path towards a Net-Zero Economy: A Review of the Main Challenges in the Energy Domain," *Energies*, vol. 17, no. 5, p. 1039, 2024. DOI: 10.3390/en17051039. [Online]. Available: https://www.mdpi.com/1996-1073/17/5/1039

V. Sood, "Quantum computing: Impact on energy efficiency and sustainable computing," *Expert Systems With Applications*, 2024. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0957417424012673

"Quantum computing in addressing greenhouse gas emissions," *Environmental Science Journal*, 2025. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1110866525000155

D. Root, "Quantum Technologies in the Context of Climate Change," *Wiley Interdisciplinary Reviews: Climate Change*, 2025. [Online]. Available: https://link.springer.com/article/10.1007/s11569-025-00468-x

= Ho, K. T. M., K.-C. Chen, L. Lee, F. Burt, S. Yu and P.-H. Lee, "Quantum Computing for Climate Resilience and Sustainability Challenges," *arXiv preprint*, Jul. 2024. [Online]. Available: https://arxiv.org/abs/2407.16296

S. Dutta, N. Innan, S. Ben Yahia and M. Shafique, "AQ-PINNs: Attention-Enhanced Quantum Physics-Informed Neural Networks for Carbon-Efficient Climate Modeling," *arXiv preprint*, Sep. 2024. [Online]. Available: https://arxiv.org/abs/2409.01626

HP Paudel et al., "Quantum Computing and Simulations for Energy Applications," *ACS Engineering Au*, 2022. DOI: 10.1021/acsengineeringau.1c00033. [Online]. Available:

https://pubs.acs.org/doi/10.1021/acsengineeringau.1c00033

K. Theophilo, "How might quantum computing impact climate change and the wider environment," *Research Directions in Quantum Technologies*, 2025. [Online]. Available: https://www.cambridge.org/core/journals/research-directions-quantum technologies/article/how-might-quantum-computing-impact-climate-change-and-the wider-environment/F9CD813E1864E160914EADD385D780F7

"Opportunities and challenges of quantum computing for climate modeling," *Environmental Data Science*, 2025. [Online]. Available: https://www.cambridge.org/core/journals/environmental-data

science/article/opportunities-and-challenges-of-quantum-computing-for-climate modeling/E6201BB7466B863020039A6D354D6579

"Final Report: Quantum for Climate & Sustainability," *National Science Foundation*, Sep. 2024. [Online]. Available: https://nsf-gov-resources.nsf.gov/files/CS22047-01%20Quantum-Workshop-Report-Current%20-

DP%20_R3_interactive.508%282%29.pdf

"Quantum machine learning early opportunities for the smart grid and renewable forecasting," F. Strata et al., *Frontiers in Quantum Science and Technology*, 2025. DOI:10.3389/frqst.2025.1653104. [Online]. Available: https://www.frontiersin.org/journals/quantum-science-and

technology/articles/10.3389/frqst.2025.1653104/full

"Quantum computing applications for sustainable supply chain," A. R. Jami et al., *Sustainable Computing: Informatics and Systems*, 2025. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S3050607725000273

11
Social Media and Youth Sustainability: A Systematic Review

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Abstract
Media platforms are vital in influencing people's attitudes, beliefs, and behaviours in a society that is becoming increasingly digital, especially among young people. Because social media makes participation and engagement easy, it is a preferred information channel for public and political players. Both political and social mobilisation among citizens can be facilitated by these new media. It is especially crucial for solving environmental problems and accomplishing sustainable development objectives. This review paper focuses on how digital media, influencers, online communities, and peer interactions support ecologically responsible behaviours to investigate how social media might be used to promote sustainable lifestyles among youth. In relation to sustainable consumption, waste reduction, ethical fashion, and climate-friendly activities, the review emphasises how social media platforms support informal learning, social norms, and group action.
Keywords: Social Media, Sustainable, Lifestyle, Youth Engagement, Digital Influence

Introduction
Media platforms are vital in influencing people's views, beliefs, and behaviours in an increasingly digital environment, especially among young people. Social media platforms that have emerged alongside notions of environmental sustainability now represent fertile ground for digital communications technologies to change perceptions and approaches to environmental issues. Sustainable communication approaches and practices are becoming more urgently needed throughout the world due to growing environmental issues, such as climate change, biodiversity loss, and pollution. It is simple to understand how environmental issues have a detrimental impact on people's lives, and rapid climate change has been a hotly debated topic in recent years. Social media has become a major new source of entertainment in users' everyday lives because it contributes to spreading information of primary importance. Sustainability is often used interchangeably with words like "green" and "environment-friendly" (Peattie, 1995). Sustainable tourism is a concept that encourages the utilisation of tourism services while respecting people, tourists, culture, heritage, and the environment (Fien et al., 2010). Other studies have examined the link between public knowledge of climate change and social media. While environmental issues are becoming more known around the world, most previous research on environmental behaviours has been conducted in developed countries. By reducing and regulating the detrimental effects of garbage on ecosystems and natural resources, sustainable waste management techniques are crucial to environmental conservation. These procedures incorporate the appropriate handling of solid waste to guarantee that it is transformed into a resource that supports sustainable growth by offering inexpensive raw materials. According to scholarly studies, social media platforms have a big

impact in raising environmental consciousness. According to research by Lai and To (2015), users' comprehension of sustainability issues improved when they came across environmental material on Facebook and Twitter. According to Anderson's (2017) research, young adults' concern for the environment increased when they saw environmental content on Instagram. According to Hamid et al. (2017), visual-centred platforms such as YouTube and TikTok are suitable for teaching complex environmental information to non-professionals. Environmental degradation, climate change, excessive waste generation, and unsustainable consumption patterns pose serious challenges to global development. Youth, who constitute a significant proportion of the world's population, are both contributors to and victims of these challenges. At the same time, young people are among the most active users of social media platforms such as Instagram, YouTube, Facebook, X (formerly Twitter), and emerging short-video applications. There are many methods to promote a sustainable lifestyle, but in this Review paper I have specifically focused on how waste can be reduced. There are many methods to promote a sustainable lifestyle, but in this Review paper I have specifically focused on how waste can be reduced. The production of waste has no beneficial effects on the climate. Both beneficial and detrimental effects on the climate might result from waste treatment and disposal; priority is given in order to waste minimisation, re-use, recycling, waste-to-energy, and finally landfill (See Fig.1)

Fig. 1 Waste Hierarchy Pyramid
Source - https://nordsense.com/wp-content/uploads/2022/07/The-Waste-Hierarchy.png

For around 40 years, the waste hierarchy principle has been in place. Van Ewijk and Stegemann (2016) claim that the idea was first introduced in the United States by the private company 3M (Overcash, 2002) and in Europe by the Dutch politician Ad Lansink, who put forth the idea in the Dutch Parliament in 1979 (Parto et al., 2007). It is based on the idea of prioritising waste reduction, recycling, and reuse over treatment or disposal. The European WFD defines the waste hierarchy as the priority order of operations to be followed in the management of waste: prevention, preparing for reuse, recycling, other recovery (including energy recovery), and disposal. In 2016, the waste hierarchy was included in the 12th Sustainable Development Goal (SDG) of the 2030 Agenda for Sustainable Development adopted by the 193 United Nations countries (UN, 2016), named "Responsible consumption and production": "by 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse".

Reduction of waste. Reuse and recycling help accomplish post-generation. Developed and underdeveloped countries also have different recycling procedures. For instance, low-tech, poorly controlled paper recycling facilities in impoverished nations may have substantial greenhouse gas emissions, which could lessen the net climate benefit of paper recycling. However, it may be reasonable to expect improvement in facility performance across the globe as standards progress into the future. The informal recycling sector often plays a significant, yet largely unrecognised role in waste management of developing nation cities. For example, Delhi waste pickers collect and recycle 15-20% of the city's MSW (Chintan, 2009).

Rationale of the Study

The growing urgency of environmental challenges such as climate change, resource depletion, and pollution has intensified the need for sustainable consumption and production practices across societies. Waste reduction is one of the most important aspects of sustainability since it minimises material consumption, reduces emissions from production and disposal, and conserves natural resources, all of which directly address the underlying causes of environmental degradation. Young people nowadays are also fully engrossed in digital ecosystems, with social media influencing their everyday decision-making, identities, beliefs, and interpersonal connections. This confluence of youth, digital participation, and environmental urgency offers a strong justification for investigating how social media might serve as a useful tool for encouraging trash reduction. Waste reduction is one of the most important aspects of sustainability because it minimises material consumption, reduces emissions from production and disposal, and conserves natural resources—all of which directly address the underlying causes of environmental degradation. Simultaneously, today's youth are engrossed in digital environments, with social media influencing their identities, morals, interpersonal connections, and everyday choices. This confluence of youth, digital involvement, and environmental urgency offers a strong justification for investigating social media's potential as a useful tool for encouraging waste reduction.

Objectives of the Study

- To examine the impact of social media usage and the promotion of sustainable lifestyles among youth.
- To review the role of social media in encouraging waste reduction practices such as recycling, reuse, minimalism, and zero-waste lifestyles among youth.
- To suggest directions for future research, policy, and practices for effectively using social media as a tool for promoting sustainable waste management among youth.

Literature Review

Influence of Social Media Platforms on Public Awareness

The internet is increasingly being utilised to promote environmental awareness since it allows individuals to comment and contribute rapidly and because of its vast reach and accessibility. Younger generations are becoming more avid users of new media channels. Youths today are tremendously connected to global/local concerns through the internet, especially on Facebook and Twitter. WhatsApp, Facebook, and Twitter are examples of social networking platforms

that have significantly broadened our horizons in terms of global affairs and improved international understanding. Facebook alone has a slew of pages dedicated to environmental awareness and conservation. As a communication tool, new media have become increasingly trendy among various kinds of professions, including professors, teachers, learners, and the general public.

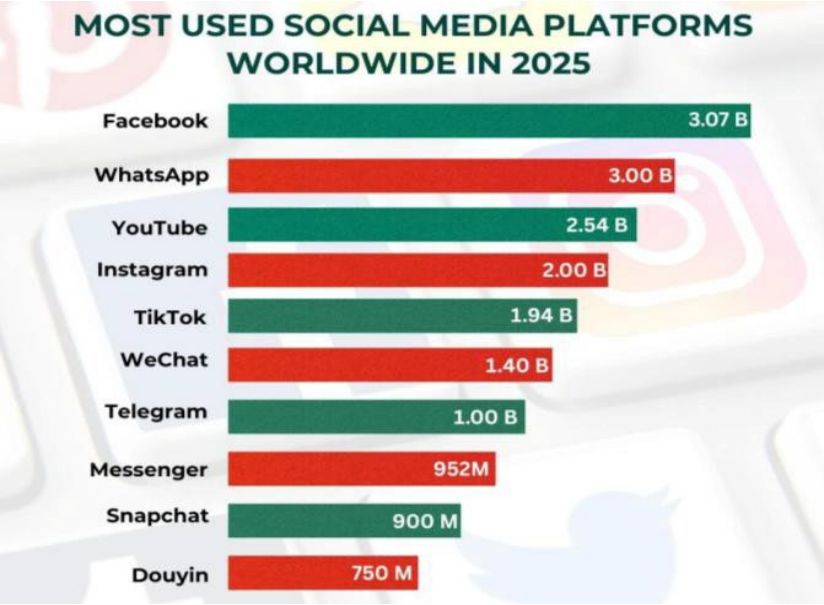

Fig-2 . Most used social media platforms in India in 2025
Source: DataReportal

To support the government's Swachh Bharat drive, local entrepreneurs have created several free apps that help users keep their cities and towns clean across various parts of the country. People from all walks of life have stepped up to join the Swachh Bharat Abhiyan (National Cleanliness Campaign). They are raising awareness through social media by shooting photos and videos of places afflicted by inadequate sanitation and uploading them to various social media sites like Facebook, Twitter, and WhatsApp, where they are shared with a large number of people.

Influence and Exposure Through Social Media on Youth

Some social media awareness campaigns have gone viral and reached millions of youths. With a rapidly growing population and increasing urbanisation, waste management has become a critical challenge for India. Social media sites like Instagram, YouTube, TikTok, and Twitter are now essential in influencing public opinion, particularly among young people.

These websites are useful tools for education and advocacy, not just for entertainment. One of their key roles is to educate youth about sustainable lifestyles. When influencers, environmental activists, and even ordinary people share content about eco-friendly practices, ethical fashion, and zero-waste living, complex environmental issues become more approachable and realistic. Digital media promotes transparency through brand accountability and user reviews. Social media users frequently uncover greenwashing, discuss their experiences with products and services, and highlight businesses that genuinely adhere to ethical and environmental standards.

Influencers and Content Creators' Roles

Influencers have a significant impact on how young people behave, especially when it comes to promoting environmentally friendly shopping. Because of their wide audience and relatable content, several eco-conscious creators have emerged as significant figures in promoting environmental stewardship. By encouraging minimalism and ethical consumption, these influencers persuade their followers to choose quality over quantity and to reevaluate their purchasing habits. Influencers frequently collaborate with eco-friendly companies to promote ethical goods. They connect their viewers to eco-friendly substitutes like reusable items, organic skincare products, or ethically made clothes through sponsored content and frank evaluations. Because their followers frequently regard them as genuine and reliable, their recommendations are significant. Their programming, which includes zero-waste shopping recommendations and composting instructions, encourages young people to take modest but significant steps toward sustainability.

Table No. 1: Major Government Initiatives and Policies for Waste Management in India (2014- 2018)

Initiative / Policy	Year of Launch	Primary Objectives	Key Focus Areas
Swachh Bharat Mission	2014	To achieve universal sanitation coverage, eliminate open defecation, and improve cleanliness standards across urban and rural India.	Construction of household and community toilets, behavioural change through awareness campaigns, source segregation of waste, and adoption of scientific waste processing technologies.
Solid Waste Management (SWM) Rules	2016	To establish a comprehensive legal and institutional framework for the management of municipal solid waste.	Defined responsibilities for waste generators, local bodies, and waste processors; mandatory segregation into biodegradable, recyclable, and inert waste; emphasis on scientific treatment and disposal.
Plastic Waste Management Rules	2016 (Amended in 2022)	To minimize plastic pollution and promote responsible plastic production, use, and disposal.	Extended Producer Responsibility (EPR), regulation of plastic packaging, recycling targets, and a nationwide ban on identified single-use plastic items.

Initiative / Policy	Year of Launch	Primary Objectives	Key Focus Areas
Waste-to-Energy (WTE) Projects	Ongoing (Policy support post 2015)	To reduce landfill dependency by converting waste into usable forms of energy	Generation of electricity, bio-CNG, and compost from municipal solid waste using advanced waste processing technologies.
GOBAR-Dhan Scheme	2018	To promote the conversion of organic waste into wealth-generating resources such as biogas and organic manure.	Utilisation of cattle dung, agricultural residues, and biodegradable waste; establishment of biogas and bio-CNG plants in rural areas.

The Solid Waste Management

The pace at which municipal solid trash is generated in developing nations has significantly increased due to factors such as population growth, economic expansion, fast urbanisation, and improvements in community living standards (Minghua et al., 2009). Municipalities, which are often responsible for managing garbage in urban areas, face the difficulty of offering residents an efficient and successful system. However, they frequently deal with issues that the local authority is unable to handle (Sujauddin et al., 2008), mostly because of a lack of funding, structure, complexity, and multidimensionality of the System (Burntley, 2007).

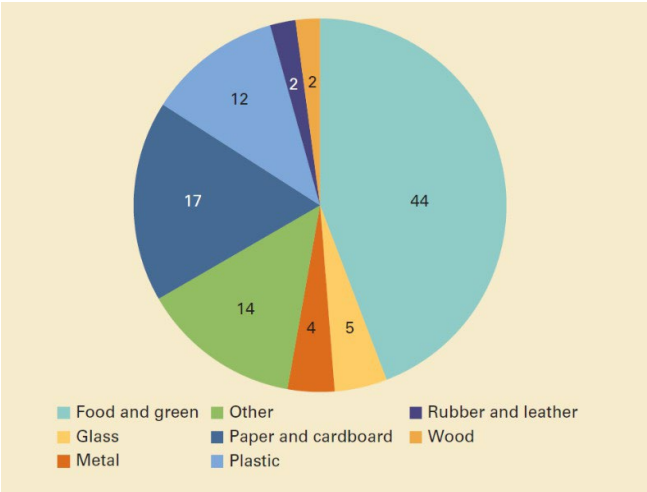

Fig. 3- Global waste composition (per cent)

Source- https://datatopics.worldbank.org/what-a waste/img/v2_global_waste_composition.png

The graphical distribution in Fig. 3 of waste materials provides important insights into the nature of solid waste generation. The chart reveals that food and green waste form the largest component of the total waste stream, contributing 44%. This predominant percentage shows that a sizable amount of waste comes from biodegradable sources such as garden waste, vegetable peels, and kitchen leftovers. The large percentage of organic waste emphasises the potential of bio-waste treatment and composting as efficient waste reduction techniques. Paper

and cardboard make up 17% of all waste, making them the second-largest category. This illustrates how commonplace paper-based materials are in everyday tasks, such as packing. Paper and cardboard make up the second-largest group, accounting for 17% of all garbage. This
illustrates how paper-based products are widely used in everyday tasks like packing, instruction, and communication. Because cardboard and paper are recyclable, their high presence in the waste stream indicates that better segregation techniques could greatly increase recycling results.

Twelve per cent of all waste is made up of plastic waste. Plastic is still an issue for the environment because of its persistence and low biodegradability, even if it is smaller than organic and paper waste. Significant amounts of plastic highlight the need for a shift in behaviour, a decrease in reliance on single-use plastics, and a greater understanding of sustainable alternatives. The prevalence of mixed or miscellaneous goods that are frequently challenging to categorise or recycle is indicated by the category of other waste materials, which accounts for 14% of the total. This section highlights the need for improved waste management education and illustrates inefficiencies in garbage sorting at the source. Glass waste (5%) and metal waste (4%) have smaller percentages. Despite making up a smaller portion of the overall volume, these materials have a high recycling value and, with proper collection and processing, can be successfully reintegrated into production cycles. Wood (2%) and rubber and leather (2%) are the least prevalent waste categories, indicating either low production or restricted use of these materials in the waste stream under observation. Overall, the distribution shows that recyclable and biodegradable materials account for the majority of trash production, suggesting significant opportunity for waste reduction through recycling, composting, and better sorting techniques. The results highlight how crucial it is to implement sustainable waste management strategies at the home and community levels to reduce environmental effects and promote the ideas of the circular economy.

Methods of Solid Waste Management

Solid waste management involves collecting rubbish from specific neighbourhood locations and transporting it in vans to tipping locations. After that, each sort of material is separated, processed, and disposed of. Solids may be taken for landfill disposal, while toxic materials may be burned, treated, recycled, and finally disposed of. Danbuzu (2011) discusses several methods of disposing of waste and divides them into four groups: burial, recycling, controlled tipping, and burning.

Burial Method- This method involves the metaphorical burial of waste, as well as the burying of unwanted objects such as broken bottles, potsherds, or hygienic landfill composting.

This practice has a negative effect on human health. For example, nobody wants a rubbish burial site close by because of their detrimental effects. After organic material is buried, leachate may be created, which often contaminates boreholes, wells, and aquifers. The hole excavated on the property will not yield any transportable water for human consumption. It is well known that when organic material is buried, heat is produced, which results in the creation of biogas, or methane.

Burning Method - The average Nigerian produces 0.45 grams of garbage each day, according to some estimates. The previously mentioned waste disposal standards have an impact on the waste vanes' content and quality. The primary component is organic matter, which accounts for 60–80% of the total waste. Although incineration is a common method of disposing of waste, it has disadvantages since it is merely a means to an end rather than the end in and of itself. By setting it on fire, the garbage gets burned. Fire is produced when low heat and oxygen are mixed.

Controlled Tipping (Sanitary Landfill)- By dispersing solid waste in thin layers, compacting it to the lowest particle volume feasible, and covering it with soil every working day, sanitary landfills are made to dispose of solid waste on land in a way that protects the environment. A sanitary landfill is the most efficient way to dispose of waste because it leaves no residue and transforms a wasted piece of land into something useful.

Recycling method-Other pulverisation, composting, and incineration byproducts may be deemed recycled or salvaged if they are utilised for one or more uses. The components that have a market and are found in large enough amounts in the waste to justify their separation are the ones that are more recoverable. Ferrous metals, aluminium, paper, cardboard, plastic, glass, and other nonferrous metals have all been recovered from solid waste. Among the companies that use waste are paper mills, cardboard factories, steel rolling mills, aluminium factories, and plastic factories.

Barriers and Challenges

Although there are many advantages to using sustainable waste management techniques, there are also a number of obstacles and difficulties in their general acceptance. The shift to more sustainable waste management methods may be hampered by a lack of infrastructure, financial limitations, social opposition, etc. Furthermore, several studies have shown that the complexity of waste streams and the need for stakeholder cooperation pose significant obstacles. Environmental conservation is greatly impacted by sustainable waste management techniques, which can be greatly impacted by a number of challenges. Numerous studies highlight these difficulties and obstacles, illuminating the constraints and complexities encountered by various sustainable waste management programs.

Lack of Infrastructure: Well-developed and efficient infrastructure is necessary for composting plants, recycling facilities, waste-to-energy facilities, and other sustainable waste management solutions. Regrettably, the main barrier to the successful implementation of sustainable waste management strategies is usually the lack of such infrastructure.

Financial limitations: According to a number of studies, adopting sustainable waste management practices requires significant upfront expenditures. This financial challenge is one of the barriers to the adoption of ecologically friendly waste management systems. **Social opposition and behaviour change:** Another major obstacle to altering the disposal of waste is motivating individuals and different communities to embrace sustainable techniques. A recent study has highlighted the need to remove behavioural obstacles and increase knowledge in order to encourage positive changes.

Inadequate Regulation and Enforcement: Inadequate waste management regulations or slack enforcement can lead to improper garbage disposal and illegal dumping. It has been

discovered that establishing and upholding strict waste management laws is essential to promoting sustainable practices.

Limited Market Demand for Recycled Products: One of the main reasons recycling is successful is the market's desire for recycled materials. Research indicates that promoting the use of recycled products and raising customer demand are crucial for sustainable waste management.

Technological Restrictions: In certain places, a lack of access to state-of-the-art waste management technologies may hinder the adoption of more sustainable practices. Research shows that to overcome these limitations; technological developments are essential.

Myths and Misconceptions: Advancement may be hampered by false information or misconceptions about waste management strategies. Educating the public about the benefits of sustainable alternatives and the detrimental effects improper rubbish disposal have on the environment is necessary to promote behavioural change.

Lack of Public Education and Awareness: People who are unaware of the importance of sustainable waste management practices may become apathetic or indifferent. Studies underscore the significance of educational initiatives and public awareness campaigns in promoting sustainable waste management. Despite these challenges, proactive measures by governments, businesses, communities, and individuals can help develop sustainable waste management practices. By addressing these problems, society can significantly increase waste management's contribution to environmental protection and a more sustainable future.

Social Media Campaigns Targeting Plastic Waste Reduction

Social media has emerged as a powerful catalyst for young people to transform environmental consciousness into sustainable action. In 2024, Ananda Jirasit carried out the research titled "The Impact of Social Media Campaigns on Reducing Plastic Waste in Thailand's Coastal Areas." In order to lessen plastic waste in Thailand's coastal regions, the study concentrated on how social media campaigns impact public attitudes and behaviour. This systematic study examines how social media has altered public perceptions about plastic pollution and its consequences on the environment by comparing behaviour and awareness before and after major campaigns. Millions of tourists go to beaches like those in Phuket, Pattaya, Krabi, and other coastal areas each year, creating a major problem with plastic waste. In recent years, social media sites like Facebook, Instagram, Snapchat, Instagram Threads, and Twitter X have emerged as vital resources for environmental campaigning due to their ability to increase awareness, engage young people, spur action, and influence change. Significant amounts of plastic garbage wind up in the ocean, aggravating environmental degradation and posing a serious threat to marine life because the waste generated through these locations often surpasses the capacity of local waste treatment systems. When used properly, it can significantly contribute to sustainable development and environmental conservation. These campaigns have not only raised awareness but also actively pushed people to adopt more eco-friendly practices, which has led to significant reductions in single-use plastics, an increase in participation in recycling programs, and an increase in neighbourhood-based cleanup efforts. One of the most prominent trends is the public's declining usage of single-use plastics. Campaigns like #NoMorePlastic and #BeatPlasticPollution encourage people to make small, manageable

changes to reduce their plastic footprint. Because of this, an increasing number of people are using these alternatives in their daily lives, which is contributing to a more substantial change in the direction of sustainability. Recycling habits have also improved as a result of social media activism.

Conclusions

The review's conclusions show that social media has a big, multifaceted impact on young people's sustainable living choices, especially when it comes to waste reduction. Young people were consistently shown to be active consumers and distributors of environmental information on social media sites like Facebook, Instagram, YouTube, X (Twitter), and new short-video apps across the evaluated literature. It has been discovered that exposure to sustainability related content on these platforms increases environmental consciousness, concern, and individual accountability, particularly with regard to waste reduction, recycling, and decreased plastic usage.

The effectiveness of interactive and visual content in conveying waste-related information is one of the review's most notable findings. It has been demonstrated that platforms that prioritize graphics and videos can make difficult environmental issues easier for non-experts to understand. Higher levels of comprehension and engagement were shown by young people who often came across postings, reels, and brief videos about recycling, composting, zero waste lifestyles, and waste segregation. This lends credence to the idea that social media-based informal learning enhances formal environmental education by converting abstract sustainability objectives into practical, everyday actions.

The review also emphasises how online communities, peer networks, and influencers help normalise sustainable habits. By portraying trash reduction as socially desirable and attainable, influencers who support ethical consumption, minimalism, and plastic-free alternatives have been shown to have a major impact on young people's views. Positive social norms surrounding waste reduction were further reinforced by peer interactions, such as discussing individual sustainability journeys or taking part in online challenges. Individual activities become collective movements as a result of these digital contacts.

