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CONTRIBUTORS

Anoop Poomadam, Director, Satwa Foundation for Mental Hygienics and Holistic Wellness.

Gnana Deepa, Sri Ramachandra Institute of Higher Education and Research, Chennai (India).

Haribansh Prasad Singh, Assistant Professor, Department of Mathematics, Teachers' Training College, Bhagalpur, Affiliated to T.M. Bhagalpur University, Bhagalpur, Bihar (India).

Hemamalini T., M.Ed Student, Government College of Education, Pudukkottai.

K. Saileela, Assistant Professor in Education, Government College of Education, Pudukkottai.

K. Sudhakar, Principal, Vadaranyam College of Education, Tiruvallur District, Tamil Nadu.

M. Murali, Ph.D. Research Scholar, Department of Management Studies, Vidhyaa Arts and Science College, Salem.

Madhurya Chetia, Assistant Professor, Department of Economics, Karmashree Hiteswar Saikia College.

Nancy J. Fernandez

Nisha T. N. K., Research Scholar, Department of Education, Annamalai University.

P. Kennady Kumar, Sri Ramachandra Institute of Higher Education and Research, Chennai (India).

P. U. Mahalingam, Gandhigram (Deemed) University, Dindigul (India), E-mail: shinyvincentscc@gmail.com

Padmasrikanth, Sri Ramachandra Institute of Higher Education and Research, Chennai (India).

R. Usha Kalyani, Guest Lecturer, Department of Zoology, Government Arts College (A), Salem, Tamil Nadu, India.

Rashida Farsath, Ph.D., Research Scholar, Department of Commerce, Dr. R.A.N.M. Arts & Science College, Erode.

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Editorial Office
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The Efficacy of Psycho-Nutritional Intervention on Mental Health and Engagement Among University Students in Digital Learning Environments

Dr. Anoop Poomadam*

Abstract

This research investigation examines the efficacy of a psycho-nutritional intervention in enhancing mental health outcomes among university students undergoing digital learning during post-pandemic Kerala, India. The intervention, which was carried out at the SATWA Foundation for Mental Hygienics & Holistic Wellness in 2022, included cognitive-behavioral therapy (CBT), counseling, an almost raw plant food diet, yoga, and mindfulness meditation. Thirty-six university students participated in a four-week facilitated program with weekly face-to-face sessions and follow-ups at home with a facilitator. The Depression Anxiety Stress Scales (DASS 21 scores) was used to assess pre- and post-intervention mental health. Statistical analysis demonstrated statistically significant depression, anxiety, and stress reduction. The results lend support to the provision of holistic, non-pharmacological interventions in augmenting the psychological well-being of university students within online learning environments.

Keywords: Psycho-nutritional intervention, university students, online learning, mental health, DASS 21 scores, Kerala, CBT, mindfulness, yoga

INTRODUCTION

The onset of online learning in the wake of COVID-19 has gone on transforming learning processes across the world. Though ease of access and convenience make digital platforms inviting, the shift has also been accompanied by heightened psychological problems for university students. Problems like screen burnout, social isolation, and less physical activity are some of the causes of high levels of anxiety, depression, and stress (Aristovnik et al., 2020; Son et al., 2020). In India too, these

*Director, Satwa Foundation for Mental Hygienics and Holistic Wellness.

trends continue even in the post-pandemic era, and there is a necessity for innovative mental health interventions that transcend conventional counseling.

This research aims to explore the effectiveness of a holistic psycho-nutritional treatment that integrates evidence-based psychological procedures with diet and lifestyle change. From integrative health practice, the model appreciates the co-existence and interdependence of physical, emotional, and cognitive health. From an experiment that applies a controlled four-week regime among university students in Kerala, the research tests whether such treatment can be very effective in eliminating psychological distress for online learners.

LITERATURE REVIEW

Psychological Well-being and Online Learning

Studies on the COVID-19 pandemic and its aftermath have necessarily involved the psychological cost of online learning. Aristovnik et al. (2020) set up heightened anxiety, burnout, and disengagement among students in 62 nations. Son et al. (2020) found that remote learning stress or anxiety in more than 70% of U.S. university students. Similarly, Mehta et al. (2021) also recorded high levels of emotional exhaustion and decreased academic motivation among Indian students following the pandemic. Such observation points to a need to address mental health within digital education platforms.

Psycho-Nutritional Interventions

The incorporation of nutritional strategies within the treatment of mental illness has been more emphasized in recent years. Jaska et al. (2017) proved that Mediterranean diets can reduce depression symptoms, and the SMILES trial showed that improvement in diet could significantly reduce major depressive episodes.

Complementary treatments like mindfulness and yoga have also been found to be beneficial. Kuyken et al. (2015) identified that mindfulness-based cognitive therapy was effective in avoiding depression relapse. Narayanan et al. (2020) discovered that yoga and breathing regulation skills increase emotional resilience and decrease stress.

The psycho-nutritional model that incorporates both of them is augmented by findings of Sarris et al. (2015) and Lopresti et al. (2013), which established the synergistic action of nutritional, exercise, and psychotherapeutic treatments for mental well-being.

OBJECTIVES OF THE STUDY

To evaluate the efficacy of a psycho-nutritional intervention in reducing depression, anxiety, and stress among university students engaged in digital learning.

To assess the feasibility of implementing such an intervention in educational and wellness settings.

METHODOLOGY

Research Design

This study employed a pre-post experimental design without a control group. Participants' mental health was assessed at baseline and again four weeks after the intervention using a validated scale.

Participants

A total of 36 university students from Kerala participated in the study. Participants were recruited through purposive sampling and attended sessions in small groups based on availability.

Intervention Protocol

The four-week intervention was held once a week at the SATWA Foundation for Mental Hygiene & Holistic Wellness, Kozhikode. Each session lasted approximately three hours and included:

Cognitive Behavioral Therapy (CBT): Focused on reframing negative thoughts and behavioral activation.

Individual Counseling: One-on-one support sessions.

Psychoeducation: Discussions on mental health, lifestyle, and coping strategies.

Based Organic Diet: Emphasis on raw fruits, vegetables, sprouts, and whole foods.

Yoga: Guided physical postures and breathing exercises.

Mindfulness Meditation: Practices aimed at increasing awareness and reducing rumination.

Participants were encouraged to follow daily routines at home, including dietary practices, journaling, and 20 minutes of mindfulness meditation.

Tool for Measurement

The Depression Anxiety Stress Scales (DASS-21), a 21-item self-report scale developed by Lovibond & Lovibond (1995), was used to assess psychological distress. The scale includes three subscales: Depression, Anxiety, and Stress.

Data Collection and Analysis

Data were collected at two time points: before the intervention and four weeks after its completion. Paired sample t-tests were conducted to assess changes in DASS-21 scores using SPSS.

RESULTS

Participant Profile

Average Age: 21.3 years
Gender: 61% female, 39% male

DASS-21 Scores

Pre-Intervention Scores: Depression: M = 24.5, SD = 6.2 Anxiety: M = 21.1, SD = 5.8
Stress: M = 26.3, SD = 6.0 Post-Intervention Scores (After 4 Weeks):
Depression: M = 14.2, SD = 5.4
Anxiety: M = 12.3, SD = 4.9
Stress: M = 16.5, SD = 5.1
Statistical Analysis: Significant reductions were found in all three dimensions
Depression: $t(35) = 8.45$, $p < .001$
Anxiety: $t(35) = 7.88$, $p < .001$
Stress $t(35) = 9.02$, $p < .001$

DISCUSSION

There were significant psychological benefit gains following intervention. The results are in line with the growing literature confirming the place of integrative therapies aimed at psychological and physiological health (Sarris et al., 2015; Jacka et al., 2017).

The CBT and counseling helped to correct maladaptive thought processes, while yoga and meditation presumably enhanced emotional regulation and neuroplasticity. The diet likely helped by alleviating inflammation and improving gut-brain axis function (Logan & Jacka, 2014).

Self-reporting was higher for increased self-awareness, better energy levels, and fewer complaints of irritability. Structuring each week and home follow-ups maintained continuity and established behavioral change.

IMPLICATIONS FOR PRACTICE

This research shows that a short, structured, and integrative intervention can substantially reduce psychological distress in university students. Schools and mental health professionals should consider adopting similar programs to promote student well-being in online learning environments.

LIMITATIONS AND FUTURE RESEARCH

Small sample size and lack of a control group restrict generalizability.

Dependence on self-report data may involve bias.

No long-term follow-up data were available.

Future studies must conduct randomized controlled trials, involve biological markers, and quantify long-term impacts.

CONCLUSION

This post-pandemic analysis shows the potential of psycho-nutritional treatment to promote university students' mental well-being. Combining CBT, mindfulness, and dietary interventions yielded drastic improvements in depression, anxiety, and stress levels. With the prevailing trend for online learning, these combined interventions offer a viable, non-drug model that can be sustainably maintained as an investment for student mental health.

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The Role of Social Media in Higher Education Engagement

Haribansh Prasad Singh*

Abstract

Social media has emerged as a transformative tool in higher education, influencing how students, faculty, and academic institutions interact. This paper explores the role of social media in enhancing engagement in higher education, focusing on its impact on communication, learning outcomes, and community building. The primary aim of this study is to investigate how social media platforms contribute to student engagement in higher education settings. The study examines the types of social media tools used by students and faculty, the benefits and challenges of social media integration, and its influence on academic performance, peer collaboration, and institutional communication. A mixed-methods approach was employed, combining surveys and interviews. The survey was distributed to students and faculty members at several universities to assess the frequency, purpose, and effectiveness of social media use in academic contexts. In-depth interviews with key stakeholders provided qualitative insights into their experiences with social media for learning and engagement. Key findings indicate that social media is widely used for academic purposes, including sharing resources, facilitating discussions, and promoting collaboration. Platforms such as Facebook, Twitter, and LinkedIn were reported as common tools for engaging students in academic content and networking. Many students reported increased communication with professors and peers, enhancing their learning experience. Social media also played a vital role in fostering a sense of community, particularly for distance learners or those in large institutions. However, challenges such as privacy concerns, distraction, and a lack of guidelines for professional conduct were noted. The study suggests that higher education institutions should develop comprehensive strategies for integrating social media into their educational practices. Universities should offer training to students

*Assistant Professor, Department of Mathematics, Teachers' Training College, Bhagalpur, Affiliated to T.M. Bhagalpur University, Bhagalpur, Bihar (India).

and faculty on the responsible use of these platforms, ensuring that social media enhances rather than hinders academic goals. Policies should be put in place to address privacy and academic integrity issues. In conclusion, social media has the potential to significantly improve engagement, communication, and collaboration in higher education. By adopting a balanced approach and providing proper guidelines, institutions can harness the benefits of social media while minimizing its challenges, ultimately enhancing the learning experience.

Keywords: Social media, higher education, engagement, communication, collaboration, academic performance.

INTRODUCTION

In the 21st century, the rapid expansion of digital technologies has profoundly influenced how people communicate, collaborate, and acquire knowledge. One of the most transformative elements in this digital era is the widespread use of social media, which has become a dominant force not only in everyday social interaction but also in education, particularly higher education. Platforms like Facebook, Twitter (now X), Instagram, LinkedIn, YouTube, and TikTok have evolved from simple networking tools into robust environments for information exchange, content creation, and real-time dialogue. This transformation has presented both opportunities and challenges for educators and students alike.

Higher education, traditionally characterized by in-person lectures, rigid curricula, and institutional gatekeeping of knowledge, is undergoing a paradigm shift. Social media has disrupted conventional boundaries between educators and learners, transforming students from passive recipients of information into active participants in knowledge construction. Through blogs, discussion forums, video tutorials, podcasts, live Q&A sessions, and digital study groups, social media facilitates new forms of engagement, enabling students to interact with content, instructors, and peers in unprecedented ways.

The COVID-19 pandemic further accelerated this digital transition. With the sudden shift to online learning, social media platforms became essential tools for maintaining academic continuity and student engagement. Universities utilized platforms such as Zoom, Microsoft Teams (integrated with LinkedIn), Facebook groups, and even TikTok to support learning, promote institutional communication, and foster a sense of community amid physical distancing (Perez et al., 2023). As

remote and hybrid learning models persist beyond the pandemic, understanding the pedagogical role of social media becomes even more critical.

Social media engagement in higher education encompasses a wide array of interactions, from course-related discussions and collaborative assignments to digital networking and extracurricular participation. These platforms have also become vital channels for institutional branding, recruitment, alumni engagement, and student support services. Moreover, students increasingly rely on social media to access information about internships, job opportunities, academic resources, and peer feedback, highlighting its integration into both academic and professional spheres (Lukose & Agbeyangi, 2025).

However, despite these advantages, the integration of social media into academic life is not without pitfalls. Concerns related to privacy, digital distraction, misinformation, and cyberbullying continue to surface. Educators and administrators often grapple with striking a balance between encouraging meaningful engagement and regulating misuse. Furthermore, the digital divide, characterized by unequal access to devices and internet connectivity, remains a barrier to inclusive and equitable social media participation in education.

This chapter explores the multifaceted role of social media in higher education engagement. It examines how social media enhances learning, supports communication, and strengthens community building while also analyzing the associated risks and challenges. By adopting a data-informed, theory-backed perspective, the chapter aims to provide educators, researchers, and policy-makers with actionable insights for integrating social media into higher education effectively and responsibly.

OBJECTIVES

The rapid integration of social media into higher education has revolutionized how students, faculty, and institutions interact and engage. This transformation brings forth both opportunities and challenges, requiring a structured inquiry into how these platforms contribute to academic and social engagement within higher learning environments. The following objectives have been carefully formulated to guide the focus and analysis of this chapter:

1. **To Explore How Social Media Enhances Student Academic Engagement**
   One of the primary goals of this chapter is to understand how social media platforms contribute to academic involvement among students. This includes evaluating how students use platforms such as WhatsApp, Facebook, LinkedIn, YouTube, and Telegram to discuss coursework, collaborate on

assignments, seek clarification, and share learning materials. The aim is to investigate whether such engagement improves comprehension, knowledge retention, and motivation for academic success.

2. **To Investigate the Role of Social Media in Fostering Collaborative and Peer-to-Peer Learning**
   Social media offers a space for collaborative learning, where students can exchange ideas, give and receive feedback, and engage in academic discussions outside of the formal classroom setting. This objective seeks to determine the extent to which these platforms encourage peer mentoring, group study habits, and community learning, which are essential components of a modern, student-centered learning approach.
3. **To Assess the Impact of Social Media on Teacher-Student and Institutional Communication**
   Effective communication is central to student engagement. This objective addresses how social media is being used by educators and institutions to improve accessibility, transparency, and communication flow with students. It explores how platforms like Twitter, Facebook, or even institutional YouTube channels are being leveraged for making announcements, sharing resources, answering questions, and delivering timely feedback.
4. **To Identify the Educational Benefits and Limitations of Social Media Use in Higher Education**
   While many advocate for the educational benefits of social media, such as informal learning opportunities, increased participation, and wider access to knowledge, it is equally important to critically examine its drawbacks. This objective evaluates concerns such as digital distraction, information overload, cyberbullying, and the blurring of academic and personal boundaries, and how these affect engagement and academic integrity.
5. **To Examine Social Media's Role in Enhancing Career Readiness and Professional Networking**
   With platforms like LinkedIn, social media plays a crucial role in career development, allowing students to build digital resumes, connect with industry professionals, and access internships and job opportunities. This objective seeks to understand how higher education institutions can integrate such platforms into career counseling and professional development efforts.

6. **To Develop Strategic Recommendations for Responsible and Effective Use of Social Media in Academic Contexts**
   Based on the analysis of empirical data and academic literature, the final objective is to provide actionable recommendations for educators, administrators, and policymakers. These will focus on how to safely, ethically, and effectively integrate social media into teaching practices, institutional communication, and student support services. The goal is to promote sustainable engagement while minimizing risks related to privacy, misuse, and inequity.

Together, these objectives form the foundation for a comprehensive analysis of how social media influences higher education engagement. They aim to bridge the gap between technology and pedagogy, fostering an understanding of how digital tools can be effectively aligned with educational goals to enhance student learning, communication, and professional growth.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Literature Review

The integration of social media into higher education has garnered significant attention in recent years, with numerous studies exploring its impact on student engagement, learning outcomes, and institutional practices.

Social Media's Role in Enhancing Student Engagement

Research indicates that social media platforms can foster increased student engagement by facilitating communication, collaboration, and access to resources. For instance, platforms like WhatsApp and Facebook have been utilized to create study groups, enabling students to discuss course materials and share information outside the traditional classroom setting.

Impact on Academic Performance

While social media offers avenues for academic support, its influence on academic performance is nuanced. Some studies suggest that moderate use of social media for educational purposes can enhance learning, whereas excessive or non-academic use may lead to distractions and decreased academic achievement.

Institutional Communication and Branding

Higher education institutions have adopted social media as a tool for communication and branding. By maintaining active profiles on platforms like LinkedIn and Instagram, universities can disseminate information, engage with stakeholders, and enhance their public image.

Challenges and Ethical Considerations

Despite its benefits, the use of social media in academia raises concerns regarding privacy, cyberbullying, and the potential for misinformation. Institutions must navigate these challenges by developing clear policies and providing guidance on appropriate usage.

Theoretical Framework

To understand the multifaceted role of social media in higher education engagement, several theoretical models offer valuable insights:

Uses and Gratifications Theory (UGT)

UGT posits that individuals actively select media channels to satisfy specific needs, such as information seeking, social interaction, or entertainment. In the context of higher education, students may use social media to fulfill academic needs, connect with peers, or seek support, highlighting the platform's role in meeting diverse student motivations.

Technology Acceptance Model (TAM)

TAM explores how users come to accept and use technology, emphasizing perceived usefulness and ease of use as primary factors influencing adoption. Applying TAM to social media in education suggests that students are more likely to engage with platforms they find beneficial for learning and easy to navigate.

Social Constructivism

Social constructivism emphasizes the importance of social interactions in the construction of knowledge. Social media facilitates collaborative learning environments where students can co-construct understanding through discussions, peer feedback, and shared resources.

Media Richness Theory (MRT)

MRT assesses the capacity of communication media to effectively convey information. Rich media, characterized by immediate feedback and multiple cues, is more effective for complex tasks. Social media platforms, offering various communication tools, can enhance the richness of educational interactions.

Social Presence Theory

This theory focuses on the degree to which a person is perceived as "real" in mediated communication. High social presence in online learning environments, facilitated by interactive social media features, can lead to increased student satisfaction and engagement.

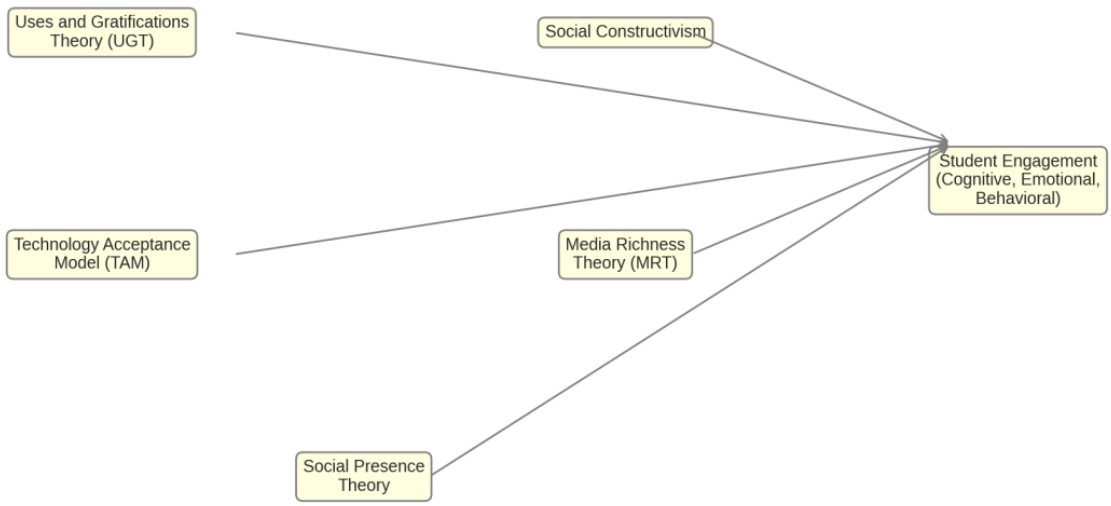

Figure 1: Theoretical Framework Explaining Social Media's Impact on Engagement

METHODOLOGY

Research Design

This study employed a mixed-methods design, integrating both quantitative and qualitative approaches to provide a comprehensive understanding of how social media influences student engagement in higher education. The quantitative component

involves a structured survey to gather numerical data on students' social media usage patterns and their perceived impact on academic engagement. The qualitative component comprises semi-structured interviews to delve deeper into students' personal experiences and perceptions regarding social media's role in their educational journey.

Research Questions

The study is guided by the following research questions:

- What are the prevalent patterns of social media usage among higher education students?
- How does social media usage correlate with different dimensions of student engagement (behavioral, emotional, and cognitive)?
- What are students' perceptions of the benefits and challenges associated with using social media for academic purposes?

Population and Sampling

The target population for this study includes undergraduate and postgraduate students enrolled in higher education institutions across various disciplines. A stratified random sampling technique is employed to ensure representation across different academic years, fields of study, and demographic backgrounds. The sample size consists of 500 students for the survey component and 30 students for the interview component.

Collection Instruments

Survey Questionnaire

A structured questionnaire is developed, comprising the following sections:

- Demographic Information: Age, gender, academic year, and field of study.
- Social Media Usage Patterns: Frequency, duration, and purpose of using platforms like Facebook, WhatsApp, Instagram, LinkedIn, and YouTube.
- Student Engagement Scale: Adapted from validated instruments measuring behavioral, emotional, and cognitive engagement.
- Perceived Impact: Students' perceptions of how social media influences their academic performance and engagement.

The questionnaire is pilot-tested with a small group of students to ensure clarity and reliability.

Semi-Structured Interviews

An interview guide is developed to explore:

- Students' experiences with using social media for academic collaboration and communication.
- Perceived advantages and disadvantages of integrating social media into their learning processes.
- Suggestions for effective utilization of social media in educational settings.

Interviews are conducted either face-to-face or via video conferencing platforms, depending on participants' preferences and availability.

Data Collection Procedure

Survey: The questionnaire is distributed electronically through institutional email lists and learning management systems. Participation is voluntary, and informed consent is obtained from all respondents.

Interviews: Participants for interviews are selected from survey respondents who indicate a willingness to participate further. Interviews are scheduled at convenient times and recorded with participants' consent for transcription and analysis.

Data Analysis

Quantitative Data Analysis

Survey responses are analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics summarize demographic data and usage patterns. Inferential statistics, including correlation and regression analyses, examine relationships between social media usage and student engagement dimensions.

Qualitative Data Analysis

Interview transcripts are analyzed using thematic analysis. This involves coding data to identify recurring themes and patterns related to students' experiences and perceptions of social media's role in their academic engagement.

Ethical Considerations

The study adheres to ethical research standards, including:

- Obtaining informed consent from all participants.
- Ensuring confidentiality and anonymity of participant data.

- Allowing participants the right to withdraw from the study at any point without penalty.
- Securing ethical clearance from the relevant institutional review board before data collection.

FINDINGS AND DISCUSSION

Quantitative Findings

The survey conducted among 500 undergraduate and postgraduate students revealed several key insights into social media usage patterns and their correlation with academic engagement:

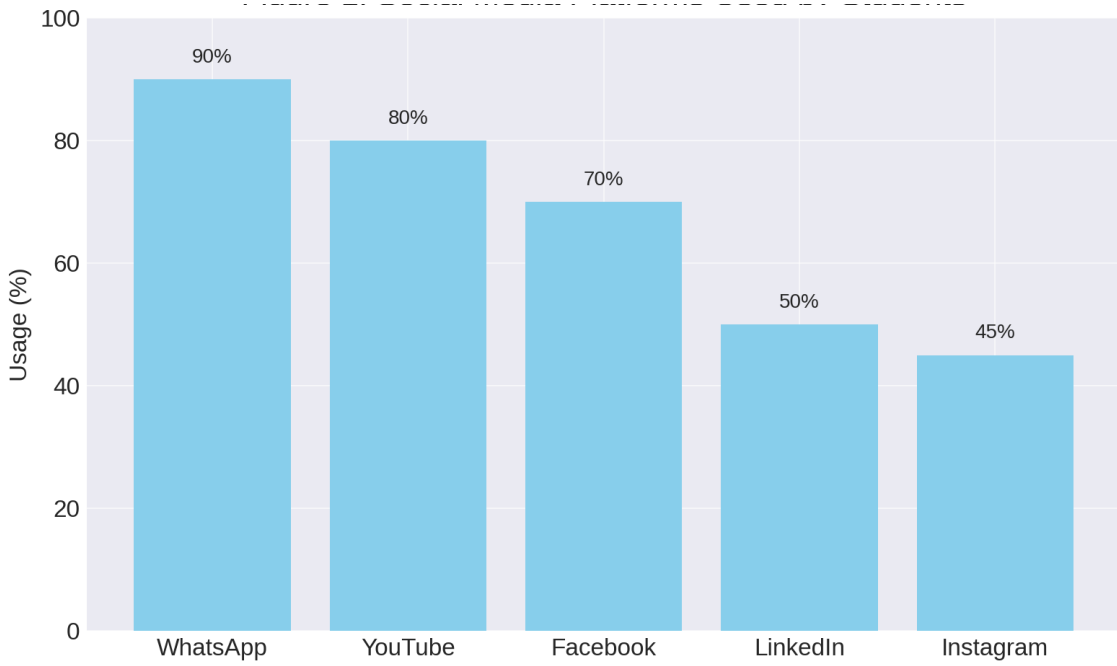

Figure 2: Social Media Platforms Used by Students

- **Prevalence of Social Media Usage:** A significant majority (approximately 85%) of students reported using social media platforms daily for academic purposes. Platforms such as WhatsApp, Facebook, and YouTube were the most commonly utilized for sharing study materials, participating in group discussions, and accessing educational content.

- **Correlation with Academic Engagement:** Statistical analysis indicated a positive correlation between the frequency of academic-related social media use and levels of student engagement. Students who frequently engaged with academic content on social media reported higher levels of behavioral and cognitive engagement in their studies.

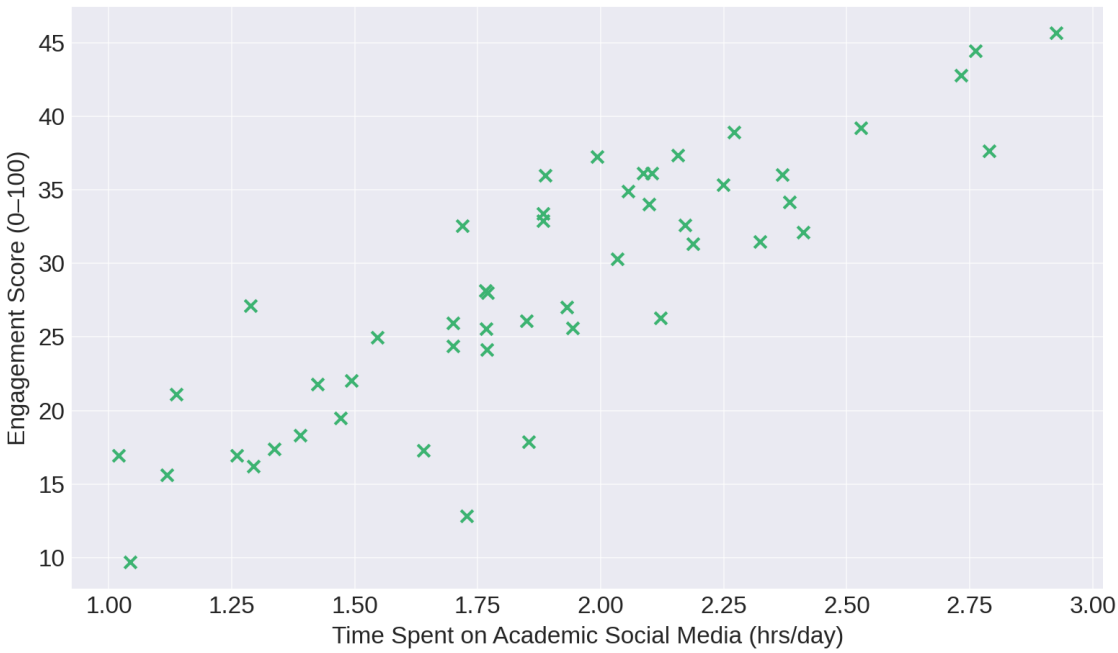

Figure 3: Correlation between Social Media Time and Engagement

- **Time Management Challenges:** Despite the benefits, approximately 40% of students acknowledged that excessive use of social media, particularly for non-academic purposes, led to procrastination and negatively impacted their academic performance.

These findings align with previous research indicating that while social media can enhance academic engagement, it also poses challenges related to time management and potential distractions.

Qualitative Insights

Semi-structured interviews with 30 students provided a deeper understanding of their experiences and perceptions:

- **Enhanced Collaboration:** Students emphasized the role of social media in facilitating collaborative learning. Platforms enabled real-time communication, peer-to-peer support, and collective problem-solving, which enriched their learning experiences.
- **Access to Diverse Resources:** Participants appreciated the accessibility of diverse educational resources through social media, including tutorials, lectures, and scholarly articles, which complemented their formal learning.
- **Distractions and Mental Well-being:** Several students expressed concerns about the addictive nature of social media and its impact on their mental well-being. The constant influx of information and notifications often leads to decreased concentration and increased stress levels.

These qualitative insights highlight the dual-edged nature of social media in education, offering both opportunities for enhanced learning and challenges that need to be managed effectively.

Discussion

The integration of social media into higher education presents a complex landscape:

- **Opportunities:** Social media platforms serve as valuable tools for fostering engagement, collaboration, and access to information. They support diverse learning styles and provide flexible learning environments that extend beyond traditional classroom settings.
- **Challenges:** The potential for distraction, information overload, and negative impacts on mental health necessitate the development of strategies to promote responsible and balanced use of social media among students.
- **Institutional Role:** Educational institutions play a crucial role in guiding students on effective social media use. This includes integrating digital literacy programs, establishing clear usage policies, and providing support systems to address the challenges associated with social media in academic contexts.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The evolving digital landscape has transformed the way students interact with educational content, instructors, and peers. Among the most transformative elements is social media, which has emerged as a significant tool in shaping academic

engagement in higher education. This chapter has examined the role of social media in facilitating learning, enhancing engagement, and promoting academic collaboration among students and faculty.

The findings indicate that social media platforms such as WhatsApp, YouTube, LinkedIn, Facebook, and Instagram have become integrated into students' academic routines. These platforms foster real-time communication, peer-to-peer interaction, access to learning materials, and direct engagement with instructors, contributing to enhanced behavioral, emotional, and cognitive engagement (Garrison & Kanuka, 2004; Akhtar et al., 2025).

However, the study also highlights several challenges. Distractions due to excessive non-academic use, digital fatigue, cyberbullying, and mental health issues have been reported as side effects of unchecked social media engagement (Carrier et al., 2015; Lukose & Agbeyangi, 2025). While the academic advantages of social media are substantial, they are accompanied by risks that must be managed through institutional guidance, digital literacy, and self-regulation strategies.

Thus, the dual nature of social media in higher education—as both a catalyst for engagement and a potential source of distraction—requires a structured, policy-driven approach to maximize benefits while minimizing adverse effects.

Recommendations

To make social media a constructive force in higher education engagement, the following actionable recommendations are proposed:

1. **Develop Institutional Policies for Social Media Use**
   Universities should formulate clear guidelines on the acceptable and educational use of social media. These policies should delineate ethical usage, data privacy, academic integrity, and digital etiquette to create a productive digital learning environment (Aliyu et al., 2024; Advance HE, 2024).
2. **Integrate Social Media into Pedagogical Practice**
   Educators are encouraged to leverage social media tools for enhancing active learning. Examples include using discussion groups on WhatsApp or Telegram, curating content on YouTube or LinkedIn Learning, and fostering class-based debates or peer feedback on platforms like Twitter and Instagram Stories (Henrie et al., 2015; Schindler et al., 2017).
3. **Enhance Digital Literacy**
   Students should receive regular training on how to evaluate the credibility of online sources, manage digital distractions, and protect their digital identity. A

digitally literate student body is better prepared to use social media constructively for academic purposes (Ziatdinov & Cilliers, 2022; Alruthaya et al., 2021).

4. **Monitor and Support Student Well-being**
   Institutions must proactively address the psychological and emotional challenges related to excessive social media usage. Counseling services, mindfulness programs, and workshops on time management can mitigate issues such as digital burnout and anxiety (Mok, 2024; Carrier et al., 2015).
5. **Encourage Collaborative Learning Models**
   Faculty should design collaborative learning activities using social media tools. Group assignments, virtual labs, and interactive assessments using social platforms can boost engagement and help students develop skills in communication, teamwork, and leadership (Payne, 2019; Garrison & Kanuka, 2004).
6. **Promote Continuous Evaluation and Research**
   Given the rapidly evolving nature of digital platforms, it is essential that institutions continuously research and evaluate the role of social media in academic engagement. Feedback from students and faculty can guide updates to curriculum and teaching strategies (Rahman et al., 2020; Graham, 2014).

In conclusion, while social media presents undeniable opportunities for innovation and engagement in higher education, it also introduces complexities that require thoughtful intervention. When strategically integrated and ethically used, social media can become a powerful ally in nurturing informed, connected, and engaged learners.

Area	Action	Responsible Party
Policy	Create institutional guidelines for ethical use	University Admin
Pedagogy	Use WhatsApp, LinkedIn, YouTube in course design	Faculty
Digital Literacy	Offer workshops on digital identity and source credibility	IT/Library Team
Well-being	Provide counseling, mindfulness & time management training	Student Affairs
Collaboration	Design group tasks using social platforms	Faculty
Continuous Research	Regularly evaluate social media impact on engagement	Academic Researchers

Figure 4: Strategic Recommendations for Effective Social Media Use in Higher Education

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EdTech Startups and Investment Trends in Higher Education in India

Madhurya Chetia*

Abstract

The landscape of education in India has been undergoing significant transformation, propelled by the rapid adoption of digital technologies. The Indian EdTech sector has witnessed significant growth over the past decade, driven by advancements in technology, increased internet penetration, and a large untapped market for educational solutions. Startups in India's EdTech space have received substantial investments, making India one of the fastest-growing markets for educational technology worldwide. With the increasing demand for skill development, digital learning platforms, and professional certifications, the higher education sector in India has witnessed a surge in investments. This paper aims to analyze the investment trends in EdTech startups in India, focusing on their impact on the higher education sector. It explores the factors driving investment, key players in the sector, and the challenges and opportunities for both startups and investors. It analyzes the role of venture capital, private equity, and government initiatives in shaping the investment landscape and explores how these investments are transforming the education sector. Furthermore, the paper highlights the opportunities and risks associated with investing in this space and offers insights into future trends.

Keywords: Digital India, Skill India, investment, MOOCs, skill, Data Analytics

INTRODUCTION

The Indian EdTech sector has experienced significant growth over the past decade, driven by technological advancements, increased internet penetration, and a rising demand for quality education. Particularly in higher education, EdTech startups have emerged as pivotal players, offering innovative solutions ranging from online certifications to test preparation and upskilling programs.

*Assistant Professor, Department of Economics, Karmashree Hiteswar Saikia College.

India's education sector has witnessed a significant digital transformation in recent years, particularly accelerated by the COVID-19 pandemic. Traditional classrooms rapidly shifted to online platforms, leading to widespread adoption of digital tools and e-learning solutions. Government initiatives like Digital India and SWAYAM played a key role in promoting technology in education.

The rise of EdTech startups such as Byju's, Unacademy, and upGrad revolutionized learning by offering accessible, personalized, and skill-based education. Increased internet penetration, affordable smartphones, and AI-driven platforms have further enabled students across urban and rural areas to access quality education. This digital shift has not only bridged geographical gaps but also transformed the way knowledge is delivered and consumed in higher education.

The digital revolution has significantly impacted higher education institutions in India, pushing them to adopt technology-driven models of teaching and learning. Universities and colleges are increasingly collaborating with EdTech startups to offer online degrees, certification programs, and hybrid learning experiences.

EdTech startups like upGrad, Coursera, and Eruditus have enabled institutions to expand their reach beyond traditional classrooms, offering flexible, skill-based, and industry-aligned courses. These platforms provide tools for personalized learning, digital assessments, and real-time feedback, improving student engagement and outcomes.

As a result, higher education is becoming more inclusive, accessible, and relevant to the demands of a rapidly changing job market. EdTech is not just a support system but a strategic partner in transforming the future of higher education in India.

This paper explores the evolution of EdTech startups in India, examining investment trends, challenges, and future prospects.

OBJECTIVES

- To analyze the investment patterns in Indian EdTech startups focusing on higher education.
- To identify key factors influencing investor interest in this sector.
- To assess the impact of these investments on the quality and accessibility of higher education in India.
- To provide recommendations for stakeholders to foster sustainable growth in the EdTech ecosystem.

METHODOLOGY:

This study employs a qualitative research approach, utilizing secondary data collected from industry reports, news articles, and academic journals. Data analysis includes trend analysis of funding patterns, case studies of prominent EdTech startups, and expert opinions from industry leaders. The research also incorporates a comparative analysis of investment trends pre- and post-pandemic to understand the sector's resilience and adaptability.

ANALYSIS

Investment Trends

The Indian EdTech sector witnessed a funding surge during the COVID-19 pandemic, with investments reaching a peak of $4.1 billion in 2021. However, subsequent years have seen a decline, with 2023 recording only $321 million in funding, an 87% drop from the 2021 peak. Despite this downturn, the first half of 2024 showed signs of recovery, with $164 million raised, indicating renewed investor confidence.

India's EdTech sector has experienced significant fluctuations in investment over recent years, reflecting broader economic conditions and evolving market dynamics.

Peak and Decline

In 2021, the sector reached its zenith, securing approximately $4.1 billion in funding. This surge was largely driven by the pandemic-induced demand for online education. However, subsequent years saw a sharp decline. By 2023, funding had plummeted by 87% to $321 million, with only one major funding round exceeding $100 million.

Recovery Signs in 2024

Despite the downturn, 2024 has shown signs of recovery. The first half of the year saw a 96% increase in funding compared to the second half of 2023, totaling $164 million. This rebound indicates renewed investor interest, particularly in areas that complement traditional education.

Sectoral Shifts and Strategic Focus

The decline in funding has led to a strategic shift within the sector. Companies are focusing on profitability and sustainability, moving away from rapid expansion.

This recalibration has attracted investors back to the sector, with early-stage funding more than tripling in 2024.

Challenges and Opportunities

While the sector faces challenges such as macroeconomic factors and a return to traditional learning models, opportunities remain in areas like professional upskilling and niche educational services. Companies like Avanse and LawSikho have secured significant investments, and LawSikho has gone public, highlighting the potential for growth in specialized segments.

CONCLUSION

In summary, India's EdTech sector is navigating a period of transformation. While past years have seen substantial declines in investment, the current year offers a more optimistic outlook, driven by strategic shifts and a focus on sustainable growth. The sector's long-term prospects remain positive, contingent on continued innovation and adaptation to market needs.

Sectoral Focus

Investments have been predominantly directed towards online certifications and test preparation segments, reflecting the demand for skill-based learning and competitive exam readiness. Startups like Avanse and Lawsikho have garnered significant attention, with Avanse raising $120 million and Lawsikho going public in 2024

India's EdTech sector has evolved from offering broad-based learning solutions to developing specialized, sector-focused offerings. The key areas of focus include K-12 education, test preparation, higher education, professional upskilling, and study-abroad services.

Test preparation and online certification remain dominant, attracting the highest investment, with startups like Unacademy and Physics Wallah leading in competitive exam prep. Higher education and executive learning are also gaining traction, supported by platforms like upGrad and Eruditus, which partner with universities to offer online degrees and certifications.