The connection between social media marketing and behavioural change is another important finding. Initiatives to reduce plastic waste, cleanliness campaigns, and recycling programs showed quantifiable increases in public involvement. Youth were encouraged to adopt reusable products, steer clear of single-use plastics, and take part in community cleanup events by hashtag-based campaigns and user-generated content. Social media has been shown to effectively support national initiatives like the Swachh Bharat Mission in India by allowing users to share local success stories, report sanitation issues, and encourage civic duty.

The review's analysis of national and international trash data further highlights the significance of these conclusions. The results highlight the potential of youth-led waste reduction initiatives, with organic waste accounting for the largest share of worldwide waste composition, followed by paper, plastic, and other recyclable materials. Young consumers' adoption of sustainable consumption behaviours was linked to increased awareness of waste hierarchy concepts, such as prevention, reuse, and recycling.

The analysis also identifies differences in waste management strategies across developed and developing regions. Informal recycling industries are vital but often overlooked in poor nations. It was discovered that social media platforms helped close the gap between policy frameworks and practical applications by giving these unofficial players attention. This visibility promotes inclusive approaches to sustainable waste management and helps waste pickers gain more public prominence. Overall, the findings imply that social media serves as a catalyst for behavioural change in addition to serving as a route for information. Social media greatly aids in encouraging waste reduction and sustainable lifestyles among young people by influencing attitudes, upholding social standards, and facilitating group participation.

Suggestions

Based on the review's findings, a number of recommendations can be made to improve social media's ability to encourage young people to lead sustainable lifestyles and reduce waste. First, creating platform-specific sustainable content needs more attention. Policymakers, educators, and environmental organisations should prioritise short films, infographics, and interactive formats that clearly illustrate waste reduction techniques like composting, reuse, and source segregation because visual-centric platforms have proven very effective. Long-term engagement and comprehension can be enhanced by simplifying technical material without sacrificing accuracy.

Second, it is important to actively promote partnerships with social media influencers. Influencers who are already well-known among young people can serve as ambassadors for sustainability by incorporating messages about waste reduction into their frequent posts.

Nonetheless, sincerity ought to take precedence over marketing messaging. Influencers who truly engage in sustainable practices are more likely to inspire imitation and trust. Transparent collaborations between digital producers and environmental organisations can help prevent misinformation and ensure adherence to sustainability objectives.

Third, educational establishments want to incorporate social media-based learning into their environmental education initiatives. Universities and colleges can encourage students to take part in digital campaigns, produce sustainability-focused content, and evaluate online environmental narratives. This strategy would empower young people to become active contributors rather than passive consumers of sustainability information, while also improving digital literacy.

Fourth, government organisations ought to use social media much more to promote waste management programs and policies. Interactive reporting systems, feedback channels, and acknowledging citizen participation are ways to improve current initiatives like the Swachh Bharat Mission. Showcasing regional achievements and neighbourhood-based projects can encourage greater involvement and a sense of shared accountability. To promote inclusive and socially equitable sustainability communication, special attention should be paid to elevating the voices of informal trash workers.

Fifth, to better understand the long-term behavioural effects of social media exposure, future research should use multidisciplinary and mixed-method approaches. Even while current research shows that pro-environmental behaviour and internet participation are positively correlated, further long-term studies are required to determine whether these behaviours persist

over time. Finding region-specific tactics for successful digital sustainability communication would also be aided by comparative research across various cultural and socioeconomic contexts.

Sixth, algorithmic visibility and specialised features should motivate platform developers to assist sustainability projects. The beneficial effects of social media ecosystems on the environment can be increased by promoting reliable environmental material, limiting the dissemination of false information, and offering resources for community mobilisation. Features like community forums, challenges, or sustainability badges could encourage youth involvement even further.

Lastly, it is important to acknowledge young people as co-creators of long-lasting change. Social media can become an active platform for environmental action by promoting peer-to-peer learning, digital storytelling, and grassroots involvement. Social media may significantly contribute to the advancement of waste reduction and sustainable development objectives by coordinating digital interaction with practical activities.

References

Abdul−Muhmin, A. G. 2007. "Explaining Consumers' Willingness to beEnvironmentally Friendly," International Journal of Consumer Studies (31:3), pp.237−247. • Ames, M. and Naaman, M. (2007), "Why we tag: motivations for annotation in mobile and online media", Proc SIGCHI Conference Human factors Computer System, No. 1, pp. 971 980, doi: 10. 1145/1240624.1240772.

Ashton, W., M. Chertow, and M. Shenoy (2009). Industrial Ecology – Developing Systemic Solutions to Climate Change and other Environmental Challenges in Indian Industry. Sustainability Tomorrow, October-December 2009.

Ayeh, J.K. (2015), "Travellers' acceptance of consumer-generated media: an integrated model of technology acceptance and source credibility theories", Computers in Human Behavior, Vol. 48, pp. 173-180

Bach, J. and Stark, D. (2004), "Link, search, interact the co-evolution of NGOs and interactive technology", Theory, Culture and Society, Vol. 21 No. 3, pp. 101-117.

Barnes, S., & Milne, K., (2020). Social media as a tool for environmental activism: A case study of plastic waste reduction campaigns. Journal of Environmental Communication, 14(3), 215-232.

Carfagna, L. B., et al. (2014). The Myth of the Ethical Consumer. Journal of Consumer Research, 41(6), 1336–1354.

Dhiman, A. K. (2017). Environment Awareness through Social Media. ICCLIS'17, pp.45-49. • Dhir, A., et al. (2021). Sustainable consumption from the lens of social media: A systematic literature review. Sustainable Production and Consumption, 27, 1149–1167. • Driscoll, A.W., Conant, R.T., Marston, L.T., Choi, E. and Mueller, N.D. (2024), "Greenhouse gas emissions from US irrigation pumping and implications for climate-smart irrigation policy", Nature Communications, Vol. 15 No. 1, p. 675.

Fashion Revolution. (2024). Fashion Transparency Index Report. Retrieved from https://www.fashionrevolution.org

Gazzola, P., et al. (2020). The role of digital media in supporting circular economy and sustainability: A case study approach. Sustainability, 12(12), 4940.

Huun, K. Waste and its Contribution to Climate Change. In Environmental Centre; University of Colorado Boulder: Boulder, CO, USA, 2020.

Jharotia, Anil Kumar (2017). The Role of Social Media in Libraries, ICCRMEMC'17, pp.56-

59.

Jharotia. Role of Media in Enhancement of Environmental Awareness. At Conference Power of Media: Shaping the Future, at Tecnia Auditorium, New Delhi; 2018.Available:https://www.researchgate.net/publication/323751233_Role_of_Media_i n_E enhancement of_Environmental_Awareness

Kaza, S.; Yao, L.; Bhada-Tata, P.; Van Woerden, F. What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development; World Bank Publication: Washington, DC, USA, 2018.

Khan, A. (2016). Media's Support in Promoting Environment Awareness. IJSRE, 4 (8), pp.5588-5595.

Kotler, P., & Keller, K. L. (2016). Marketing Management (15th ed.). Pearson. • Kritsanavarin, N. (2021). Trash Hero Thailand: A grassroots approach to tackling plastic pollution. Environmental Research Letters, 16(7), 074017.

Moura, M.R.; Falcão, S.M.; daSilva, A.C.; Neto, A.R.; Montenegro, S.M.G.L.; da Silva, S.R. Developing a plastic waste management program: From river basins to urban beaches (case study). J. Eng. Technol. Sci. 2020, 52, 108–120. [CrossRef]

Muheirwe, F.; Kombe, J.W.; Kihila, M.J. Correction to: Solid Waste Collection in the Informal Settlements of African Cities: A Regulatory Dilemma for Actor's Participation and Collaboration in Kampala; Urban Forum: Abu Dhabi, United Arab Emirates, 2024; Volume 35, p. 23.

Nayak S., Budhwar P, Pereira V, Malik A. Exploring the dark-side of E-HRM: A study of social networking sites and deviant workplace behaviour. International Journal of Manpower. 2022; 43(1):89-115.

Nguyen, D. T., & Tran, H. L., (2019). The impact of influencer marketing on plastic waste reduction: A social media analysis in Southeast Asia. Social Media & Society, 5(4), 133-148. •Prakash, Vidyut. (2015). Role of Media in Environmental Awareness. Vidyutprakash.blog.com. April 18, 2015.

Sallwey, J.; Hettiarachchi, H.; Hülsmann, S. Challenges and Opportunities in Municipal Solid Waste Management in MOZAMBIQUE: A Review in the Light of Nexus Thinking; AIMS Environmental Science: Springfield, MO, USA, 2017; pp. 621–639.

Sharma K. Online communities play an influential role in creating environmental awareness; 2021. https://www.pinkvilla.com/tech/news/how-social-media platforms-are becoming-one-of-the-popular-forms-of communication-for-environmental-activism 904163 •

Sharma T. Effective Use of Media towards Swachh Bharat Abhiyan (SBA): A Study about Chhattisgarh State.Journal of Information and Computational Science. 2019;9(8):336-341. http://www.joics.org/gallery/ics 1241.pdf

Singh, A., & Gupta, K. (2020). Impact of digital marketing on consumer behavior among millennials: A study in the Indian context. Journal of Digital Marketing, 2(1), 20–30. •Sørensen, E. B., & Larsen, V. (2021). Youth and ethical consumption: How digital tools create new forms of activism. Journal of Consumer Culture, 21(2), 261–279.

Spano, A. How Do We Measure Public Value? From Theory to Practice. In Public Value Management, Public Value Management, Measurement and Reporting; Emerald Publishing Limited: Leeds, UK, 2014.

United Nations Environment Programme (UNEP). (2020). Youth and Sustainable Consumption: Empowering Youth for Sustainable Lifestyles.

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Artificial Intelligence, Educational Access, and the Politics of Displacement: Structural Inequalities in Mobile Learning Contexts

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Abstract
The rapid proliferation of artificial intelligence within educational systems has generated considerable enthusiasm regarding its capacity to democratise learning, personalise instruction, and enhance administrative efficiency. Such optimistic narratives, however, frequently rest upon problematic assumptions: stable educational trajectories, continuous institutional membership, standardised learner profiles, and uninterrupted access to technological infrastructure. These assumptions collapse when examined against the lived realities of displaced populations—refugees, internally displaced persons, and migrants—whose educational experiences are fundamentally shaped by mobility, legal precarity, linguistic marginalisation, and fractured relationships with state institutions. This paper undertakes a critical examination of the intersections between artificial intelligence, education, and displacement, arguing that technological interventions designed without sensitivity to these structural conditions risk deepening rather than ameliorating educational inequalities. Drawing upon interdisciplinary scholarship from the sociology of education, forced migration studies, and critical technology research, this analysis situates AI-enabled educational initiatives within their broader historical, political, and institutional contexts. Particular attention is devoted to the Indian subcontinent, where diverse displaced populations navigate complex educational landscapes alongside the expanding reach of digital governance systems. The paper incorporates empirical insights derived from long-term sociological research on Tibetan refugees in India (Mishra, 2014), demonstrating significant intra-group heterogeneity in educational trajectories shaped by migration histories, institutional cultures, language regimes, and collective identity projects in exile. This analysis reveals that education in displacement contexts serves multiple social functions extending well beyond skills acquisition—including cultural preservation, identity formation, intergenerational transmission of historical memory, and the articulation of future-oriented political aspirations. The paper concludes by advancing a framework for AI-enabled educational governance that foregrounds contextual sensitivity, participatory design, equity orientation, and the preservation of human judgement in high-stakes educational decisions.
Keywords: Artificial intelligence; education; displacement; refugees; internally displaced persons; migration; sociology of education; digital inequality; algorithmic governance; India; cultural capital

Introduction: Situating AI In The Educational Governance Of Displacement

On a recent Tuesday morning, I came across three newspaper stories that sat uncomfortably alongside one another. The first, from the Times of India's Parenting supplement, asked whether AI was becoming 'the third parent' — a benevolent presence filling emotional and academic gaps for children whose busy parents could not keep up (Times of India, February 2026a). The second, from the same paper's Special edition, reported on research showing that large language models consistently assign high-status jobs to upper-caste names and mental labour to those associated with Dalit and Adivasi identities — a bias, researchers noted, that is particularly alarming given India's ambitions to host the AI Impact Summit (Times of India, February 2026b). The third was an op-ed by the Ukrainian envoy, marking the fourth anniversary of Russia's invasion: 'Our kids growing up without heat and stable schooling, displaced from their homes, will never forget' (Times of India, February 2026c). Three stories, three worlds. And yet the educational technology discourse in India — and globally — tends to address only the first.

This paper begins from the premise that these three stories belong together — and that the educational technology world has not yet understood why. We are living through two simultaneous global developments. First, AI is being built into educational systems at speed, promising personalised instruction, automated assessment, and administrative efficiency (Knox, 2020; McConvey & Guha, 2024). Second, forced displacement has reached a scale without modern precedent — over 117 million people currently uprooted by conflict, persecution, climate change, or development projects (Global Partnership for Education, 2024). Put these two developments together and the questions become urgent: what happens when AI systems designed for settled, documented, institutionally continuous learners encounter the realities of displacement? The scholarship has not kept up.

My central argument is this. AI in education can be useful — I am not arguing otherwise. But the risks are real and underacknowledged. When AI systems are deployed without serious attention to who is missing from their training data, whose documentation they assume, and whose educational goals they project, they do not simply fail to help displaced learners. They actively reproduce existing inequalities in a new technical form. The problem is not the technology itself. It is the set of assumptions baked into how the technology is built and for whom.

These are not abstract concerns. When an algorithm determines a child's learning level, sets their educational pathway, or flags them as at risk — and when that child is a refugee, an internally displaced person, a seasonal migrant — the stakes are concrete. Educational access for such children means far more than skills. It means psychosocial recovery. It means social belonging. In many cases it means cultural survival. Getting the governance of AI wrong in these contexts does not merely inconvenience — it forecloses.

I bring to this analysis three overlapping vantage points. The first is a research programme on Tibetan refugees — and, at M.Phil level, on Afghan and Tibetan refugee children comparatively — conducted over nearly three decades, including extended ethnographic fieldwork documented in my earlier monograph (Mishra, 2014) and continued through subsequent research and consultancy. The second is a formation in refugee protection spanning formal legal training in international humanitarian and refugee law (Indian Society of International

Law, 2001, supported by UNHCR and ICRC), an internship in UNHCR's Community Services and Protection Unit in New Delhi (2001), and over a year of professional work as Consultant and Social Worker at the Socio-Legal Information Centre (SLIC), New Delhi — an implementing partner of UNHCR (2002–03) — working directly with refugee communities on protection and socio-legal matters while simultaneously conducting M.Phil research. The third is close familiarity with India's evolving digital governance landscape — Aadhaar, the CAA, the NRC, the NEP 2020 — where the promises and failures of technology-led inclusion are visible in daily life and in the scholarly literature. I hope this combination of perspectives produces an analysis that is at once theoretically grounded and practically useful.

The paper moves as follows. Section 2 builds the theoretical framework — Bourdieu, Malkki, and critical technology scholarship. Section 3 provides the Indian policy and legal context: the Foreigners Act, the CAA, the NRC, the RTE Act, Aadhaar. Section 4 reviews the AI-in-education literature and names its blind spots. Section 5 looks at emerging practice globally and in India. Sections 6 and 7 address internal displacement and the governance politics of educational AI. Section 8 is the empirical core — my fieldwork with Tibetan refugees. Sections 9 and 10 draw out implications for design and press on the limits of automation. Section 11 offers policy directions. Section 12 concludes.

Theoretical Framework: Capital, Displacement, and Algorithmic Power

Three bodies of scholarship frame the analysis that follows. The first is Bourdieu's sociology of education, particularly his account of how cultural capital circulates unequally through institutions. The second is critical work on displacement and refugee studies, which insists on understanding forced migration as a structural condition rather than an exceptional one. The third draws on critical technology scholarship, asking what it means when AI becomes a mode of governance rather than merely a tool. None of these frameworks, taken alone, is sufficient. Together they let us ask the right questions.

Cultural Capital and Educational Inequality

Bourdieu's account of cultural capital remains indispensable for thinking about educational inequality. Capital, in his framework, takes three forms: embodied (the linguistic dispositions, aesthetic judgements, and taken-for-granted competencies we carry in our bodies); objectified (cultural goods — books, instruments, art); and institutionalised (credentials, qualifications recognised by official bodies). What schools do, in Bourdieu's analysis, is not neutrally measure merit. They measure how well a student's accumulated capital matches what the institution already recognises as legitimate (Bourdieu, 1986; Bourdieu & Passeron, 1990). This is a consequential difference.

For displaced people, this is not an abstraction. When you cross a border — or an internal administrative boundary — the cultural capital you have accumulated may simply not translate. Your credentials may go unrecognised. The languages you speak may mark you as foreign rather than competent. The cultural knowledge that earned respect in one setting becomes invisible or illegible in another (Erel, 2010). The school or the platform then encounters what looks like underperformance. It is not underperformance. It is a structural mismatch between accumulated capital and institutional expectation.

This is precisely where AI systems create a new problem. An adaptive learning algorithm trained on data from mainstream educational settings will encode particular forms of cultural capital as normal. The student whose competencies look different — whose literacy was built in a different script, whose analytical style reflects a different pedagogical tradition — will be measured against a standard that does not fit them. The result is not a neutral assessment. It is a bias embedded in architecture. Recent empirical work confirms that algorithmic systems in education do exactly this: they reproduce and amplify existing disadvantages, doing so through processes that appear technical and therefore objective (Baker & Hawn, 2021; Gándara et al., 2024).

Displacement as Structure, Not Exception

Liisa Malkki's (1995) critique of the 'national order of things' remains one of the most important interventions in refugee studies. Her argument was simple and devastating: when scholars and policymakers treat refugees as persons out of place — anomalies in a world that should be organised by matching people to national territories — they obscure the political processes that produce displacement in the first place. Displacement is not an exception to normal life. It is produced by the same states and political economies that claim to be normal.

When you extend this argument to education, something important follows. Displaced learners are routinely positioned as exceptions to systems designed for someone else — beneficiaries of emergency programmes, problems to be managed, populations requiring special modules rather than full institutional inclusion. AI systems replicate this logic when they are designed for 'normal' learners and then retrofitted for displaced populations. The displacement is treated as a technical problem. In fact, it is a political one, and no technical fix will substitute for addressing it at that level.

What fieldwork teaches — and I have learned this over three decades of research — is that 'refugee' and 'IDP' are homogenising categories that conceal enormous internal variation. Class, gender, prior educational attainment, migration route, legal status, length of displacement, language, age: all of these interact to produce educational experiences that differ radically from one person to the next (Dryden-Peterson, 2011). I return to this at length in Section 8, drawing on my own fieldwork. The point here is that any AI system designed around a generic 'displaced learner' profile will fail most of the actual people it is supposed to serve.

South Asian scholarship on displacement has produced some of the most rigorous structural analysis in this domain. Ranabir Samaddar's edited volume on refugees and the state — spanning 1947 to 2000 — documents something that remains true: India's hospitality to displaced populations has always been simultaneously generous and controlling (Samaddar, 2003). The state extends welcome and exercises power over those it welcomes. His later work situates this within broader patterns of transborder movement, labour migration, and statelessness that have defined the subcontinent since Partition (Samaddar, 2020). Paula Banerjee's work on internal displacement and gendered border existences is equally necessary — it makes visible the compound vulnerabilities that women and girls in displacement face at the intersection of mobility, patriarchy, and state indifference (Banerjee, 2005; 2010). Neither framework is optional for anyone working on AI and education in India. Without them, the analysis is borrowed rather than grounded.

Algorithmic Governance, Caste, and Digital Exclusion

The third pillar draws on critical technology studies. Noble (2018) and Benjamin (2019) have made the core argument convincingly: AI systems are not neutral tools. They are forms of governance. They make decisions — or structure the conditions under which decisions are made. And they encode values: in the data selected for training, in the features engineered, in what counts as success, in what gets flagged as risk. These choices are made by humans, reflect existing social arrangements, and carry consequences for the people the systems touch.

The India-specific finding I find hardest to set aside concerns caste. Research published in early 2026 tested what happens when large language models — GPT-4o, GPT-3.5, LLaMA variants — are asked to assign jobs to people with different names (Times of India, February 2026b). The results were consistent across models: upper-caste names received high-status, knowledge-economy roles. Dalit and Shudra names were directed toward manual and service work. The researchers called this stereotype reinforcement at a structural level. For this paper, that finding is not peripheral — it is central. If the language models underpinning educational AI in India encode caste hierarchies as their default, then deploying those systems in schools serving displaced, Dalit, or Adivasi children is not democratisation. It is discrimination in a new technical form.

Displaced populations face compounded risks from algorithmic governance. Their data is scarce and fragmented — they are underrepresented in training sets, so models perform worse for them (Gándara et al., 2024). Documentation gaps mean exclusion from systems requiring verified identities. Educational histories interrupted by displacement get misread as evidence of low ability rather than structural circumstance. Aadhaar — India's massive digital identity programme — shows the pattern clearly: intended to include, it has produced a well-documented set of exclusion errors for people whose biometrics fail, whose documents don't match, whose addresses are not fixed (Panigrahi, 2021; Khera, 2019).

Intersectionality and Compound Marginalisation

Intersectionality matters throughout this analysis. Displacement does not arrive alone. It combines with gender, caste, class, language, disability, and generation to produce experiences that differ dramatically from one person to the next. Displaced women and girls carry particular burdens: interrupted schooling, domestic expectations, heightened vulnerability to gender-based violence, systematic exclusion from opportunities that patriarchal settings reserve for men (Brookings Institution, 2020). Children with disabilities in displacement settings face compound disadvantage that generic technological responses will not reach.

My own sustained research on Tibetan refugees in India has been concerned with exactly these intersections (Mishra, 2014). What I found, and what I believe holds more broadly, is that displaced learners are always navigating two things at once: their individual educational trajectory and a collective cultural or political project that their community has invested in education to carry. Standard institutional metrics — and AI systems built on those metrics — will see only the individual. They will miss the collective. And missing the collective is missing the point.

Historical and Policy Context: Education, Displacement, and Digital Governance in India

India is a particularly important context for this argument — not because it is exceptional, but because it concentrates so many of the relevant dynamics in one place. The subcontinent has hosted displaced populations for over six decades: Tibetan refugees since 1959, Sri Lankan Tamils from the 1980s, Afghans, Rohingya, and millions of internally displaced persons and internal migrants alongside them. The scale is significant. Equally significant is the legal framework—or rather, the absence of one.

The Legislative Architecture of Exclusion: Foreigners Act, CAA, and NRC

Start with what is absent. India has never ratified the 1951 Refugee Convention or its 1967 Protocol. There is no domestic refugee law. The legal position of refugees was governed, for most of the period under analysis, by the Foreigners Act of 1946 — a colonial-era statute enacted by the Imperial Legislative Assembly, designed to give the state powers over foreign nationals. It defined a foreigner simply as someone who is not an Indian citizen. It made no distinction between tourists, migrants, and people fleeing persecution. Under Section 3(2), the Central Government could detain and deport. The burden of proving citizenship fell on the individual. The Act was repealed only in 2025 by the Immigration and Foreigners Act — but for the six decades it governed refugee lives in India, its consequences for documentation, education, and access were severe.

What this means for education is concrete. A refugee whose legal status is indistinguishable from an undocumented tourist has no enforceable right to schooling, no guaranteed service access, no legal protection from deportation. India has, in practice, extended different degrees of hospitality to different groups — through UNHCR administrative arrangements and bilateral understandings — but the variation this produces is itself the problem (Brinham & Johar, 2024). Tibetans have Registration Certificates, a Yellow Book for travel, reserved university seats, government-built schools. Rohingya are treated as illegal immigrants. Sri Lankan Tamils in Tamil Nadu camps occupy an uncomfortable middle ground. This differentiation is not based on any assessment of relative suffering. It is politics, strategic calculation, and the absence of any rights framework.

The Citizenship Amendment Act of 2019 changed the landscape in a specific and consequential way. The CAA amended the 1955 Citizenship Act to offer an accelerated citizenship pathway to undocumented migrants from Hindu, Sikh, Buddhist, Jain, Parsi, and Christian communities from Afghanistan, Bangladesh, and Pakistan — those who entered before December 2014. It was, explicitly, the first time religion appeared as a formal criterion in Indian citizenship law. The exclusion of Muslims — including Rohingya who fled genocide, Sri Lankan Tamils who do not qualify on other grounds — drew immediate criticism from the UN, Amnesty International, and multiple Special Rapporteurs. Article 14 of the Constitution guarantees equality; the CAA's critics argued it violated that guarantee (Government of India, 1949; USCIRF, 2020). The Supreme Court has heard challenges. Implementation rules were notified in March 2024.

For a paper concerned with AI-enabled education and displacement, the CAA matters for a specific reason. It establishes, for the first time in Indian legal history, that the state's

willingness to extend protection and pathways to citizenship is organised by religious identity. When AI systems operating in educational governance contexts inherit the documentation infrastructure of this legal regime — when platform access requires Aadhaar, when Aadhaar requires stable documentation, when documentation reflects the stratified protections of the CAA — the algorithmic system reproduces the discrimination that the legislative framework has codified. The AI is not neutral with respect to the CAA. It inherits it.

The CAA must also be read alongside the National Register of Citizens (NRC), the parallel project to document all genuine Indian citizens. The Assam NRC — monitored by the Supreme Court and finalised in 2019 — excluded nearly 1.9 million people from its final list, many of them from marginalised communities including ethnic Bengali Hindus, women who had married across administrative boundaries, and members of the Tea tribes who lacked the specific documentary proof required (Hari & Nagpal, 2022). The consequences for those excluded are severe: inability to access food rations, bank accounts, employment, and education. Scholars have noted that UNICEF data shows only 52% of births are registered in India, meaning that the documentary burden placed upon citizens by the NRC is one that a substantial portion of the population — including many who are unambiguously Indian — cannot easily meet (Hari & Nagpal, 2022). For displaced, mobile, and poor populations, this documentation burden is not a bureaucratic inconvenience; it is the mechanism through which exclusion from public life, including education, is operationalised.