Another growing focus is professional and career upskilling, where platforms provide short-term, job-ready courses in emerging fields like AI, data science, and

cybersecurity. Startups like LawSikho have tapped into niche verticals such as legal education, while others explore healthcare, finance, and tech-specific training.

Overall, India's EdTech sector is becoming more specialized, catering to the diverse educational and professional needs of students and working professionals alike.

A. Regional Distribution

India's EdTech landscape is characterized by a concentration of activity in certain regions, driven by infrastructure, talent availability, and market demand. Here's an overview of the regional distribution

1. B**engaluru (Karnataka)**
   - **Tech Hub:** Known as the "Silicon Valley of India," Bengaluru is the epicenter of India's EdTech industry.
   - **Key Players:** Home to major EdTech companies like BYJU's, Unacademy, and Vedantu.
   - **Investment Magnet:** Attracted significant investments, with Bengaluru-based companies raising $944 million during the pandemic.
2. **Delhi NCR (Delhi, Gurugram, Noida)**
   - **Diverse Ecosystem:** Hosts a variety of EdTech startups catering to different educational needs.
   - **Notable Startups:** Companies like Physics Wallah (PW) and Schoolnet India have their headquarters in Noida. **Funding Activity:** Gurugram-based startups raised $33.19 million during the pandemic
3. **Hyderabad (Telangana)**
   - **Emerging Hub:** Hyderabad has become a significant player in the EdTech sector.
   - **Infrastructure:** Hosts large campuses of global tech giants and a growing number of startups.
   - **Employment:** As of 2023, over 900,000 employees are in the IT/ITES sector in Hyderabad
4. **Chennai (Tamil Nadu)**
   - **SaaS Capital:** Chennai is recognized as the "SaaS Capital of India," with a strong presence of software and EdTech companies.
   - **Educational Institutions:** The city boasts numerous engineering colleges, providing a steady talent pool for EdTech firms

5. **Tier II & III Cities**
   - **Expanding Reach:** EdTech platforms are increasingly catering to students in smaller cities and rural areas.
   - **Inclusive Education:** Companies are developing low-bandwidth solutions and distributing devices to enhance accessibility

Conclusion: While metropolitan areas like Bengaluru, Delhi NCR, Hyderabad, and Chennai remain central to India's EdTech sector, there's a noticeable shift towards inclusivity and accessibility, with platforms expanding their reach to Tier II and III cities to bridge educational divides.Bengaluru leads the EdTech landscape, accounting for over 64% of total funds raised, followed by Delhi and Mumbai. This concentration highlights the city's role as a hub for EdTech innovation and investment.

Challenges and Setbacks

The sector has faced challenges such as governance issues and financial mismanagement. Byju's, once valued at $22 billion, has experienced a dramatic decline, now valued below $2 billion, due to alleged financial mismanagement and compliance issues. This underscores the importance of corporate governance in sustaining investor confidence.

Challenges and Setbacks of India's EdTech Sector

India's EdTech sector, though rapidly growing, has faced several challenges and setbacks in recent years.

1. **Post-Pandemic Slowdown:**
   As schools and colleges reopened after COVID-19, the demand for online learning declined. This led to reduced user engagement and revenue for many platforms.
2. **Funding Winter:**
   After peaking in 2021, investor interest significantly declined. In 2023, EdTech funding dropped by over 85%, causing financial strain on startups and layoffs across the sector.
3. **Regulatory Uncertainty:**
   The lack of clear government guidelines on online education, especially for degrees and certifications, has created compliance issues for EdTech companies.

4. **Governance and Trust Issues:**
   High-profile cases like Byju's financial mismanagement and corporate governance lapses have affected investor confidence and public trust in the sector.
5. **Market Saturation & Competition:**
   The rapid influx of startups led to intense competition, with many offering similar services. This made customer acquisition costly and unsustainable for smaller players.
6. **Accessibility Gaps:**
   Despite technological advances, many students in rural and low-income areas still lack access to stable internet and digital devices, limiting the sector's reach.

CONCLUSION

India's EdTech sector is at a turning point. While it holds immense potential, companies must focus on transparency, sustainable growth, and inclusive innovation to overcome these challenges. EdTech startups in India are playing a pivotal role in reshaping the higher education landscape by offering scalable, flexible, and affordable learning solutions. The surge in investments reflects the growing confidence of investors in the potential of these companies to address India's education challenges. With the backing of venture capital, private equity, and government initiatives, the future of EdTech in India looks promising.

However, challenges such as intense competition, the digital divide, and regulatory hurdles must be overcome to ensure that these platforms reach their full potential. By addressing these issues and continuing to innovate, EdTech startups can play a significant role in improving the quality and accessibility of higher education in India, contributing to the country's growth and development.

FINDINGS

- The Indian EdTech sector remains a significant player globally, with over 11,000 active companies and six unicorns.
- Investment trends indicate a shift towards niche areas like online certifications and test preparation.
- Despite funding challenges, the sector shows resilience, with signs of recovery in 2024.

- Regional hubs like Bengaluru continue to attract the majority of investments.
- Governance issues have impacted investor confidence, as seen in the case of Byju's.

RECOMMENDATIONS

- **For Startups**: Focus on innovation and quality to differentiate offerings in a competitive market.
- **For Investors**: Conduct thorough due diligence, emphasizing corporate governance and financial transparency.
- **For Policymakers**: Create a supportive regulatory environment that encourages innovation while ensuring accountability.
- **For Educational Institutions**: Collaborate with EdTech startups to integrate technology into traditional learning models, enhancing accessibility and quality.

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Utilization of Social Media on Academic Development – An Empirical Study Among College Students in Erode District, Tamilnadu

M. Murali* and Dr. S. M. Venkatachalam**

Abstract

In the past two decade, the education sector has promising use of social media for developing academic performance of their students in an effective way. Because of more implementation of social media in recent years, it has witnessed an increased interest of using social media in higher education. So, this research has mainly aimed to understanding and utilization of the social media among the students of Arts and Science colleges for their academic development in Erode district of Tamilnadu, India. For this, the researcher has aimed to identify the college students who are utilized more the social media for their academic development. In this way, around 135 college students have been identified and collected their opinion about the usage of social media through a structured questionnaire. The questionnaire has been categorised into two heads viz., demographic factors and utilization of the social media for their academic advancement. The collected details are subdued into tables and graphs with the help of SPSS 22.0. For identifying the nature of the demographic variables, percentage analysis, mean and SD have been used. For examining the utilization of social media on academic development with regard to selected independent variables, Anova test has been performed and multiple regression analysis has been applied to examine the highly influenced factors. The result from analysis showed that the students are utilizing the social media at the maximum level who belongs to PG, Science department, using Facebook regularly and utilizing the social media for 5-8 years.

Keywords : Social Media, College Students, Academic Development, Higher Education, Facebook, Digital Learning.

*Ph.D. Research Scholar, Department of Management Studies, Vidhyaa Arts and Science College, Salem.

**Principal, Vidhyaa Arts and Science College, Salem.

INTRODUCTION

Social media has become a potent instrument in the current digital era, having a significant impact on many facets of life, including education. Particularly among college students, social media platforms are being used more and more for academic as well as communication and enjoyment purposes. Interest in comprehending the function of social media in academic development has increased as a result of this change in how students use digital resources. This study aims to investigate how much social media helps or hinders college students' academic success in Erode district, Tamilnadu. The study intends to provide light on the various ways students integrate social media into their learning processes by concentrating on this particular group. The study explores how academic performance and skill development are impacted by various activities, such as using platforms for academic collaboration, accessing educational resources, or asking peers and mentors for academic support. The study uses an empirical technique to gather data directly from Erode college students in order to investigate social media usage patterns, the reasons behind them, and the academic results linked to various forms of participation. In doing so, it also aims to comprehend the benefits social media presents for improving academic performance as well as the possible drawbacks, such distractions, that students may experience when using it.

REVIEW OF LITERATURE

Over the past decades, educational research has become increasingly interested in the impact of social media on academic growth. The quick assimilation of digital technology into daily life, especially among college students, has made social media platforms an important instrument for learning and academic engagement in addition to communication and enjoyment. The connection between social media use and academic achievement has been the subject of numerous research. Facebook use and a decline in academic achievement are significantly correlated, according to Junco (2012). Social media platforms were blamed for this performance drop since they divert students' attention and cut down on the amount of time they spend on schoolwork. Similarly, Kirschner and Karpinski (2010) pointed out that students who spend a lot of time on social media sites like Facebook receive worse scores than those who use them sparingly. But the relationship isn't always clear-cut because, when used properly, social media may also be a tool for improving academic

performance. Social networking can be a useful tool for academic growth, on the plus side. Students that utilise social media for educational objectives, like group discussions, information sharing, and collaboration, do better academically, claim Al-Rahmi and Zeki (2017). Students can engage with peers and professionals, obtain educational content, and get help with homework or test preparation through social media sites. These exercises have the potential to make learning more dynamic and interesting, which will ultimately improve academic performance.

According to a 2009 study by Pempek, Yermolayeva, and Calvert, students use Facebook for academic collaboration as well as socialising. This includes exchanging study materials, talking about lecture themes, and asking questions about academic concepts. It has been demonstrated that social media platforms help students develop a sense of community by encouraging collaborative learning and the sharing of ideas, both of which enhance critical thinking and problem-solving abilities. Social media platforms have emerged as key hubs for academic networking, allowing students to connect with professors, professionals, and peers, expanding their learning opportunities outside of traditional classroom settings (Ainin et al., 2015). Furthermore, social media's addictive qualities are a further worry. According to research by Shehzadi and Kausar (2017), some students become dependent on social media, which seriously disrupts their study schedules. Students may find it challenging to maintain focus on their academic work due to the continual notifications, chats, and updates on social media.

Students' use of social media has significantly increased in India, particularly in metropolitan and semi-urban areas. Similar patterns can be seen in India, according to research conducted in Malaysia by Karaj and Siti (2018), which demonstrates that the influence of social media on academic achievement may vary depending on cultural and geographical characteristics. Indian students' usage of Facebook and WhatsApp has been linked to academic distraction as well as collaboration. Social media may be both a resource for academic success and a possible barrier for pupils in Tamil Nadu, where education is extremely competitive. Little is known about how social media affects academic growth in Indian colleges, especially in smaller cities like Erode. However, new research shows that students from semi-rural and rural areas tend to use social media less for academic content and more for amusement and socialising (Al-Rahmi & Zeki, 2017). This trend emphasises the necessity of doing research tailored to a particular region in order to gain a deeper understanding of the distinct ways that students in various parts of India interact with social media and how this affects their academic performance.

STATEMENT OF THE PROBLEM

College students' usage of social media has grown dramatically in recent years, with many integrating sites like Facebook, YouTube, Instagram, Twitter, and WhatsApp into their everyday lives. Although social media has ingrained itself into students' academic and personal life, its effects on academic growth are still up for debate. It is unclear how social media might help or hurt students' academic achievement, skill development, and information acquisition, especially when it comes to college students in rural and semi-urban areas of Erode district in Tamilnadu. Even while social media is becoming more and more common, thorough studies explicitly looking at how these platforms impact students' academic performance in this area are scarce. Some studies point to possible drawbacks, such increased distraction, procrastination, and a drop in academic performance, while others show benefits like enhanced communication, peer collaboration, and access to academic resources. The lack of knowledge about how students of Arts and Science colleges in the Erode area use social media for academic growth is the issue that this study aims to solve. It seeks to determine whether social media may be used to improve academic performance or if it mostly works as a source of distraction that impairs students' ability to focus, engage, and do well in class. Understanding the precise ways that social media affects academic achievement in this environment is essential for educators, policymakers, and students themselves, especially in light of the increasing dependence on digital resources for communication and education.

OBJECTIVES OF THE STUDY

- To study the demographic profile and social media utilization of the selected arts and science college students in Erode district, Tamilnadu.
- To assess the extent of social media usage among college students in Erode district.
- To examine the effectiveness of social media on academic development of the college students.

HYPOTHESES OF THE STUDY

- There is no significant difference in mean utilization of social media on academic development with regard to studying department of the college students.

- There is no significant difference in mean utilization of social media on academic development with regard to studying degree of the college students.
- There is no significant difference in mean utilization of social media on academic development with regard to period of using the social media of the students.
- There is no significant difference in mean utilization of social media on academic development with regard to type of social media using of the students.
- There is significant relationship with utilization of social media on academic development among selected variables.

RESEARCH METHODOLOGY

This study adopts a descriptive research design to examine the utilization of social media on the academic development of Arts and Science college students. A structured questionnaire was developed as the primary survey tool, comprising two sections: demographic details and the students' academic development through social media usage. A total of 135 students from Arts and Science Colleges in Erode, Tamil Nadu were selected as respondents. The collected data were organized into tables using MS Excel and analyzed with statistical tools such as percentage analysis, mean scores, standard deviation, and ANOVA, using SPSS version 26.0.

RESULT AND DISCUSSION

Demographic Profile of the College Students

The following table discusses the demographic profile of the selected college students and their utilization of social media on academic development.

Table 1: Demographic Profile and Utilization of Social media on Academic development

No.	Variables Name	Number of Respondents	%	Mean	Standard Deviation
1	**Gender**				
	• Male	83	61.5	3.79	0.59
	• Female	52	38.5	3.61	0.66
	Total	**135**	**100.0**		

No.	Variables Name	Number of Respondents	%	Mean	Standard Deviation
2	**Age**				
	• 17-20 years	43	31.9	3.69	0.67
	• 20-23 years	64	47.4	3.85	0.55
	• Above 23 years	28	20.7	3.60	0.57
	Total	**135**	**100.0**		
3	**Studying Department**				
	• Arts	71	52.6	3.63	0.64
	• Science	64	47.4	3.83	0.57
	Total	**135**	**100.0**		
4	**Studying Degree**				
	• UG	76	56.3	3.61	0.58
	• PG	40	29.6	4.01	0.51
	• Ph.D.	19	14.1	3.79	0.68
	Total	**135**	**100.0**		
5	**Type of Social media used.**				
	• Whatsapp	31	23.0	3.67	0.66
	• Facebook	14	10.4	4.30	0.26
	• YouTube	46	34.1	3.61	0.69
	• Twitter	18	13.2	3.95	0.37
	• Instagram	26	19.3	3.51	0.48
	Total	**135**	**100.0**		
6	**Period of Using Social Media**				
	• Upto 5 years	48	35.6	3.65	0.71
	• 5-8 years	56	41.4	3.82	0.39
	• Above 8 years	31	23.0	3.71	0.71
	Total	**135**	**100.0**		

- It is noticed from the above table that 61.5% are male students and 38.5% are female among the selected students of Arts and Science colleges. Also, male students have a higher mean score (3.79) in utilizing social media for academic development compared to female students (3.61).
- From the analysis, it is assumed that the largest group of students falls within the 20–23 years age range (47.4%), followed by 17–20 years (31.9%) and above 23 years (20.7%). Further, students aged 20–23 years show the highest mean utilization (3.85), followed by those aged 17–20 years (3.69) and above 23 years (3.60).
- It is displayed from the analysis that 52.6% of students are from Arts departments, while 47.4% belong to Science departments. Hence, science students have a higher mean score (3.83) in using social media academically compared to Arts students (3.63).
- The analysis illustrated that 56.3% of the respondents are undergraduate (UG) students, while 29.6% are postgraduates (PG) and 14.1% are pursuing Ph.D. Additionally, postgraduate students report the highest mean score (4.01), followed by Ph.D. students (3.79) and UG students (3.61) in academic use of social media.
- From the analysis, it is mentioned that YouTube is the most used platform (34.1%), followed by WhatsApp (23.0%), Instagram (19.3%), Twitter (13.2%), and Facebook (10.4%) among the college students. In addition, Facebook users demonstrate the highest mean academic development (4.30), followed by Twitter (3.95), while Instagram users show the lowest (3.51).
- It is explored from the analysis that 41.4% of the students have used social media for 5–8 years, 35.6% have used it for up to 5 years, and 23.0% have used it for more than 8 years. Moreover, college students using social media for 5–8 years have the highest mean utilization (3.82), followed by those using it for 8 years (3.71) and up to 5 years (3.65).

Utilization of Social Media on Academic Development

This section discusses the utilization of social media on academic development among the selected arts and science college students in the following table. For this study, the researchers have framed eight statements related to the utilization of social media on academic development.

Table 2: Utilization of Social Media on Academic Development

S. No	Factors	Mean Score	SD
1	Social media helps me improve my understanding of academic topics	3.49	1.16
2	Social media platforms motivate me to learn new academic subjects	3.90	1.12
3	Social media helps me in time management by keeping track of my academic tasks	3.64	1.31
4	I rely on social media to clarify doubts when teachers are not available	3.42	1.14
5	Social media plays a significant role in my overall academic development	4.31	0.90
6	Social media tools help me collaborate with classmates on academic projects	3.68	1.24
7	I feel more confident in my academic abilities due to social media use	3.73	1.07
8	I frequently use social media to access academic resources and materials	3.60	1.48

It could be explored from the analysis that the Cronbach Alpha value for the statements of utilization of social media on academic development is 0.873. This study indicates that the reliability of the utilization of social media on academic development is good and fit for analysis. It is indicated among factors of utilization of social media on academic development that most of the college students opined as ‘social media plays a significant role in my overall academic development’ with the mean score and standard deviation of 4.31 and 0.90 respectively followed by ‘social media platforms motivate me to learn new academic subjects’ with the mean score and standard deviation of 3.90 and 1.12 respectively.

Relationship between Demographic Profile and Utilization of social media on academic development

This section has analyzed that the relationship between the demographic profile and utilization of social media on academic development of selected college students.

To examine the relationship between selected independent variables and utilization of social media on academic development, a hypothesis has been framed and tested by using ANOVA.

Studying Department and Utilization of Social Media on Academic Development

H_0: There is no significant difference in mean utilization of social media on academic development with regard to studying department of the college students.

Table 3: Studying Department and Utilization of Social Media on Academic Development

	Sum of Squares	df	Mean Square	F	'p' value
Between Groups	1.365	1	1.365	3.649	0.058^{NS}
Within Groups	49.750	133	0.374		
Total	51.115	134			

Note: NS - Not Significant

From the above analysis, it is assumed that the 'p' value is greater than 0.05; consequently, the null hypothesis is accepted. It is found that there is no significant difference in the mean utilization of social media on academic development with regard to the studying department of the college students.

Studying Degree and Utilization of Social Media on Academic Development

H_0: There is no significant difference in mean utilization of social media on academic development with regard to studying degree of the college students.

Table 4: Studying Degree and Utilization of Social Media on Academic Development

	Sum of Squares	df	Mean Square	F	'p' value
Between Groups	2.739	2	1.369	3.737	0.026**
Within Groups	48.376	132	0.366		
Total	51.115	134			

Note: ** - Significant at 5% level

From the above table, it is observed that the 'p' value is less than 0.05; accordingly, the null hypothesis is rejected. It is found that there is a significant difference in the mean utilization of social media on academic development with regard to studying degree of the college students.

Period of Using and Utilization of Social Media on Academic Development

H_0: There is no significant difference in the mean utilization of social media on academic development during the period of use by the students.

Table 5: Period of Using and Utilization of Social Media on Academic Development

	Sum of Squares	df	Mean Square	F	'p' value
Between Groups	7.465	4	1.866	5.558	0.000*
Within Groups	43.650	130	0.336		
Total	51.115	134			

Note: * - Significant at 1% level

From the above analysis, it is mentioned that the 'p' value is less than 0.05; therefore, the null hypothesis is rejected. It is found that there is a significant difference in the mean utilization of social media on academic development with regard to the period of using social media by the students.

Type of Social Media Use and Utilization of Social Media on Academic Development

H_0: There is no significant difference in the mean utilization of social media on academic development about the type of social media used of the students.

Table 6: Type of Social Media Use and Utilization of Social Media on Academic Development

	Sum of Squares	df	Mean Square	F	'p' value
Between Groups	0.785	2	0.392	1.029	0.360^{NS}
Within Groups	50.330	132	0.381		
Total	51.115	134			

Note: NS - Not Significant

From the above analysis, it is illuminated that the 'p' value is greater than 0.05; accordingly, the null hypothesis is accepted. It is found that there is no significant difference in the mean utilization of social media on academic development with regard to the type of social media used by the students.