Educational access for refugees has consequently depended heavily upon community-led institutions and civil society interventions rather than systematic inclusion within national education systems. Tibetan refugees provide the most extensively documented example, having established an impressive network of schools under the aegis of the Central Tibetan Administration with support from the Government of India and international donors (Mishra, 2014; Mishra, 2022). Other refugee groups have experienced more precarious access — Sri Lankan Tamils in camps in Tamil Nadu, Afghan refugees in urban settlements, and Rohingya refugees facing particular marginalisation given India's lack of formal recognition of their status.

Internal Displacement, Migration, and the Right to Education Act

Numbers matter here. The Internal Displacement Monitoring Centre put India's internally displaced population at approximately 6 million in 2022 — and most scholars regard that as a substantial undercount. These are not refugees in the formal sense. They are Indian citizens displaced by dam construction, mining, conflict, floods, cyclones. Their children's schools shift with their parents' movements. Their educational records are spread across multiple states. They hold Indian citizenship — and yet the documentation requirements of Indian educational systems exclude them as effectively as any border.

The scale matters. India's internally displaced population was estimated at approximately 6 million in 2022 — and most scholars consider that a significant undercount. These are not refugees in the formal sense. They are Indian citizens displaced by dams, mines, conflict, floods, cyclones. Their children move with them. School records exist in multiple states, or nowhere. Documentation needed to enrol is often held by a different state authority than the one the family now lives under. The RTE Act of 2009 — which made free elementary education a fundamental right and placed a specific duty on local authorities to enrol migrant children

under Section 9(k) — was supposed to change this. In practice, as the UNESCO GEM data shows, 80% of migrant children across seven Indian cities lacked access to education near worksites. The law and the reality remained far apart (UNESCO GEM, 2019; Chandrasekhar & Bhattacharya, 2018).

The distance between the RTE Act's provisions and their implementation for migrant children is well-documented. Local authorities frequently do not know how many migrant children are in their jurisdiction, are not familiar with the relevant provisions, and continue to require proof of residence for enrolment even where that requirement has technically been waived (Chandrasekhar & Bhattacharya, 2018). None of this is addressed by the arrival of AI-enabled educational platforms. If anything, it is compounded.

This is the terrain into which AI-enabled education is being introduced. The NEP 2020 acknowledges disadvantaged groups including migrants and commits to their inclusion. What it does not specify is what digital education means for children without Aadhaar, without stable addresses, without continuous school records. The emphasis on technology as the vehicle for inclusion risks encoding, into the foundations of those systems, precisely the structural conditions that produce exclusion in the first place.

Digital India and the Quiet Spread of AI

India's digital infrastructure expansion has been dramatic. Over 1.3 billion Aadhaar registrations. Digital payment systems now standard. Online welfare delivery normalised. The NEP 2020 makes technology-enabled learning and data-driven monitoring central to educational transformation (Government of India, 2020). The scale is real, and some of the reach is genuine.

What is striking, though, is the texture of how this AI revolution is actually arriving in India. A Times of India investigation published in February 2026 documented what it called 'AI's quiet spread beyond metros' — rural women doing data-labelling work from their homes in Jharkhand, farmers in Madhya Pradesh using AI-enabled pest detection apps, a Bengali farmer using an AI-based IoT farm lab, a village schoolboy in West Bengal using an AI tool to draft official documents and plans (Times of India, February 2026d). The story is, in one reading, inspiring. In another, it is revealing: the populations benefiting from this 'quiet spread' are generally those with fixed locations, some documentation, and enough stable infrastructure to engage with digital platforms. The displaced, the seasonally mobile, the undocumented — they are largely absent from this picture.

This digital expansion has significant implications for displaced populations. Aadhaar enrolment requires documentation that many displaced persons lack; biometric authentication can fail for elderly persons, manual labourers, or those with disabilities affecting fingerprints; and the assumption of fixed residential addresses underlying many digital systems conflicts with the mobility that defines displacement. Research has documented how Aadhaar-enabled welfare systems have produced exclusion errors — cases where entitled beneficiaries are denied services due to authentication failures, data mismatches, or documentation gaps (Khera, 2019; Panigrahi, 2021). When such systems extend to education, similar exclusion dynamics may affect displaced learners.

Critical Review: AI in Education and The Displacement Blind Spot

The scholarship on AI in education has grown fast over the past decade. It is not short of intelligence or sophistication. What it has consistently lacked is any serious engagement with displacement and mobility as conditions that shape large numbers of actual learners. The gap is not incidental. It reflects assumptions built into the research itself — assumptions about who the learner is, where they live, what continuity they have.

Dominant Narratives and Their Limits

The dominant narrative goes roughly as follows. AI in education can personalise instruction, provide immediate feedback, identify struggling students early, and reduce the burden on teachers (UNESCO Institute for Lifelong Learning, 2022). These are real possibilities. Adaptive platforms can do things that a single overworked teacher in a large classroom cannot. The claims are not dishonest. What they are is incomplete.

The incompleteness becomes visible when you ask what assumptions the narrative depends on. Effective adaptive learning requires continuous data. The algorithm needs to build a model of the learner over time — which requires the learner to be present, consistently, across sessions, on a device, with a connection. It requires a stable learner identity that the system can track. It requires educational goals that remain relatively constant. For a child in a seasonal labour camp, or a newly arrived refugee, or an internally displaced family moving every few months, almost none of these conditions hold.

The discourse about AI as an educational democratiser is similarly visible in India's mainstream media. The Times of India's Parenting supplement recently ran a feature asking whether AI is becoming 'the third parent' — noting that children are increasingly turning to chatbots in times of emotional distress and academic need (Times of India, February 2026a). Experts quoted in that piece warn that teaching healthy engagement might be key, and flag the risks of emotional dependency and the widening gap between children for whom AI is an accessible supplement and those for whom it remains out of reach. This mainstream framing is instructive precisely because of what it takes for granted: the child in question has a smartphone, a data connection, emotional bandwidth to engage with a chatbot, and a stable home from which to do so. The displaced child — in a transit camp, a seasonal labour site, a cramped urban settlement without documentation — does not figure in this conversation at all.

Evidence from Algorithmic Bias Research

Empirical evidence on algorithmic bias in education has grown rapidly. Predictive models for student success produce racially biased outcomes — less accurate for minoritised students (Gándara et al., 2024). AI tools designed without attention to linguistic background reduce engagement when cultural contexts do not match algorithmic assumptions (Farahani & Ghasemi, 2024). These are not surprising findings. What makes the India case specific and urgent is caste.

For India, the caste dimension adds a layer of particular urgency. The research reported in the Times of India (February 2026b), drawn from work by researchers at IIT and partner institutions, found that when GPT-4o and similar models are asked to assign jobs to persons with different names, they consistently favour upper-caste names for knowledge-economy roles and push lower-caste names toward manual or service work. The researchers describe the

model's tendency to promote dominant castes while consistently associating Dalits and Shudras with lower-status roles—a pattern that emerged even when models were prompted to avoid bias. The implications for AI-enabled educational systems that make recommendations about academic tracks, career pathways, or learning interventions are serious and underexplored.

The Displacement Literature

In contrast to the technology-focused scholarship, research on refugee education has long highlighted structural barriers that no technology alone can resolve. Dryden-Peterson's (2011) wide-ranging global review documented how refugees encounter interrupted schooling, linguistic exclusion, curriculum misalignment, certification gaps, and teacher shortages — barriers rooted in political economy and institutional design rather than information scarcity. Technological interventions addressing symptoms while leaving structural causes untouched risk producing what critics term 'solutionism' — the application of technical fixes to fundamentally political problems.

Research on internally displaced persons points to similar themes: educational disruption persists not because solutions are technologically unavailable but because institutional arrangements fail to accommodate mobility, because resources are insufficient, and because displaced populations lack political voice to demand better (IDMC, 2022). The challenge is to bring these literatures into productive dialogue. AI education scholarship offers technical sophistication but displacement blindness; refugee education scholarship offers structural awareness but limited engagement with algorithmic systems.

Emerging Practices: AI-Enabled Education for Displaced Populations

Systematic research on AI specifically designed for refugee or IDP educational contexts is still thin. What exists is a mix of policy frameworks, pilots, and programmatic experiments — useful, but not yet a settled evidence base. What the available material does suggest is that the technology is rarely the limiting factor. Governance, institutional embedding, and sensitivity to context matter more than the sophistication of the tool itself.

Global Frameworks

UNHCR's Refugee Connected Education Challenge represents perhaps the most developed framework in this space. Its core insight is worth holding onto: technology is not a substitute for formal education. It is, at best, a complement — and only when three things are in place: quality, accredited content; capacity among both educators and learners; and reliable connectivity and infrastructure (UNHCR, 2019). UNESCO's comparative work adds that what distinguishes effective from ineffective technology-based interventions in displacement contexts is cultural responsiveness, linguistic inclusivity, and attention to learners' actual social circumstances (UNESCO Institute for Lifelong Learning, 2022). None of this is surprising. All of it is routinely ignored in practice.

Emerging Research Evidence

What limited evidence exists on AI-supported learning in refugee settings suggests cautious optimism under specific conditions. When AI tools are integrated into human-facilitated learning environments, with community-oriented pedagogies rather than substituting for them, engagement and psychosocial wellbeing can improve (ReadyAI, 2023). The word 'integrated'

is doing a lot of work in that sentence. It means the tool is in a context — a relational, culturally embedded context. Strip that context out and the results deteriorate.

The 'unplugged' approaches that organisations like ReadyAI have developed are revealing in what they acknowledge: the most sophisticated AI tools remain beyond reach for many learners in displacement contexts. Teaching AI concepts without digital infrastructure at least ensures children are not simply excluded. It also — though this is rarely stated explicitly — acknowledges that understanding how AI works may matter as much as having it work for you.

The Indian Context

In India, there is almost no published research specifically on AI-enabled education for refugees or IDPs. The broader landscape gives us the relevant context. The NEP 2020 emphasises AI literacy and technology-mediated delivery. DIKSHA, SWAYAM, and the National Digital Education Architecture are the vehicles. The assumption throughout is that digital infrastructure is becoming available and that barriers to access are being progressively reduced. That assumption may be accurate for settled, documented, urban and peri-urban populations. For those who move, who lack documentation, who live in areas without stable connectivity, it does not hold.

The Aadhaar experience is instructive here. The system was built to streamline welfare delivery and reduce duplication. It has done this in some domains. It has also produced a well-documented set of exclusion errors — entitled beneficiaries denied food rations because biometric authentication failed, pensions blocked because data did not match, healthcare inaccessible because the number could not be verified. These are not hypothetical risks. They have been documented, litigated, and partially acknowledged by the Supreme Court. When education platforms follow the same logic, the same exclusions follow.

Internal Displacement, Migration, and The Challenges of Mobility

Internal displacement and seasonal migration receive far less attention than refugee flows in policy and research — despite affecting larger numbers of people in India. These are not marginal populations. In Bihar, Odisha, Chhattisgarh, and Jharkhand, seasonal migration is a central feature of working-class life. The children of migrant families are among the most educationally vulnerable in the country. Their situation is shaped by mobility, not by any single dramatic rupture — and that makes them harder to see and easier to ignore.

Educational Disruption in Mobile Contexts

Children from displaced and migrant families encounter multiple barriers to educational continuity. Frequent movement disrupts attendance and prevents sustained engagement with curricula designed for sedentary learners. Documentation requirements for school enrolment may be impossible to satisfy when families lack permanent addresses or recognised identity papers. Linguistic differences between states of origin and destination compound learning difficulties, particularly for children moving across India's linguistic regions.

The research on seasonal migration patterns in India documents something straightforward: the educational calendar and the migration calendar do not match. Brick kiln work, sugarcane cutting, construction labour — these move families during the school term. Children go with parents, as carers for younger siblings, as additional earners, or simply because there is no

alternative. Months of schooling are lost. The losses accumulate into permanent disadvantage. An adaptive learning algorithm trained on attendance data encounters these children's records and reads structural displacement as individual disengagement. It would be wrong — and the wrongness would have consequences.

Institutional Responses and Their Limitations

Effective programmatic responses to this situation share a common logic: they adapt to the child's mobility rather than requiring the child to overcome it. Bridge schools offer condensed instruction during migration periods. Seasonal hostels let children stay behind when parents leave. Mobile teachers travel with migrant communities. Worksite schools follow families to brick kilns and construction sites. These approaches work. What makes them work is relational — teachers who know individual children, communities that trust the institution, continuity built through human relationships rather than through data systems.

The implication for AI is direct. The mechanisms that make education work for mobile children are precisely the mechanisms that AI cannot replicate. An adaptive learning platform cannot know a child the way a mobile teacher who has travelled with their family knows them. It cannot build community trust. It cannot adjust to circumstances it has not been programmed to anticipate. This is not a temporary limitation awaiting a technical solution. It reflects what education for mobile populations actually requires.

Digital Education and the Reproduction of Exclusion

Digital and AI-enabled education is frequently proposed as the solution that transcends geography — available anywhere, requiring no local presence, scalable without limit. The pitch is seductive. The evidence for it, in displacement contexts, is limited. What the evidence actually shows is that when the underlying structural constraints — documentation gaps, connectivity gaps, mobility, poverty — go unaddressed, digital systems reproduce existing exclusions efficiently rather than resolving them.

The displaced child in this scenario is not lazy. Not disengaged. Not constitutionally at risk. But an algorithm trained on attendance data, progress metrics, and engagement patterns will not know the difference between a child who has been out of school for three months because of seasonal migration and one who has dropped out. The recommendation it generates will be wrong. And in the logic of algorithmic systems, being wrong consistently, at scale, is how inequality is reproduced in a new technical form.

AI, Governance, and The Politics of Educational Decision-Making

When AI enters educational governance, something shifts. Not just in how decisions are made — in who makes them, and with what accountability. A teacher who places a child in a remedial stream is visible, reachable, contestable. An algorithm that makes the same recommendation is opaque, technically legitimate, and hard to challenge. For displaced learners, whose families are often unfamiliar with educational bureaucracies, who may fear authorities, who lack the linguistic resources to navigate formal systems — this shift in decision-making is not neutral. It reduces already limited recourse.

Algorithmic Authority and the Displacement of Judgement

Teachers, counsellors, and school administrators make decisions about children based on contextual knowledge built over time. They know when a student's poor performance reflects limited ability and when it reflects a crisis at home, a recent traumatic experience, or a documentation problem that has disrupted attendance. That contextual knowledge is relational. It comes from relationships. When algorithmic systems make or strongly influence these decisions, the contextual knowledge is stripped out and replaced with pattern-matching on available data.

The consequences for displaced learners are specific. Their circumstances routinely produce precisely the patterns that algorithms flag as risk: absences, gaps in records, underperformance on standardised assessments, inconsistent engagement. A teacher who knows the child knows what these patterns mean. An algorithm does not. The result is that displaced children may be systematically misread at exactly the moments when getting the assessment right matters most.

Digital Identity and Access

Aadhaar offers the clearest illustration India has of digital identity infrastructure in practice — its possibilities and its failures. The system has extended coverage widely. It has also produced exclusion. The Supreme Court's 2018 ruling acknowledged this, holding that Aadhaar cannot be mandatory for essential services precisely because authentication failures were denying entitled citizens access to food, healthcare, and pensions. The exclusions were not bugs. They were predictable consequences of a system that assumed stable documentation, stable biometrics, and stable addresses. Educational platforms built on similar infrastructure will produce similar outcomes.

For displaced learners, documentation gaps create cascading barriers. Without recognised identity documents, obtaining Aadhaar may be impossible; without Aadhaar, accessing digitally mediated services becomes difficult; without access to digital educational platforms, learning opportunities narrow. AI systems built upon digital identity infrastructure may thus inherit exclusion mechanisms operating upstream of the education system itself.

Transparency, Accountability, and Redress

Accountability is the central question. For displaced populations — legally precarious, often fearful of state institutions, linguistically marginalised — the ability to contest algorithmic decisions is already constrained. Proprietary systems may be opaque even to the institutions deploying them. Without deliberate design for contestability and redress, AI in education becomes governance without recourse for the very populations most vulnerable to its errors.

Education, Identity, and Diversity: Insights from Tibetan Refugees in India

I want to be careful here not to let this section become merely illustrative — a case study that confirms what the theoretical framework has already established. The Tibetan refugee community in India is genuinely complex, and that complexity has taught me things I did not expect to learn. What follows draws upon ethnographic research conducted over an extended period, documented in Tibetan Refugees in India: Education, Culture, and Growing Up in Exile (Mishra, 2014) and in subsequent published work (Mishra, 2022), as well as ongoing fieldwork and reflection that has continued to refine my understanding.

I am, of course, not the first scholar to study this community. Girija Saklani's (1984) foundational sociological study of Tibetan refugees — grounded in fieldwork in Dharamshala, Delhi, and Dehradun — remains an essential reference, documenting the remarkable social and economic adaptation of a community that had arrived with almost nothing. Saklani captured something important: the relationship between continuity and change that defines exile community formation. Where I would supplement her analysis is in attending to the internal differentiation that has deepened over subsequent decades, and to the educational implications of that differentiation. Dibyesh Anand's postcolonial scholarship on Tibetan diaspora identity offers another essential perspective—his critique of essentialist constructions of 'Tibetanness' and his attention to how the diaspora has invested in particular representations of identity for strategic purposes (Anand, 2000; 2003) provide the political context within which educational institutions operate. The Tibetan school system is not simply educating children; it is constructing a national subject in exile. That is a fundamentally different project from what most educational AI systems are designed to support.

Migration Histories and Educational Trajectories

Among the most significant distinctions within the Tibetan refugee population lies between those born in India to refugee parents or grandparents and those who arrived from Tibet — often as unaccompanied minors. This distinction between what I have called settlement-born Tibetans and newcomers shapes educational experiences profoundly, and in ways that no standardised learner profile could capture.

Individuals born in Tibet typically experienced early childhood socialisation within Tibetan cultural and linguistic environments, followed by abrupt disruption through migration. Many arrived having attended Chinese-medium schools where Tibetan language instruction was limited or absent. Their educational trajectories in India were marked by discontinuity, adjustment challenges, and the emotional weight of separation from family. Some possessed strong foundations in Mandarin Chinese but required intensive support in English and Hindi; others arrived with limited formal schooling.

By contrast, Tibetans born in India grew up within institutional settings shaped by six decades of exile community-building. They developed familiarity with Indian languages and social norms from early childhood. Their educational trajectories, while still shaped by exile conditions, followed more predictable patterns. Yet they too faced particular challenges: accusations from newcomers of being insufficiently Tibetan, questions about cultural authenticity, and complex negotiations between Indian, Tibetan, and increasingly global identities. Neither group fits the profile of a standardised 'refugee learner.'

Institutional Cultures and Educational Goals

Schooling institutions further shaped these differences. Tibetan-run schools — particularly the Tibetan Children's Village system and Central Tibetan Schools Administration institutions — were designed to serve both educational and cultural-political objectives. These schools provided instruction that was often bilingual or Tibetan-medium in early years, with curricula emphasising Tibetan history, religion, and collective identity alongside standard academic subjects. Education in these settings was framed explicitly as responsibility toward cultural

preservation and the broader political project of exile — maintaining Tibetan identity so that future return to Tibet would find a community intact rather than assimilated.

In contrast, Tibetan students educated in Indian convent schools or government schools encountered different institutional cultures. These schools prioritised English or Hindi as the medium of instruction and aligned with mainstream Indian curricula. Students in such settings often developed greater facility navigating Indian higher education institutions and labour markets, and tended to articulate broader career aspirations, including professional roles within Indian society and transnational spaces.

What strikes me, looking back at this material, is how inadequate any algorithmic approach to 'personalised learning' would be in this context. An adaptive learning system that adjusted content difficulty based on prior performance data would be working with fragments — incomplete records, inconsistent assessment, educational histories that crossed national and linguistic boundaries. It would have no way of knowing whether a student's apparent weakness in English reflected a cognitive gap or simply the fact that they had spent their first twelve years in a Chinese-medium school in Lhasa.

Language, Identity, and Belonging

Language operates as a central site of tension in Tibetan refugee education. The Tibetan language — in its literary, spoken, and regional varieties — carries profound significance as a marker of identity, vehicle of religious practice, and connection to homeland. Yet educational and economic success in India frequently requires English and Hindi, while younger generations increasingly gravitate toward global English as a medium of aspiration.

My research documented how language competencies shaped social positioning within the refugee community. Newcomers speaking Tibetan with accents or vocabulary influenced by Chinese were sometimes stigmatised as culturally contaminated. Settlement-born youth who struggled with literary Tibetan faced questions about their authenticity. English proficiency opened doors to employment but also created distance from older community members. These linguistic dynamics intersected with generational differences, regional origins, and social class to produce complex hierarchies of belonging that no algorithm would be equipped to navigate.

My own fieldwork documented these dynamics in considerable depth (Mishra, 2014). For newly arrived young Tibetans — separated from families left behind in Tibet, navigating an unfamiliar institutional landscape in India — the pursuit of educational credentials becomes entangled with a quest to recover a sense of self that has been profoundly disrupted. The educational aspiration is real and often intense; so is the structural precarity surrounding it. What I observed repeatedly was that the fragmentation visible in a student's academic record — gaps, inconsistencies, apparent underperformance — was not evidence of limited ability but of the extreme conditions from which they were trying to rebuild a life. An AI adaptive learning system calibrated to progress metrics and engagement data would encounter these learners at their most vulnerable moment and interpret their fragmentation as underperformance. It would be wrong, in ways that matter enormously for the child in question.

What the Tibetan Case Reveals

The goals of education in this community extend far beyond individual skills acquisition. Education serves collective purposes: maintaining language that might otherwise be lost,

transmitting historical memory to generations who have never seen Tibet, preparing potential leaders for uncertain political futures. AI systems oriented toward individualised learning outcomes may fail to support — or may actively undermine — these collective educational projects. This is not a romantic or traditionalist point. It is an empirical observation about what communities actually want from education, and what they will resist if education does not provide it.

The parallels with other displacement contexts are worth noting. The Ukrainian children described in the Times of India op-ed — growing up without heat and stable schooling, their parents told they will never forget — are not simply behind on a curriculum. They are experiencing an interruption of collective life that education must eventually repair, not just an individual skills gap that adaptive software can fill (Times of India, February 2026c). Understanding that difference requires the kind of contextual, historically informed, relational knowledge that the best teachers and community workers bring to their work. It cannot be automated.

Implications for AI Design and Educational Governance

Against Standardisation

AI systems in education generally do what they are designed to do: standardise. They apply uniform data categories, consistent assessment rubrics, normalised pathways. For most learners, this is manageable. For displaced learners — who have interrupted schooling histories, multilingual competencies, culturally specific educational goals, and migration trajectories that cross administrative boundaries — standardisation does not fit. The variation that standardised systems treat as noise is, in fact, the signal.

The argument is not against AI. It is for a different kind of AI design — one that accommodates heterogeneity rather than minimising it. This means flexible assessment that can recognise competence expressed in multiple forms. It means adaptive systems that adjust not just difficulty but modality, language, and content. It means credentialing that values diverse pathways rather than enforcing a single standard. None of this is technically impossible. All of it requires deliberate design choices that current systems do not make.

Data Justice and Representation

Data shapes what algorithms learn, and displaced populations generate less data — and less legible data — than settled ones. This underrepresentation is not random. It reflects the same marginalisation that produces educational disadvantage in the first place. An AI system trained on data that systematically excludes displaced learners will perform worse for them. Addressing this is ethically complex: generating better data raises its own concerns about surveillance, consent, and the potential misuse of information about vulnerable populations. There is no clean technical fix.

Human Oversight and Professional Judgement

Human oversight in educational decision-making is not optional for displaced populations — it is a condition of doing the work responsibly. AI tools can usefully support educators: identifying learning gaps, flagging students who may need support, suggesting resources. But

the consequential decisions — placement, progression, certification — cannot be safely delegated to algorithmic systems for learners whose circumstances require interpretation that standard data cannot capture. The educator who knows the child must retain that authority.

Community Participation and Accountability

In my fieldwork with Tibetan refugees, one thing became clear early: the community had educational goals that no external designer would have predicted. They were not primarily concerned with optimising individual outcomes for Indian labour market entry. They were concerned with cultural survival — with maintaining a language, transmitting a historical memory, producing people who could carry a political project forward under conditions of exile. AI systems designed around individualised learning outcomes would have missed this entirely. Governance of AI in education for displaced communities must include those communities.

Human Judgement, Refugee Status Determination, and The Limits of Automation

I want to dwell here on something that has shaped my thinking in ways that are difficult to fully systematise. Between 2001 and 2003 — first as an intern in UNHCR's Community Services and Protection Unit in New Delhi, and then as a Consultant and Social Worker at the Socio-Legal Information Centre (SLIC), an implementing partner of UNHCR — I worked directly with refugee communities on protection and socio-legal matters. This was simultaneous with my M.Phil research on Afghan and Tibetan refugee children. The two things were not separate: what I encountered in the SLIC office during the week shaped what I was trying to understand through my research. That experience has never left me, and it speaks directly to the question of what automation can and cannot do in high-stakes decisions involving displaced populations.

RSD as Interpretive Practice

Refugee Status Determination is, at its core, an interpretive act. An adjudicator listens to a narrative — often fragmented, non-linear, shaped by trauma, fear, and cultural norms about what can be said to a stranger in a formal setting — and makes a judgement about whether that person faces a well-founded fear of persecution. There is no algorithmic substitute for this. What looks like inconsistency to a pattern-matching system is often entirely explicable to someone with country knowledge, cultural competency, and the capacity to attend to a particular human being in front of them.

This process resists reduction to algorithmic decision-making. Asylum narratives may be fragmented, non-linear, or incomplete — not because claimants are fabricating but because trauma affects memory, because cultural norms shape self-presentation, and because fear affects disclosure. What looks like inconsistency to a pattern-matching system may be entirely explicable to a trained interviewer with country knowledge and attentiveness to the specific person sitting across the table. The stakes of error — returning someone to persecution — demand accountability that algorithmic systems cannot provide.