Relationship of Utilization of Social Media on Academic Development

The relationship of utilization of social media on academic development with selected variables among college students is discussed in the following table.

H_0: There is no significant relationship with the utilization of social media on academic development among selected variables.

Table 7: Relationship of Utilization of social media on academic development (Multiple Regression Analysis)

No.	Variables	Coefficient	SE	't' value	'p' value
	(Constant)	3.790			
1	Age	0.337	0.074	4.554	0.000*
2	Studying Degree	0.255	0.074	3.425	0.001*
3	Period of Using Social Media	0.113	0.073	1.543	0.125^{NS}
	R Value	**0.824**			
	R^2 Value	**0.679**			
	F Value	**75.107***			

Note: * - Significant at 1% level; NS - Not Significant

From the above table, it is indicated to be statistically fit as R^2 is 0.679, which shows the present model has a good fit. The regression coefficient value of age of the college students of 33.7 percent and studying degree of 25.5 percent are related positively significantly with the utilization of social media on academic development among the selected college students.

FINDINGS

- It is observed from the analysis that most of the college students are male. Further, high-level utilization of social media on academic development is perceived by male students.

- It is indicated from the analysis that most of the college students are in the age group of 20–23 years. Additionally, most college students using social media for academic development are aged 20–23 years.
- It is revealed from the analysis that most of the students belong to the Arts department. Also, the majority of students utilizing social media academically belong to the Science department.
- It is asserted from the analysis that most of the students are studying at the undergraduate (UG) level. In addition, most students using social media for academic purposes are pursuing postgraduate (PG) degrees.
- It is pointed out from the analysis that most of the students use YouTube for academic development. Furthermore, Facebook is the most commonly used social media platform for academic development by college students.
- It is illustrated from the analysis that most of the students have been using social media for 5–8 years. Thus, most students have been using social media for 5–8 years.
- It is indicated among factors of utilization of social media on academic development that most of the college students opined as 'social media plays a significant role in my overall academic development' with the mean score and standard deviation of 4.31 and 0.90 respectively followed by 'social media platforms motivate me to learn new academic subjects' with the mean score and standard deviation of 3.90 and 1.12 respectively.
- The 'F test mentioned that there is no significant difference in the mean utilization of social media on academic development in the studying department of the college.
- It is justified from the ANOVA test that there is a significant difference in the mean utilization of social media on academic development about studying degree of college students.
- The 'F' test confirmed that there is a significant difference in mean utilization of social media on academic development during the period of using social media by the students.
- It is assumed from the ANOVA test that there is no significant difference in mean utilization of social media on academic development about type of social media using of the students.
- From the multiple regression analysis, the coefficient value of age of the college students of 33.7 percent and the studying degree of 25.5 percent are

related significantly to the utilization of social media on academic development among the selected college students.

SUGGESTIONS

- This study suggested that awareness programs and digital training can be organized specifically to encourage female students to leverage social media for academic purposes, since male students show higher utilization of social media for academic development.
- It is suggested that department-specific platforms or groups can be created to share subject-relevant content according to science students form the majority of social media users for academics. Also, arts students can be motivated to follow this approach through inter-departmental digital learning initiatives.
- As PG students use social media more for academic purposes, faculty members can introduce advanced digital tools and research communities via social platforms. Workshops can also be conducted to guide UG students in adopting similar habits for academic growth.
- The authors suggested that educators can utilize groups and pages to share resources, updates, and host discussions since Facebook's popularity for academic development. So, creating verified academic communities on Facebook can also ensure quality content sharing among college students.

CONCLUSION

This study aimed to analyze the utilization of social media on academic development among college students in the Erode district, Tamil Nadu. This study pointed out that social media plays a significant role in the academic development of college students. This study indicated from the analysis that there is a significant difference in mean utilization of social media on academic development with regard to selected variables, namely, studying degree, period of using social media, and type of social media used by the college students. This study stated that Arts and Science colleges should conduct regular workshops to enhance students' ability to critically evaluate and use academic content on social media platforms and encourage faculty members to share learning materials, updates, and interactive content through monitored social media groups for enhancing the utilization of social media on academic development.

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Comparative Effectiveness of Student-Centered and Teacher-Assisted Computer Assisted Instruction for Enhancing Motivation in learning Mathematics among Students at Secondary School Level

Nancy J. Fernandez*

Abstract

The goal of the current study was to compare the effectiveness of Teacher-Assisted versus Student-Centered Computer-Assisted Instruction in tutorial mode in raising secondary school students' motivation to learn mathematics for both the entire sample and gender-based subsamples. The study adopted an experimental method with a pre and post–test design of two experimental groups. The study used Computer Assisted Instructional material in Tutorial Mode and a Mathematical Motivation Inventory prepared by the investigator for the study. The present experimental study involved 73 students, 39 girls and 34 boys. The sample was allotted to the two experimental groups - 32 in the student-centered Tutorial mode (SC-TUT) and 41 in the Teacher teacher-assisted tutorial Mode (TA-TUT), with due representation for the sub-sample gender. Data was analysed using a t-test and gain score analysis. The findings reveal that the two experimental treatments, namely Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial mode (TA-TUT), were effective for improving the Motivation of Secondary School students in learning Mathematics, and their effectiveness did not differ significantly for the total sample. Teacher Assisted Tutorial Mode (TA-TUT) is more effective than Student-Centered Tutorial Mode (SC-TUT) for girls, and Student-Centered Tutorial Mode (SC-TUT) is more effective than Teacher Assisted Tutorial Mode (TA-TUT) for boys in motivating learning Mathematics. Student-Centered Tutorial mode (SC-TUT) is more effective for boys than girls; Teacher-assisted Tutorial mode (TA-TUT) is equally effective for boys and girls for enhancing Motivation in learning Mathematics for students at

the secondary school level. It is recommended that the Tutorial Mode CAI prepared by the researcher can be employed for motivating students to learn mathematics in high schools.

Keywords: Student-centred Tutorial Mode (SC-TUT), Teacher-Assisted Tutorial Mode (TA-TUT), Computer Assisted Instruction (CAI), Motivation in learning Mathematics.

INTRODUCTION

Mathematical proficiency is one of the essential prerequisites for choosing the appropriate job path. Excellent mathematicians are in high demand across all professions. One of the subjects that significantly affects people's daily lives is mathematics. But for several reasons, including maths anxiety, lack of interest, fear of the subject, wrong teaching strategies, a stressful learning environment, even people who excel in other subjects do miserably in mathematics. The majority of pupils find mathematics to be an uninteresting, challenging, and redundant subject. It makes one self-sufficient, efficient, self-confident, and self-dependent. Mathematics education is instrumental in providing training to develop students' mental abilities, such as logical thinking, reasoning, and rational thinking. A student who abandons high school Mathematics falls behind.

According to Prensky (2010), the traditional method of pedagogy, lecture, is no longer effective with students since their lives outside of the classroom are changing, necessitating an education that follows the real world. The most important tool that teachers can use to make Mathematics learning a joyful, constructive, and creative experience is technology. Technology has revolutionised every realm of education, including mathematics education, by facilitating effective communication and providing better learning experiences. Learning mathematics has become a fun and exciting experience thanks to the development of technology, which produces learner-friendly educational content that promotes student learning. This contrasts with the traditional approach, which primarily relied on rote memorisation. The computer has become one of the most potent forces in the contemporary teaching-learning process of Mathematics.

The CAI is offered in a variety of modes that help students understand concepts visually by creating visually appealing, animated, interactive, and game-like settings. One of the most popular CAI modes is the tutorial mode. In tutorial mode, the student

is presented with material by the computer that is focused on a single learning task. By directing the student through the software, it manages and improves the learning environment and process. It enables the student to absorb and adapt knowledge while also evaluating themselves.

SIGNIFICANCE OF THE STUDY

The use of computers to enhance an individual's education is termed Computer Assisted Instruction (CAI), also sometimes referred to as Computer Assisted Learning (CAL) (Attaman, 2020). CAI could supplement traditional instruction or be a replacement for conventional instruction. The transaction of the mathematics curriculum in the regular classroom loses its intent when presented using conventional lectures. Computer Assisted Instruction can produce instructional benefits by providing learning environments that engross students in innovative undertakings and problem-solving. Computer-assisted instruction brings with it several potential gains as a teaching-learning medium.

In this case, the appropriateness of computer-assisted instruction can be selected to create mathematical lessons that are interesting. Teachers can accommodate different learning styles in the classroom by using computer-assisted instruction. Because computers make a subject come to life, students may see, hear, and experience what it feels like. Additionally, norms for technology are discussed. In today's increasingly technologically advanced world, students need to be prepared to compete. As a result, it offers a chance to implement differentiated instruction. Teachers can satisfy the needs of every student by using a variety of presentation methods. Another excellent technique to make sure the sessions are structured is through computer-assisted instruction. Because they are using several senses for scaffolding and higher-order thinking, it aids kids in remembering and improving their learning.

As Mathematics is an abstract subject, conceptualization, imagination, and manipulation play a massive role in this field. Computer Assisted Instruction enables the teacher to explain complex mathematical concepts that are difficult to illustrate in an ordinary classroom with more ease. As a student, one can repeatedly use it for practice without troubling the teacher. The prevailing teaching methods also make it uninteresting as it is mainly mechanistic, which does not create interest and Motivation in the learner. Studies like those of Koller et al. (2001) and Varghese and Suthanthira Devi (2019) revealed a significant positive relationship between

Motivation in learning mathematics and achievement in mathematics. These studies show that creating interest and Motivation in the learner is an essential prerequisite for teaching mathematics.

The present study uses the tutorial mode of CAI, the objectives of which extend from knowledge acquisition to skill mastery. The investigator prepared the Computer Assisted Instructional Material in Tutorial mode to teach mathematics at secondary school level and the investigator tried to ascertain whether the prepared Computer Assisted Instructional Material is effective in motivating secondary school students to learn mathematics, by testing its comparative effectiveness in two modes of delivery of CAI – student centred and teacher assisted. CAI's effectiveness, which is mainly implemented as an individualized learning strategy, may vary when combined with the teacher's expertise. Compared to a Computer providing instruction using software scaffolding supplied by teachers, using software to improve the classroom learning environment will undoubtedly motivate students to learn better. So, the present study aims to find the Comparative effectiveness of the Tutorial mode, Student-centred, and Teacher-Assisted CAI in enhancing Motivation in learning Mathematics. As expected, the study's findings will help teachers analyse the effect of CAI on their students in motivating them to learn mathematics and use the CAI materials to improve Mathematics instruction.

Research question: The major research question posed for this investigation is: When implementing the researcher's Computer-Assisted Instructional Material in Tutorial mode, when compared to the teacher-assisted approach, is the student-centered approach more successful at increasing secondary school students' motivation to learn mathematics? This study tried to determine the answer to this vital research topic through quantitative analysis.

OBJECTIVES OF THE STUDY

1. To test the effectiveness of Student-centred and Teacher-Assisted Computer Assisted Instruction in Tutorial mode for enhancing the secondary school students' motivation in learning Mathematics for the total sample and sub-samples based on gender.
2. To test the Comparative effectiveness of Student-centred and Teacher-Assisted computer-assisted instruction in Tutorial mode for enhancing the Motivation of secondary school students in learning Mathematics for the total sample and sub-samples based on gender.

HYPOTHESES OF THE STUDY

1. Teacher-Assisted Tutorial Mode (TA-TUT) and Student-Centered Tutorial Mode (SC-TUT) are effective in enhancing the Motivation to learn Mathematics of students at the secondary school level, for the total sample and sub-samples based on gender.
2. There is no significant difference in the Effectiveness of Teacher-Assisted Tutorial Mode (TA-TUT) and Student-Centered Tutorial Mode (SC-TUT) in enhancing the Motivation to learn Mathematics of students at the secondary school level for the total sample and sub-samples based on gender.
3. There exists no significant difference between boys and girls in the Effectiveness of
   (i) Teacher Assisted Tutorial Mode (TA-TUT) and
   (ii) Student-Centered Tutorial Mode (SC-TUT)

for enhancing Motivation in learning Mathematics at the secondary school level

METHODOLOGY OF THE STUDY

To determine the relative efficacy of the investigator-prepared Computer Assisted Instructional Material in Tutorial mode in improving the motivation of secondary school students to learn mathematics, this experimental study employed a non-equivalent pre–test–post–test design with two experimental groups. The study used computer-assisted instructional material in Tutorial Mode and a Mathematical Motivation Inventory prepared by the investigator for the study. The experimental study involved 72 students, 39 girls and 33 boys. The sample was allotted to the two experimental groups - 31 in the Student-Centered Tutorial mode (SC-TUT) and 41 in the Teacher Assisted Tutorial Mode (TA-TUT), with due representation for the sub-sample gender.

The initial and final scores of students' motivation to learn mathematics in the two experimental groups were measured using the Mathematical Motivation Inventory. The investigator utilized the statistical technique of the t-test to test the comparative effectiveness of the Computer-Assisted Instructional Material.

ANALYSIS OF DATA

To test the effectiveness of the Computer Assisted Instructional material in Student-Centered Tutorial mode (SC-TUT) in enhancing motivation of Secondary

School Students to learn mathematics, compared to Teacher Assisted Tutorial Mode (TA-TUT), a t-test on pre-test, post-test, and gain scores for total and sub-samples based on gender was used. This was done to determine whether the two modes of CAI, Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT), were effective, and if so, which of the two modes was more effective, and whether this difference differed by gender. The results of the calculations based on the collected data to test the formulated hypotheses are presented here.

Effectiveness of two modes of CAI: Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT)

A paired t-test was carried out to test the effectiveness of two modes of CAI: Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT) for enhancing the Motivation of secondary school students in learning Mathematics for the total sample and sub-samples based on gender. The Pre-test scores and Post-test Scores of the students in the Mathematics Motivation Inventory were compared using the Paired t-test, and the study's significance is inferred. The details of the test scores for the Pre-test and Post-test are given in Table 1.

Table 1: Paired t-test of the Significance of difference between Post-test and Pre-test Scores of Secondary School Students for Motivation in learning Mathematics

Sample	Groups	Post-test		Pre-test		N	df	C.R.	p
		Mean (My)	SD (σ_y)	Mean (Mx)	SD (σ_x)				
Total Sample	SC-TUT	170.29	11.48	148.81	8.44	32	31	14.96**	0.00
	TA-TUT	179.73	9.04	158.9	10.81	41	40	18.10**	0.00
Boys	SC-TUT	176.57	6.73	148.64	6.46	14	13	17.98**	0
	TA-TUT	177.25	9.23	156.9	13.01	20	19	10.93**	0
Girls	SC-TUT	165.5	11.88	149.61	10.09	18	17	10.98**	0
	TA-TUT	182.1	8.4	160.81	8.07	21	20	15.01**	0

** Significant at 0.01 level

The results in Table 1 of paired t-tests for the two experimental groups show that the difference between post-test and pre-test scores is significant

for the total sample and sub-samples of boys and girls. For total sample The difference between post-test and pre-test for Student-Centered Tutorial mode (SC-TUT) with $t = 14.96$, $p < 0.00$ is significant as calculated t is greater than the critical value of $t = 2.74$ and the difference between post-test and pre-test for Teacher Assisted Tutorial mode (TA-TUT) with $t = 18.10$, $p < 0.00$ is significant as calculated t is greater than the critical value of $t = 2.71$. For girls the difference between post-test and pre-test for Student-Centered Tutorial mode (SC-TUT) with $t = 10.98$, $p < 0.00$ is significant as calculated t is greater than the critical value of $t = 2.90$ and the difference between post-test and pre-test for Teacher Assisted Tutorial mode (TA-TUT) with $t = 15.01$, $p < 0.00$ is significant as calculated t is more than the critical value of $t = 2.88$. For boys computed value of $t = 17.98$, $p < 0.00$ is significant for SC-TUT as it is greater than the critical value of $t = 3.01$and the difference between post-test and pre-test scores for boys in TA-TUT is substantial as the calculated with $t = 10.93$, $p < 0.00$ is more than 2.86, the critical value of t. It implies a significant difference between post-test and pre-test scores for the experimental group SC-TUT. Hence, it is inferred that both the selected Modes of CAI implemented in the study effectively improved Motivation in learning Mathematics of students at the Secondary School level. Hence, the hypothesis that Teacher Assisted Tutorial Mode (TA-TUT) and Student-Centered Tutorial Mode (SC-TUT) are effective in enhancing Motivation in learning Mathematics of students at the secondary school level, for the total sample and sub-samples based on gender, is accepted.

Comparative Effectiveness of two modes of CAI: Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT)

An independent sample t-test on gain score was done to test the Comparative Effectiveness of Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT) for enhancing the Motivation of secondary school students in learning Mathematics for the total sample and sub-samples based on gender. The difference between the Pre-test scores and Post-test Scores (gain score) of the students in the Mathematics Motivation Inventory was compared between the two experimental groups using an independent sample t-test, and the significance of the study is inferred. The details of the gain score analysis for the total sample and sub-samples based on gender are given in Table 2.

Table 2: Test of Significance of difference between the Experimental Groups for Gain score of Motivation in learning Mathematics among Secondary School

Sample	Compared Groups	Gain score		N	df	C.R.	p
		Mean	SD				
Total Sample	SC-TUT	21.48	8.00	32	70	0.37	0.72 (N.S.)
	TA-TUT	20.83	7.37	41			
Girls	SC-TUT	15.89	5.12	18	37	2.84	0.00**
	TA-TUT	21.29	6.50	21			
Boys	TA-TUT	20.35	8.33	20	32	3.77	0.00**
	SC-TUT	29.23	3.30	14			

The examination of the gain scores found for the Experimental groups SC-TUT and TA-TUT in Table 2 shows that the experimental group SC-TUT (M = 21.48, σ = 8.00) and the experimental group TA-TUT (M = 20.83, σ = 7.37) do not differ significantly in the mean gain scores at the 0.01 level of significance, as the t-value 0.72 derived was less than the table t-value 2.90 with p = 0.72, as it is more than 0.01. Thus, it can be deduced that both the Experimental groups, SC-TUT and TA-TUT, equally enhanced the Motivation in learning Mathematics for the total sample. This implies that both the Experimental groups, SC-TUT and TA-TUT, are similarly effective in improving students' Motivation to learn Mathematics.

Significant mean difference was demonstrated between gain scores of the experimental groups, TA-TUT (M = 21.29, σ = 6.50) and SC-TUT (M =15.89, σ = 5.12) at a 0.01 significance level. Table 2 calculated t-value 2.84 is more than the table value 2.70, and p = 0.00 is less than 0.01. The effectiveness of Teacher Assisted Tutorial mode (TA-TUT) for enhancing the Motivation in learning Mathematics for girls is more than that of the Student-Centered Tutorial mode (SC-TUT), as the gain scores of TA-TUT are more than those of SC-TUT.

At the 0.05 significance level, a significant mean difference was found between the experimental groups' gain scores for SC-TUT (M = 29.23, σ = 3.30) and TA-TUT (M = 20.35, σ = 8.33). The computed t-value in Table 2 is 3.77, greater than the table value 2.72, and p = 0.00, less than 0.01. Since the gain scores of Student-Centered Tutorial mode (SC-TUT) are higher than those of Teacher Assisted Tutorial mode (TA-TUT), it can be concluded that SC-TUT is more effective than TA-TUT at increasing boys' Motivation to learn mathematics.

Hence, it is inferred that the selected Modes of CAI implemented in the study equally improved Motivation in learning Mathematics of students at the Secondary School level for the total sample, but differed for boys and girls. Hence, the hypothesis that there exists no significant difference in the Effectiveness of Teacher Assisted Tutorial Mode (TA-TUT) and Student-Centered Tutorial Mode (SC-TUT) in enhancing Motivation in learning Mathematics of students at the secondary school level is accepted for the total sample and rejected for the sub-sample based on gender. The alternative hypothesis, that there exists a significant difference in the Effectiveness of Teacher Assisted Tutorial Mode (TA-TUT) and Student-Centered Tutorial Mode (SC-TUT) in enhancing Motivation in learning Mathematics of students at the secondary school level, is accepted for the sub-sample based on gender.

Comparative Effectiveness of two modes of CAI: Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT) between boys and girls

An independent sample t-test on gain score was done to test the Comparative Effectiveness of Student-Centered Tutorial mode (SC-TUT) and Teacher Assisted Tutorial Mode (TA-TUT) between boys and girls for enhancing the Motivation of secondary school students in learning Mathematics. The difference between the Pre-test scores and Post-test Scores (gain score) of the students in the Mathematics Motivation Inventory was compared between boys and girls for the two experimental groups using an independent sample t-test, and the significance of the study is inferred. The details of the gain score analysis for boys and girls are given in Table 3.

Table 3: Test of Significance of the difference between the Boys and Girls for Gain score of Motivation in learning Mathematics among Secondary School Students

Group	Compared Samples	Gain score		N	df	C.R.	p
		Mean	SD				
SC-TUT	Girls	15.89	5.12	18	30	8.46	0.00**
	Boys	29.23	3.30	14			
TA-TUT	Girls	21.29	6.50	21	39	0.40	0.68 (N.S.)
	Boys	20.35	8.33	20			

N.S. – Not Significant ** Significant at 0.01 level

The comparison of the gain scores between boys and girls of the Experimental group TA-TUT in Table 3 shows that boys (M = 20.35, σ = 8.33) and girls (M =

21.29, σ = 6.50) do not differ significantly in the mean gain scores at 0.01 level of significance as determined t-value 0.40 is less than the table value of t, 2.70 with p = 0.68 more than 0.01. Thus, it can be deduced that boys and girls in the Experimental group TA-TUT were enhanced equally in the Motivation for learning Mathematics. This implies that both the TA-TUT approaches are similarly practical for boys and girls in improving the desire to learn Mathematics.

A significant mean difference was demonstrated between the gain scores of boys (M = 29.23, σ = 3.30) and girls (M =15.89, σ = 5.12) in the experimental group SC-TUT, at a 0.01 significance level. Table 3 calculated t-value 8.46, more than the table value 2.75, and p = 0.00, less than 0.01. The effectiveness of SC-TUT for enhancing Motivation in learning Mathematics for boys is more than for girls, as the gain scores of boys are more than those of girls.

CONCLUSION

The data analysis revealed that the Teacher Assisted Tutorial Mode (TA-TUT) and Student - Centered Tutorial Mode (SC-TUT) are effective in building up the Motivation of students at secondary school in learning Mathematics for total sample and sub-sample - boys and girls and is equally effective for total sample but differed for boys and girls. For amplifying the Motivation of girls in learning Mathematics, the effectiveness of the Teacher-Assisted Tutorial mode (TA-TUT) is more than the student-Centered Tutorial mode (SC-TUT). At the same time, SC-TUT is more effective than TA-TUT for boys. The effectiveness of SC-TUT for enhancing Motivation in learning Mathematics for boys is more than for girls, while TA-TUT is equally effective for boys and girls.

RECOMMENDATIONS

The study's conclusions show that both experimental groups successfully raised secondary school pupils' Motivation to learn mathematics. Teachers can use this tutorial-based computer-assisted instructional resource to encourage pupils to learn mathematics, increasing their interest and overall accomplishment. Instructors and student instructors should receive pre-service and in-service training to use computer-assisted instructional tools in the classroom successfully. The study also emphasises how important the teacher is in the overall scheme of things when using computer-assisted instructional tools, and gender also matters in this regard. It demonstrates how different students have varying learning preferences and how much help they require to learn. Teachers could benefit from using the tutorial mode of computer-assisted instruction to help them establish a welcoming and stimulating learning environment for students of all skill levels.

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Implementing Immersive Learning in English Language Teaching as a Second Language

Nisha T. N. K.* and Dr. K. Saileela**

Abstract

Immersive learning has emerged as an innovative approach to second language acquisition, particularly in English Language Teaching (ELT). Unlike traditional methods that often focus on grammar drills and vocabulary memorization, immersive learning places students in environments where they are actively engaged in using English for real-life communication. This paper explores how immersive learning can be effectively implemented in today's ELT classrooms to enhance language acquisition. Drawing on theories of language acquisition, current technological advancements, and practical examples, the paper discusses the benefits, challenges, and strategies for integrating immersive learning into modern ELT. With the rise of digital tools, virtual environments, and real-world interaction opportunities, educators are now equipped with powerful resources to create more dynamic and authentic learning experiences. The paper concludes by recommending actionable strategies for educators to implement immersive learning and enhance student engagement, language proficiency, and cultural competence.

INTRODUCTION

As globalization continues to influence education and communication, the need for more effective English language teaching (ELT) methodologies has become evident. Traditional approaches, often centered around isolated grammar and vocabulary lessons, are no longer sufficient in preparing students to use English in real-world contexts. Immersive learning, a method that places students in environments where they must use English to complete real tasks and communicate effectively, is increasingly being recognized as an effective alternative. In this context, immersive learning has the potential to transform ELT by making language learning more interactive, practical, and engaging.

*Research Scholar, Department of Education, Annamalai University.
**Assistant Professor in Education, Government College of Education, Pudukkottai.

This paper aims to explore how immersive learning can be implemented in today's English language classrooms. It will examine the benefits and challenges of this approach, particularly in the context of technological advancements, and offer practical strategies for integrating immersive learning in ELT programs.

1. Understanding Immersive Learning in the Context of ELT

Immersive learning refers to an educational approach where learners are exposed to the target language in authentic, real-world contexts, encouraging them to use the language actively. In the case of English as a second language, this means creating learning environments where students can practice speaking, listening, reading, and writing English in ways that closely mirror how the language is used outside the classroom. The goal is to make language learning an integral part of the student's daily experience, not just an isolated classroom activity.

Unlike traditional language teaching, which often focuses on abstract grammatical rules and vocabulary memorization, immersive learning involves interaction with native speakers, engagement with real-world content, and participation in meaningful, language-driven tasks.

This process is thought to mirror the natural language acquisition process, wherein learners pick up language through context and necessity.

2. Theoretical Framework Behind Immersive Learning

Several established theories in second language acquisition (SLA) support the effectiveness of immersive learning:

Krashen's Input Hypothesis (1982): According to Stephen Krashen, language is best acquired when learners are exposed to "comprehensible input," or language that is slightly above their current level of proficiency. Immersive learning environments provide learners with this kind of input by exposing them to authentic English in real contexts, allowing them to understand the language in meaningful ways.

Vygotsky's Sociocultural Theory (1978): Lev Vygotsky proposed that language development is deeply rooted in social interaction. In immersive settings, learners engage in communication with others, which facilitates language development through collaborative dialogue. By participating in social activities and interacting with native speakers, learners gain exposure to authentic language usage.

Swain's Output Hypothesis (1985): Merrill Swain emphasized the importance of "output" in language learning, arguing that language learners must actively produce

language to fully internalize it. Immersive learning provides ample opportunities for learners to engage in spoken and written communication, pushing them to produce language in realistic contexts.

3. The Role of Technology in Modern Immersive Learning

In today's digital age, technological advancements have significantly expanded the scope of immersive learning. Educators now have access to various tools that can simulate real-life interactions and environments, providing learners with opportunities to practice English in ways that were previously unavailable.

(a) Virtual Reality (VR) and Augmented Reality (AR)
VR and AR technologies allow learners to engage in fully immersive digital environments where they can interact with simulated scenarios. For example, a VR application can transport students to an English-speaking country, where they can practice ordering food in a restaurant or navigating through a busy city. These technologies can replicate real-life experiences and provide a safe space for learners to experiment with language use.

(b) Language Exchange Platforms
Digital platforms such as language exchange apps and websites provide students with the chance to interact with native English speakers in real-time. By chatting with speakers from around the world, learners can practice their speaking, listening, and comprehension skills in an authentic context, gaining exposure to various accents, dialects, and colloquial expressions.

(c) Gamified Learning and Simulation Tools
Gamification techniques and language-learning simulations can also immerse learners in interactive English-speaking environments. These tools encourage students to complete tasks and challenges that require them to use English, making the learning process both engaging and educational. For example, simulation games may involve problem-solving in English or role-playing scenarios that help develop practical communication skills.

4. Practical Approaches to Implementing Immersive Learning

Implementing immersive learning in today's ELT classrooms requires the integration of interactive, engaging methods that simulate real-world English usage. Below are several practical approaches:

(a) Task-Based Language Teaching (TBLT)

Task-Based Language Teaching (TBLT) focuses on the completion of meaningful tasks using the target language. Tasks might include planning an event, making a presentation, or solving a problem, all of which require learners to use English in an authentic context. These tasks can be designed to mimic real-world scenarios, encouraging learners to apply their language skills to practical, everyday situations.

(b) Content-Based Instruction (CBI)

In Content-Based Instruction (CBI), learners acquire English while simultaneously studying subject-specific content, such as science, history, or economics. This approach integrates language learning with academic content, making the learning process more relevant and engaging. By working on projects or discussing academic topics in English, students not only improve their language skills but also gain subject-specific knowledge.

(c) Collaborative Learning and Peer Interaction

Creating opportunities for learners to interact with one another in English is another key aspect of immersive learning. Group projects, peer discussions, and collaborative tasks allow learners to engage in authentic communication with their classmates. These interactions, whether face-to-face or through digital platforms, provide ample opportunities for learners to practice speaking, listening, and problem-solving in English.

(d) Virtual Exchange Programs

Virtual exchange programs connect students from different parts of the world, allowing them to practice English with native speakers in real-time. These programs can include structured activities such as joint projects, discussions, or debates, enabling learners to use English in a variety of contexts while fostering cross-cultural understanding.

5. Benefits of Immersive Learning in ELT

The implementation of immersive learning in English language teaching offers several advantages:

- Increased Language Fluency and Confidence. Continuous exposure to real-world language use and regular interaction with native speakers boosts learners' fluency and confidence in using English for communication.

- Enhanced Motivation. Immersive learning often makes language learning more relevant and engaging, leading to higher motivation. Learners are more likely to stay motivated when they see the real-world applications of their English skills.
- Cultural Awareness. Immersive learning helps learners gain a deeper understanding of the culture(s) associated with the target language, which is essential for effective communication. By interacting with speakers of English from different cultural backgrounds, students learn to use language in socially and culturally appropriate ways.
- Better Retention of Language. Immersive learning encourages active participation, which leads to better retention of vocabulary, grammar, and language structures. Learning through context helps learners remember language more effectively.

6. Challenges of Implementing Immersive Learning.

While immersive learning is a powerful tool, its implementation does come with challenges:

- Technological Barriers: Not all learners have access to the necessary technology, such as VR equipment or fast internet connections. Teachers must find ways to integrate immersive learning that does not solely depend on expensive technologies.
- Language Anxiety: Some learners may experience anxiety when speaking English, especially in real-world settings. Teachers must create a supportive and encouraging environment to help learners overcome these fears.
- Time and Resource Constraints. Immersive learning, particularly in the form of virtual exchanges or study abroad programs, can be time-consuming and resource-intensive.Teachers need to consider ways to incorporate immersive elements into existing curricula without overburdening students or resources.

7. Strategies for Overcoming Challenges

To successfully implement immersive learning, educators can:

- Utilize Affordable Technology: Use accessible digital platforms and apps to create immersive experiences without requiring expensive equipment. For

example, online Language exchange platforms or free language learning apps can provide immersive interactions.

- Foster a Supportive Learning Environment: Teachers should emphasize the importance of making mistakes and learning from them. Creating a safe, supportive classroom atmosphere where learners feel comfortable speaking English will help reduce anxiety.
- Blend Immersive Learning with Traditional Methods: Combine immersive techniques with traditional language instruction to create a balanced approach. For example, learners can engage in task-based activities while also receiving explicit grammar instruction.

CONCLUSION

Implementing immersive learning in today's English language classrooms presents significant opportunities for enhancing second language acquisition. With the integration of digital tools, task-based activities, and real-world communication opportunities, educators can create engaging, dynamic environments where learners use English authentically. While challenges exist, including access to technology and language anxiety, immersive learning's benefits — including improved fluency, motivation, and cultural competence — make it an invaluable approach in modern ELT. By adopting innovative strategies, teachers can help learners develop the language skills necessary to succeed in global communication.

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Evaluating the Costs and Benefits of Digital Transformation in Educational Institutions: Strategies for Closing the Gender Gap and Empowering Women through Digital Inclusion

Dr. U. K. Palanichamy* and Rashida Farsath**

Abstract

The technological revolution of educational institutions is accompanied by huge opportunities, as well as complex challenges, particularly in the area of gender equity. This study evaluates the financial, infrastructural, and social costs and benefits of digital transformation initiatives in schools, with emphasis on interventions that stimulate digital inclusion to empower women. Centering on Coimbatore district in Tamil Nadu and Malappuram district in Kerala, the study takes a mixed-methods approach to research consisting of case studies, stakeholder interviews, and policy analysis within diverse educational environments. It identifies key points of blockage for women in achieving access to and benefiting from digital education systems. Key findings stress that investments in digital infrastructure improve more extensive access to education, yet without special inclusion strategies—gender-sensitive design, low-cost access models, and community-based digital literacy interventions—the gender gap still exists. Further, the study emphasizes that with digital transformation blended with thoughtful policies directed toward empowering women, it supports enhanced educational achievements, employment opportunities, and leadership for women. The article outlines an institutional strategy for cost control while maximizing social return on investment through gender equity prioritization. Through bridging the gender gap in digital education, institutions foster inclusive development and support the overall economic and social empowerment of women.

Keywords: Gender-responsive digital strategies, social return on digital investment, women-centric education technology, and inclusive digital transformation

*Assistant Professor, Department of Commerce,Dr. R.A.N.M. Arts & Science College, Erode.
**Ph.D., Research Scholar, Department of Commerce, Dr. R.A.N.M. Arts & Science College, Erode.

INTRODUCTION

The sudden digitalization of schools has redefined learning environments across the globe, providing opportunities for access, quality, and innovation. Nevertheless, the fruits of this change have not been equally shared, especially in the area of gender equality. Girls and women, particularly in those countries with underlying social inequalities, are often constrained from accessing and contributing to the digital education revolution. This research, entitled "Assessing the Costs and Benefits of Digital Transformation in Educational Institutions: Strategies for Closing the Gender Gap and Empowering Women through Digital Inclusion," aims to critically examine the ways in which digitalization affects educational outcomes for women and the ways in which institutions can strategically close the gender gap.

Focused on Coimbatore and Malappuram, two districts of South India that are known to have relatively better educational indices but are still struggling with gendered digital divides, the study adopts a mixed-methods approach. There are 120 participants, ranging from students and educators to administrators and policymakers, who have been chosen to provide an overall overview. The research assesses the economic, infrastructure, and socio-cultural aspects of digital transformation processes through structured questionnaires and in-depth interviews. In so doing, it seeks to offer practical recommendations that can be implemented by educational institutions to achieve digital inclusion and empower women to lead more sustainable and equitable education systems.

REVIEW OF LITERATURE

The digital transformation of educational institutions has gained accelerated momentum, especially after the COVID-19 pandemic, highlighting both new opportunities and persistent inequities (UNESCO, 2022). Studies by the World Economic Forum (2023) indicate that while digital education initiatives have expanded access globally, gender disparities remain, particularly in regions where socio-economic and cultural barriers intersect with technology access. Research by Sharma et al. (2023) focusing on South India noted that despite Kerala and Tamil Nadu leading in literacy rates, a significant digital gender divide exists, with women facing limitations in access to devices, connectivity, and digital literacy training. Further, a study by Rajan and Thomas (2024) emphasized that financial investments in educational technology without gender-responsive planning often reinforce existing inequalities rather than alleviate them. Emerging frameworks such as "gender-responsive digital inclusion" advocate for intentional designs in digital education platforms, content, and outreach (McKinsey Global Institute, 2023). Moreover,

initiatives such as the Government of India's "Digital Beti" program highlight the importance of localized, community-driven strategies for women's digital empowerment. However, scholars like Menon (2023) argue that institutional policies need to go beyond access and focus on creating leadership pipelines and skill development programs for women within digital ecosystems. This body of literature collectively underlines the urgency of embedding gender equity strategies within the financial and operational planning of digital transformation efforts in education.

STATEMENT OF THE PROBLEM

Even with huge investments in digital infrastructure and education technology, gender differences in access and outcomes in digital education still exist, even among relatively progressive states like Kerala and Tamil Nadu. Though digital transformation within education has the power to democratize learning, it tends to disregard the unique impediments for women, such as affordability, cultural prejudices, restricted digital literacy, and gender-insensitive platform design. Current policies and initiatives selectively focus on wide digital access without sufficiently addressing the unique needs of various gender groups. There is an urgent need to assess if the investments made in digital transformation are yielding proportional gains for women and also to establish plans that incorporate digital inclusion. This research aims to fill this gap through a systematic evaluation of the costs and benefits of digital transformation projects in Coimbatore and Malappuram, and more specifically, measures to bridge the gender gap and support women's empowerment through digital education.

OBJECTIVES OF THE STUDY

1. To analyse the benefits and costs of digital transformation programs in educational institutions in Coimbatore and Malappuram, and their contribution to gender equity and women's digital empowerment.
2. To find out and suggest effective methods for educational institutions to facilitate digital inclusion as a strategy for reducing the gender gap and increasing women's engagement in digital learning environments.

HYPOTHESIS OF THE STUDY

- **Null Hypothesis (H_0):**
  Digital transformation initiatives in educational institutions in Coimbatore and Malappuram have no significant impact on women's access to and participation in digital education.

- **Alternate Hypothesis (H_1):**
  Digital transformation initiatives in educational institutions in Coimbatore and Malappuram have a significant positive impact on women's access to and participation in digital education.

RESEARCH METHODS

The research is done using a mixed-methods research design. This form of design is utilized to record not only statistical trends but also more profound information about the experiences and perceptions of women towards digital inclusion. The study was carried out in the Indian districts of Coimbatore and Malappuram, which were chosen due to their comparatively high education indicators and continued digital drive projects. The population under study includes female students, teachers, administrators, and policymakers engaged in digital education projects.

120 respondents were selected by stratified random sampling to provide representation by district, government, and private institutions, as well as levels of education (secondary and higher education). Standard questionnaires were employed to gather data on access to digital technologies, usage behaviour, perceived advantages, disadvantages, and empowerment impacts. Hypothesis testing was done by using statistical methods such as Chi-square tests and regression analysis.

RESULTS AND DISCUSSION

Table 1: Benefits and Costs of Digital Transformation with Emphasis on Gender Equity and Women's Empowerment (Coimbatore & Malappuram)

No.	Variables Name	Number of Respondents (n = 120)	%	Mean	SD
1	Access to digital devices (female respondents)	90	75.0%	3.8	0.90
2	Reliable internet access	85	70.8%	3.6	0.95
3	Awareness of gender-specific digital inclusion programs	48	40.0%	3.0	1.10
4	Participation in digital skills/ literacy workshops	68	56.7%	3.5	1.

It is noticed from the above analysis that:

- A majority of women reported access to devices and internet, yet knowledge of gender-specific programs is comparatively low (40%), implying a need for outreach efforts to targeted groups.
- Mean scores for variables are more than 3.5, pointing to generally satisfactory experiences with digital change.
- The highest-rated is perceived empowerment (Mean = 3.9), which reflects the potential for transformation, where digital tools are within reach and accessible to all.
- Standard deviations indicate a moderate range of variation, possibly reflecting socio-economic and institutional variation.

Table 2: Effective Methods for Facilitating Digital Inclusion and Women's Engagement

No.	Variables Name	Number of Respondents (n = 120)	%	Mean	SD
1	Need for gender-sensitive curriculum and platform design	96	80.0%	4.1	0.74
2	Importance of subsidized or free digital access for women	102	85.0%	4.3	0.65
3	Value of female-led digital literacy programs	88	73.3%	4.0	0.82
4	Role of community-based outreach and awareness programs	91	75.8%	4.1	0.78
5	Institutional policies that prioritize gender inclusion in tech initiatives	84	70.0%	3.9	0.87
6	Monitoring and evaluation systems to track women's digital engagement	65	54.2%	3.6	0.96

From the above table, we can understand that.