Recent policy debates have explored AI applications in asylum processing and identity verification. Proponents argue that automation could improve efficiency, consistency, and speed. Critics counter that algorithmic systems risk entrenching bias, excluding populations

poorly represented in training data, and eroding the individualised assessment that international law requires. I count myself firmly among the critics — not merely on abstract principle but from having spent over a year at SLIC watching what refugee protection work actually requires: patience, contextual knowledge, the ability to hold a person's fragmented story with care and interpret it accurately. Those qualities cannot be automated.

Parallels with Educational Assessment

The parallels with educational assessment run directly. A displaced student's academic record may be fragmented, inconsistent, lacking documentation — for the same reasons an asylum narrative may be fragmented: not because the person is deficient, but because the institutions that normally generate evidence of competence were disrupted by exactly the forces that caused their displacement. Reading those gaps as evidence of low ability is wrong in precisely the same way that reading a non-linear asylum narrative as evidence of fabrication is wrong.

Automated assessment systems make exactly this error. They flag the absences, the inconsistencies, the gaps — and generate recommendations based on surface patterns rather than underlying realities. The capable student is misclassified. The intervention recommended is wrong. The opportunity is closed. These are not hypothetical errors. They are the predictable consequences of applying pattern-recognition to populations whose patterns have been shaped by exceptional circumstances that the training data does not contain.

The Enduring Importance of Human Agency

Both domains — asylum processing and educational assessment — point toward the same conclusion about the appropriate role of automation. AI can support human decision-making. It can process information, identify patterns, flag cases that need attention. What it cannot do is replace the judgement, accountability, and ethical reasoning that consequential decisions require. This is not a romantic defence of human decision-making, which has its own well-documented biases. It is a recognition that algorithmic systems and human judgement have different failure modes — and that for populations whose situations require contextual interpretation, the failure modes of algorithmic systems are more dangerous.

Policy Framework: Towards Equitable AI-Enabled Education

The policy implications of this analysis are concrete. Current governance frameworks for AI in education — at national and international levels — treat displacement as peripheral. Mobile and displaced learners appear, if at all, as edge cases requiring special provisions. The argument of this paper is that they should be treated as a design requirement: as populations whose inclusion must be built into AI systems from the outset, not retrofitted afterwards.

Recognition of Displacement as Structural Condition

Recognition matters first. Policy frameworks should explicitly name displacement — external and internal — as a structural condition affecting significant learner populations in India and globally. This has practical implications: educational technology standards should include mobility requirements; impact assessments should evaluate effects on displaced populations before systems are deployed; funding should support AI applications designed for displacement contexts rather than simply adapted from systems built for settled ones. For India, this means

the NEP 2020 implementation guidelines must answer a question they currently avoid: what does digital education mean for children without Aadhaar, without fixed addresses, without continuous schooling records?

Flexibility in Credentialing and Assessment

Credentialing flexibility is essential. The rigid progression requirements embedded in most educational AI systems create barriers that such systems enforce more efficiently than human gatekeepers ever could. Displaced learners with interrupted schooling histories, credentials from unrecognised institutions, or non-linear educational trajectories cannot navigate these requirements. Recognition of prior learning, modular credentialing, and alternative assessment mechanisms should be design requirements, not afterthoughts.

Multilingual and Culturally Responsive Design

Linguistic and cultural responsiveness must be built in from the start, not layered on after deployment. For displaced populations in India — who may speak any of dozens of languages, who may come from educational traditions that differ from Indian mainstream norms, whose educational goals may be shaped by cultural and political projects that adaptive systems are not designed to recognise — translation of interfaces is the minimum. What is needed is adaptation of pedagogical approaches, assessment instruments, and content. For India specifically, this includes addressing caste bias in the language models that underpin educational AI — the research evidence now makes clear that this bias exists and is systematic. It cannot wait.

Safeguards Against Exclusion

Safeguards against exclusion are non-negotiable. Human override mechanisms. No mandatory digital identity requirements for educational access. Data protection standards that prevent the surveillance of vulnerable populations. Regular audits that identify disparate impacts on displaced and mobile learners. These should be requirements, not recommendations.

Participatory Governance

Participation by affected communities is not a consultation exercise. It is a governance requirement. The Tibetan case I have documented over decades illustrates why: communities whose educational goals are shaped by cultural survival, collective identity, and political aspiration will resist AI systems that reduce education to individualised skills acquisition — and rightly so. Meaningful participation means representation in standards development, involvement in system design, and access to redress mechanisms that work for people constrained by legal status, linguistic marginalisation, or economic precarity.

Preservation of Human Judgement

Human judgement must remain central to high-stakes educational decisions. AI systems can inform — they can process data, flag patterns, suggest resources. They should not have final authority over placement, progression, certification, or opportunity for learners whose circumstances require the kind of contextual interpretation that data systems cannot perform. This is especially true for displaced learners. Their situations demand educators capable of understanding what the data cannot show.

Conclusion: Educational Justice in Mobile Futures

I began this paper with three newspaper stories, and I want to return to them in closing. The story about AI as third parent, the story about Ukrainian children who will never forget their displacement, and the story about caste bias in language models — these three are not separate phenomena. They are facets of the same problem: we are building AI systems for education in a world of profound mobility, inequality, and diversity, while imagining a world of settled, documented, homogeneous learners.

The conclusions I draw are not pessimistic ones. I have seen, in my fieldwork among Tibetan refugees, what education can accomplish in conditions of profound adversity. I have seen communities build schools, preserve languages, transmit historical memory across generations, and maintain collective identity through deliberate institutional effort. Technology did not do this — people did, with vision, commitment, and an understanding of what was at stake. The question is whether AI, thoughtfully governed, can support rather than undermine this kind of work.

The path forward requires not abandoning technology but governing it wisely — ensuring that AI serves educational justice rather than deepening the marginalisation of those already most excluded. For India, where refugees, migrants, and internally displaced persons navigate complex educational landscapes amid rapid digital expansion, aligning AI-enabled education with principles of equity and inclusion is both a policy imperative and moral necessity.

Four specific challenges deserve priority attention as this agenda moves forward. First, the caste bias documented in current large language models must be addressed before those models are deployed in Indian educational settings — this is a concrete, tractable problem that researchers and developers have now clearly identified. Second, the digital identity requirements embedded in educational platforms must be redesigned to accommodate learners without stable documentation or fixed addresses. Third, the relational and community dimensions of education for displaced populations must be recognised as features to be supported by AI, not functions to be replaced by it. And fourth, displaced communities — including the Tibetan community in India, internal migrants, and others — must have meaningful participation in the governance of systems that will shape their children's educational futures.

The choices made now about how to design, deploy, and govern educational AI will shape the life chances of displaced children and youth for generations. Those children — including the Ukrainian children whose story appeared in an Indian newspaper on the fourth anniversary of their displacement — are not edge cases to be handled by a special module. They are the test of whether our commitment to educational justice is real.

References

Anand, D. (2000). (Re)Imagining nationalism: Identity and representation in the Tibetan diaspora of South Asia. Contemporary South Asia, 9(3), 271–287.

Anand, D. (2003). A contemporary story of diaspora: The Tibetan version. Diaspora: A Journal of Transnational Studies, 12(3), 211–229.

Baker, R.S., & Hawn, A. (2021). Algorithmic bias in education. International Journal of Artificial Intelligence in Education, 32, 1052–1092.

Banerjee, P. (Ed.). (2005). Internal displacement in South Asia: The relevance of the UN's

Guiding Principles. Sage Publications.

Banerjee, P. (2010). Borders, histories, existences: Gender and beyond. Sage Publications.

Benjamin, R. (2019). Race after technology: Abolitionist tools for the new Jim Code. Polity Press.

Bourdieu, P. (1986). The forms of capital. In J.G. Richardson (Ed.), Handbook of theory and research for the sociology of education (pp. 241–258). Greenwood Press.

Bourdieu, P., & Passeron, J.C. (1990). Reproduction in education, society and culture (2nd ed.). Sage.

Brinham, N., & Johar, A. (2024). Refugee experiences of identity documents and digitisation in India and Myanmar. Journal of Refugee Studies, 37(1), 45–68.

Brookings Institution. (2020). India's National Education Policy 2020: A reformist step forward? https://www.brookings.edu/blog/education-plus-development/2020/08/12/indias-national-education-policy-2020/

Chandrasekhar, S., & Bhattacharya, L. (2018). Education of children from migrant rural households in India: Moving towards a coherent policy framework (Background paper GEM Report 2019). UNESCO.

Citizenship (Amendment) Act, 2019, No. 47, Acts of Parliament, 2019 (India). https://egazette.nic.in/WriteReadData/2019/214646.pdf

Citizenship Act, 1955, No. 57, Acts of Parliament, 1955 (India) (as amended 2019).

Foreigners Act, 1946, No. 31, Acts of Parliament, 1946 (India). [Superseded by the Immigration and Foreigners Act, 2025.]

Dryden-Peterson, S. (2011). Refugee education: A global review. UNHCR.

Erel, U. (2010). Migrating cultural capital: Bourdieu in migration studies. Sociology, 44(4), 642–660.

Farahani, M., & Ghasemi, S. (2024). Algorithmic bias in educational systems: Examining the impact of AI-driven decision making in modern education. World Journal of Advanced Research and Reviews, 25(1), 253–269.

Gándara, D., Anahideh, H., Ison, M.P., & Picchiarini, L. (2024). Inside the black box: Detecting and mitigating algorithmic bias across racialized groups in college student-success prediction. AERA Open, 10, 1–20.

Global Partnership for Education. (2024). Education for refugees. https://www.globalpartnership.org/focus-areas/refugees-and-displaced-populations

Government of India. (1949). The Constitution of India. https://legislative.gov.in/constitution-of-india

Government of India. (2020). National Education Policy 2020. Ministry of Education.

Hari, A., & Nagpal, S. (2022). The National Register of Citizens (NRC) in India and the potential for statelessness in situ: A cautionary tale from Assam. Contemporary South Asia, 30(2), 156–172.

Internal Displacement Monitoring Centre. (2022). Barriers to education for internally displaced children. IDMC.

Khera, R. (2019). Dissent on Aadhaar: Big data meets big brother. Orient BlackSwan.

Knox, J. (2020). Artificial intelligence and education in China. Learning, Media and Technology, 45(3), 298–311. https://doi.org/10.1080/17439884.2020.1754236

Malkki, L. (1995). Refugees and exile: From 'refugee studies' to the national order of things. Annual Review of Anthropology, 24, 495–523.

McConvey, K., & Guha, S. (2024). Algorithmic accountability in education: Challenges and opportunities. Journal of Learning Analytics, 11(1), 45–62.

Mishra, M. (2014). Tibetan refugees in India: Education, culture, and growing up in exile. Orient BlackSwan.

Mishra, M. (2022). Education of Tibetan refugees: Sowing future seeds of Tibet. In S. I. Rajan (Ed.), The Routledge handbook of refugees in India (pp. 565–583). Routledge.

Noble, S.U. (2018). Algorithms of oppression: How search engines reinforce racism. NYU Press.

Panigrahi, S. (2021). Marginalized Aadhaar: How the world's largest digital identification programme led to the exclusion of marginalised communities. Yoti Foundation. https://www.yoti.com/blog/yoti-fellowship-marginalised-aadhaar/

ReadyAI. (2023). We need to bridge the AI education gap for refugees. Medium. https://medium.com/readyai-org/we-need-to-bridge-the-ai-education-gap-for-refugees

Right of Children to Free and Compulsory Education Act, 2009, No. 35, Acts of Parliament, 2009 (India). https://legislative.gov.in/sites/default/files/A2009-35.pdf

Saklani, G. (1984). The uprooted Tibetans in India: A sociological study of continuity and change. Cosmo Publications.

Samaddar, R. (Ed.). (2003). Refugees and the state: Practices of asylum and care in India, 1947–2000. Sage Publications.

Samaddar, R. (2020). The postcolonial age of migration. Routledge.

Times of India. (2026a, February). How AI is becoming the third parent, and why that's scary. Times of India.

Times of India. (2026b, February). AI knows how caste works in India. Here's why that's a worry. Times of India.

Times of India. (2026c, February). 'Our kids growing up without heat & stable schooling, displaced from their homes...will never forget' [Op-ed by Oleksandr Polishchuk]. Times of India.

Times of India. (2026d, February). AI's quiet spread beyond metros. Times of India.

UNESCO Institute for Lifelong Learning. (2022). From radio to artificial intelligence: Education for displaced populations. UNESCO.

UNESCO Global Education Monitoring Report. (2019). Migration, displacement and education: Building bridges, not walls. UNESCO.

UNHCR. (2019). Refugee connected education challenge. https://www.unhcr.org/refugee-connected-education-challenge.html

United States Commission on International Religious Freedom. (2020). Factsheet on the Citizenship (Amendment) Act in India. USCIRF. https://www.uscirf.gov/sites/default/files/2020%20Factsheet%20-%20India%20CAA_0.pdf

13
Economic Growth and Environmental Sustainability in India: Challenges and Prospects

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Abstract
India is one of the fastest-growing economies in the world, growing at the rate of 6 to 7 per cent annually since the 1991 liberalisation. This growth has helped lift millions of Indians out of poverty, but it has serious repercussions for the country's environmental quality due to the excess waste and pollution it creates. This study aims to examine the validity of the Environmental Kuznets Curve (EKC) hypothesis, that is, whether income has the capacity to clean up the environment on its own or whether India needs active government policy intervention. The study uses a narrative review of literature from 1993 to 2025, along with the reports issued by the World Bank, IPCC and India's environment ministry. This study examines disagreement over EKC validity instead of validating it with a new set of data and checks the findings against India's policy framework. The literature does not agree on the validity of EKC, but it agrees well on the development of renewable energy sources, eco-friendly technology, and regulatory enforcement. Despite the presence of a policy framework to protect the environment in India, its lack of implementation still creates many problems for sustainable development. The study recommends faster renewable energy sources, stricter enforcement, increased investment in green technology, and decentralising control for better policy implementation.
Keywords: Economic Growth; Environmental Sustainability; India; Environmental Degradation; Climate Change; Sustainable Development; Carbon Emissions; Energy Consumption; Green Growth; Environmental Policy.

Introduction
Economic growth has long been regarded as the bedrock of development, generating employment and improving infrastructure, thereby raising the standard of living. However, rapid economic growth is often associated with high environmental impact. The experience of many developed nations demonstrates that industrialisation initially deteriorates the environment, which is later restored through effective policies and technological advancements (World Bank, 2023). Today, developing economies like India face an even more complex situation than the developed countries. Unlike earlier industrialised nations, India will have to seek sustained economic growth while simultaneously addressing environmental concerns, as environmental degradation and climate change have become global priorities that need constant and continuous monitoring (Intergovernmental Panel on Climate Change [IPCC], 2023).
Since the 1991 economic liberalisation reforms, India's economy has witnessed strong and sustained economic growth at an average of 6 to 7 per cent a year, making it one of the fastest-

growing major economies of the world (Government of India, 2025; World Bank, 2025). This remarkable progress has helped India lift millions of Indians out of poverty, expand industrial production, accelerate urbanisation, and strengthen the country's global economic position (World Bank, 2025). However, this has negatively affected the country's environmental quality, leading to a rise in air pollution, deteriorating water quality, rapid depletion of groundwater resources, deforestation, loss of biodiversity, and growing greenhouse gas emissions. Fourteen of the world's fifteen most polluted cities, by particulate matter, are in India. The Ganga, Yamuna, and dozens of small rivers carry huge volumes of industrial and municipal waste (IQAir, 2025); even groundwater is pulled out faster than it can refill, especially across the Indo-Gangetic plain. These challenges are well documented in government reports and independent studies, highlighting the urgent need to balance growth and environmental quality (Ministry of Environment, Forest and Climate Change [MoEFCC], 2023).

The relationship between economic growth and environmental quality has been extensively studied in economic literature using the concept of the Environmental Kuznets Curve (EKC). The idea of EKC was developed in the early 1990s and is based on the assumption that the process of economic development initially causes environmental quality to deteriorate, but it begins to improve after a country reaches a certain level of income (Grossman & Krueger, 1991; Grossman & Krueger, 1995). According to this theory, rich societies can afford cleanup, thereby demanding stronger regulatory frameworks, cleaner technologies, and increased investment in sustainable practices. Although the EKC has been tested extensively across countries and various environmental indicators, empirical evidence remains mixed, especially for emerging economies like India (Dinda, 2004; Stern, 2004). While some studies support the inverted U-shaped relationship, others suggest that economic growth alone is sufficient to improve environmental quality without government intervention (Stern, 2017).

The Indian economy is an important case study for examining this relationship because it is pursuing rapid economic growth, large-scale industrialisation, and ambitious climate commitments. As it is one of the world's largest economies by population and among the leading contributors of global greenhouse gas emissions, India's development choices have significant implications not only for its own environmental future but also for global sustainability efforts ([IEA], 2024; United Nations Environment Programme [UNEP], 2024). The key question, therefore, is whether continued economic growth will naturally improve the environment, as suggested in the EKC, or whether proactive government intervention is necessary to ensure sustainable economic development.

Against this background, the present paper examines the relationship between economic growth and environmental quality in India by reviewing existing literature, identifying the major environmental challenges associated with the country's growth process, and evaluating the prospects for achieving sustainable development. The study also explores the policy measures for sustainable economic development, thereby contributing to the ongoing debate on sustainable development in India.

The remainder of the paper is organised as follows. Section 2 works through the existing literature on economic growth and environmental quality in India. Section 3 identifies the research gap addressed by the study. Section 4 sets out the objectives of the study, followed by the methodology in Section 5. Section 6 lays out the findings of the study necessary for

ensuring sustainable development. Section 7 offers policy recommendations, and Section 8 concludes the study.

Review of Literature

The relationship between economic growth and environmental quality has been extensively examined in the development economics literature, with EKC being the dominant theoretical framework. The EKC hypothesis was first proposed by Panayotou (1993), who suggested that environmental quality initially degrades with economic growth but improves as a country's income level increases. Since 1993, the hypothesis has been widely tested across various countries and indicators, although the empirical evidence remains far from conclusive (Dinda, 2004; Stern, 2004).

In the Indian context, studies on the growth-environment nexus have focused primarily on testing the validity of the EKC using advanced econometric techniques. Behra (2021) applied the Autoregressive Distributed Lag (ARDL) approach for the period 1971-2016; the findings supported the conventional inverted U-shaped relationship, and the study further revealed that energy consumption significantly increases emissions, whereas foreign direct investment (FDI) and trade openness have a limited impact. Similarly, Sinha and Shahbaz (2017) also supported the EKC for India using data from 1971-2015, and they argued that India has not yet reached the estimated income turning point of about US$2,938 per capita, suggesting that economic growth is unlikely to improve environmental quality in the near future. Their study also indicated that renewable energy plays a significant role in lowering CO_2 emissions.

The study by Pata et al.(2022) found a U-shaped relationship for India instead of an inverted U-shaped relationship using the Residual Augmented Least Squares (RALS) Fourier cointegration approach; therefore, their study rejected EKC for India. Similarly, Adeneye and Rasheed (2025) examined a panel of seventeen coal-consuming countries; their study found that EKC was valid for developed economies and not for developing ones, including India. A comparative analysis of India and China by Jiao et al. (2022) found similar results. Their results showed that China had decoupled economic growth from environmental outcomes by 2017, but in India, there still exists a positive relationship between the said variables, and the rising population exerts even more pressure on the environment. Recognising that economic growth alone cannot fully explain the environmental outcomes, recent studies have examined the other determinants of environmental sustainability. In this line, a study by Sharmiladevi (2024) found that factors like agricultural value added, industrial growth, and fossil fuel consumption significantly increase carbon emissions, whereas trade openness and foreign direct investment reduce emissions, challenging the traditional pollution haven hypothesis. This study also incorporated institutional quality and urbanisation into the nexus and highlighted that urbanisation reduces environmental degradation, while institutional quality increases it. This implies that stronger governance initially supports economic growth rather than improving environmental quality. Similarly, Li and Zhang (2025), while studying six SAARC countries, found that institutional quality helps to protect the environment only when it is paired with renewable energy adoption and financial development, while industrialisation and unchecked globalisation continue to increase pressure on the environment.

Various studies have also focused on the role of energy transition and technological innovation in achieving sustainable development. Studies like Raihan et al. (2024) highlighted that increased nuclear energy consumption significantly reduces greenhouse gas emissions in the long run. Bhardwaj and Chauhan (2025) further showed that renewable energy capacity and economic growth Granger-cause each other, indicating that investment in clean technology helps in sustainable economic growth. Similarly, Pachiyappan et al. (2022) found that environmental patents substantially reduce carbon emissions.

Recent studies have also broadened the analytical view by including cross-country and subnational comparisons. A study by Jie and Rabnawaz (2024) used data from 55 countries and argued that technological innovation can help to reduce carbon emissions if it is complemented with institutional governance to effectively use that clean technology. Within India, Kumar et al. (2025) found evidence supporting EKC for the state of Haryana, suggesting that significant regional differences exist in the income-environment network. This finding raises questions regarding the appropriateness of treating India as a homogeneous unit.

Beyond econometric investigations, many studies have examined the policy and governance aspects of sustainable development. Mani et al. (2012) found that the long-term economic costs of environmental damage (such as water contamination and air pollution) are far greater than the short-term costs associated with environmental regulation. Dubash (2012) observed that weak enforcement and institutional limitations continue to weaken policy effectiveness despite the Environmental (Protection) Act, 1986. Similarly, Datt and Ravallion (2002) highlighted the strong relationship between poverty and environmental quality, arguing that poor households rely heavily on natural resources and remain the most vulnerable to environmental shocks. Recently, the study by Singh (2018) assessed India's Nationally Determined Contributions (NDCs) under the Paris Agreement and concluded that, since the country's climate goals are ambitious, stronger policy coordination in the transport, energy, and urban sectors. Supporting these findings, NITI Aayog (2021) identified green energy, eco-infrastructure, sustainable agriculture, energy conservation, and sustainable town planning as important pillars for India's long-term low-carbon development strategy.

Therefore, the existing literature does not converge on a single answer to whether growth enhances environmental quality. Empirical findings vary by environmental indicator, sample period, and econometric method, and factors such as renewable energy consumption, technological innovation, effective governance, and sector-targeted government policies significantly shape the curve. This is the gap that this paper's policy section tries to address.

Research Gap

Despite the extensive literature on the relationship between economic growth and environmental quality in India, many important gaps remain. Results on EKC validity are conflicting; some studies verify it (Behera, 2021; Sinha and Shahbaz, 2017), while others reject it (Pata et al., 2022; Adeneye and Rasheed, 2025). This inconsistency in the results mainly arises from variation in sample periods, econometric techniques applied, and variables used to measure environmental quality. No paper in this literature pulls this apart, and this paper can address this gap.

Secondly, several recent papers study multi-country panels where India is one case among the many countries; therefore, a paper considering India alone is important.
Finally, while many studies concentrate on validating EKC through econometric analysis, very few studies translate their findings into coherent policy recommendations; this study aims to fill these gaps by providing a thorough review of the relationship between variables, and instead of just testing the validity of EKC, the study synthesises evidence from recent research to find the main drivers of sustainable economic growth and also identify the policy measures that can help India to achieve long term economic growth while maintaining the quality of the environment.

Objectives

This study has the following objectives:

1. To critically review current literature and policy framework to understand the relationship between economic growth and environmental quality in India, with a focus on the EKC hypothesis.
2. To evaluate India's current policy framework against the existing literature and to suggest which policy is actually effective.
3. To produce policy recommendations that hold up regardless of the validity of the EKC hypothesis.

Research Methodology

The present study uses the descriptive and analytical research methodology, with a narrative review that brings together what researchers have done to understand the relationship between environmental quality and economic growth in India, specifically studying the Environmental Kuznets Curve. The study relies on peer-reviewed articles from 1993 to 2025, including reports published by reputable organisations such as the World Bank, the Intergovernmental Panel on Climate Change (IPCC), and the Indian Ministry of Environment and Forests (MoEF). The studies relevant to the topic are analysed to assess whether the researchers reach a consensus on the relationship between the said variables. Specific attention is paid to the indicators used in the studies, the research methodology adopted, and the economic policy suggested to resolve the problem.
To check the effectiveness of India's current policy system, the results of the empirical literature were compared with national policies and programs regarding climate change, pollution control, renewable energy, and sustainable development. The interpretative nature of the study helps compare findings to assess the validity of the EKC. Since the study does not use any primary data or new statistical or econometric methods, it gathers evidence from the existing literature to build a clear understanding of the relationship between economic growth and environmental quality in India. The study also makes evidence-based policy recommendations that remain valid despite of the conflicting results on EKC validity.

Results and Discourse

After reviewing the existing literature and policy documents, the complex relationship between economic growth and environmental quality. This relationship cannot be explained by the EKC hypothesis. Various studies confirm the U-shaped relationship (Behera, 2021; Sinha and

Shahbaz, 2017), but many others either reject the EKC or suggest alternative views based on the indicators, study period and econometric technique used (such as Pata et al., 2022; Adeneye & Rasheed, 2025). Therefore, this shows the importance of environmental quality indicators and the econometric technique used to understand the interplay, and it also suggests that economic growth alone does not play a significant role in determining environmental quality. Empirical studies that used carbon dioxide emission as a measure of environmental quality often support the EKC hypothesis, while others using the ecological footprint reject it. Similarly, econometric techniques such as ARDL, FMOLS, DOLS, and RALS-Fourier Cointegration used in the study also play a major role in explaining the variations.

Despite controversy regarding the validity of the EKC hypothesis, the reviewed literature shows agreement on the determinants of sustainable development. Evolution and investment in renewable energy prove to be the most important factors contributing to sustainable development (Raihan et al., 2024; Bhardwaj & Chauhan, 2025). At the same time, developments in green technology and R&D in environmentally friendly products help reduce greenhouse gas emissions in the long run, as suggested by Pachiyappan et al. (2022). Another important determinant of environmental quality is governance and institutional quality of a country, although there are conflicting results concerning this; still, it can be said with confidence that implementation of environmental regulations, good governance and institutional quality have a significantly positive effect on the environment (Dubash, 2012; Li & Zhang, 2025). Moreover, the study suggests that policy effectiveness depends upon its implementation rather than mere creation.