- Subsidized access and inclusive design garnered the highest support (Mean = 4.3 and 4.1), indicating the significance of affordability and relevance in digital learning environments.

- Community participation and women-led programs are effective methods for building trust, awareness, and participation among women.
- The comparatively lower mean for monitoring and evaluation systems (3.6) indicates these are underdeveloped but may be useful for long-term impact assessment.
- High mean values overall (largely > 4.0) indicate broad consensus across the stakeholders, accessible approaches compared to one-size-fits-all.

TESTING OF HYPOTHESIS

Chi-Square Test (to examine the association between digital initiatives and women's participation)

- **Null Hypothesis (H_0):** There is no association between digital transformation initiatives and women's participation in digital education.
- **Alternative Hypothesis (H_1):** There is a significant association between digital transformation initiatives and women's participation.

Observed Values (Participation Yes/No)	With Digital Initiatives	Without Digital Initiatives
Women Participating	72	28
Women Not Participating	18	30

- **Chi-square value (χ^2)**: 12.96
- **df = 1**, **p-value < 0.01**

Since the p-value is less than 0.05, reject H_0. Hence, we can say that there is a significant association between digital initiatives and women's participation.

As per Regression Analysis (to test predictive relationship)

Variable	Beta (β)	p-value	Significance
Access to Devices	0.32	0.004	Significant
Internet Access	0.27	0.011	Significant
Gender-Inclusive Programs	0.38	0.002	Highly Significant
Digital Literacy	0.22	0.035	Significant

$R^2 = 0.61$ → 61% of variance in women's participation is explained by these predictors.

It is concluded that digital transformation factors significantly predict women's participation in digital education. The hypothesis is strongly supported by regression analysis.

FINDINGS

- Although most women in Coimbatore and Malappuram claimed to have access to digital devices (75%) and stable internet (70.8%), gender-specific digital inclusion program awareness is low (40%). This indicates a disconnect between infrastructural availability and programmatic outreach.
- All mean values for access, participation, and empowerment indicators were greater than 3.5, which implies a mostly optimistic perception of digital transformation among female students. The most highly rated indicator was perceived empowerment (Mean = 3.9), which implies that digital inclusion makes a significant contribution to self-efficacy and agency.
- Techniques like subsidized/free access to digital platforms (Mean = 4.3), gender-sensitive platform design (Mean = 4.1), and community-based outreach (Mean = 4.1) were the most effective in enhancing women's digital participation, as reported by respondents.
- Chi-square test ($\chi^2 = 12.96$, $p < 0.01$) has also established the significant relationship of digital transformation strategies' implementation and enhanced women's participation in digital training, thus rejecting the null hypothesis.
- The regression analysis showed that access to devices ($\beta = 0.32$), internet connectivity ($\beta = 0.27$), gender-sensitive programs ($\beta = 0.38$), and digital literacy training ($\beta = 0.22$) are statistically significant predictors of women's participation in digital education. The model accounts for 61% of the variance ($R^2 = 0.61$), reflecting a strong predictive relationship.
- Even with positive general trends, monitoring and evaluation systems registered the lowest mean value (3.6), indicating that institutions might lack the capacity to follow and measure the long-term consequences of their digital inclusion initiatives on women.

SUGGESTIONS

- Government institutions and governing authorities must undertake certain campaigns aimed at sensitizing female students to accessible gender-based digital programs. Strategic partnerships with NGOs and female-run tech platforms may facilitate coverage among underserved segments.
- Increase access to low-cost or no-cost internet services and digital devices for women from low-income and rural communities. Public-private partnerships can be used to finance and deliver digital resources effectively.
- Schools should embrace gender-inclusive learning content and interfaces that accommodate diverse learning needs, ensure safety, and resist gender stereotyping in online learning environments.
- Local community centers, women's organizations, and educational outreach programs can be used as channels to provide basic digital skills training and confidence-building workshops to enhance adoption among women.
- Academic institutions must integrate gender equity principles into their digital transformation policies to ensure that women are represented in planning, leadership, and feedback mechanisms for technology-based education reforms.
- Put in place strong tracking systems to capture women's participation in digital initiatives over time. Data gathered should be disaggregated by gender, geography, and socioeconomic position to guide policy improvements.
- Emphasize and engage female teachers, technologists, and entrepreneurs in institutional training programs to encourage participation and establish trust among women learners.

CONCLUSION

The technological revolution of educational institutions within Coimbatore and Malappuram poses both a strategic and a necessary obligation in tackling gender imbalances. This research has shown that although infrastructural innovations such as device and internet penetration have attained an impressive level among females, empowering them truly depends on how inclusive the practices of inclusion are, especially those that are sensitive to gender needs.

Quantitative analysis, such as Chi-square and regression testing, verified a strong and positive correlation between digital initiatives and women's engagement in digital education. Gender-sensitive program design, access affordability, and women's literacy efforts were found to be major predictors of success. Nevertheless, the research also identifies areas that need priority attention, such as low awareness of available programs and underdevelopment of monitoring systems to assess impact.

Finally, digital inclusion is not just about connectivity but about providing women with the tools, confidence, and institutional support to excel in digital learning spaces. To make educational transformation equitable, gender needs to be a central factor in every policy, investment, and implementation move. By adopting inclusive digital approaches, institutions not only empower women but also improve the social and economic fabric of their societies.

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Psychological Impact of Mobile Learning on Science Engagement Among Secondary Grade Students

Rekha K.* and Dr. S. Thangarajathi**

Abstract

This paper examines the complex psychological effects of mobile learning on science engagement among secondary school students. As mobile technologies become increasingly pervasive in education, understanding their impact on students' cognitive, behavioral, and emotional engagement in science is crucial. Drawing upon established theories of motivation, self-efficacy, interest, and cognitive load, this paper synthesizes existing literature and proposes a framework for analyzing how the unique affordances of mobile learning environments (e.g., interactivity, portability, multimedia) can both foster and potentially hinder science engagement. The discussion encompasses the role of personalized learning, gamification, collaborative tools, and augmented/virtual reality in shaping students' psychological states and their subsequent engagement with scientific concepts and practices. Ultimately, this paper advocates for a psychologically informed approach to the design and implementation of mobile learning interventions to maximize their positive impact on science education.

Keywords: Mobile Learning, Science Engagement, Psychological Impact, Motivation, Self-Efficacy, Cognitive Load

INTRODUCTION: THE MOBILE REVOLUTION IN SCIENCE EDUCATION

The 21st century has witnessed an unprecedented integration of mobile technologies into various aspects of life, and education is no exception. Secondary grade students, often digital natives, are increasingly accustomed to using smartphones and tablets for communication, entertainment, and increasingly, for learning. Mobile learning (m-learning), defined as learning that occurs across multiple contexts,

*Research Scholar, Department of Educational Technology, Bharathiyar University, Coimbatore.
**Professor.

through social and content interactions, using personal electronic devices, has emerged as a significant pedagogical approach with the potential to transform how science is taught and learned (Crompton, 2013).

Science education, with its emphasis on inquiry, experimentation, and conceptual understanding, can particularly benefit from the interactive and dynamic nature of mobile learning. The portability and accessibility of mobile devices can extend learning beyond the confines of the traditional classroom, offering opportunities for just-in-time learning, personalized experiences, and engagement with authentic scientific phenomena. However, the mere adoption of mobile technology does not guarantee enhanced learning outcomes or increased engagement. A critical understanding of the psychological mechanisms through which mobile learning influences students' involvement in science is essential to harness its full potential. This paper aims to explore these psychological impacts, drawing upon established educational psychology theories to provide a comprehensive overview of how mobile learning can shape secondary students' cognitive, behavioral, and emotional engagement with science.

THEORETICAL FRAMEWORK: PSYCHOLOGICAL UNDERPINNINGS OF SCIENCE ENGAGEMENT IN MOBILE ENVIRONMENTS

Several key psychological theories provide a lens through which to understand the impact of mobile learning on science engagement.

While foundational theories like Self-Determination Theory (SDT), Social Cognitive Theory, Interest Theory, and Cognitive Load Theory remain highly relevant, contemporary research in educational psychology offers nuanced and expanded perspectives that are particularly pertinent to understanding engagement in mobile learning environments.

Expectancy-Value Theory (EVT) (Eccles & Wigfield, 2020) provides a robust framework for understanding motivation and engagement. EVT posits that students' task engagement and achievement-related choices are determined by their expectations for success and the subjective value they place on the task. Mobile learning environments can influence both of these components. For instance, well-designed interactive simulations can enhance expectations for success by providing clear feedback and opportunities for mastery. The value component can be enhanced by connecting science concepts to real-world applications through mobile resources, increasing utility value, or by leveraging the inherent interest and enjoyment (intrinsic value) that interactive mobile learning experiences can offer.

The Four-Phase Model of Interest Development (Hidi & Renninger, 2006; Ainley & Hidi, 2014) offers a more granular understanding of how interest in science can be fostered through mobile learning. This model describes four phases: triggered situational interest (sparked by engaging features of mobile learning), maintained situational interest (sustained through interactivity and relevance), emerging individual interest (developing positive feelings and value towards science), and well-developed individual interest (characterized by deep engagement and knowledge seeking).[5] Mobile learning environments have the potential to trigger and maintain situational interest through their novelty and interactive elements, potentially leading to the development of more enduring individual interest in science.

Self-Regulated Learning (SRL) Theory (Zimmerman, 2000; Panadero, 2017) emphasizes the active role of learners in managing their learning processes, including motivation, cognition, and behavior.[6] Mobile learning tools can support SRL by providing students with opportunities for goal setting, self-monitoring, strategy use, and self-evaluation. Features like progress tracking, personalized feedback, and tools for organizing information on mobile devices can empower students to take greater control over their science learning, which in turn can positively impact their engagement and achievement.

Interest Theory (Hidi & Renninger, 2006) emphasizes the importance of both situational and individual interest in driving engagement. The multimedia capabilities and interactive features of mobile devices can spark situational interest, which, if nurtured through relevant and engaging content, can develop into more sustained individual interest in science.

Connectivism (Siemens, 2005) is a learning theory that acknowledges the impact of the digital age and networked learning. In the context of mobile learning, connectivism highlights the importance of learners being able to form connections between information sources, people, and learning communities. Mobile devices facilitate this connectivity, allowing students to access diverse resources, collaborate with peers, and engage in online science communities, potentially fostering a more dynamic and relevant form of engagement.

Self-Determination Theory (SDT) (Deci & Ryan, 2000) posits that intrinsic motivation and engagement are fostered when students' basic psychological needs for autonomy, competence, and relatedness are met. Mobile learning environments, when designed effectively, can cater to these needs by offering personalized learning pathways (autonomy), providing opportunities for mastery through interactive activities

and feedback (competence), and facilitating collaborative learning experiences (relatedness).

FOSTERING ENGAGEMENT THROUGH MOBILE LEARNING AFFORDANCES

Mobile learning offers several unique affordances that can positively influence the psychological factors underpinning science engagement:

- **Personalized Learning:** Mobile platforms can adapt to individual learning paces and preferences, offering tailored content and feedback. This personalization can enhance students' sense of autonomy and competence, leading to increased motivation and engagement (Hwang et al., 2012).
- **Gamification:** Incorporating game-like elements such as points, badges, challenges, and leaderboards into mobile science learning activities can increase motivation, enjoyment, and persistence, thereby fostering behavioral engagement (Kim et al., 2018).
- **Interactive Simulations and Virtual Labs:** Mobile devices can host interactive simulations and virtual laboratory environments that allow students to explore scientific concepts and conduct experiments safely and engagingly. These experiences can enhance conceptual understanding, build self-efficacy through hands-on learning, and spark interest (de Jong et al., 2013).
- **Multimedia Integration:** The ability to seamlessly integrate text, images, audio, and video on mobile devices can cater to diverse learning styles and make abstract scientific concepts more accessible and engaging, fostering both cognitive and emotional engagement (Mayer, 2009).
- **Collaborative Learning Tools:** Mobile apps and platforms can facilitate communication and collaboration among students on science projects and discussions, promoting a sense of relatedness and enhancing social aspects of engagement (Lai & Hong, 2015).
- **Augmented and Virtual Reality (AR/VR):** Emerging mobile-based AR and VR technologies can overlay digital information onto the real world or immerse students in virtual scientific environments, offering novel and highly engaging ways to visualize and interact with scientific phenomena, potentially boosting interest and deeper understanding (Ibáñez & Delgado-Kloos, 2018).

POTENTIAL PSYCHOLOGICAL CHALLENGES AND CONSIDERATIONS

While mobile learning holds significant promise for enhancing science engagement, it also presents potential psychological challenges that need careful consideration:

- **Cognitive Overload:** Poorly designed mobile learning interfaces or an overwhelming amount of information presented on small screens can lead to extraneous cognitive load, hindering understanding and reducing engagement (Low & Sweller, 2014).
- **Distractions and Off-Task Behavior:** The inherent connectivity of mobile devices can be a double-edged sword, potentially leading to distractions from social media, games, and other non-educational content, thus negatively impacting behavioral and cognitive engagement (Froese et al., 2016).
- **Digital Divide and Equity:** Unequal access to reliable internet and suitable mobile devices can exacerbate existing educational disparities, potentially leading to decreased engagement among students from disadvantaged backgrounds (van Deursen & van Dijk, 2019).
- **Superficial Engagement:** The novelty and interactivity of some mobile learning applications might lead to superficial engagement without deep processing of scientific concepts (Chi et al., 2014).
- **Teacher Role and Integration:** The effective integration of mobile learning requires teachers to adapt their pedagogical approaches and provide appropriate guidance and support. Lack of teacher training and support can hinder the positive psychological impact of mobile learning (Sharma, 2020).

STRATEGIES FOR PSYCHOLOGICALLY INFORMED MOBILE LEARNING DESIGN IN SCIENCE

To maximize the positive psychological impact of mobile learning on science engagement, educators and designers should adopt a psychologically informed approach:

- **Design for Optimal Cognitive Load:** Ensure clear and intuitive interfaces, break down complex information into manageable chunks, and use multimedia judiciously to enhance understanding without overwhelming students.

- **Foster Autonomy and Choice:** Provide students with opportunities to select learning activities, explore topics of interest, and control their learning pace within the mobile environment.
- **Promote Competence and Self-Efficacy:** Offer well-structured activities with clear learning goals, provide timely and constructive feedback, and scaffold learning to ensure students experience success.
- **Cultivate Interest and Relevance:** Connect science concepts to real-world applications, use engaging multimedia and interactive elements, and encourage inquiry-based learning activities that spark curiosity.
- **Facilitate Relatedness and Collaboration:** Integrate opportunities for peer interaction, group projects, and online discussions within the mobile learning environment.
- **Minimize Distractions:** Design learning activities that are inherently engaging and relevant, and educate students on the importance of focused learning during mobile learning sessions.
- **Address Equity Concerns:** Ensure equitable access to devices, internet connectivity, and technical support for all students.
- **Provide Adequate Teacher Training:** Equip teachers with the pedagogical knowledge and skills to effectively integrate mobile learning into their science instruction in a way that supports student engagement.

CONCLUSION AND FUTURE DIRECTIONS

Mobile learning holds significant potential to transform science education by fostering deeper and more meaningful engagement among secondary grade students. By understanding and addressing the underlying psychological factors that influence engagement, such as motivation, self-efficacy, interest, and cognitive load, educators and designers can create mobile learning experiences that are not only technologically innovative but also pedagogically sound.

Future research should focus on longitudinal studies to examine the long-term psychological impact of mobile learning on science engagement and achievement. Further investigation is also needed to explore the effectiveness of specific mobile learning features (e.g., AR/VR, adaptive learning) on different dimensions of engagement and across diverse student populations. Moreover, research on effective teacher professional development for integrating psychologically informed mobile

learning strategies into science instruction is crucial. By embracing a nuanced understanding of the psychological landscape of mobile learning, we can harness its power to cultivate a more engaged, motivated, and scientifically literate generation of learners.

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The Impact of Digital Technologies on the Teaching and Learning of English Literature

W. M. Seenivas Leandar Bias*

Abstract

The combination of technology with traditional learning in literature classrooms is a significant revolution in education. We can see a growing support for infusing technology into teaching. However, we must remember that while technology can certainly improve traditional teaching, it will never supersede traditional teaching. Teachers are not just facilitators of knowledge; they are role models, whom students can look to picture the value of life, not only in terms of their emotions, but also their emotional intelligence, empathy, moral values, and ethical values, which technology cannot fully replicate. Technology offers teachers a wide variety of resources to support teaching and learning, i.e., video, audio, educational apps, and games. These technologies offer teachers and students different ways of instruction, while providing new opportunities for engaging students in their studies. Although literature is an area of study that is based on truth, emotion, and, more often than not, some kind of contextual dialogue, technology is an area of continuing instantaneously capture tone and emotion with more clarity than a teacher could merely model on their own. E-book and e-courseware are becoming more prevalent in today's classrooms, and paper is increasingly being swapped for electronic materials so students can have more ways of accessing learning in the classroom. E-lectronic books are also more engaging, are less expensive to purchase, more accessible, portable, and environmentally-friendly, and they can often have embedded media elements, i.e., video and audio, that enhance a learning experience.

Keywords: Literature Pedagogy, Student Engagement, Digital Tools, Learning Outcomes, Classroom Applications

*Ph.D Research Scholar, Department of English, Maruthupandiyar College, (Affiliated to Bharathidasan University, Tiruchirappalli), Thanjavur.

INTRODUCTION

India's higher educational system has been transformed through the process of digitalization, and it has many advantages and uses like democratizing access to education, having formalized models in evaluation systems, offering collaboration opportunities worldwide, empowering teachers, securing and protecting privacy and data, because modelling and assessing and evaluating digital initiatives, in literature classrooms where the delivery of feelings, tone and cultural specifics are important, digital media enables deeper insights and therefore engagement. The purposeful use of digital tools in our practice can reduce educational inequality, fuel creativity, and prepare learners for a technology-rich and interdependent world.

Teaching prose with technology can be realized in more ways than anyone thinks, for example: audiobooks can improve listening skills and pronunciation; digital annotations can help students ground complex vocabulary or cultural anchors; interactive e-books can have embedded links, images and videos to add layers of context; discussion forums or blogs were designed to promote a literary critique and provide limited space to enter into a dialogue with peers. Although technology may eliminate human practitioners, its best usage is to augment, not replace, human impact. While many faculty members might see technology as a distraction, students will be more engaged in learning literature and will incorporate elements of emotional and aesthetic experience previously mentioned to take advantage of learning like it were their research paper.

The study explores the integration of Information and Communication Technology (ICT) in enhancing literary education in India. Prose, a fundamental component of literature, is a subject that often leads to a decline in student interest due to prolonged reading. To address this issue, ICT tools can be strategically employed to enhance engagement and comprehension. Some ICT tools for teaching prose effectively include documentaries based on novels, short story videos, digital boards with moving text in large font sizes, e-newspapers, e-magazines, and e-journals, and blogs by renowned authors. These tools help students better understand narrative structures and themes, making them more relatable and visually engaging. Survey data reveals that most literature students favor digital tools like videos, audio, and films in the classroom, aiding in better understanding and retention.

Theoretical frameworks for digital integration can include connectivism, which was founded by George Siemens, which contends learning is the building of networks, and digital Bloom's Taxonomy, which was originally created by Benjamin Bloom in 1956 and later expanded by Lorin Anderson and David Krathwohl, which offers

a formalized way of utilizing technology in classrooms to support critical thinking, creativity, and collaboration. As a discipline, literature conveys emotion, passion, and human experience. There is difficulty in finding the right way to express these human understandings, but technology around us can help bring literature to life. Teaching poetry through technology allows the teacher to use ICT (Information and Communication Technology) to recreate the oral tradition and enhance students' understanding of poetry. Video presentations, instrumental music, native speaker recitations, digital media, voice recorders, and performance recordings can aid students in understanding how characters interact with each other and stagecraft.