Efforts like the National Action Plan on Climate Change, the National Green Hydrogen Mission, development in renewable energy sources, increasing reliance on electric vehicles, afforestation measures, and contribution to the Paris Agreement clearly show that India's development policy has already incorporated the idea of protecting the quality of the environment while ensuring growth and development. However, implementing these policies faces several challenges, including regulatory and coordination issues, funding allocation, uneven technology adoption, and regional differences in environmental performance. The empirical literature also shows that environmental sustainability can be achieved through proper urban planning, water resource management, improved agriculture, a better transport system and technological innovation. Therefore, an integrated policy measure is required to ensure growth while protecting the environment. Thus, the discussion around EKC is significant in the academic setup, but it does not have a significant effect on decision-making in practice, and an active policy framework is required instead of just validating the EKC hypothesis.

Policy Recommendations

The results of the study recommend the following policy measures:

i. Accelerate the transition to renewables: More investment should be made in solar, wind power, green hydrogen, and modern electricity infrastructure to reduce dependence on fossil fuels.
ii. Strengthen environmental governance: Regulatory enforcement needs to be improved through constant monitoring, auditing and increasing industrial accountability.

iii. Promote eco-friendly innovation: More investments should be made in research and development of eco-friendly and clean technology, and circular economy practices need to be promoted.
iv. Integrate sustainability in growth planning: The environment should be protected and conserved while framing policies for urbanisation, industrialisation, agriculture and infrastructure development.
v. Decentralise policy implementation: Since India is a diverse country, state governments should be given the flexibility to formulate sustainable development strategies best suited to their regional needs.
vi. Increase investment in sustainable development and create public awareness: Public-Private Partnerships in green finance should be promoted, and more awareness must be created among the citizens of the country to protect the environment.

Conclusion

Presently, India is at a critical phase of the development process, where the challenge is to accelerate the economic growth of the country without compromising the quality of the environment. This study examined the empirical literature and policy documents to understand the relationship between income and the environment, using the case of the Environmental Kuznets Curve.

The existing literature presents inconclusive results regarding the validity of the EKC, as some studies validate the U-shaped relationship while others reject it or present alternative results depending on the environmental indicator and methodology used. Therefore, the EKC should not be seen as a universal theory to explain India's environmental trajectory.

Nevertheless, the empirical literature has rightly presented the policy interventions necessary to improve environmental quality. The major factors that affect the quality of the environment include the development of renewable energy sources, eco-friendly technology, effective regulatory enforcement, infrastructure development and integrated climate policies.

The analysis of India's policy framework suggests that significant efforts have been made in terms of commitment to climate protection, developing renewable energy sources, initiating pollution control programs, and other strategies to ensure sustainable development. Nonetheless, there are still many problems in policy implementation, including the need for sustained investment in environment-friendly sustainable development. Therefore, the study suggests that future studies should not rely on EKC; instead, countries should work to incorporate social, economic and sustainable concepts in the policy framework.

References

Adeneye, Y. B., & Rasheed, R. O. (2025). Economic growth, coal consumption and environmental sustainability: Revisiting the Environmental Kuznets Curve in developed and developing economies. *Environmental Science and Pollution Research*. Advance online publication.

Behera, S. R. (2021). Economic growth, energy consumption and environmental degradation in India: Evidence from the Environmental Kuznets Curve hypothesis. *Environmental Science and Pollution Research, 28*(36), 50387–50403. https://doi.org/10.1007/s11356-021-14086-5

Bhardwaj, A., & Chauhan, R. (2025). Renewable energy capacity and economic growth nexus in India: Evidence from ARDL and Granger causality analysis. *Energy Policy*. Advance online publication.

Central Pollution Control Board. (2024). *National water quality monitoring programme report*. Ministry of Environment, Forest and Climate Change, Government of India.

Datt, G., & Ravallion, M. (2002). Has India's post-reform economic growth left the poor behind? *Journal of Economic Perspectives, 16*(3), 89–108. https://doi.org/10.1257/089533002760278730

Dinda, S. (2004). Environmental Kuznets Curve hypothesis: A survey. *Ecological Economics, 49*(4), 431–455. https://doi.org/10.1016/j.ecolecon.2004.02.011

Dubash, N. K. (Ed.). (2012). *Handbook of climate change and India: Development, politics and governance*. Oxford University Press.

Government of India. (2025). *Economic Survey 2024–25*. Ministry of Finance.

Grossman, G. M., & Krueger, A. B. (1991). *Environmental impacts of a North American Free Trade Agreement* (NBER Working Paper No. 3914). National Bureau of Economic Research.

Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *Quarterly Journal of Economics, 110*(2), 353–377. https://doi.org/10.2307/2118443

Intergovernmental Panel on Climate Change. (2023). *Climate change 2023: Synthesis report*. IPCC.

International Energy Agency. (2024). *India energy outlook 2024*. IEA.

IQAir. (2025). *World air quality report 2024*. IQAir.

Jiao, Y., Xing, L., Zhang, Y., Ma, X., & Wang, S. (2022). Decoupling carbon emissions from economic growth in China and India: A comparative decomposition analysis. *Journal of Cleaner Production, 350*, 131470.

Jie, L., & Rabnawaz, M. (2024). Renewable energy transition, institutional absorptive capacity and environmental sustainability: Evidence from 55 countries. *Renewable Energy, 231*, 121091.

Kumar, A., Fatima, S., Khan, M., & Alnafisah, K. (2025). Economic growth and environmental sustainability in Haryana: Evidence from cointegration analysis. *Environmental Monitoring and Assessment*. Advance online publication.

Li, Y., & Zhang, X. (2025). Institutional quality, renewable energy and ecological footprint in SAARC countries: Evidence from CS-ARDL estimation. *Environmental Science and Pollution Research*. Advance online publication.

Mani, M., Markandya, A., Sagar, A., & Strukova, E. (2012). *An analysis of physical and monetary losses of environmental health and natural resources in India* (Policy Research Working Paper No. 6219). World Bank.

Ministry of Environment, Forest and Climate Change. (2023). *India: State of environment report*. Government of India.

National Institution for Transforming India. (2021). *India's long-term low carbon development strategy*. Government of India.

Pachiyappan, D., et al. (2022). Green innovation, economic growth and carbon emissions in India: Evidence from bootstrap ARDL analysis. *Environmental Science and Pollution Research, 29*, 67540–67558.

Panayotou, T. (1993). *Empirical tests and policy analysis of environmental degradation at different stages of economic development* (Working Paper WP238). International Labour Organization.

Pata, U. K., Shahzad, U., Fareed, Z., & Rehman, A. (2022). Investigating the Environmental

Kuznets Curve hypothesis in India using ecological footprint pressure index and RALS-Fourier cointegration. *Environmental Science and Pollution Research, 29*, 62863–62878.

Raihan, A., Zimon, G., Alam, M. M., Khan, M. A., & Sadowska, B. (2024). Nuclear energy consumption and greenhouse gas emissions in India: New evidence from ARDL and cointegration analysis. *Nuclear Engineering and Design, 422*, 113071.

Sharmiladevi, J. (2024). Agriculture, industrialisation, trade openness and environmental degradation in India: An ARDL approach. *Environmental Science and Pollution Research*. Advance online publication.

Sharmiladevi, J. (2025). Institutional quality, urbanisation and ecological footprint in India: Evidence from dynamic time-series analysis. *Environmental Science and Pollution Research*. Advance online publication.

Singh, C. (2018). India's climate policy and the Paris Agreement: Challenges and opportunities. *Climate Policy, 18*(5), 640–651. https://doi.org/10.1080/14693062.2017.1418497

Sinha, A., & Shahbaz, M. (2017). Estimation of Environmental Kuznets Curve for CO_2 emission: Role of renewable energy generation in India. *Renewable Energy, 119*, 703–711. https://doi.org/10.1016/j.renene.2017.12.058

Stern, D. I. (2004). The rise and fall of the Environmental Kuznets Curve. *World Development, 32*(8), 1419–1439. https://doi.org/10.1016/j.worlddev.2004.03.004

Stern, D. I. (2017). The Environmental Kuznets Curve after 25 years. *Journal of Bioeconomics, 19*(1), 7–28. https://doi.org/10.1007/s10818-017-9243-1

United Nations Environment Programme. (2024). *Emissions gap report 2024*. UNEP.

World Bank. (2023). *World development report 2023: Migrants, refugees, and societies*. World Bank.

World Bank. (2025). *World development indicators*. World Bank. https://databank.worldbank.org/source/world-development-indicators

14
Crime Among Youth and its cause: A study of under-trial youths in Nagpur Central Prison

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Introduction

India ranks first in population, with around 1.46 billion people, surpassing China's population. Indeed, the youth are the gems and future of India. While there is so much to celebrate about youth in India, unfortunately, some engage in immoral, unbecoming behaviour, committing crimes and related activities that harm society and raise concerns about public safety, security, and well-being. Crime is one of the most baffling problems of human society. It is a national and a global issue.

Crime and law: In legal terminology, crime is defined as any violation of a country's statutes, interpreted as any violation of the legal statutes of the country. The elements necessary to comprise a crime are the following:

1. A perpetrator committing the crime and a victim of that crime.
2. There must be evidence of the perpetrator's legal intent.
3. Substantiated evidence of the intent to commit a crime. 4. Substantiated evidence as proof of the crime committed. (Huda 1902).

Crime statistics: There was a documented increase in violent crimes and murders from the 1950s to the 1990s. There were 55,726 violent crimes committed in 1961, but they increased substantially by 1996, when there were continued increases of 243,574 crimes. 1986 Statistics revealed 27,269 homicides, which rose dramatically to 37,671 in 1996. In 2004, there were nearly 35,000 murders in India and about 28,000 attempted murders (NCRB 2004). 1992 was the highest crime occurrence. (NCRB 2004). There were 243,574 about 4,000 & " culpable homicides not amounting to murder (NCRB 2004). In 2004, there were more than 64,000 deaths from negligence (NCRB 2004). Most Indian murder victims were between 18 and 30 years of age and male (NCRB 2004). The most prevalent crimes are stabbings and beatings (NCRB 2004). Additionally, in 1971 there were 2,500 rapes committed and reported to the authorities. In 1993, that number increased to 12000. (NCRB 2004). By 2004, the number of rape cases rose to 18,233 (NCRB 2004). In 1980, approximately 23,000 robberies were reported in India. In 1992, the number of rapes increased to its peak year for rapes to be committed. In 1992, there was a staggering increase to 26,444. Moreover, by 2004, the number of reported robberies had declined to about 18,5000, In 1975, there were 192,854 reported burglaries. In 2004, it declined to 92,490 (National Crime Records Bureau, 2004).

The age range for youth, as defined by the United Nations (2003), is 15-24 years. India's national youth policy for 2014 expanded the age range from 15 to 29 years. This bridges the link between the early and late stages of development. The youth stage is influenced by social, economic, political, and cultural factors. Statistics show that various social, economic, political, and cultural factors influence adolescents.

Also contributing factors include family, peers, neighbourhoods, schools, and communities. All these factors play a vital role in the development and growth of the youth. From adolescence to adulthood, youth face many roadblocks. It is crucial to recognise that this transition is not solely a physical process but also a complex social and economic issue, as Prakash (2013) emphasises. Bennell (2007) further highlights that young individuals residing in rural areas of India are expected to contribute to their families' way of life. However, they encounter various barriers, including limited access to education, limited skills, financial constraints, and limited land ownership (Zaneta, 2022), all of which hinder their entry into the workforce. Adding to this is limited access to opportunities that may affect their growth and development. To understand young people's well-being, it is essential to consider social, political, cultural, and historical contexts (Kehily, 2007). Before COVID-19, most youth had limited access to employment opportunities. The number of non-working youths was estimated at 6.1 per cent, the highest in 45 years, according to the periodic Labour Force Survey (PLF5) for 2017-2018. It declined further in 2018-19 to 5.8 per cent (Gupta, M., & Kishore, A., 2022). Panel data on monthly changes in conception and employment status showed that 4.6 per cent of households reported that a member who was working in March 2019 had become unemployed in April 2019. (Gupta, M., & Kishore, A., 2022). National Sample Surveys took three different approaches to this problem to determine the status of each unemployed youth.

There are three different approaches adopted in the National Sample Surveys (NSS) to determine the activity Status of each person in the population-

1. The Customary Status approach: A youth is considered unemployed if he was not working or seeking employment for a period of 1 year.
2. The Weekly Status approach: A person's status is determined by how long he has worked and the length of that work, or by his status as a person deemed to be unemployable is determined by how long he has worked and the length of that work, or the availability to work for that week.
3. The Daily Status approach: An individual is given one or more activities for each day of a week.

A person is unemployed if he/she has not worked for at least one hour on a given day of the week, and has been seeking work or available for work at any time during the week (Satya Paul, 1988). To reduce poverty, productivity has to increase, which would be a great thing for people experiencing it. Even though the nation's GDP has increased, unemployment has not grown to that extent. There is also concern regarding the educated unemployed, which can lead to the waste of human resources and social tensions. (S. Mahendra Dev, Mahajan 2002). There are three basic facts about unemployment in India:

1. Most of them work as self-employed or on a daily-wage basis, and only a few hold regular jobs.
2. There is limited access to social security for all; only a few who are well off have social security.
3. Say's Law of employment Holds That the Supply of labour creates its own demand. (Ajit K. Ghose 2004).

Juvenile offences in India increased by about 2.7% compared to 2022 (National Crime Records Bureau 2023). There were 31,365 registered juvenile cases nationwide. 40,036 Juveniles were

apprehended, of whom 79% were aged 16-18. (National Crime Records Bureau 2023). Delhi recorded the highest juvenile crime rate. Maharashtra had about 12% of juvenile crime cases in 2023. (Times of India 2023) More serious offences were committed by youth in recent years, such as murder, rape, attempted murder, robbery, and extortion. Police reports testify that juveniles were involved in gangs and violent crimes in some major cities. (Unacademic, 2025). Violent crimes are more common than petty crimes, and petty crime is declining. Underlying causes for these offences are said to be socioeconomic stress, influence of violent media, weak parental supervision, and association with gangs or organised crime elements. (Unacademic 2025). Crime is a significant concern in India, especially in urban areas. Several studies have examined the causes, patterns, and consequences of Crime among youth. A study by Kumar and Verma (2018) found that illiteracy and school dropout rates significantly increased the likelihood that youth would engage in criminal activity, especially in urban areas. Another study by Singh (2017).

A study on Juvenile delinquency in Indian prisons revealed that friends have a very significant impact on initiating crime among youth; many offenders reported that their friends or gangs influenced them, and they felt identity and belonging. These findings align with social theory, which states that social behaviours are learned through interactions with close friends. According to a study by Patil (2015), youth from dysfunctional families, broken families, and families with a history of Crime or severe poverty are more vulnerable to criminal activities. Lack of parental supervision and discipline has contributed to behavioural problems and delinquency. A research study conducted by Roa and Mehta (2019) said that youth who are exposed to violent movies, crime-based television shows, and media with violent content have been influenced by it. A report by the National Crime Records Bureau (NCRB, 2022) stated that a significant portion of prisoners under trial in India are youth. Delays in the judicial process, repeated arrests, and custodial mistreatment further affect the psychological well-being and chances of rehabilitation. These studies, of course, provide considerable insights, yet there remains a lack of focused research on undertrial youth in central prisons. The early juvenile court reformers argued that the justice system should offer young offenders treatment that would help them to cure them of their antisocial ways. The justice system fails to take age and immaturity into account when calculating criminal punishment. In 2005, the United States Supreme Court abolished the Juvenile death penalty as cruel and unusual punishment, emphasising that the immaturity of adolescents was found to be less culpable than that of adult Criminals. (Scott, E.S., Steinberg, L., 2008). The authors present a developmental model for the justice system to revise the Juvenile justice policy that treats adolescents neither as children nor as adults, but as an intermediate legal category. This model, they stress, is compatible and more likely to promote social welfare by reducing the societal cost of juvenile crime. (Scott, E.S., Steinberg, L. 2008).

A study by Meek R (2006) in England says that the rural policy and practice have failed to meet the needs of young people, particularly those caught up in the criminal justice system. The key issues within rural communities include a lack of Services, isolation, and inter-generational tensions, which could increase the chance for the young to commit a crime again when returning to their communities after release from prison. (Meek, R. 2006). (USA) Virginia Powell, in her Study of juvenile justice, reveals that the system followed at present is

not conducive to youth and their development of life skills as they experience animosity and loneliness in jail. Putting youth behind bars is not a long-term solution to their crime; rather, it brings more profound psychological consequences. Among youth who are incarcerated, emotional and behavioural issues are found. These suggest a more developmental and diplomatic approach within the juvenile justice system to provide effective treatment for the youth. (Virginia Powell 2014).

Researchers' questions in the study:

- What is the pattern and prevalence of crime committed by youth globally and nationally?
- What types of crimes are commonly committed by youth?
- How do youth vary by age, gender, and locality (Urban and Rural)?
- What socioeconomic factors are associated with youth involvement in Crime?
- How has youth crime changed over the last decade in India?
- What interventions could be done to reduce youth crime? What policies and programs would help rehabilitate and reintegrate youth back into society?

The objective of the research in studying this topic:

- To study the nature and patterns of crime among youth.
- To understand the personal and family backgrounds of youths; know the personal and Family background of the youths who are engaged in various crimes.
- To understand the economic status of the youth criminals.
- To identify the various factors responsible for youth becoming criminals. Find out various possible factors responsible for the youth becoming criminals.
- To suggest various remedies to prevent the youth from committing crimes.
- To elucidate the characteristics of youth criminals. To study their educational background.

Methodology

Social work research plays a vital role in the field of professional social work. The profession of Social Work requires systematic, empirical, reality-based data collection and its validation through rigorous methods. It seeks to discover new truths and explanations.

Rationale of the Study

Youth crime is increasing day by day. The increasing number of such crimes poses a threat to society. In a country like India, the majority of the crimes are committed by the youth. As far as the researcher's knowledge goes, a microscopic Study has been done among youth criminals. The researcher himself is a professional social worker specializingwith a specialization in criminology and correctional administration. He has been gaining knowledge of criminals from books, but his knowledge is limited to young criminals. He was curious about why youths are becoming criminals. In other words, the researcher wanted to know what factors are responsible for turning youths into criminals.

Crimes committed by youth are seen as a breakdown in the established order of society. Youth crime is increasing day by day. The increasing number of such offenders poses a threat to society. It affects a vast number of people in society in various ways. In a country like India,

the majority of crimes are committed by the youth. Crimes committed by youth are violations of the law. Given the numerous laws, there are many ways to become a criminal. The researcher wanted to know which factors are responsible for youth becoming criminals. At the same time, he wanted to understand the problems faced by youth and propose solutions to those problems.

Research Design for the topic

Research design is a temporary plan that undergoes many modifications as the Study progresses. It is a blueprint that helps the researcher. In it, a general scientific model is translated into different research procedures. It provides an outline of the research program's structure and process. Without such a plan, no scientific study is possible.

Type of Research Design

For the proposed Study, the researcher will use a descriptive and exploratory method.
The descriptive method highlights the characteristics of an individual, group, or a situation
Descriptive studies require prior knowledge of the universe, measurement techniques, and related methods. It is mainly concerned with the past form of the problem. The problem is described, and a hypothesis is formulated based on the description of existing data or material. Its aim is not to cause the problem or provide a solution, but to acquire knowledge. Moreover, in an exploratory Study, new facts are discovered. In the present Study, the researcher also aims to acquire more information about youth crime and its causes. At the same time, he wants to discover new facts on the causes of youth crimes.

Sampling Universe, Method and Size

The research project topic was "Crime among youth and its causes: A study of undertrial youths. Nagpur Central Prison. It includes all youth criminals currently in the Central Prison.
For the present Study, the researcher used purposive sampling. Here, the researcher purposively selects a few units as a sample. He is free to choose them as he wishes. Hence, it is called purposive sampling. The researcher has selected the purposive sampling method because he selected those respondents who, in his judgment, support the whole data. The researcher selected the respondents with a specific purpose in mind. A sample of 50 male respondents from the Central Prison, Nagpur, was selected through purposive sampling.

Tools of Data Collection

For the present study, the researcher used an interview schedule as a data collection tool.
An interview schedule is a set of questions to be asked of the respondent in a particular format. An interview is the best tool for data collection, as it provides an opportunity for an informal conversation with respondents and to explore relevant aspects beyond formal data collection.

Limitations of the Study:

1. As the research period was limited, it was not possible for the researcher to conduct a census study or take a larger sample size. So the Study was restricted to the findings on the responses of 50 respondents.
2. As the researcher had to complete his research project within a specific timeframe, he limited his study to youth offenders.

3. The Prison authority did not permit women prisoners, which is why the Study was limited to male prisoners only.
4. As the criminals were on trial, they were not accepting their crimes and were also giving wrong information

Quantitative Analysis of Youth and Crime

Youths have different character structures, goals, aspirations, values, and a radically different tempo of life. They have competitive and aggressive attitudes toward life and possess courage, guilt-free morality, and a settled self-judgment. When they experience frustration at their ego being attacked and traumatised, they project hostility. The search of the youth or the adult in the new society has emulated a desperate and futile quest. Often, they find it quite difficult to perform the expected roles. Some of the youths feel alienated, detached, isolated, frustrated, and relatively deprived. Society provides very little that is stable, relevant, and meaningful. They often look in vain for values, goals, means, and institutions to which they can commit, because their drive to do so is strong. The youth crime information of the respondents includes the age at which Crime started, reason for Crime, awareness about Crime, reasons for becoming a criminal, encouragement from the media, ambition as a child, whether a family member was arrested, time of committing Crime, and likeness towards Crime. These factors, combined, provide the background of the respondents. In this chapter, the investigator has attempted to present the analysis of the mentioned factors.

1. It was found that the majority, i.e., 74 per cent of the respondents, started committing crimes before age 18crimeCrime below 18. The percentage of respondents aged 25 and above is significantly lower in the middle-aged group.
2. The response of 64 per cent of respondents shows that they were aware of their crime, yet they committed it. This shows that circumstances compelled them to break the law and commit a crime.
3. 34 per cent of the respondents committed a crime to get money. In India, poverty is a major problem. So, poor people, to get money, become criminals. 4.88 per cent of the respondents do not want to continue in this field. This also shows that they committed a crime accidently. Whereas some of the youth criminals, i.e., 12% of respondents, want to be in this field only. They are mostly habitual criminals, or they want to take revenge on the opposite party; that's why they wanted to do it again.
4. 56 per cent of the respondents are good at quarrelling. This is very common among the youth, and that's why the maximum respondents belong to this category, whereas murder and gambling percentages are very low because in this category, youth are not very interested, and they are afraid of murder.
5. It was found that 40 per cent commit a crime with no specific time. The second-highest group of respondents commits a crime at a friend's request. This proves that friends play an important role in a respondent's life.
6. The majority, i.e., 56 per cent of the respondents, are not encouraged by the media. That means some other factors are also responsible for their crime.

7. 68 per cent of the respondents said that the police did not arrest family members; this shows that youth can become criminals, even when their parents were not arrested or involved in criminal activity.
8. The respondents wanted to be in a good field. But for one reason or another, they becamebecome criminals. However, some respondents have wanted to become criminals since their childhood. Their ambition was to become criminals.

Personal and Family Background Results Analysis

The necessity of personal information arises out of the fact that one's background, to a certain extent, influences one's understanding and attitude towards every aspect. The personal information includes age, marital status, caste, religion, type of Family, and earning members in the Family. One of the most direct sources of youth becoming criminals has been traced to the family's failure to meet needs, provide necessary emotional support, maintain social control, and transmit society's moral and social values of society. Youth aged ~~16-25~~ ~~are~~ still very much dependent on family support, which provides love, affection, and sympathy from both parents.

The family information includes the family atmosphere, the father's occupation and income, the family's relationship after the crime, and the family's habits. These factors, combined, provide the background of the respondents. In the chapter, the investigator has attempted to present the analysis of the mentioned factors.

1. It is noted that 36 per cent of the majority of the respondents are in the age group of 18-28, and the crime committed by these people is more than that of middle-aged people. During youth, a person is not established mentally. So a person's mental condition is also related to crime.
2. 34 per cent of the respondents are illiterate, and only a few have higher education. This shows that an illiterate person has a high likelihood of becoming a criminal.Hindu respondents were in higher numbers, i.e., 48 per cent. In India, the majority of the population is Hindu, so the Study reflects the same ratio.
3. The maximum percentage of respondents (72 per cent) are unmarried. This suggests that married people have more responsibility. Whereas an unmarried person is totally free from responsibility, so he lives according to his own will and pleasure.
4. The majority, i.e., 66 per cent of the respondents, live in an urban area. Most of the people in India live in rural areas, but the crime rate is higher in urban areas.
5. Marathi mother tongue respondents were the maximum, i.e., 56 per cent. The local language of Maharashtra is Marathi, so respondents with a Marathi mother tongue are more.
6. The majority of the respondents, i.e., 38 per cent, are very close to their mothers. This is because the mother is the person who loves the child from birth. Moreover, no one loves a person more than a mother.
7. The majority of the respondents, i.e., 56 per cent, have been arrested more than 5 times. There are youth criminals who are habitual in this field. However, sometimes when the police do not find the right criminal, they arrest these youth criminals.

8. The largest share of respondents, i.e., 58 per cent of the friends circle, are moderately educated; at the same time, the percentage of highly educated people is very low.
9. The majority of the respondents, i.e., 52 per cent, are addicted to alcohol. Of these, 36 per cent belong to the 18-23 age group.
10. The majority, i.e. 64 per cent of the respondents, want to earn money steadily. The commoner also wants to earn steadily, so there is not much difference between the respondents and the common man.
11. 72 per cent of the respondents believe in God. They say it is the work of the devil that has put them in prison. In every human being, there is a fear of some external forces. The soul, which is given to humanity, always speaks against evil. That is why the majority of the respondents believe in God.
12. It is found that the majority of the respondents, i.e., 48 per cent, think that family members alone can change a youth criminal. This is because family members of the Family are very close to a criminal, and they never want to harm him.
13. It shows that the majority, i.e., 50 per cent of the respondents, have a relationship with a family member that has not spoiled, even after committing a crime.
14. Most respondents (32 per cent) want to continue in this field, and the same percentage want to join as daily labourers.
15. It is found that the majority of the respondents, i.e., 48 per cent, want to leave the criminal field.
16. The family with a peaceful atmosphere, i.e., 58 per cent, are in the majority. This states that a criminal can also come from a peaceful Family. However, there is a greater chance of becoming a criminal, stemming from a quarrelsome or neglectful Family.
17. The majority of the respondents, i.e., 24 per cent of fathers, are illiterate or have significantly less education.
18. Most of the respondents' mothers are illiterate (36 per cent). In most Indian states, women lack access to education, except in a few states like Kerala. Women in Maharashtra also lack education and have no impact on their children
19. Most of the respondents' fathers are daily labourers, i.e., 32 per cent. This means they do not have a permanent job, and also do not have any fixed income.
20. The majority of the respondents, i.e.. 38 per cent of neighbourhood people work as daily labourers because they lack education and come from poor backgrounds.
21. The largest number of respondents are cool-minded, at 48 per cent; their percentage is 48. Nevertheless, usually cool-minded people do not become criminals easily, so the data may not be authentic.
22. Most of the youths, i.e., .58 per cent of the respondents, belong to the middle-medium class. The percentage is high in this class because they are economically weak and, moreover, they don’t have any status.
23. It was found that 56 per cent of the respondents' fathers are earning between Rs. 2000 to 3000. This means they are earning less than Rs 100 per day, which is not at all sufficient to support a family in modern times.

Result Analysis on Causes of Youth Crime

A lot of debates are going on about the possible factors which are responsible for promoting the youth to move towards crime and criminality. Biological and psychological researchers who believe that genetic, environmental, hereditary, temperament, and intelligence are factors need to be studied by criminologists. Biological researchers believe it is the genetic composition (i.e., low arousal) and/orand / or heredity, and if the parents are criminal, then there is a high tendency of that particular youth to become criminal. Whereas the Psychological scholar states that the personality of the offenders plays an important role rather than biology. The unconscious elements (i.e. Freud) and impulsive antisocial behaviour are the characteristics of youth offenders. Hence, youth offenders have no control or are not able to balance these characteristics and ultimately such youths are more likely to engage in criminal activity. The spectrum in the middle includes social organisation, social control, and developmental scholars have their own theories of factors contributing to criminal behaviour. For example, social control scholars say that the types of formal and informal social controls an individual determines their criminality. Schools, sports organisations, and churches are referred to as informal controls. Developmental and Age- graded scholars have a longitudinal approach, covering the life span of an individual and their movements towards crime. According to Age -graded scholars, juvenile delinquency and childhood antisocial behaviour are the best predictors of adult criminality. Developmental theorists assert that some factors may explain criminality that begins in early adolescence, but other factors may explain criminality that starts in adulthood (Daniel, C. 1998). The information regarding causes of youth crime includes spending Money, opinions toward Crime, the cause of becoming a criminal, supporting factors, encouraging factors, discouraging factors, and the likeness of the movie. The combined factors provide the background of the respondents. In this chapter, the investigator has attempted to present an analysis of the mentioned factors.

1. In the majority of the respondents, i.e., 52 per cent, the responsible factors are those that they don't want to share. The other factors includethat included politicians, gangs, teams, and other social phenomena. For the next majority group, i.e., 38 per cent of the respondents, the main factor is poverty, which is a social cause for crime.
2. A high number of respondents, i.e. 34 per cent of the respondents, committed a crime for monetary gain. In India, poverty is indeed a significant problem.
3. The majority, i.e., 24 per centper cent of the respondents, are involved in criminal activity. However, in this group, only the respondents' friends are involved.
4. It is found that the majority, i.e., 68 per centper cent of the respondents, are not supported by anyone and hence they are alone. But it is very strange that 14 per centper cent of the total respondents are supported by the police. Police receive a certain percentage of the criminal's money as support.
5. 58 per cent of respondents believe that prison can't change their life. It shows that youths are ready to commit crimes again and again, and they have no fear of punishment in jail. It proves that a fearless lifestyle also leads to crime among youths.
6. The majority, i.e., 48 per centper cent of the respondents, share their criminal experiences with friends at any time without experience at any time with their friends without any fear, shame, or hesitation.

7. Mostly, i.e., 86 per cent of the respondents, are discouraged by family members from committing crimes. It is because the Family teaches the person all the good things. Nevertheless, the youths disobey the teachings and commit a crime. Disobedience is the cause.
8. The majority, i.e., 38 per cent of the respondents, are not encouraged by anyone. But friends and police are the factors that encourage them to commit a Crime.
9. A high number of respondents, i.e., 30 per cent, like criminal movies. This shows that the youths are very much interested in criminal movies. By watching criminal movies, youths want to learn the techniques shown and follow them in their future criminal lives.
10. The youth criminals who are unmarried may spend their money on a luxurious life. But the youth criminal who is married spends the Money on his Family.
11. The majority, i.e., 40 per cent of the respondents, share their Money with friends. It is because the youth tend to form friend circles and don't have much responsibility.
12. The maximum number of respondents, i.e., 34 per cent, are illiterate. Out of the 34 per cent who are illiterate, 12 per cent of respondent belong to the age group of 18-23, who are very young in age.

Conclusion

The present research study gave significant conclusions. In this study, most of the aims and objectives were achieved. The purpose of the study is to understand the patterns of crime among youths and the factors that lead youths to become criminals. To know the family and personal backgrounds, to understand the economic status of youth criminals, to identify possible factors responsible for youths becoming criminals, and to study their educational background of the youths who are engaged in crimes, to understand the economic status of the youth criminals, to find out the possible factors responsible for the youth to become a criminal, and to study the educational background.

In this study, it was observed that 74 per cent of the undertrial youths began their criminal activities before the age of 18. This shows that the youths' parents have no control over them, and that the youths acted independently. 64 per cent of undertrial youth criminals are well aware of their crimes, but still they commit them. 34 per cent of the undertrial youth criminals are committing crimes to get money. This indicates the poverty of the youth's family. 56 per cent of youth criminals are experts at quarrelling. This shows the family background. Parents failed to teach them about patience. In this study, 68 per cent of the undertrial youths' parents were never arrested or committed crimes. However, their children have committed crimes. It proves that society helps youths commit crimes. Another factor revealed that 24 per cent of the undertrial youths' ambition as a child was to become a criminal. This is a strange thing. Most of them may be the children of old criminals. In the next factor, 36 per cent of the study youth criminals are aged 18-23. This may be due to a lack of job opportunities. The government should take special steps to curb youth crime and engage these youths in productive work.

About 34 per cent of the youth criminals are illiterate. This shows that our country still has a long way to go in education. Proper educational facilities should be available in all prisons to avoid such miserable conditions. As per the study, 48 per cent of youth criminals are Hindus

and 42 per cent are Buddhists. 10 per cent are Muslim youth criminals. In all religions, there are many ways to transform humanity from doing evil to doing good. Nevertheless, none of the religions seems to have attracted the youth criminals. Proper moral instruction classes should be conducted in prisons for youth criminals to avoid such a lack. The next factor is caste. 86 per cent of the youth criminals belong to S.C. and S.T., 14 per cent belong to O.B.C. This shows that S.C. and S.T. people are still living as they did in the pre-independence era. S.C. and S.T. youths are not utilising the facilities available to them. The government should establish more welfare information centres to benefit S.C. and S.T. youths.

In this study, around 72 per cent of the youth criminals are unmarried, and 66 per cent of the youth are from urban areas. Unmarried youths are free from responsibilities and live according to their own will. Urban youths are not as hardworking as rural youths. Urban youths are lazy and irresponsible, so urban youth crime is more prevalent. According to a study, 56 per cent of youth criminals were arrested more than 5 times. Indian prisons are good for nothing. Still, 56 per cent of the youths wanted to stay at their place frequently. For them, prison is better than being outside. The prison authority should partner with a reputable NGO to support the rehabilitation of youth criminals, so that the youths are not habituated to this field.

It is observed that almost 100 per cent of the youth criminals are addicted to one or another harmful thing, like drugs, smoking, and alcohol. 52 per cent are addicted to alcohol, 30 per cent to smoking, and 18 per cent to drugs. This is not only bad for health but also very bad for society. Various youth counselling centres should be opened to give proper guidance to young people to avoid dangerous addictive substances. A study revealed that 48 per cent of the youth criminals wanted to leave the criminal field. It is a perfect sign. For such youth offenders, alternative arrangements should be made to support their livelihoods. Priority should be given to these youths in job placements.

It has been observed that up to 86 per cent of the family members of youth criminals discourage their criminal activities. The family members do not want their kin to suffer in prison. So they discourage the youths from committing crimes. On the other hand, 34 per cent of the youth criminals are encouraged by the police. This should not have happened. This may be occurring at the lowest level of the police department. Higher police authorities should take note of this and take serious action to avoid police officers encouraging youth criminals.

After a detailed study, it is observed that the factors for crime among youth criminals are poverty, poor education, addiction, greed for money, encouragement of friends/police, unemployment, bad society, criminal movies, sharing of criminal experience, unawareness of law and circumstances.

References

Huda, S. (1919). Principles of the Law of Crimes in British India. Calcutta, Butterworth & Co.

N. Prabha Unnithan. (2013). Crime and Justice in India. Sage Publications Pvt. Ltd.

Gupta, M., & Kishore, A. (2022). Unemployment and Household Spending in Rural and Urban India: Evidence from Panel Data. The Journal of Development Studies, 58(3), 545–560. https://doi.org/10.1080/00220388.2021.1983171

Satya Paul. (1988). Unemployment and Underemployment in Rural India. Economic and Political Weekly, 23(29), 1475–1483. http://www.jstor.org/stable/4378766

S. Mahendra Dev, & Mahajan, V. (2003). Employment and Unemployment. Economic and Political Weekly, 38(12/13), 1252–1261. http://www.jstor.org/stable/4413376

Ajit K. Ghose. (2004). The Employment Challenge in India. Economic and Political Weekly, 39(48), 5106–5116. http://www.jstor.org/stable/4415834

Scott, E. S., & Steinberg, L. (2008). Adolescent Development and the Regulation of Youth Crime. The Future of Children, 18(2), 15–33. http://www.jstor.org/stable/20179977

Meek, R. (2006). Social deprivation and rural youth crime: Young men in prison and their experiences of the "rural idyll". Crime Prevention and Community Safety, 8(2), 90–103.

Powel, V. (2014). Breaking Youth Behind Bars: A Literature Review. What are the Psychological Effects of Incarceration on Youth? UC Merced Undergraduate Research Journal, 7(1).

Verma, M., & Sharma, R. (2021). Education and youth crime: a review of the empirical literature. ACADEMICIA: An International Multidisciplinary Research Journal, 11(12), 581–586.

Bui, L., & Deakin, J. (2021). What we talk about when we talk about vulnerability and youth crime: A narrative review. Aggression and Violent Behaviour, 58, Article 101605. https://doi.org/10.1016/j.avb.2021.101605

Fuller, R. C., & Myers, R. R. (1941). Some aspects of a theory of social problems. American Sociological Review, 6(1), 24–32.

Singh, K. (1979). Criminology and social disorganization. Prentice Hall of India.

Devasia, V. V., & Devasia, L. (1992). Criminology, victimology and corrections. Ashish Publishing House.

Kumar, S. (1972). Social survey and research methods and techniques. National Publishing House.

Ahuja, R. (1996). Youth and crime. Rawat Publications.

Daniel, C. (1998). Crime reduction toolkits. http://www.crimereduction.gov.uk/toolkits/as020206.htm

Bandura, A. (1977). Social learning theory. Prentice Hall.

Banerjee, S. (2018). Psychological impact of prolonged undertrial detention on youth prisoners in India. Indian Journal of Social Work, 79(2), 215–230.

Government of India. (2022). Prison Statistics India 2021. National Crime Records Bureau, Ministry of Home Affairs.

Kumar, R., & Verma, S. (2018). Education, unemployment, and youth crime in urban India. Journal of Criminology and Criminal Justice, 6(1), 45–58.

Patel, M. (2015). Family environment and juvenile delinquency: A sociological study. Indian Journal of Criminology, 43(1), 67–82.

Rao, P. S. (2020). Media violence and its influence on youth criminal behaviour. Journal of Media Studies, 12(3), 101–115.

Rao, P. S., & Mehta, R. (2019). Substance abuse and criminal tendencies among youth offenders. Indian Journal of Mental Health, 6(4), 312–320.

Sharma, A. (2016). Socioeconomic determinants of youth crime in India. International Journal of Social Sciences, 4(2), 89–98.

Singh, R. (2017). Peer group influence and juvenile delinquency: An Indian perspective. Journal of Youth Studies, 10(1), 55–70.

United Nations Office on Drugs and Crime. (2019). Handbook on children recruited and exploited by terrorist and violent extremist groups. United Nations.

World Health Organisation. (2014). Preventing youth violence: An overview of the evidence.

15
Overcoming Cognition and Communication Challenges to Foster A Positive Psyche Identity, Unlocking Prosperity and Wellbeing

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Abstract
This is a generation of digital and information overload, social-media language, increased screen time, anxiety and stress resulting in deteriorating mental health. The pressures that pop up are self-doubt, fear of unknown, juggling of work, imaginative scepticism increasing cognitive and communication challenges. To overcome these challenges it is important to nurture them with positive attitude , emotional awareness to exploring mindfulness practices that support mental clarity. This develops in them positive psyche identity ,unlocking prosperity and well-being. In view of this a study was designed on 150 adolescents to assess their positivity quotient , communication and stress level. Their feedback were recorded on introducing mindfulness practices. Both Random and Convenience sampling method was used through assessment with standardized tools i.e Positivity Quotient Scale (PQs) and intrinsic feedback on stress level. The study revealed low positivity quotient with decreased optimism, lifestyle, resilience and communication level among adolescents. Students responded positively on introducing mindfulness practices which accompanied yoga, meditation, mindful daily activities focusing on individual's interest ,mindful eating and mindful lifestyle. Their feedback included that they stopped being judgemental, started accepting themselves as they are, focused on present moment, trusting themselves and letting things go beyond their control which further reduced their stress level.
Keywords: Cognitive and Communicative Challenges, Positive Attitude, Positivity Quotient, Mid fullness practices, Unlocking prosperity and Well being

Introduction
This is a generation of digital and information overload, social-media language, increased screen time, anxiety and stress resulting in deteriorating mental health. The students are constantly found occupied with processing information gained, dealing with notifications and juggling updates on social media, making them prone to a state of anxiety and confusion. The emerging language of social media, in the form of emojis and abbreviations, can be fun but can deeply affect meaningful communication and face-to-face interactions. This results in loneliness and anxiety, which can further be intensified into depression. Also, constantly watching reels on social media leads to the development of delusional conceptualisations. Though the easy access to knowledge given to students cannot be denied, if not utilised efficiently, it can be hazardous due to lack of focus, sleep, negativity, and mental health pressures. So it is important to equip students with the resources to balance their digital and offline lives.
Some of the pressures that pop up are-

Self-doubt:

> "I didn't choose the right subject; it will take me nowhere."
>
> "I am not good enough to compete; my friends get so many likes on their social media posts"
>
> "I will sound stupid if I speak my mind"
>
> **"**I feel that I am good for nothing.**"**

When students don't have the ability to filter out digital overload, they exhibit symptoms of low self-esteem and self-doubt due to comparison. They start to underestimate their worth and get overwhelmed. The worst form is self-criticism taking a toll on their mental health. This drained mental energy needs to be channelised again with learning mindful comparison, hopefulness and setting digital boundaries.,

Fear of unknown:

> "I am afraid that everyone makes fun of me".
>
> "I feel I will not be able to live; nobody likes me"
>
> "I will not attempt today; I will fail"
>
> "I will not ask; he will say no"

The students have developed a phenomenon called fear of the unknown, which stems from excessive use of technology, leading to catastrophizing, procrastination, and getting stuck, making them unable to move forward in life and affecting their personal development and Lifestyle. Mindfulness grounding is required to build confidence in such students.

Juggling of work:

> "I am on a constant run juggling with my assignments and social media presence."
>
> "I sit down to do my research work and end up discussing reels with my friends."
>
> "I make my to-do list in the morning to find myself doing something else not even mentioned in my list"

It is found that due to constant connectivity, students are juggling work, reducing their efficiency and productivity. Their generation is tagged with an always-on culture. Also, this has a huge impact on them personally, with an imbalance between work and personal life, a reduced attention span, no boundaries, exhaustion, and burnout. It is essential for students to set time limits and priorities and practise the mindful use of technology. Also, they need to be resilient in rebuilding their social lives for their well-being.

Imaginative scepticism:

> "I scroll through news and loads of information, unable to come to decisions"
>
> "I can't handle their opinions; I keep on trying to be accepted."
>
> "Every option seems to be right. Which one to choose."
>
> "Oh! Facts and figures confuse me. The sources are so contradictory."
>
> "I always find worldly reasons for my failures"

Students' creative and decision-making abilities have declined due to severe effects on

their perceptual capacities. Due to an overflow of information, prevalent biases, and fake content, they are hyper-focused on analysis and interpretation rather than on innovation and synthesis to create, innovate, and be productive. The conflicting views made them less sensitive to understanding others, less inclined to tolerate extreme viewpoints, and led to a sort of decision paralysis, with guesses, doubts, and one-sided scrutiny. It is highly desirable that students should be taught mindful reasoning and kindness.

Increasing cognitive challenges:

"I cannot concentrate and have sleepless nights"

"I have so many thoughts together that I constantly suffer from headaches"

"I either don't eat till midday or eat just carbs"

"I am so confused which attire to wear today"

"I always feel alone in social gatherings"

Due to cognitive overload on students, which includes distraction, attention span, memory loss, decision conflicts and lifestyle problems, concerns have risen about psychologically impacted disorders like ADHD (Attention Deficit Hyperactivity Disorder), Mental fatigue, decreased Social Emotional Intelligence, Sleep disorders like Amnesia, Eating Disorders like Anorexia, bulimia and binge eating. Also, the cultural shift due to technology has created a new challenge: cultural shock with respect to dressing, role-plays, and behaviour in society. With mindfulness, students should be addressed for lifestyle changes, cognitive restructuring, and compensatory strategies, which include routinising the day and maintaining work calendars and daily checklists for improving memory.

Increasing communication challenges:

"I feel I have become a robot communicating just with a screen"

"Someone else is using my fake ID and bullying me"

"I doubt that if I am speaking French, people don't understand what I say."

"I sent my assignment on time; they didn't receive it. We are not talking "

"They mistook me for the emojis I sent"

Communication challenges in the digital world are manifold for students. Starting with a lack of human interaction, it detaches them from non-verbal cues, tone of voice, and emotional expressions, giving them a feeling of isolation. Also, misinterpretation of messages can foster distrust among them. Sometimes technical glitches hamper human bonds and trust. A lack of emotional confrontation leads to human detachment and a lack of sensitivity and empathy in relationships. Also, cases of cyberbullying, harassment and manipulation with fake IDs have increased, making innocent victims go through helplessness and hopelessness. The students should become resourceful in meeting communication challenges by intentionally becoming mindful of using digital tools, combining them with human connection to overcome cognitive load and reduce the anxiety associated with it. Technology is taken as a supplement, not a replacement, for human-level communication.

To sum up, to overcome these challenges, it is important to nurture students with a positive attitude and emotional awareness, and to explore mindfulness practices that

support mental clarity. This develops a positive psychological identity in them, unlocking prosperity and well-being. The following 8 attributes of positive quotient are important to bring emotional awareness in students:

Kindness: This can be kindled by providing activities and opportunities that foster kindness among students. It can be done through open discussions and sharing stories to cultivate empathy. The daily planning and checklist can be introduced as essential tasks that include how one can be kind to oneself and others. This will improve social relationships by increasing social-emotional intelligence, giving an individual's psyche confidence and a positive outlook.

Honesty: It is important for students to learn to create a safe space for themselves through honesty. The positive reinforcement technique of rewarding an honest behaviour, even after a difficult and punishable mistake can do wonders in bringing the students in line with reality and reducing fears that might be the cause of anxiety and deteriorating mental health.

Gratitude: This can be developed in students by promoting thank-you notes and visual reminders of kind acts, such as collages, bulletin boards, and charts. Gratitude jars can be used where every student has to drop a write-up of appreciation for someone they felt good to be with, to be read later. This will give them a sense of belonging and shift their focus towards positivity, improving mental health and well-being.

Optimism: It is important to develop optimism among students, especially those with a very negative attitude, which leads to dissatisfaction at work, cognitive biases, delusional conceptualisations, and decision-making conflicts. It can be developed by teaching them practical skills such as focusing on solutions rather than problems, reframing thoughts, using humour to feel at ease during a bad phase, and setting achievable goals with an optimal level of aspiration.

Lifestyle: It is high time for this generation to set their lifestyle with desirable changes in their habits, such as exercising, proper nutrition, sound sleep, overcoming procrastination, managing time, and managing emotions, to get rid of emotional stress with people, friends, family, and society at large. This can be done by knowing their strengths and weaknesses, learning how to manage their weaknesses, and developing their persona with improved self-awareness and healthy habits.

Resilience: This skill is a must for students today, as they face many hardships, problems, and concerns. They need to develop the skills of adaptability to overcome stress, psychological and emotional trauma, and academic and financial setbacks. They need to develop a growth mindset to bounce back in life. They need to learn to move forward, using difficult moments as fuel to charge them, to try more, and to grow stronger. This can be an ongoing process where life's ups and downs become learning opportunities, and hurdles are turned into opportunities.

Eloquent Communication: With communication problems increasing day by day, it is important to nurture students with the skills to speak, listen and communicate. They should be taught to use smooth and expressive language, taking care of their own and others' emotions so as to convince and be influential. The concerns of low self-esteem, anxiety, fear, and lack of motivation can be dealt with by providing a positive environment, promoting open communication and supporting with active listening. It

also includes promoting apt writing skills. At the core level, communication concerns like disinterestedness, anxiety and shyness are thought to be dealt with by removing language barriers and instilling confidence.

Cultural Values: With the diverse cultural values students are going through, culture shock and identity conflicts are increasing, and students are succumbing to mental pressure. Even academically, the shift from one culture to another for higher studies is making students vulnerable to styles that don't match theirs. So it is important to build awareness by practising positive strategies, such as teaching empathy and balancing one's culture with newly found norms. It is important to foster inclusion and adjust to different educational styles. The dire need to be open-minded and understanding by participating in different cultural styles will make youth more resourceful and positive in adapting to the latest changes offered by different cultural heritages. This also helps in building social intelligence.

Defining Mindfulness: Mindfulness is a relatively new practice for students, encouraging them to live in and accept the present rather than dwelling on the past. They are taught to acknowledge their thoughts, feel without judging and recognise their sensations. Understanding their surroundings makes them less reactive when they are overwhelmed and stressed. This improves their focus on academics as well as on social, emotional, and personal relationships. Mindfulness helps develop resilience, as the focus is more on oneself and growth, fostering an attitude to challenge social-emotional pressures and turn turmoil into a balanced focus. It is a skill that needs to be developed consciously among students through well-researched techniques like yoga, including breathing exercises and meditation. Students are equipped with the skills to put in effort to carry out their daily activities with attention so as to achieve maximum output. It includes almost every activity like mindful thoughts, mindful eating, sensory walks, reading, writing, and even listening to music, watching television and social media screen time.

So, to sum up, mindfulness can be defined as a technique and skill to minimise stress and balance emotional states by acknowledging the present moment, bodily sensations, and emotional feelings, resulting in calmness and compassion, so as to achieve social-emotional intelligence.

Introducing Mindfulness Techniques

Yoga and Meditation: Both Yoga and Meditation, as independent factors and together, are recognised as powerful means to bring awareness of the bodily senses and the environment. They give impetus to the nervous system to become calm and to connect body and mind, creating a spiritual space through yoga asanas with mindful movements and deep focus on sensations. Breathing exercises, like pranayama, and yoga postures support various bodily regions and help bring awareness throughout the session. The benefits include a reduction in anxiety and depression, improved focus, reduced overthinking and clarity and vision. It also helps balance emotions by promoting non-judgemental observation. The thoughts are understood, and feelings are recognised with purpose.

Mindful Daily Activities: The daily activity schedule of students should be taught to be

charted mindfully. From the beginning of the day, as they leave home for the respective educational institution and then come back home, they should be encouraged to develop sensory awareness (recognising sights, sounds, and touch). They can go for body scans when experiencing emotional engagement and tension. The 5 senses (5-4-3-2-1) focus technique is found to be most effective, in which students are asked to check five things they see, feel 4 things they can touch, recognise 3 things they can hear, 2 things they can smell, and 1 thing they can taste. This will make them fully aware of their immediate environment.

Mindful eating: This includes becoming aware of what, how, and why of the eating experience. What senses are involved in eating in relation to the hunger drive? How are emotions attached to what one eats? Why is it important to improve digestion and become healthier?

When awareness comes, it not only improves digestion but also reduces stress and anxiety. It helps one check emotional needs so as not to fall prey to impulsive eating. It helps one focus on eating to eliminate distractions, such as not eating while using mobile phones or working on laptops.

Mindful Lifestyle: Mindful living can be cultivated intentionally by focusing on bad and unhealthy habits. Becoming aware of bad habits is itself a start of a mindful lifestyle. Procrastination, which means consciously delaying things for no appropriate reasons and lacking time management, is one of them. In this, one becomes uncomfortable due to stress and anxiety and starts projecting them through not completing the work. Mindfulness helps one understand anxious judgments and intentionally delayed actions, which might stem from a deep-rooted fear of failure. On a positive front, mindful practices help develop confidence that if you start with faith, you will end with an outcome. Another Lifestyle concern with students these days is mindful clothing. Cognitive biases are challenging to deal with. To deal with this, the students should be encouraged to dress with good intentions, prioritising comfort, becoming creative in personal styling rather than becoming copycats of trends, and curating a mindful wardrobe with clothes that spark feelings of joy and purpose. This will cure the problem of decision fatigue among students.