Digital literacy and ICT tools do not supplant traditional education but rather complement it with imagery and experiential learning. With careful use of these tools, teachers can avert education gaps, support creativity, and prepare students to exist in a digital, technologically savvy, and interconnected world. Prose is a type of literature that highlights plot as well as direct and indirect characterization. Yet if a student is engaged in a prolonged reading in class of prose, it is likely that their interest and attention may diminish. ICT can be used judiciously to enable and enhance engagement and understanding. Possible ICT tools for better teaching of prose include documentaries based on novels, short story images or videos, digital boards with moving text in a larger font size, e-newspapers, e-magazines, e-journals, and blogs from established or famous authors. Survey evidence suggested that the majority of literature students preferred digital technology tools in class, such as videos, audios, and films, for better understanding and recall.

The study explores the way traditional or analogue teaching strategies with digital technology affects student learning outcomes in the literature. The study used a descriptive design and worked with secondary sources, specifically journal articles, conference proceedings, book chapters, formal websites, and personal observation. The participants of the study were those students that were studying and having literature degrees. The feedback that was received from the students surveyed showed that bringing digital pedagogical media into the classroom can greatly benefit and enhance learning across all pedagogies, as it can transform learning from passive knowledge ingestion to stimulating, active learning environments. Digitalization of higher education in India has come a long way and, in some instances, has been a path-dependent process with some of the challenges of integrating digital technology, ICT tools, and means of communication into traditional or analogue education. Digital media, tools, and technologies are not replacing traditional education; they belong to a new, naive

process of being interspersed with traditional approaches and facilitate the learning process, not replace it. In literature, subjectivity is significant, and teaching with digital media allows deeper engagement and understanding of subjectivity. Digital media has overcome a gap in education, allows people to become innovative or creative, and prepares students or learners for a globalized and technologically advanced space.

As we see with today's digital communications, people are becoming more interactive and participative. With the social web, audiences can consume content and also create, produce, edit, distribute, respond, and share in multiple places. This has changed the way arts organisations think about audiences and they can engage with them virtually at any time. An example of this is "The Space", a digital platform were audience members experience performances from Shakespeare's Globe Theatre, on their own computers, at their convenience. However, today's peers take issue with how much of the Shakespeare and Globe-related content exists outside of organisational boundaries, but also the question of intellectual property and creative ownership. Students engaging with the plays can consider representation, iconic characters, how performance animates a text, character interaction as a way to build tension and understand character development and arc, analyse Shakespeare's language, and make connections across lines of text and other plays. They are encouraged to appreciate the many ways in which Shakespeare's texts might be represented and experienced, including dramatisation or film.

Students from many of the groups have worked to think about the history and culture that affect reinterpretations of Shakespeare's texts and have explored how Shakespeare's plays have been re-worked and re-produced over time with new technologies and story telling practices through examining - an audiobook version of "The Tempest", an animated film adaptation of "The Tempest", and several modern film-makers who are utilizing new and modern filmic modes and techniques to adapt Shakespeare's plays, translating the language, setting, character, dialogue, etc. into meaningful, relatable contemporary contexts. These endeavours also serve to demystify classical literature in relation to contemporary media, and to encourage students to understand the text and the text's continued life in modern culture.

The curriculum is an essential aspect of English language learning, and it guides both curricular and co-curricular actions. The curriculum is the typical starting point for all educational programs, and it shapes the nature of the educational program and the outcomes that are planned for the program. Detailed and deliberate curriculum creation is done to assure that the intended learning outcomes are being achieved. This unit

will look at what a curriculum is, key principles and approaches to the curriculum, what makes a good English textbook, A good English textbook is a good resource for teachers of English language, and also for learners. A useful English textbook would ensure students were learning in a sequential, logical, and psychological fashion; it would have activities for learning, target skills development, include game-based learning, it would ensure placement of relevance to content in context, and with visuals and graphics.

Authentic materials are important elements of language instruction. Authentic materials reflect real-world language use and further content knowledge with genuine language contexts. Authentic materials can be categorized as: Authentic listening materials. These include everything from recording of native speakers being natural to live, lectures, speeches, news reports, and snippets from social media and web. Authentic reading and visual materials. Components include many traditional forms such as newspaper articles, blogs, brochures, e-mails, and social media posts. The recent growth of digital resources for English language teaching has expanded the accessibility to quality materials, from open (available online) language learning materials, and Massive Open Online Courses (MOOCs), and educational websites and YouTube videos, teacher websites and social media port, apps that build language in different ways, and open educational resources (OER). Conclusively, with an established curriculum, with skill based textbooks, and authentic materials, we increase the effectiveness of teaching and learning English.

In the 21st-century, English language teachers must have a complex and varied skillset to engage their learners and meet the expectations of a changing era of education. These skills include subject knowledge, pedagogical knowledge, technological knowledge, communication skills, and dedication to ongoing professional learning. Subject knowledge is particularly important for the English language because students often regard their teacher as an authority figure, and so, they model their understanding, knowledge, and behaviors after their teacher's knowledge and behaviors. A teacher should read from current published resources on a regular basis, engage in outer academic discussions and demonstrate thoroughness and accuracy in presenting content. Pedagogy is the practice of the science and art of teaching. The fundamental intention of pedagogy is to effect change in students' behaviors through meaningful learning by designing learning experiences for students. Teachers must also have knowledge of previous and contemporary pedagogies, and their varieties of approaches to instruction (approaches, methods, techniques), and the ability to organize and select and organize one or more strategies based on the content, context and student level and their variety of selves and knowledge to be creative, interactive, and innovative

in responding to behaviours in the classroom. Teachers must include activity-based and learner-centred approaches in their practice to make it engaging and interactive.

Technological orientation in today's world is imperative for the success of educators. The technological orientation will help educators to merge the library oriented style of learning the teachers are accustomed to and the technology-oriented style of learning. Educators need to understand how to use technology for planning and instructing their lessons, how to prepare to teach online and offline lessons using platforms such as Zoom, Google Meet, and Microsoft Teams, and how to prepare and share learning materials in multiple formats that may include video or audio recordings, a multitude of. pdf materials, hyperlinks to other materials, and when appropriate, assistive mobile assisted language learning (MALL) tools to support learning that can be achieved at any time, any where. Communication is critical for going from instructional planning to informing learners about what they are to learn. Communication is not merely passing on information. It is the sharing of feelings, thoughts, feedback. English educators have to be strong verbal and writing communicators for effective instruction. Verbal communication, in the teaching role, has many dimensions and can include effective listening skills, articulation (clarity of speech), and an encouraging tone of voice to solicit interaction and discussion to promote a communicative classroom.

English language teachers need to undergo professional development, which allows for collaboration and engaging with curriculum experts, presenting papers researched on, and using newly acquired pedagogy tools and practices. English teachers need experiences where practical application occurs from hands-on workshops; these experiences can and should cover developing teaching aids, north/online conferencing tools, phonetics/ pharmacology practices, fluency of writing, and handwriting practices. In today's context, English teachers are expected to possess the reciprocal expertise of Administrators, Pedagogy Practitioners, resident experts of the subject area, navigators of the digital world, and lifetime learners to create dynamic, safe, inclusive, and impact learning spaces for students. Digital Literature, a rapidly emergence genre, refers to literary works initially or subsequently created to enable use on a digital computing device (e.g. computers, tablets, and smart phones for e-books), is a large volume, including on electronic screens, with text and images, with reading dimensions like those of printed texts.

CONCLUSION

The digital age offers wide access to literary materials via online digital libraries, repositories, or databases that offer a large searchable collection of peer-reviewed

journals, scholarly articles, academic books, and primary resources about various topics and subject disciplines, including English Literature. Generally, digital library databases have a subscription or pay-per-view model for accessing their materials, but many academic universities and colleges offer free access to their students and faculty using university library credentials. New media and social media platforms are beginning to play an important role in the discovery of literature and ideas in the digital age. With social media sites truthfully, you can share articles and literary works in a matter of seconds, and it can trigger a viral effect reaching the world almost immediately. It has certainly changed how literature is written, published, read, and circulated, and invited readers to contribute back to a collaborative literary culture. Digitalization and self-publishing have enabled writers who write fiction, nonfiction, poetry, or essays to distribute and share their writing to a global audience instantaneously, and that has promoted a more inclusive literary culture. The transition from print to digital media has changed not only the way we consume texts, but how we construct and read texts. Educational courses in digital literature are built to help students develop the analytical and interpretive skills needed to engage with digital texts and literature that consider or employ digital technology.

Digital literature has different purposes: to explore new literary genres, to examine the role of technology in literary production, access, and democratization, to develop digital literacy, and cultural responsiveness in the 21st century. The methods offered by digital literature include literary studies, reader response studies, and digital tools and platforms. The emergent qualities of digital literature include a focus on interactivity, accessibility, and reader empowerment. Digital literature often relies on interactivity that maps the act of reading to the act of user involvement (or participant). Readers add meaning to the text through comments, sharing, and adaptations. Digital literature can have significant implications that require new meanings in an educational context: transformational learning as an act of educational change, reconceptualizing the meaning of the literary Canon, active cultural participation, and contributions to the canons, in the context of preservation of works, critical thinking, and media literacy. Educational transformation invites and enables literary studies boundaries to be pushed, to foster innovative teaching approaches in the literature classroom through use of digital texts and tools. Critical thinking and media literacy fosters skills of interaction between text, image, and audio to be interrogated alongside critical reading, and to navigate possibilities and meanings of media.

Portable technologies and telecommunications have advanced significantly. Digital technologies and ebooks were already developing every day. Modern high-speed internet and efficient telecommunications have set up multiple simultaneous

connections between authors and readers, thus facilitating a shared community of writers, readers, and curiosity about literate forms of digital culture on a global scale. Social and political activity and activism have explored new narratives that emerge out of digital participatory culture and contributed to new ways of storytelling, often with various hashtags establishing communities of shared experience and public label. Twitter, Instagram, Salesforce, and Facebook are websites and social media digital platforms where narrative expression, community building, and sharing happen, and also where alternate stories and voices are surfaced from marginalized communities. Along with social media narrativizing - cultural moments and memes - are also social media narratives which help to communicate or display social emotions and critique of sorts. All of these appear to demonstrate some notion of community copyrighting and certainly some un-objectifiable/unknowledgeable forms of digitally mediated narrative or communication that guides cultural expression.

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Digital Literacy and E-Content Preparation Skills Among B.Ed Students: A Comprehensive Assessment

Hemamalini T.* and Dr. K. Saileela**

Abstract

The present study aimed to assess the digital literacy and e-content preparation skills among B.Ed students using a normative survey method. A sample of 200 second-year B.Ed students from Pudukkottai District was selected through the random sampling technique, specifically the lottery method, to ensure fair representation. Two tools were utilized for data collection: the Digital Literacy Scale, constructed by the researcher in collaboration with Dr. K. Saileela, and the E-Content Preparation Skills Scale, developed and validated by Dr. K. Saileela. Each tool contained 15 items measured on a 3-point ordinal scale. The collected data were systematically analyzed using descriptive statistics (mean and standard deviation) and inferential statistics, including t-tests and ANOVA, to identify differences based on demographic variables. Correlation analysis revealed a positive relationship between digital literacy and e-content preparation skills. The findings indicate that students possess moderately high levels of both competencies, with notable gaps in practical exposure to advanced digital tools, suggesting the need for targeted training programs.

Keywords: Digital Literacy, E-Content Skills B.Ed Students Statistical Analysis

INTRODUCTION

In today's educational landscape, digital literacy has become a core competency for educators, driven by the increasing reliance on online, hybrid, and technology-integrated learning environments. This study assessed the digital literacy and e-content preparation skills of 200 second-year B.Ed students from Pudukkottai district using a normative survey method with random sampling. Data were collected via structured tools and analyzed using descriptive statistics, t-tests, ANOVA, and correlation

*M.Ed Student, Government College of Education, Pudukkottai.
**Assistant Professor in Education, Government College of Education, Pudukkottai.

analysis. The findings revealed that students exhibited a high level of digital literacy (mean score: 34.53 out of 45) and moderately high e-content preparation skills (mean score: 30.22 out of 45). Significant differences were observed based on gender, with male students outperforming females in e-content skills, and students from private institutions demonstrating stronger content creation abilities than those from government institutions. Additionally, students with access to both smartphones and laptops showed better performance in both areas. A positive correlation was found between digital literacy and e-content preparation skills, highlighting the interconnected nature of these competencies in preparing future-ready educators.

SIGNIFICANCE OF THE STUDY

The significance of this study lies in its timely exploration of digital literacy and e-content preparation skills among B.Ed students, who represent the next generation of educators in an increasingly technology-driven world. As classrooms rapidly transition to digital, hybrid, and online modes of instruction, teachers must be equipped with the necessary digital competencies to engage students effectively and enhance learning outcomes. This research highlights the preparedness of future teachers to use digital tools for content creation, communication, and instruction, aligning with the goals of the National Education Policy (NEP) 2020, which emphasizes the integration of technology in education. By identifying the strengths and gaps in digital and e-content skills, the study provides valuable insights for curriculum developers, teacher educators, and policymakers to strengthen digital training in B.Ed programs. It also addresses the digital divide by examining disparities based on gender, institution type, and access to devices. Furthermore, the study supports the development of targeted professional development initiatives, ensuring equitable and inclusive education. Ultimately, the research contributes to building a digitally empowered teaching force capable of meeting the evolving demands of 21st-century education and fostering a more engaging, innovative, and learner-centered classroom environment.

Literature Review

National Context

- The National Education Policy (NEP) 2020 in India emphasizes the integration of digital tools in pedagogy.

- Studies have shown moderate digital literacy among B.Ed students, with rural students often facing greater challenges due to limited ICT infrastructure.
- Gender disparities and lack of structured training in e-content development have been reported.
- Initiatives like MOOCs and SWAYAM have positively impacted digital skills when combined with practical sessions.

International Context

- Frameworks such as TPACK and DigCompEdu guide the development of digital competencies in teacher education.
- Research highlights the need for confidence-building, hands-on training, and continuous skill development.
- Digital storytelling and collaborative platforms have been effective in enhancing digital creation abilities among pre-service teachers.

OBJECTIVES

1. To assess the level of digital literacy among B.Ed students.
2. To assess the level of e-content preparation skills among B.Ed students.
3. To analyze differences in digital literacy and e-content preparation across demographic variables such as gender, education level, institution type, internet access, and place of residence.
4. To examine the correlation between digital literacy and e-content preparation skills.

METHODOLOGY

The present study adopted the normative survey method to assess the digital literacy and e-content preparation skills among B.Ed students. A sample of 200 second-year B.Ed students from Pudukkottai District was selected using the random sampling technique, specifically the lottery method, to ensure equal representation. Two tools were used for data collection: the Digital Literacy Scale, constructed by the researcher in collaboration with Dr. K. Saileela, and the E-Content Preparation Skills Scale, which was constructed and validated by Dr. K. Saileela.

i. Digital Literacy Scale

	Digital Literacy-Statement	"t"-Value
1	How would you rate your access to a personal computer or smartphone?	0.86
2	How frequently do you use digital tools for educational purposes?	0.89
3	How confident are you in your overall digital skills?	0.76
4	How familiar are you with basic digital tools like MS Office or Google Workspace?	0.53
5	How often do you use the internet to find academic resources?	0.59
6	How confident are you in finding reliable information online?	0.64
7	How often do you use e-learning platforms like Coursera, Udemy, or Khan Academy?	0.56
8	How skilled are you at creating digital presentations (e.g., using PowerPoint or Google Slides)?	0.88
9	How aware are you of safe online practices, such as using strong passwords and avoiding phishing scams?	1.00
10	How often do you back up your digital files?	0.82
11	How aware are you of copyright and plagiarism rules in the digital world?	0.88
12	Have you encountered cyberbullying or misuse of digital platforms?	0.63
13	How important do you think digital literacy is for modern-day teaching?	0.59
14	How would you rate the training or workshops you have attended on digital literacy for teaching?	0.82
15	How much do you feel you need more training to improve your digital skills?	0.35

The Digital Literacy Scale, constructed by the researcher in collaboration with Dr. K. Saileela, consisted of 15 items, each measured using a 3-point ordinal scale appropriate to the context (e.g., Low–Moderate–High, Rarely–Sometimes–Frequently). The t-values for these items range from 0.35 to 1.00, indicating varying levels of digital competence among B.Ed students. Higher t-values (such as 1.00 for awareness of safe online practices and 0.88 for digital presentation skills) suggest strong consensus and proficiency in those areas. Moderate values reflect satisfactory but improvable

skills, while lower values (e.g., 0.35 for the need for more training) indicate variability and scope for development. Overall, the findings reveal a moderately high level of digital literacy, with some specific domains requiring further attention and training support.

ii. E-Content Preparation Skills Scale

	E-Content Preparation Skills-Statements	"t"-Value
1	How familiar are you with the concept of e-content?	0.82
2	Do you have access to a computer or smartphone to create e-content?	0.53
3	Have you created any e-content for educational purposes?	0.64
4	How skilled are you in using presentation software like PowerPoint or Google Slides?	0.88
5	Have you used video editing tools (e.g., Canva, Filmora, or InShot) to create educational videos?	0.35
6	How familiar are you with screen recording tools like OBS Studio, Camtasia, or Screencast-O-Matic?	0.86
7	How comfortable are you converting documents or presentations into PDFs?	1.00
8	How knowledgeable are you about designing visually appealing educational content (e.g., color schemes, fonts)?	0.56
9	How confident are you in including multimedia elements (e.g., images, audio, video) in your e-content?	0.59
10	How proficient are you at designing quizzes or interactive elements for e-learning?	0.82
11	How often have you uploaded or shared your e-content on digital platforms (e.g., YouTube, SWAYAM, Google Classroom)?	0.63
12	How often do you use open educational resources (OER) for preparing e-content?	0.88
13	Have you ever received feedback on your e-content from peers or educators?	0.76
14	How confident are you that your e-content meets the learning needs of students?	0.89
15	Are you interested in attending workshops or training to improve your e-content preparation skills?	0.59

The **E-Content Preparation Skills Scale**, constructed and validated by Dr. K. Saileela, included 15 items assessed using a **3-point ordinal scale** tailored to each statement (e.g., *No knowledge–Some knowledge–Full knowledge*, *Not familiar–Somewhat familiar–Very familiar*, *Not confident–Somewhat confident–Very confident*). The scale covered five sections: conceptual awareness, software tools, design and content development, use of digital platforms, and feedback. The t-values ranged from **0.35 to 1.00**, showing varied levels of proficiency among B.Ed students. High t-values (e.g., 1.00 for converting documents into PDFs and 0.89 for confidence in addressing student learning needs) reflect strong technical readiness. Moderate values suggest developing competence, while lower values (e.g., 0.35 for use of video editing tools) highlight the need for hands-on experience. Overall, the results reveal a growing interest and foundational skill base in e-content preparation, with a clear need for further structured training.

The data were systematically analyzed using various statistical techniques. Descriptive statistics were employed to determine the mean and standard deviation of the responses, while inferential statistics, including t-tests and ANOVA, were used to identify significant differences among groups based on demographic variables. Additionally, correlation analysis was conducted to examine the relationship between digital literacy and e-content preparation skills. This comprehensive methodology enabled a detailed and reliable assessment of the competencies under study.

DATA ANALYSIS AND INTERPRETATION

Digital Literacy Levels

The study revealed that B.Ed students possess a high level of digital literacy. The mean score was 34.53 out of a maximum of 45, with a standard deviation of 3.69. This indicates that the majority of the students have a strong foundation in digital competencies, including the use of digital devices, online communication platforms, and basic ICT tools necessary for teaching and learning in technology-driven classrooms.

Table 1: Digital Literacy Scores

Variable	N	Mean	Standard Deviation
Digital Literacy	200	34.53	3.69

E-Content Preparation Skills

The mean score for e-content preparation skills was 30.22 out of 45, with a standard deviation of 5.42. This suggests that students have a moderately high ability to design and create digital instructional materials. However, the higher standard deviation compared to digital literacy implies a wider variation in skill levels, indicating that some students may require additional support or training in content creation tools.

Table 2: E-Content Preparation Skills Scores

Variable	N	Mean	Standard Deviation
E-Content Preparation Skills	200	30.22	5.42

Gender-Based Differences

A significant difference was found in e-content preparation skills based on gender. Male students performed significantly better than female students in this area. This may be attributed to greater prior exposure to digital tools or higher confidence levels in using content creation software among male students.