Journaling: Through journaling, students are encouraged to write down their emotional experiences. This can be done by maintaining a diary, notebook, digital book or records. This exercise is very useful in gaining insights about oneself, one's emotional journey, and mental upsets. Through conscious efforts, these records can reflect what needs to be done for positive self-rediscovery and reaching personal growth. The content, purpose, frequency and format of journaling decide the benefits one can reap from these exercises. It can benefit those with mood disturbances, mild and major mental disorders and fosters personal development and self-compassion.

Mindfulness Principle Practices in Use

Being non-judgemental: This practice teaches students not to label things, people, and situations based on their own experiences. Instead, acquire empathy to understand them. There is nothing like absolute good or absolute bad, absolute right or absolute wrong. Students need to learn to create space, accept things as they are, and go for facts rather

than entertaining delusional conceptualisations. Deciding on the basis of asking questions like what, how and why to have a clear perspective rather than following false and age-old views. Allowing others to speak, even when it does not match one's own thoughts, will help them understand you with compassion.

Acknowledging true feelings: Through this, students are taught to respect their feelings rather than suppress them. Even negative thoughts are given importance to learn and appreciate the conversion to positive ones. The turmoil, stress, anxiety, and fear of failure need to be understood as cognitive and communicative challenges so that strategies can be acquired to overcome them. Emotions are to be understood as passing experiences, not a standstill truth, so that letting go of bad decisions can be done and welcoming the desired change for growth and development can take place. Higher Social-Emotional Competence is solely dependent on the acceptance and acknowledgement of the truer self. So it is important for students to stop fighting with themselves by not allowing themselves to register true emotions. It is human to experience negative emotions, but it is important to learn from them to become positive.

Focused attention: Developing attention can be done through training the mind to create a clearer space that allows learning how to concentrate and come back when something is distracting. The cognitive challenge of enhancing memorisation skills through mindful listening, reading, and writing results in better regulation, both emotionally and academically. This focus on sensations, through sensory observations, gives students emotional control and resilience when required.

Detachment: This technique helps students understand that the things to which they were attached once and found detrimental to their growth have to be curtailed from their lives and living. They need to detach from them. They have to acquire a neutral approach where emotional baggage, which is giving them worries and mental imbalance, has to be replaced with sound, healthy ways to get on with academics and life. For this, they need to acquire an observer's approach, which means understanding oneself from an outsider's approach to correct the idiosyncrasy affecting one's life. The clearer the observation, the better the integration of focus for a distracting thought to detach from.

In view of this, a pilot study was designed on 150 adolescents to assess their positivity quotient, communication and stress level. Their feedback was recorded on introducing mindfulness practices. Both Random and Convenience sampling methods were used through assessment with standardised tools, i.e., Positivity Quotient Scale (PQs), Anxiety level through Taylor's Manifest Anxiety Scale (TMAS), and Adolescent Anxiety Scale (AAS). AAS is developed and standardised during this process by validating it against TMAS. Intrinsic feedback on stress level was also noted. Anxiety level correlates inversely with positivity; students with high anxiety levels tend to show high negativity and low positivity quotient.

Table 1: Correlation between AAS and PQ

			AAS	PQ
Kendall's tau_b	AAS	Correlation coefficient	1.000	0.339
		Sig. (2-tailed)		<00,1
		N	150	150

	PQ	Correlation coefficient	0.339	1.000
		Sig. (2-tailed)	<0.001	
		N	150	150
Spearman's rho	AAS	Correlation coefficient	1.000	0.375
		Sig. (2-tailed)		<0.001
		N	150	150
	PQ	Correlation coefficient	0.375	1.000
		Sig. (2-tailed)	<0.001	
		N	150	150

Table 2: Correlation (Pearson) between PQ and AAS

		AAS	PQ
AAS	Pearson Correlation	1	.368
	Sig. (2-tailed)		<0.001
	N	150	150
PQ	Pearson Correlation	0.368	1
	Sig. (2-tailed)	<0.001	
	N	150	150

Table 3: Correlation between PQ and AAS

			PQ	TMAS
Kendall's tau_b	PQ	Correlation coefficient	1.000	0.340
		Sig. (2-tailed)		<0.001
		N	150	150
	TMAS	Correlation coefficient	0.340	1.000
		Sig. (2-tailed)	<0.001	
		N	150	150
Spearman's rho	PQ	Correlation coefficient	1.000	0.379
		Sig. (2-tailed)		<0.001
		N	150	150
	TMAS	Correlation coefficient	0.379	1.000
		Sig. (2-tailed)	<0.001	
		N	150	150

Table 3: Correlation (Pearson) between PQ and AAS

		PQ	TMAS
PQ	Pearson Correlation	1	0.386
	Sig. (2-tailed)		<0.001
	N	150	150
TMAS	Pearson Correlation	0.386	1
	Sig. (2-tailed)	<0.001	
	N	150	150

Table 1, Table 2, and Table 3 show the correlations between PQ and AAS and between PQ and TMAS. Correlations are calculated using Kendall's tau_b formula, Spearman's rho formula, and Pearson's Correlation formula to obtain the coefficient of correlation. The table shows:

1. Kendall's tau_b results:

   The correlation between PQ and TMAS is .340 (significant at $p < .001$). indicating a positive association: as PQ scores increase, TMAS scores tend to increase as well. The analysis is based on N = 150 observations, which means high on PQ, i.e. high negativity, correlates with high anxiety level on TMAS.

2. Spearman's rho results:

   The correlation between PQ and TMAS is .379 (significant at $p < .001$). This also shows a moderate positive relationship, slightly stronger than Kendall's tau, meaning higher PQ values are associated with higher TMAS values. The sample size remains N = 150

The study revealed a low positivity quotient, with decreased optimism, lifestyle, resilience, and communication levels among adolescents.

Table 5: Statistics

	Optimism	Lifestyle	Resilience	Eloquent communication
Valid	150	150	150	150
Missing	0	0	0	0

Table 5 presents descriptive statistics for 4 variables, revealing significant observations: Optimism, Lifestyle, Resilience, and Eloquent Communication. The analysis includes 150 valid observations, and there are no missing values for any variable.

Table 6: Frequency table for optimism

level	Frequency	percent	Valid percent	Cumulative percent
Average	84	56	56	56
High	24	16	16	72
Low	42	28	28	100
Total	150	100	100	

The level distribution in Table 6 shows that the largest group (56%) has an average optimism level, with a notable 28% having a low optimism level. Only 16% were found to have a high level of optimism, indicating they need sessions and interventions to increase their hope and confidence.

Table 7: Frequency table for lifestyle

level	Frequency	percent	Valid percent	Cumulative percent
Average	58	38.7	38.7	39.3
High	75	50	50	89.3
Low	16	10.7	10.7	100
Total	150	100	100	

The level distribution in Table 7 clearly shows that 50% of the students are highly

affected by lifestyle problems, with 38.7% found to be affected to an average extent, and as low as 10.7% were not found to be affected at a low level. This shows that students require awareness sessions on lifestyle problems and need to learn a mindfulness approach to overcome them.

Table 8: Frequency table for resilience

level	Frequency	percent	Valid percent	Cumulative percent
Average	94	62.7	62.7	62.7
High	32	21.3	21.3	84
Low	24	16	16	100
Total	150	100	100	

The level distribution in Table 8 shows that the resilience level is average at 62.7% and low at 16%. Together, they show that many people need to develop a resilient attitude through mindful practices. Only 21.3% of students have high resilience and can easily cope with problems.

Table 9: Frequency table of Eloquent communication

level	Frequency	percent	Valid percent	Cumulative percent
Average	96	64	64	64
High	30	20	20	84
Low	23	15.3	15.3	100
Total	150	100	100	

The level distribution in Table 9 shows that only 20% of people know how to communicate meaningfully and eloquently. The remaining 64% were found to be average, and 15.3% were found Low on this variable, requiring mindful communication.

Students responded positively to introducing mindfulness practices that accompanied yoga, meditation, mindful daily activities focusing on individuals' interests, mindful eating, and mindful lifestyle.

Table 10: Frequency table for Yoga and meditation

	frequency	percent	Valid percent	Cumulative percent
No	6	4	4	4
Yes	139	92.7	92.7	96.7
Yes	5	3.3	3.3	100
Total	150	100	100	

Table 10 indicates very high demand for yoga and meditation as mindful practices required for students, with 96.7% affirming their importance and only 4% declining them.

Table 11: Frequency table for Lifestyle problems

	frequency	percent	Valid percent	Cumulative percent
No	8	5.3	5.3	5.3
Yes	135	90	90	95.3
Yes	7	4.7	4.7	100
total	150	100	100	

Table 11 shows that 95.3% of students agree that they have lifestyle problems and need training and assistance to overcome them.

Their feedback included that they stopped being judgemental, started accepting themselves as they are, focused on the present moment, trusted themselves, and let go of things beyond their control, which further reduced their stress levels.

Table 12: Frequency table for Less judgmental

	frequency	percent	Valid percent	Cumulative percent
Yes	144	96	96	96
Yes	6	4	4	100
Total	150	100	100	

Table 12 shows that 100% of students feel they need to be less judgemental by becoming aware, gaining knowledge, developing intention, and practising mindfulness.

Table 13: Frequency table for Moving on

	Frequency	percent	Valid percent	Cumulative percent
No	1	0.7	0.7	0.7
No	2	1.3	1.3	2
Yes	140	93.3	93.3	95.3
Yes	7	4.7	4.7	100
Total	150	100	100	

Table 13 reveals that 95.3% of students feel that they should get ahead in life by moving on with situations and things beyond their control to overcome unnecessary stress and trouble in their lives.

Conclusion

The study highlights the effectiveness of mindfulness practices in addressing cognitive and communication challenges among Indian adolescents. By incorporating mindfulness into daily life, students can develop a positive psyche, leading to improved emotional intelligence, resilience, and overall well-being. The findings suggest that mindfulness programs can be a valuable addition to school curricula, helping students navigate digital overload and mental health concerns. By fostering a mindful approach, we can empower adolescents to unlock their potential and achieve prosperity and well-being.

Future Implication of The Study

The study provides insights for educators to address high negativity (i.e., low positivity quotient), decreased optimism, lifestyle, resilience, and communication skills. It has also been shown that students view mindfulness training as a means to improve self-awareness and lead a better lifestyle to combat prevailing stresses. With this, outcomes can be strategised for use in schools, colleges, and universities to increase social-emotional competence and cultivate a positive psychological identity, unlocking prosperity and well-being. In the future, this can serve as a basis for educators and policymakers in the following ways.

Incorporation in Curriculum: The students' syllabus should include mindfulness coaching. It should be made a compulsory subject, with a separate class for it. Present-day educators who are providing mindfulness sessions have to beg the administration to give them available class time, treating it as a secondary, not primary, need for the students. Mental health has to be prioritised in education

Cultural and Communication Adaptations: The curriculum should be based on regional context in relation to the cultural values and communication styles prevalent.

Teacher's Training: Today, teachers are going through a rough phase while teaching, as they are unable to manage some students' lack of emotional competence, which disturbs their class and their timings to complete their subject curriculum. So learning mindfulness should be made an integral part of teachers' training programs so that they can cater to the students' needs while teaching their respective subjects.

Parents' Orientation sessions: Mindfulness cannot be implemented unless the home environment and parents' dealings are on par with and in sync with the mindfulness training students receive. So it becomes important to orient the parents with the knowledge, its utility, and their roles as positivity regulators, instilling discipline, so that they can do their part to bring out the best in their wards. So educational institutions should organise these sessions frequently, as they organise teachers' parent meetings.

Reducing Digital Addiction: Introducing healthy, compulsory activities like play, art, music, dance, and other activities of students' interest to channelise their psychic energy, which further becomes instrumental in shortening their screen time.

Advanced Research: Pilot studies are the basis of Longitudinal and comparative research, which are lacking in Indian education in the field of Psychology. This should be promoted through regular assessments of students to record the short- and long-term effects of mindfulness training. Also, comparative training types can be evaluated to determine the best method preferable in Indian settings. Scientific Research advances actionable implications for educators, policymakers and mental health professionals.

References

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. Clinical Psychology: Science and Practice, 10(2), 144-156.

Keller, R., & Davidson, R. J. (2015). Mindfulness and psychological well-being. Journal of Clinical Psychology, 71(8), 747-764.

Kerr, C. E., Sacchet, M. D., Lazar, S. W., Moore, C. I., & Jones, S. R. (2013). Mindfulness

starts with the body: Somatosensory attention and top-down modulation of cortical alpha rhythms in mindfulness meditation. Frontiers in Human Neuroscience.

Ludwig, D. S., & Kabat-Zinn, J. (2008). Mindfulness in medicine. Journal of the American Medical Association, 300*(11), 1350-1352.

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. Journal of Clinical Psychology, 373-386.

Gupta, A., Sharma, R., & Kumar, K. (2020). Digital addiction among Indian adolescents: A review. Journal of Indian Association for Child and Adolescent Mental Health, 16(2), 1-15.

Kumar, S., Singh, S., & Sharma, R. (2020). Mindfulness-based interventions for teacher training in India: A systematic review. Journal of Educational Psychology, 112(3), 455-468.

Patel, V., Xiao, S., Chen, S., Gannon, B., & Thapa, S. (2018). Mental health and wellbeing in the Sustainable Development Goals. Lancet Psychiatry, 5(11), 869-871.

Sharma, R., Gupta, A., & Kumar, K. (2019). Parental involvement in mindfulness-based interventions for Indian adolescents: A qualitative study. Journal of Child and Family Studies,28(10),2765-2776

Singh, S., Kumar, S., & Sharma, R. (2019). Cultural adaptation of mindfulness-based interventions in India: A review. Journal of Clinical Psychology, 75(10), 1713-1728

Jain R.(2001). Manual of Positivity Quotient. PsyCare Foundations.India.

Taylor,J.A.(1953). A personality scale of manifest anxiety.The Journal of Abnormal and Social Psychology 48(2),285-290

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A Neurolinguistic and Multimodal Approach: Integrating SDGs into English Language Learning through Documentary Films

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Abstract
Documentaries are a powerful medium to raise awareness about pressing environmental issues and to help shape learners' perceptions of planetary sustainability. While earlier research has explored the use of media and documentary formats at the tertiary level of education, work which situates these as curricular resources within an English language learning context is rather scant. The present qualitative study explores undergraduate students' perceptions of learning with documentaries as a means of integrating Sustainable Development Goals into the English curriculum while simultaneously supporting language acquisition.
This research was undertaken as a classroom research project with 45 first-year undergraduates from I & II Semester drawn from different disciplines in the Institute of Aeronautical Engineering (Autonomous), Dundigal, Hyderabad. Using visuals, narration, sound, and emotional cues, the documentary "Home" is incorporated into English lab sessions as a multimodal instructional text that enables students to engage with real-world language input. The research draws on multimodal learning theory and neurolinguistic theories to investigate how rich sensory input impacts comprehension, engagement, and awareness. Neurolinguistics is a conceptual framework for comprehending observable learning processes like attention, memory, and emotional engagement rather than a neuroscientific method of measurement.
Three main themes emerged from a thematic analysis of learner reflections and responses: (i) documentaries greatly increase learners' awareness of environmental issues; (ii) they facilitate meaningful connections with current global and environmental issues; and (iii) they improve language learning in general. Participants reported increased motivation to use English for discussion and introspection, as well as improved attentiveness and deeper comprehension. It appears that using documentaries within an English curriculum can support language development through authentic, emotionally engaging input, simultaneously promoting pro-environmental attitudes consistent with the SDGs of climate action and sustainable living. This underscores how film-based multimodal resources may play a more pronounced pedagogical role in shaping linguistically competent and environmentally awakened individuals who will face and manage a planetary future.
Keywords: Documentary-based pedagogy, English language learning, English curriculum, Sustainable Development Goals (SDGs), Multimodal learning, Neurolinguistic perspective, Planetary sustainability.

Introduction

The current natural environment faces its most severe stress level because of industrialisation, which operates without sustainability and human-caused climate change. The world experiences multiple environmental changes, which include global warming and ozone layer depletion, air pollution and greenhouse gas build-up and sea level rise, and these changes create hazardous effects on both human life and ecological systems (Arslan et al., 2012; Buchanan, Pressick-Kilborn, & Maher, 2019; Ekborg & Areskoug, 2012; Wigley, 2018). The world now faces environmental problems, including plastic pollution and habitat destruction, and these issues create severe risks that endanger both biodiversity and ecosystem stability (Van Sebille et al., 2015). The increasing environmental crises require shared responsibility between all individuals and groups to protect, restore and maintain natural ecosystems.

Environmental challenges need urgent solutions, yet educational systems treat environmental issues through superficial methods or disjointed approaches. Environmental education is integrated into the science curricula of most educational systems, but these programs treat it as an extra resource that students should study independently, particularly during the final weeks of academic terms when teachers focus on finishing required course material (Daniel, 2011; Teng, 2012). Students tend to think that they already know environmental concepts which they need to master, yet they lack the essential understanding and emotional connection with the topic. Teachers too may presume sufficient learner awareness, resulting in limited pedagogical investment in these topics.

People need direct experience with climate impacts because they face difficulty understanding how serious environmental damage affects the world. Students encounter environmental crises through their reading materials, digital content and visual media instead of actual experiences. The distance from real-life experience causes students to lose their ability to comprehend how ecological changes impact international communities, according to Teng 2012.

Insufficient environmental knowledge in students will decrease their ability to recognise environmental issues, which will decrease their environmental stewardship capacity. Hansman 2009 argues that people need to develop awareness and practical knowledge before they can demonstrate responsible environmental conduct. Environmental knowledge serves as the essential base which scholars use to explain how people change their behaviour (Bellino Adams 2017; Hungerford Volk 1990; Teng 2012). Educational methods need to teach young people about sustainability because they will create the future ecological environment through their learning and environmental behaviour. Implementing effective teaching methods becomes essential for developing environmental awareness in students while maintaining their active participation (Bellino Adams 2017; Cunningham 2010).

In modern educational settings, educational institutions utilise media-based teaching methods, including documentaries, as their primary method of environmental storytelling and awareness development (Ashraf, Shafiq & Batool, 2017; Liu, 2018). Educational media, such as movies and TV shows, blogs, articles, and documentaries, serve as powerful teaching tools that foster student comprehension of ideas and open up discussion topics in the classroom. According to cognitive psychology research, learners who receive information through both verbal and visual channels are better able to comprehend complex abstract ideas because visual symbols enhance their memory and conceptual understanding (Willingham, 2009; AyukAko, 2017).

Documentaries use narration and imagery together with emotional storytelling to create educational content which helps students develop their environmental awareness (Bahk, 2010; Liu, 2018).

Literature Review

Researchers from different academic fields have studied how educational institutions use documentaries to teach students who study different languages (Paran & Duncan, 2019), psychology (Simpson, 2008), and environmental education (Guler & Afacan, 2012; Liu, 2018). Documentaries combined with reflective activities and structured teaching methods help students learn social and emotional skills that exceed those they acquire through traditional textbook and lecture methods. The system enables students to travel to remote parts of the world while studying global environmental conditions and developing emotional ties with communities that contend with environmental difficulties (Guler & Afacan, 2012; Aziz, Manab & Othman, 2016; Liu, 2018).

The research shows that alternative documentary styles which use visual storytelling methods instead of traditional narration methods successfully boost viewer emotional connection and help them grasp environmental content better. Barbas (2009) found that non-traditional documentary styles were more successful in developing environmental awareness and creating emotional ties to environmental matters. Narrative films successfully motivate students, according to Bahk (2010), because they create emotional suspense and use relatable life situations to show environmental problems, which lead to developing empathic reactions in viewers. Reid (2012) demonstrated that documentaries help students learn difficult scientific concepts, but students do not necessarily change their attitudes after they gain new knowledge. The value of documentaries lies in their ability to create awareness and promote viewer participation.

Recent empirical studies demonstrate that documentaries serve as effective educational tools which successfully raise environmental awareness among viewers. Nolan (2010) discovered that when participants watched documentaries, their understanding of global warming increased and their greenhouse gas emission reduction plans developed. Minocher (2015) found that when students watched environmental documentaries, used social media and participated in group discussions, their civic and environmental activities increased.

Higher education institutions use documentaries as teaching materials, which help students develop environmental literacy skills and sustainability knowledge (Liu, 2018; Bahrin et al., 2018). Documentaries demonstrate their teaching value by transforming students' environmental sustainability knowledge, attitudes, and environmental behaviour patterns.

Research Gap and Purpose of The Study

People are becoming more interested in using documentaries to teach. There are still many questions about how documentaries actually help people learn, especially when it comes to learning the English language. Most of the research that has been done looks at how documentaries can be used to teach about the environment or how to use media to learn. Fewer studies have looked at using documentaries as a tool to help people learn the English language. Documentaries can support learning outcomes in English language

learning environments, and we need to learn more about how documentaries support these outcomes, specifically in the case of English language learning.

We do not know much about how using documentaries in the classroom can help students learn a language and also understand how to be sustainable. This is particularly true for students who are not studying a language. Are learning a trade or profession. We need to understand what students think about using documentaries in their classes. This will help us figure out if it is a way to teach and if students are actually learning from it. Documentary-based instruction is important. We need to know more about how it affects students, especially when it comes to language acquisition and sustainability awareness.

This study is trying to fill a gap. It looks at what undergraduate learners think about documentaries. The documentaries are used to teach people about issues and sustainability. This is done as part of a language-learning program. The study wants to answer this question:

How do undergraduate students perceive documentaries as a pedagogical tool for learning environmental education and sustainability within an English language curriculum?

Theoretical Framework

This study is based on a theory that combines a few ideas. It uses the idea that people learn in different ways, not just by listening or reading, but also looks at how our brains process language. How our feelings affect what we learn. It incorporates the fact that humans can learn kinaesthetically (by doing), visually (seeing) and verbally (reading/hearing) rather than just verbally. It also focuses on how our brains process language. It is trying to figure out how it works in a class where people are learning English.

The idea of multimodal learning theory is that people learn better when they get information in lots of ways. So they see, hear and read information rather than just reading about a subject. One way of doing this is through Documentary films. They consist of moving pictures, people speaking, music, and words on a screen. This allows people to think more about what they are learning and can help them retain the information. At the ELCS laboratory, they were shown a documentary titled *Home,* which taught individuals about the environment. It was a way to learn because it used lots of different senses at the same time, like sight and sound, to help people understand what was being said. This made it easier for people to comprehend and really get the ideas about issues.

When we learn a language, it is really connected to how we pay attention, how we feel about it and how well we remember things. If we hear or see things that are interesting and make sense, it helps our brain remember them better and learn more deeply. This study does not use tools to look at what is happening in our brain, but it uses ideas from language and brain science to understand what we can see people doing when they learn, like being more attentive, feeling more connected to what they are learning, thinking carefully about what they have learned and wanting to speak English more. Language acquisition is closely associated with attention, emotional engagement, and memory formation, especially when we are learning a language like English. The way Home

makes you feel is really important. It seems that when you are emotionally involved in something, you can think clearly and learn new languages better. Home can do this because it affects people. This emotional effect helps people learn and understand things more easily, especially when it comes to language.

Affective learning theory is important because it shows how our feelings and values play a role in learning. When we watch documentaries, they can make us feel concerned, empathetic and responsible. This can make us think about what we can do to help and actually do something. In this study, affective engagement helped people learn about the environment and use language more actively when discussing topics, reflecting on what they learned, and working together on tasks. The affective learning theory and affective engagement are key to making documentaries a useful tool for learning.

Together, these theoretical perspectives justify the pedagogical use of documentary films as multimodal, emotionally engaging, and cognitively rich resources capable of supporting language development while fostering sustainability awareness.

Methodology

General Background

This study examines how teaching English can help people learn about the environment and become more sustainable. We conducted this study in a classroom with students taking the English **Language and Communication Skills Laboratory** course at the **Institute of Aeronautical Engineering in Dundigal, Hyderabad**. The English Language and Communication Skills Laboratory course is part of the program at the Institute of Aeronautical Engineering, which is affiliated with JNTUH. We wanted to see if giving students assignments that made them think about what they were learning and how to use it in life would help them understand more about the environment and want to live in a more sustainable way. The English language instruction included practice-oriented assignments to help the English language learners become more aware of the environment and learn about sustainability.

The ELCS laboratory is different from environmental classes that teach students about being sustainable. This laboratory mainly helps undergraduate engineering students learn how to communicate. The laboratory used a documentary about the environment to help students learn a language and also learn about the environment. They wanted to see what happens when students watch documentaries and then talk about what they learned. They were trying to figure out if this way of learning would change the way students think about the environment and if they would care more about sustainability issues.

Do learners develop a better understanding of sustainability concepts after watching documentaries and participating in related discussions?

The documentary Home was incorporated into lab activities as “authentic material” to allow learners to process spoken language through audio-narration, imagery, and situational context. Reflection activities, collaborative discussions, and communication tasks were employed to prompt learners to express their understanding, opinions, and reactions to the documentary content in English. Thus, the research attempted to explore the effects of documentary-based

learning on undergraduate students' perceptions of ecological sustainability along with aiding language acquisition.

Why use Home for SDG-linked ELCS classroom activity?

Home (Arthus-Bertrand, 2009) documentary was chosen as the primary learning material of this research because it aligns closely with the SDGs, engages ELCS, is rich in multimodal content, and is appropriate for undergraduate students. The film presents an integrated view of planetary sustainability by addressing interrelated global concerns such as climate change, biodiversity loss, energy consumption, industrial expansion, resource depletion, and economic disparity—issues directly connected to SDGs including *Climate Action (SDG 13), Responsible Consumption and Production (SDG 12), Life on Land (SDG 15), and Sustainable Cities and Communities (SDG 11) (United Nations, 2015).* The documentary establishes sustainability as a global obligation, providing language students with access to SDG themes by demonstrating environmental destruction linked to human development activities.

The 'Home' serves as an English language input resource that helps ELCS students achieve their learning goals by providing authentic storytelling, real vocabulary usage, and international scientific, social, and environmental sustainability content. Authentic audio-visual materials improve listening skills and vocabulary development, as well as communication skills, because they present language in important real-life situations (Gilmore, 2007; King, 2002). The ELCS laboratory space allowed students to use the documentary for group work and speaking demonstrations while they discussed important social issues, which helped them develop their communication skills.

The documentary achieves teaching success through its multimodal design, which combines narration with high-definition aerial footage, music, and emotionally powerful storytelling. Multimodal learning theory posits that learners process information more effectively when verbal and visual channels are activated simultaneously, leading to improved retention and deeper understanding (Mayer, 2009). Home provides multiple sensory experiences that enable learners to develop both cognitive and emotional skills, according to neurolinguistic and affective learning theories, which state that this process helps students focus better, create memories, and develop motivation during their language learning.

The documentary suits engineering students because it shows how environmental challenges connect with technological advancement, industrial operations, energy usage and urban growth and infrastructure development, which all serve as fundamental elements of engineering study. Engineering education increasingly emphasises sustainability-oriented thinking and socially responsible innovation (Mulder, Segalàs, & Ferrer-Balas, 2012).

Real environmental influences will foster a sense of concern among students who watch documentaries with ecological themes. The documentary 'Home' is used as a primary material and a balancing link between the instruction of the language and the instruction of sustainability, as it offers both communication-based learning opportunities and a deep academic value.

Participants

This research involved **45 first-year Undergraduate Engineering students** pooled from both **I and II semester cohorts** at the Institute of Aeronautical Engineering (Autonomous),

Dundigal, Hyderabad. The experiment was carried out over approximately eight weeks as a part of regular English Language Communication Skills laboratory sessions. The participants for this research were taken from heterogeneous and cross-sectional engineering disciplines, including Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering (EEE), Computer Science and Engineering (CSE), Electronics and Communication Engineering (ECE), and Aerospace Engineering.

The participants were in the age bracket of 17 to 19, were entering university, and came from diverse socio-cultural academic backgrounds.

As first-year engineering students, most of them were moving from schools that taught in their regional language to colleges that taught in English; the medium of instruction changed. This made it really important for the student community to be good at communicating in English.

The English language lab class is designed to help learners improve their listening, speaking, communication, and presentation skills. The students learnt by doing things and taking part in activities. They were made to work in groups, talk to each other and think about what they had learned. All these things are a part of the class, which helped them use English in real-life situations. In this specific session, they were asked to watch documentaries to start discussions, think about what they had learned, and practice communicative skills. This helped them learn about issues, like the environment and how to protect it, while also getting better at communicating in English.

Procedures and Data Collection

The ELCS – English Language Skills Laboratory had an exercise where the students were asked to review a movie of their choice. The documentary 'Home' was given as the primary material for the task, and they were to watch it. They were asked to explore and observe the different dimensions highlighted in the documentary, and while they were getting involved in the conversations, it was observed that their speaking patterns improved along with the quality of the content.

The award-winning documentary, 'Home ', was directed by Yann Arthus-Bertrand and is 93 minutes long. It uses camera work to show how people are affecting the planet. The movie talks about issues like climate change, industry growth and how we use energy. It shows that people need to work to stop hurting the planet and to make the natural world healthy again.

The documentary was a choice for the students because it was interesting and easy to understand. The students already knew some science from before, so the movie helped them connect what they knew to life problems. As Liu said in 2018, we need to solve problems by working together and using what we know about science. The documentary showed environmental issues in a way that was easy to understand. This helped the students care more about the issues.

The ELCS Laboratory course used the documentary and some activities to make a learning space. The students watched the movie on their own. Then they had group discussions. They talked about the issues in the movie. Shared their thoughts with each other. The teacher helped the students. Did not tell them what to think. The students worked in groups and studied the movie together. They looked at parts of the movie and talked about what they saw. They discussed issues like cities growing, industry and how we use natural resources. The students

then shared what they learned with the class. This helped them develop their thinking skills and get better at talking in front of a group.
At the end of the project, the students wrote essays about what they learned. They uploaded these essays in the worksheets. They were part of their grade. The instructor gave the students some questions to answer to help them think about what they learned, how they felt about the documentary and how the film impacted them in terms of conservation of the planet.

Table 1. Student Reflection Guide

No.	Reflection Question
1	To what extent did your prior knowledge of environmental issues affect your understanding before participating in this activity?
2	Do you think that the problems discussed in the documentary are important and necessary? Please explain.
3	Do you think that the documentary presents factual truths? Explain your opinion.
4	What feelings did you experience while watching the documentary?
5	Did the documentary enhance your understanding of environmental issues? Please explain why or why not.
6	To what extent did the documentary engage and interest you? Please explain.
7	Do you think that documentaries help raise awareness about environmental issues?
8	What other approaches would you like to take to learn about environmental issues?

Data Analysis

The researchers used the constant comparative method from qualitative data analysis to study student reflections (Corbin, Strauss, & Strauss, 2015). The analytical method of this study uses repeated coding and categorisation to create themes for understanding the qualitative data patterns. The researchers used systematic comparison of responses to identify recurring ideas, which they organised into distinct thematic categories.
The process shows that researchers need to establish logical structure while making interpretive decisions to achieve proper research goal alignment with data analysis (Merriam & Tisdell, 2015). The instructor used written reflections together with classroom observation notes to document discussions and activities, which helped to establish multiple sources of evidence that increased the depth of analysis.

Validity and Reliability

Establishing research validity through qualitative research requires researchers to demonstrate research reliability (Golafshani, 2003; Merriam & Tisdell, 2015). The research team used peer evaluation to assess the trustworthiness of their analysis because they needed to maintain authentic contextual data from their study. The external expert evaluated the thematic framework through qualitative research assessment while providing essential input about the research. The research process benefits from peer review because it increases research credibility while reducing bias in data interpretation and enhancing research validity (Patton,

2002). The research team used expert insights to develop thematic analysis, which ensured their research findings matched the actual data they collected.

Ethical Considerations

The research team gave study details to participants before starting the study. Students voluntarily consented to participate through an informed consent process conducted via institutional communication platforms. Students participated in the study without any impact from their involvement on their academic assessment, which depended only on standard course evaluation methods. Participants were assured that all answers would be kept confidential and that their identities would not be revealed during data collection. The research team followed ethical guidelines throughout the study to protect participant privacy and maintain academic research standards.

Findings And Discussion:

The analysis of learner reflections together with classroom observations showed that students had positive reactions to the use of the documentary *Home* in ELCS laboratory instruction. The first-year engineering students showed high engagement levels through their extensive reflections, which demonstrated their active participation in both discussions and group work. Three major themes emerged from the analysis:

1. Document-based learning through documentaries improved students' understanding of environmental issues.
2. The documentary allowed students to apply their classroom knowledge to current global environmental issues.
3. The use of documentaries in language learning brought added value to students' overall learning experience. The report presents findings and discussions in combination, allowing a complete understanding of learner experiences while showing how new educational themes fit into teaching practices and sustainable learning tracks.

Theme 1: Documentaries Evoke Students' Environmental Awareness

The first major theme emerging from the analysis shows how documentary exposure developed environmental awareness and emotional engagement with planetary concerns for students. The documentary experience showed learners their environmental relationship, which led them to understand resource exploitation and development processes. Educational research shows that effective learning experiences require both emotional engagement and cognitive understanding as essential components of their design. The documentary established an emotional bond which led students to evaluate their environmental beliefs according to the study. Several student reflections illustrate this response:

> "Little did I realise how selfish we have been while chasing development, modernisation, and digitalisation until I watched this documentary…what have we done to our lovely planet over the years as a result of our irresponsible behaviour?" (Student 10, ln. 2–3)

> "To be honest, the documentary left me a sense of mixed feelings. From excitement to have a chance to see the very initial appearance and beauty of the globe to the sadness of the lifestyle of the owner of the Earth, flora and fauna

had been changed negatively due to humans' development." (Student 4, ln. 12–13)

"I had been shocked by the truth as I did not know humans were taking so much from our original roots. We abused all the resources on the planet greedily without preserving and conserving what should belong to it." (Student 27, ln. 7–8)

The documentary made students show their ecological knowledge through emotional awareness of human-driven environmental destruction. The ELCS laboratory activities helped students develop environmental values through their process of proving which solution they would support through their research work. According to research by Tadaki Sinner and Chan (2017), perceptions of the human–environment relationship influence decision-making processes concerning environmental responsibility. Undergraduate students who study technical education become future decision-makers because their work will determine sustainability results in their professional careers. The student explained to others the shared obligation which all people must fulfil.

"We, as inhabitants of the world, share the same planet and must be careful and considerate not to put other people and the environment in dreadful situations." (Student 22, ln. 6–7)

Thus, another student emphasised the global span of local activities:

"Our actions will have direct implications and repercussions not only in the place where we stay but also in places in other parts of the world." (Student 5, ln. 18)

Students acknowledged that past environmental damage remains permanent, but they believed that dedicated efforts could lead to gradual environmental improvements. The research findings showed that participants displayed their first signs of behavioural change through their reflective assessments. The movie used a repeating phrase which stated, "*it is too late to be a pessimist*", to create strong motivation for viewers. Students reported making minor yet significant changes to their daily routines after they watched the movie.

"This line left me with a huge sense of involvement to take actions towards making the world greener. I have started doing it, and I feel good about making differences." (Student 4, ln. 28–30)

"I have benefited greatly from the video, as my sensitivity and attitude towards the environment are now increased and I care more about my potential actions and habits." (Student 22, ln. 67)

The students demonstrated their understanding of sustainability through their evaluations of how their future work roles would impact environmental protection. The engineering students explored various design options, including the creation of energy-saving technologies and the development of environmentally sustainable infrastructure. The participants changed their daily activities by evaluating their plastic consumption patterns and waste production habits. The reflection contained the following observation:

"I have made a commitment to change bit by bit, to get a reusable straw, and to always bring a food container and a water bottle." (Student 13, ln. 62)

The environmental responsibility development process proceeds through the gradual implementation of minor behavioural modifications which people display. The reflections showed that students developed their environmental values because these values shape their understanding of resource management and conservation practices. One participant emphasised the importance of water as a life-sustaining resource, stating that water should be treated as a precious commodity. The second student showed active responsibility through his actions, which he took to protect his environment.

> "If we wait for a superhero to come and save the world, it will take forever…better than waiting, let us be the superhero ourselves because I believe we are all superheroes in our stories." (Student 1, ln. 16)

The reflections show that people have developed better skills to analyse information while taking personal responsibility for their duty to protect the environment. The findings match previous studies which demonstrate that people change their behaviour when they acquire environmental information and develop emotional awareness (Heimlich & Ardoin, 2008; Liu, 2018). The students showed an ecocentric approach to environmental issues because they understood ecosystems to possess inherent value which existed beyond their value as human resources (McMillan, Wright, & Beazley, 2004; Grey, Whyte, & Curry, 2018). The documentary narratives provided students with a platform to enhance their critical thinking skills and reflective abilities about environmental sustainability.

Theme 2: Documentary Connects Students with Current Environmental Issues

The second theme shows that the documentary allowed students to link their classroom learning with modern-day environmental problems that exist worldwide. Through visual storytelling and real-world case studies, learners encountered issues such as poverty, consumerism, migration, industrialisation, and environmental degradation in diverse global contexts. Students showed they could connect their personal experiences and their existing knowledge to the documentary material. One learner made a connection between global warming and the climate changes she observed during her travels.

> "From personal experience, the impact of global warming is also something I feel as hill stations are no longer as cold as they were when I visited as a kid." (Student 30, ln. 44)

The documentary showed two environmental issues that people raised as concerns: deforestation and biodiversity loss. Students recognised that environmental degradation in remote areas of the world would create wider ecological effects, which helped them understand how all countries around the world remained connected. Students used documentary evidence to build their analytical reasoning skills, which they applied during their discussions and reflection activities. One participant observed:

> "I would say that the oil and gas industry is a huge problem for the environment. The documentary tells us that humans' continuous greed for energy sources means that we will always look to dig up more oil, natural gas, coal, etc. This industry massively pollutes the ocean due to oil spillage." (Student 26, ln. 76)

The documentary served as a reference framework which required students to use it as

evidence for their arguments while they completed their communication assignments. The film enabled students to see how different geographical areas changed their ecosystems compared with their home regions. The scenes that showed extensive city development alongside artificial landscapes revealed how quickly development and consumer behaviour patterns damaged natural ecosystems. The representations enabled students to explore environmental issues beyond their immediate geographical area.

Global documentaries such as *Home* transcend geographical and cultural boundaries, enabling learners to engage with universal environmental concerns. Vaughan-Lee (2015) explains that documentaries help people learn by showing them international facts and new ideas about sustainability problems which exist outside their local area. This specific documentary has themes that reflect the contemporary global issues which make the viewers reflect on themselves in a critical way.

Theme 3: Effective Use of Documentaries Enhances Students' Learning Experience

The third finding is that using documentaries in class really helped students learn more about the environment and think for themselves. The ELCS laboratory framework used group discussions and reflection to help students share their thoughts on issues and solutions while looking at different perspectives (Liu, 2018; Stern, Powell, & Hill, 2014).

Many students said they did not know much about issues before watching the documentary. When we observed the classes, we saw that students often had an understanding of the environment, which they got from textbooks and awareness campaigns. One student said that before this, he only knew facts about environmental problems, but he did not understand how human actions affect the earth. Another student said that they learned about sustainability earlier in school. They did not get to practice it in a meaningful way, just doing things like recycling and crafts with reusable materials, which did not really help them understand it deeply.

The study found that the documentary kept the students engaged throughout, using pictures, narration and sound to hold their attention. The documentary-based instructional materials improved student learning because students gained knowledge while developing their ability to think critically and participate in classroom discussions about environmental issues. Barbas, Paraskevopoulos, and Stamou (2009) showed that narrative documentaries serve as effective teaching instruments because they combine environmental issues with personal stories that keep viewers emotionally connected through their storytelling methods. The learner described this experience with the following statement:

> "The documentary certainly did a good job in stirring up my emotions and feelings. For most parts of the video, I could associate strong emotions to certain visual information presented." (Student 28, ln. 79)

Another student found visual media to be an effective learning tool because he believed that textual sources did not successfully express the urgent nature of environmental emergencies.

> "Merely reading books and newspapers is often very hard for me to relate and imagine the seriousness of an issue, as there are mostly just words." (Student 37, ln. 65)

The combination of music and visual elements together with visual arts created a strong emotional connection with the audience. Students observed that the documentary's background

music together with its emotional and sad visual elements created stronger emotional reactions, which supported environmental protection messages. The first reflection showed that:

> "I was really inspired by every scene in the video; it made me want to watch until the end. Every scene from this documentary caught my attention, and I did not want to miss out on any details." (Student 18, ln. 97)

The responses demonstrate how visual elements, sound elements and storytelling elements help people maintain their focus while they learn and practice language skills needed to understand concepts. Environmental education scholars argue that effective sustainability education requires not only knowledge acquisition but also the development of practical skills, ethical awareness, and responsible attitudes (Cebrián & Junyent, 2015). The researchers used classroom observations to determine that students demonstrated their ability to participate in knowledgeable discussions and make environmental assessments by using documentary evidence. Learners appreciated that the documentary grounded its narratives in scientific facts and research-based evidence. The student made this observation:

> "The video is also relevant as it utilises plenty of facts to support and prove its claims." (Student 3, ln. 12–13)

The research demonstrates that Van Dijck's (2006) theory about multimedia presentations proves scientific claims through their use of audiovisual content and spoken words, and visual data shows their scientific proof through visual evidence. Documentaries function as scientific relationship bridges which enable public access to complex scientific knowledge while presenting it in a way that people can understand. The research findings show that documentaries used by teachers to educate students bring better educational results than when students watch documentaries without guidance, according to Liu (2018). The ELCS laboratory used documentary-based teaching methods to help students understand environmental problems while they developed their communication skills, reflective thinking abilities and group learning skills, which enhanced their total learning experience.

Theme 4: Documentary-Based Learning Supports Language Development

The research study examined two main aspects. The research proved that students learned to use English language skills when they studied for their English Language and Communication Skills (ELCS) laboratory. Students in documentary-based instruction developed their English skills through active participation in authentic communication situations, which included listening, speaking and writing their thoughts.

Students improved their listening skills because they heard real documentary narration which included different accents and specialised vocabulary from their field of study. Students learned to express their understanding of language through visual elements, which helped them process information more easily and understand better.

The students developed their speaking skills through controlled group discussions and class-wide interaction sessions. Students expressed their viewpoints while defending their points of view, and they exchanged understanding about the environmental issues presented in the documentary. The activities helped first-year engineering students who were new to English-medium instruction to develop their spoken English skills.

The reflective writing assignment helped students develop academic writing skills

because they had to combine different sources of information while presenting their personal opinions and assessing worldwide matters through correct language usage. The documentary served as a common reference point, enabling learners to organise ideas coherently and employ topic-specific vocabulary related to sustainability, science, and global citizenship.

The way in which we taught using documentaries really worked to get students excited about learning English. This is extremely important because when learners are motivated, they do better at learning languages. Students said they were more interested and paid attention more, which meant they took part in class more and kept working on tasks. The results show that using documentaries to teach really helps students learn English while they are studying subjects.

Alignment with Sustainable Development Goals

The study shows that teaching with documentaries meets the education goals set by the United Nations. Students who used *Home* as the primary source of material learned about problems that are being faced by the world like climate change, which is connected to the goal of taking action on climate change (SDG 13) and being responsible with what we use and make (SDG 12) and taking care of the earth and its animals (SDG 15) and making cities better places to live (SDG 11). These are all part of the United Nations goals, like the one about climate action, the one about use of resources, the one about keeping the earth healthy and the one about making cities good places to live. The learners' reflections showed they developed better comprehension about how human activities such as industrialisation, excessive resource consumption, deforestation, and urban expansion contribute to environmental degradation. Through this knowledge development, people developed a collective environmental responsibility which matched the SDG framework's requirements for joint efforts and sustainable decision-making processes. The students showed they planned to reduce their plastic waste, protect resources, and apply sustainable methods in their upcoming jobs. The documentary made engineering students think about how technological progress and infrastructure development affect environmental issues.

The study demonstrates how language classrooms function as educational platforms for sustainability education by integrating SDG-related themes into ELCS instruction, which uses documentary films for teaching. The use of documentary-based multimodal pedagogy enables students to develop their language skills while creating environmentally responsible global citizens who support sustainable development objectives.

Conclusion

The current study shows how documentaries and visual media can be the primary source of material in teaching and how they aid learners in understanding global environmental issues as well as proficiency in using the English Language. It is found that documentary films are an interesting way to teach English since they provide authentic and contemporary information, presented through deep research, and help students understand sustainability topics effectively. This method, combined with collaborative learning, makes students more interested in environmental issues and better at communicating their ideas among their peers.

The documentary "Home" helped students think critically and discuss issues emotionally, which is much needed in the current generation. Students became more aware of challenges they should get involved in and cared more about sustainability, resource use and ecological responsibility. The documentary's cinematic visuals and storyline helped students connect classroom discussions to contemporary environmental issues in the world. This made them think about mending their routines and responsibilities as future professionals, especially in engineering and technological fields, as they are a part of the wider spectrum. The study also proves that the educators can benefit from utilising media resources that provide a lot of context, which is not really possible in a conventional classroom. Using documentaries in ELCS lab sessions made them more interactive and engaging. Students improved their listening and speaking skills by discussing real-world problems.

This research suggests that language learning works best when combined with global ecological issues, making students competent communicators and responsible global citizens. The research is new because it shows how documentary-based learning can be used in English language teaching rather than treating environmental education as a separate field; it should be considered a multidisciplinary zone. It also shows that language instructors can teach sustainability themes while achieving their communication goals in the classroom because the future of betterment begins with the early days of education.

However, the study has some limitations. It only involved a group of students from one engineering institution, which limits its generalizability. Future research should try educational methods on various groups of students from multiple colleges and disciplines in a heterogeneous approach. Long-term studies that measure behavioural and language development over time will provide insights into using documentaries and visual media as the primary source for teaching. The research demonstrates that using documentaries in English language courses helps students develop language skills and environmental awareness through classroom practice and beyond. Documentary-based teaching methods and sustainable development practices will certainly help students become global citizens and promote awareness and sustainability.

References

Arslan, O., Cigdemoglu, C., & Moseley, C. (2012). A three-tier diagnostic test to assess pre-service teachers' misconceptions about global warming, greenhouse effect, ozone layer depletion, and acid rain. *International Journal of Science Education, 34*(11), 1667–1686.

Arthus-Bertrand, Y. (Director). (2009). *Home* [Film]. EuropaCorp.

Bahk, C. M. (2010). Environmental education through narrative films: Impact of *Medicine Man* on attitudes toward forest preservation. *The Journal of Environmental Education, 42*(1), 1–13. https://doi.org/10.1080/00958960903479811

Barbas, T. A., Paraskevopoulos, S., & Stamou, A. G. (2009). The effect of nature documentaries on students' environmental sensitivity: A case study. *Learning, Media and Technology, 34*(1), 61–69.

Bellino, M. E., & Adams, J. D. (2017). A critical urban environmental pedagogy: Relevant urban environmental education for and by youth. *The Journal of Environmental Education, 48*(4), 270–284.

Buchanan, J., Pressick-Kilborn, K., & Maher, D. (2019). Promoting environmental education for primary school-aged students using digital technologies. *EURASIA Journal of*

Mathematics, Science and Technology Education, 15(2), 1–15.

Cebrián, G., & Junyent, M. (2015). Competencies in education for sustainable development: Exploring student teachers' views. *Sustainability, 7*(3), 2768–2786.

Corbin, J., Strauss, A., & Strauss, A. L. (2015). *Basics of qualitative research* (4th ed.). Sage.

Cunningham, W., & Cunningham, M. A. (2010). *Principles of environmental science* (5th ed.). McGraw-Hill Higher Education.

Daniel, E. G. S. (2011). To escape the "finishing the biology syllabus syndrome": An action research exploratory study in explicit modeling for Malaysian biology teacher training. *Systemic Practice and Action Research, 24*(3), 211–236.

Ekborg, M., & Areskoug, M. (2012). How student teachers' understanding of the greenhouse effect develops during a teacher education programme. *Nordic Studies in Science Education, 2*(3), 17–29.

Gilmore, A. (2007). Authentic materials and authenticity in foreign language learning. *Language Teaching, 40*(2), 97–118. https://doi.org/10.1017/S0261444807004144

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597–607.

Gray, J., Whyte, I., & Curry, P. (2018). Ecocentrism: What it means and what it implies. *The Ecological Citizen, 1*, 130–131.

Guler, M. P. D., & Afacan, O. (2012). A study on developing a behaviour scale towards sustainable environmental education. *Journal of Baltic Science Education, 11*(3), 205–216.

Heimlich, J. E., & Ardoin, N. M. (2008). Understanding behavior to understand behavior change: A literature review. *Environmental Education Research, 14*(3), 215–237.

Jeronen, E., Jeronen, J., & Raustia, H. (2009). Environmental education in Finland: A case study of environmental education in nature schools. *International Journal of Environmental and Science Education, 4*(1), 1–23.

King, J. (2002). Using DVD feature films in the EFL classroom. *Computer Assisted Language Learning, 15*(5), 509–523. https://doi.org/10.1076/call.15.5.509.13468

Liu, S. C. (2018). Environmental education through documentaries: Assessing learning outcomes of a general environmental studies course. *EURASIA Journal of Mathematics, Science and Technology Education, 14*(4), 1371–1381.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press.

McMillan, E. E., Wright, T., & Beazley, K. (2004). Impact of a university-level environmental studies class on students' values. *The Journal of Environmental Education, 35*(3), 19–27.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation* (4th ed.). John Wiley & Sons.

Mulder, K. F., Segalàs, J., & Ferrer-Balas, D. (2012). How to educate engineers for/in sustainable development: Ten years of discussion, remaining challenges. *International Journal of Sustainability in Higher Education, 13*(3), 211–218. https://doi.org/10.1108/14676371211242535

Nolan, J. M. (2010). "An Inconvenient Truth" increases knowledge, concern, and willingness to reduce greenhouse gases. *Environment and Behavior, 42*(5), 643–658.

Paran, A., & Duncan, S. (2019). Snapshots of reality: How teachers use film in the language and literature classroom. In E. Domínguez Romero, J. Bobkina, & S. Stefanova (Eds.), *Teaching literature and language through multimodal texts* (pp. 1–21). IGI Global. https://doi.org/10.4018/978-1-5225-5796-8.ch001

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage.

Reid, G. (2012). The television drama-documentary (dramadoc) as a form of science communication. *Public Understanding of Science, 21*(8), 984–1001. https://doi.org/10.1177/0963662511414982

Simpson, K. E. (2008). Classic and modern propaganda in documentary film: Teaching the psychology of persuasion. *Teaching of Psychology, 35*(2), 103–108.

Stern, M. J., Powell, R. B., & Hill, D. (2014). Environmental education program evaluation in the new millennium: What do we measure and what have we learned? *Environmental Education Research, 20*(5), 581–611.

Tadaki, M., Sinner, J., & Chan, K. M. A. (2017). Making sense of environmental values: A typology of concepts. *Ecology and Society, 22*(1), Article 7.

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations.

Van Dijck, J. (2006). Picturizing science: The science documentary as multimedia spectacle. *International Journal of Cultural Studies, 9*(1), 5–24.

Van Sebille, E., Wilcox, C., Lebreton, L., Maximenko, N., Hardesty, B. D., Van Franeker, J. A., & Law, K. L. (2015). A global inventory of small floating plastic debris. *Environmental Research Letters, 10*(12), 124006.

Vaughan-Lee, L. (2015). Documentary film and global citizenship education. *Kosmos Journal*.

Willingham, D. T. (2009). *Why don't students like school?* John Wiley & Sons.

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