Table 3: E-Content Skills by Gender

Gender	N	Mean	Standard Deviation	t-value	Significance
Male	82	31.91	6.17	3.57	Significant
Female	118	29.05	4.51		

Institution Type

The type of institution was also a factor influencing performance in e-content preparation. Students from private institutions scored higher than their counterparts from government institutions. This could be due to better access to digital infrastructure, training, and resources in private colleges, enabling students to engage more effectively in content creation.

Table 4: E-Content Skills by Type of Institution

Institution Type	N	Mean	Standard Deviation	t-value	Significance
Government	126	29.50	5.56	2.04	Significant
Private	74	30.96	5.17		

Access to Digital Devices

Students who used both smartphones and laptops demonstrated higher levels of both digital literacy and e-content preparation skills. This finding underscores the importance of multi-device access in developing technological proficiency, as exposure to varied platforms likely enhances both usage confidence and creative application.

Table 5: Skills by Access to Digital Devices

Device Access	N	Mean (Digital)	SD	Mean (E-Content)	SD	F-value	Significance
Smartphone	146	34.53	3.78	29.76	5.44	12.95	Highly Significant
Laptop/ Desktop	44	35.09	3.34	30.50	5.75		
Both Smartphone & Laptop	10	33.00	3.46	35.20	6.24		

No Significant Differences in Digital Literacy

The analysis showed no significant difference in digital literacy scores across gender, educational qualification (UG/PG), or type of institution. This suggests that basic digital competencies have become more uniformly developed among students regardless of these demographic variables.

Table 6: No Significant Difference in Digital Literacy (Gender, Qualification, Institution Type)

Variable	Groups	Mean	S.D	t/F-value	Significance
Gender	Male	35.05	3.55	1.67	Not Significant
	Female	34.17	3.76		
Qualification	UG	34.38	3.72	0.91	Not Significant
	PG	34.90	3.63		
Institution Type	Government	34.44	3.72	0.74	Not Significant
	Private	34.77	3.67		

No Significant Differences in E-Content Skills (Some Variables)

E-content preparation skills did not show significant variation with respect to students' educational qualification or frequency of internet usage. This indicates that content creation ability may not be directly influenced by academic background or how often the internet is accessed, but rather by the quality of training and practical exposure to tools.

Table 7: No Significant Difference in E-Content Skills (Qualification, Internet Usage)

Variable	Groups	Mean	S.D	t/F-value	Significance
Qualification	UG	30.90	6.06	1.06	Not Significant
	PG	29.94	5.14		
Internet Usage	Daily	30.35	5.47	0.78	Not Significant
	Weekly	27.29	4.27		
	Occasionally	28.00	-		
	Never	29.80	5.02		

Correlation Between Digital Literacy and E-Content Skills

A positive correlation was observed between digital literacy and e-content preparation skills. This means that students who are more digitally literate also tend to have better skills in preparing digital content. The finding reinforces the idea that strengthening digital literacy can directly enhance the capacity for effective e-content creation.

Table 8: Correlation Between Digital Literacy and E-Content Skills

Variables	Correlation Coefficient	Significance
Digital Literacy & E-Content Skills	Positive	Significant

FINDINGS

1. B.Ed students demonstrate high digital literacy.
2. Their e-content preparation skills are adequate but varied.

3. Gender, institution type, and device access significantly influence these skills.
4. Strong correlation exists between digital literacy and e-content proficiency.

RECOMMENDATIONS

- Integrate hands-on digital content creation modules in B.Ed curriculum.
- Offer specialized workshops on video editing, multimedia tools, and learning management systems.
- Promote equitable access to devices and internet connectivity.
- Encourage gender-inclusive digital skill development initiatives.

SUGGESTIONS FOR FURTHER RESEARCH

- Expand the study to other districts or states for comparative analysis.
- Conduct longitudinal studies to assess digital skill progression post-training.
- Investigate the impact of digital training on actual classroom teaching effectiveness.

DISCUSSION

The findings of the present study align closely with national and international research, emphasizing the growing importance of digital literacy and e-content preparation skills among pre-service teachers. The high level of digital literacy observed among B.Ed students corresponds with the framework proposed by Mishra and Koehler (2006), who introduced the Technological Pedagogical Content Knowledge (TPACK) model that underlines the integration of technology into teaching practices. Similar to Joshi (2018), who reported moderate digital literacy levels in rural Maharashtra due to limited ICT infrastructure, this study found that access to digital devices significantly influenced students' competencies.

Kaur (2020) noted that although many B.Ed students were aware of digital tools, their ability to create interactive content remained limited—an observation echoed in this study, where e-content preparation skills showed greater variation compared to digital literacy. The gender-based differences found here also support Spante et al. (2018), who concluded that digital confidence affects students' content creation abilities. Furthermore, Ng (2012) emphasized the need for training programs that address technical, cognitive, and socio-emotional aspects of digital literacy.

Voogt et al. (2013) and Redecker (2017) advocated for the integration of digital competencies in teacher education curricula. This reinforces the present study's conclusion that structured, equitable, and practice-based digital training is essential for preparing future educators for 21st-century classrooms.

CONCLUSION

The present study concludes that digital literacy and e-content preparation skills are essential competencies for B.Ed students in today's rapidly evolving educational environment. As future educators, their ability to integrate technology effectively into teaching practices is crucial for fostering engaging, inclusive, and learner-centered classrooms. The findings revealed that the sampled B.Ed students possess a high level of digital literacy and a moderately high level of e-content preparation skills. However, variations were observed based on gender, type of institution, and access to digital devices, indicating the need for more equitable and structured digital training across teacher education programs. The positive correlation between digital literacy and e-content skills emphasizes that strengthening one can significantly enhance the other. This calls for an integrated approach in B.Ed curricula that combines technical know-how with pedagogical strategies for content development. The study also aligns with the objectives of India's National Education Policy (NEP) 2020, which advocates for building digital capacity among educators. In conclusion, the study highlights the urgency of equipping B.Ed students with comprehensive digital competencies to meet the demands of 21st-century education. It further recommends incorporating hands-on training, improving digital infrastructure, and providing continuous support to ensure a digitally empowered and pedagogically skilled teaching force.

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Empowering Healthcare Professionals: The Transformative Role of Digital Health Education and Telemedicine in Shaping Future Care Delivery

Shiny Vincent*, Gnana Deepa**, Dr. T. Dhanasekar***, Dr. P.U. Mahalingam****, Dr. Padmasrikanth***** and Dr. P. Kennady Kumar******

Abstract

Patient care is being increasingly aided by digital technology. Digital health education is another aspect revolutionizing the healthcare industry. It offers microlearning, information regarding recent advances in the field, and professional collaboration, enhancing the proficiency of Health Care Professionals (HCPs).

Telemedicine provides fair and affordable access to medical advice, thus improving the way healthcare is delivered. Thanks to wearable technology, which enables remote monitoring of patients, and AI, telemedicine facilitates ongoing and proactive communication with patients. It also leads to personalised medicine and better data handling. Merging telemedicine and digital health is important for advancements in healthcare delivery.

This review explores the current scenario and future of digital health and telemedicine, with an emphasis on supporting HCPs to make the most of them. The future promises better healthcare for all patients by developing a team of HCPs who are well-educated, experienced, and empowered via digital technology and telemedicine tools.

Keywords: Digital Health Education, Telemedicine, Healthcare professionals.

*Sri Ramachandra Institute of Higher Education and Research, Chennai (India).
**Sri Ramachandra Institute of Higher Education and Research, Chennai (India).
***Sri Ramachandra Institute of Higher Education and Research, Chennai (India).
****Gandhigram (Deemed) University, Dindigul (India), E-mail: shinyvincentscc@gmail.com
******Sri Ramachandra Institute of Higher Education and Research, Chennai (India).
*****Sri Ramachandra Institute of Higher Education and Research, Chennai (India).

INTRODUCTION

Digital health education encompasses the use of electronic devices, online learning platforms, and interactive materials to support the continuous education of healthcare providers (HCPs). These digital solutions enable HCPs to learn at their own pace, accommodating different learning styles and periods, instead of depending entirely on conventional means. The availability of excellent educational material has democratized knowledge acquisition, enabling physicians to stay up to date on the most recent developments in health care, treatment techniques, and emerging technology regardless of their geographic location (Ferreira et.al, 2025).

Patient-provider interactions have been completely transformed by telemedicine, the delivery of medical treatments using digital communication technologies. Telemedicine provides a workable way to increase access to healthcare, particularly in underserved areas, by overcoming geographical and time constraints. By utilizing telemedicine, medical providers can broaden their reach and offer prompt treatments, improving patient participation and treatment plan compliance (Ezeamii et.al, 2024).

The advent of telemedicine and education for digital health has undoubtedly changed the face of healthcare, bringing about a paradigm shift in how medical professionals learn and provide patient care. With the rise of information and communication technologies, HCPs now have the possibility of improving their skills, which can lead to better results for patients and the overall health care service (Almond & Mather, 2023).

METHODOLOGY

This review article adopts a systematic review methodology to synthesize current evidence on how digital health education and telemedicine empower healthcare professionals and shape future care delivery.

RESEARCH DESIGN AND OBJECTIVES

The review was designed to provide a comprehensive, unbiased synthesis of existing literature on the transformative impact of digital health education and telemedicine on healthcare professionals. The primary objective was to identify, evaluate, and summarize findings on empowerment, clinical outcomes, adoption barriers, and enabling strategies.

SEARCH STRATEGY

Electronic searches were conducted in major scientific databases, including PubMed, Scopus, and Web of Science, covering literature published in the past ten years and limited to English-language, peer-reviewed articles. Search terms combined key concepts such as “digital health education,” “telemedicine,” and “healthcare professionals.” Reference lists of relevant articles were also screened for additional sources.

INCLUSION AND EXCLUSION CRITERIA

Studies were included if they focused on digital health education or telemedicine interventions targeting healthcare professionals and reported outcomes related to empowerment, knowledge, workflow, collaboration, or patient care. Exclusion criteria included studies not involving healthcare professionals, non-English publications, conference abstracts without full texts, and articles not addressing digital health or telemedicine.

STUDY SELECTION AND DATA EXTRACTION

Titles and abstracts were screened independently by two reviewers. Full texts of potentially relevant articles were retrieved and assessed for eligibility. Data were extracted using a standardized form capturing study design, setting, participant characteristics, intervention details, outcomes, and key findings.

DATA SYNTHESIS AND DOCUMENTATION

Findings were synthesized narratively, with quantitative results summarized in tables where applicable. Key themes were identified regarding the impact of digital health education and telemedicine on healthcare professional empowerment, workflow, and care delivery, as well as barriers and facilitators to adoption. All steps of the review process, including search strategies, inclusion/exclusion decisions, and quality assessments, were thoroughly documented to ensure transparency and reproducibility.

DIGITAL HEALTH TECHNOLOGIES

The intersection of digital health, telemedicine, and the advent of AI technologies announces a future in which health professionals and patients get significant benefits,

preparing the scenario for transformative changes in health services and results. The successful integration of digital health programs into health systems can be illustrated by various case studies that illustrate effective adaptation practices, challenges, and strategies. Digital health technologies not only facilitate personalized care for patients, but also equip health care providers with data analysis capacities that can shed light on decision-making processes (Petretto et al, 2024).

The increasing frequency of chronic diseases, aging populations, and rising health care expenditures are the primary trends driving the significance of telemedicine and digital health education. Health practitioners need to be skilled in using technology to enhance daily operations and take care of patients. Health professionals should gain knowledge in handling data, telemedicine, and ethical uses of artificial intelligence. Since the healthcare industry is embracing technology rapidly, its workers need to be well prepared and understand how to use these tools (Nguyen et al, 2023).

THE EVOLUTION OF DIGITAL HEALTH EDUCATION

Patients' comprehension of their diseases and treatment plans is enhanced by digital health education, and this has a direct impact on their capacity to adhere to recommended procedures.

Maha et al. reported that patients who participated in telehealth programs showed a 20% increase in medication adherence. In particular, chronic disease management initiatives, such as telemonitoring programs for hypertension and diabetes, stressed that patients were more likely to remain in conformity when they received regular virtual monitoring and education on the importance of their drug calendars. The incorporation of reminders and alerts via mobile applications has also proved to be effective, which has caused improved adherence rates. Digital health education provides complex medical information in an accessible language, thus equipping patients with the tools necessary to make informed decisions concerning their health.

Digital health education covers a variety of learning modalities, including online courses, web seminars, and interactive platform tools, which are designed to improve essential competencies for modern health environments (Jarva, 2024). These skills extend beyond traditional medical knowledge and clinical skills to include digital literacy, data interpretation, and experience with Telesalud technologies, which are increasingly relevant as patient care depends more on digital platforms (Jose et al., 2024).

CURRENT LANDSCAPE AND GAPS

Despite the widespread belief among healthcare professionals that digital health tools can improve patient outcomes, formal education in digital health remains limited. Most clinicians have not received structured training on how to effectively integrate digital health solutions-such as apps, wearables, and telemedicine platforms-into their practice. This gap underscores the need for comprehensive digital health education that is accessible, practical, and aligned with evolving clinical workflows (Maha et al, 2024).

INNOVATIVE EDUCATIONAL MODELS

To address these needs, initiatives like the Digital Health Academy have emerged, offering CPD-accredited, online courses developed in collaboration with healthcare professionals and academic institutions. Users can also explore modules tailored for treating issues such as mental health, diabetes, and care during pregnancy, as well as learn about digital health in general. Since frontline staff are busy, digital upskilling works best with short and video-based learning lessons (Burrell, 2024)

They are also including digital health in their courses for undergraduate and graduate students. So, medical schools are now researching virtual reality, artificial intelligence guides, and remote learning for future doctors. These methods develop flexibility, agility, and critical thinking—qualities that are crucial for aspiring health leaders.

BRIDGING THE KNOWLEDGE GAP

Conventional medical education frequently finds it difficult to keep up with the rapid advancements in technology and medical understanding. A dynamic and easily available answer is provided by digital health education (Stoumpos et al.,2023).

Online platforms provide HCPs with access to a wealth of up-to-date information, including research findings, clinical guidelines, and best practices. Better patient outcomes result from specialists staying up to date in their specialties thanks to this continuous learning methodology (Jarva,2024).

Digital platforms are designed to allow individual customization of what is being taught based on a student's preferences. Experiencing virtual reality and playing with simulations and modules helps students engage more (Canaud et al, 2024).

Online education allows remote areas that have few opportunities to benefit from the same high-quality instruction as big cities. It also helps reduce the costs that happen in ordinary workshops and conferences (Pietrantonio et al, 2024).

Digital tools provide people with opportunities to learn necessary skills such as using electronic health records (EHRs), analyzing data, and talking with patients over the internet. As a result, healthcare pros are competent in using the innovative technology driving changes in healthcare (Nguyen et al, 2023).

TELEMEDICINE

Doctors can communicate with patients more easily and amicably when they use telemedicine consultation techniques. It enables patients to receive the required care without having to travel great distances in the majority of underserved or remote areas. One effective strategy to provide medical assistance to previously underserved communities is to integrate telemedicine with healthcare (Nwankwo et al., 2024). According to Nguyen et al., 85% of telemedicine users expressed satisfaction, primarily because of the ease of accessing care, prompt assistance, and first-rate service.

Telemedicine allows health professionals to provide cheaper, convenient, and flexible health care, opening up more options to all patients, thus promoting health equity. With cutting-edge systems ensuring that everyone receives the specific, long-term therapies they require, telemedicine is completely changing the way health care is provided globally. Access to telemedicine allows patients to overcome barriers to seeing specialists. Introducing technology innovations allows healthcare workers to perform better, while patients experience better outcomes(Ezeamii et al., 2024).

Digital health education fosters an atmosphere that encourages proactive health management even while it enables medical experts to deliver comprehensive instruction remotely. The overall effect of combining telemedicine with digital health education is to increase patients' health literacy, which is linked to better health outcomes and will change how health care is provided in the future (Lloyd et al, 2023).

THE FUTURE OF TELEMEDICINE

A number of significant themes influence the direction of telemedicine, including cloud-based solutions, advanced video and voice analytics, remote patient monitoring and the Internet of Things, hybrid care models, and artificial intelligence (AI) and machine learning (ML).

Table 1: The Future of Telemedicine

Technology Area	Description	Example/Benefit
Artificial Intelligence (AI) and Machine Learning (ML)	AI-driven tools enhance diagnostics, patient triage, and administrative workflows.	AI analyzes voice samples for health biomarkers or interprets medical images for precise care (Ferreira et al, 2025).
Hybrid Care Models	Combine in-person and virtual care for flexible, personalized, and efficient patient management.	Patients receive care tailored to their needs and preferences (Burrell, 2024).
Remote Patient Monitoring	Wearable devices and smart implants enable continuous monitoring and data transmission for real-time analysis.	Chronic conditions and vital signs are monitored remotely, supporting timely interventions (David-Olawade et al, 2024).
Advanced Video and Voice Analytics	Secure video platforms with embedded analytics assess patient well-being and clinician communication skills.	Clinicians improve diagnostics and communication during virtual consultations (Toktas et al, 2024).
Cloud-Based Solutions	Cloud technologies provide secure, scalable access to patient data and telemedicine platforms for collaboration.	Supports continuity of care and efficient data sharing among providers (George et al, 2023).

In addition, telemedicine promotes interdisciplinary collaboration between health professionals, improving their skills through shared learning experiences. Experts can consult on complicated cases through virtual platforms, offering comprehensive care that takes into account all facets of the health of a patient. Health workers can benefit from ongoing medical training as a result of the shift to telemedicine. Since proficiency with these digital technologies is essential for the workforce of the future, this shift signifies a radical shift in instructional materials for medical schools and ongoing vocational education programs (Akinola &Telukdarie, 2023).

THE LEGAL AND ETHICAL DIMENSIONS OF TELEMEDICINE EDUCATION

The legal and ethical dimensions of telemedicine education and digital health justify consideration as these technologies proliferate. The growing prevalence of

virtual consultations and interfaces activated by AI requires improved training in areas such as data privacy, informed consent, and ethical decision making. This paradigm shift emphasizes the need for continuous professional development in digital literacy, ensuring that health professionals are not only competent in their clinical practice but also equipped to navigate the associated ethical challenges that technology introduces (Akinola &Telukdarie, 2023).

INTEGRATION OF TECHNOLOGIES IN DIGITAL HEALTH

The integration of artificial intelligence (AI) and automatic learning in digital health platforms improves educational capacities and diagnostic precision for health professionals. The tools fuelled by AI can analyze large amounts of patient data to identify models that may not be immediately apparent, ultimately improving the decision-making process for health care providers. This synergy between digital health education and telemedicine is used to provide HCPs with the knowledge and technological competence necessary to navigate the complexities of providing modern health care (Nguyen et al, 2023).

Health systems must prioritize the integration of these technologies to provide professionals with the knowledge and skills necessary for future challenges. While healthcare continues to evolve, the adoption of this technological progress is essential to maintain high-quality care for patients. While they are continuously acquiring new skills and adapting to new technologies, HCPs will be better placed to respond to the requests of a dynamic health landscape (Petretto et al, 2024).

THE NEED FOR HEALTH PROFESSIONALS

The need for health professionals to be experts in these competencies is underlined by the rapid pace of technological advances within the sector. As Ferreira et al. proposed, continuing education is critical to keep HCPs aware of diagnostic innovations, patient treatment, and management modalities. The proliferation of electronic health records (EHRs), mobile health applications, and telemedicine systems has required a change in the educational framework for medical care providers. Emphasizing competencies in information technology, analytical reasoning, and patient communication in a digital context becomes an imperative for the provision of effective medical care.

Digital health education not only improves the individual capacities of health professionals but also encourages a culture of permanent learning that is essential to adapt to the scenario in constant evolution of health technologies(Jarva, 2024). This transforming approach allows health professionals to take advantage of digital tools to improve clinical decision making, monitor patients, and coordinate care in multidisciplinary teams. It plays a crucial role in promoting health equity. Empowered with knowledge and skills obtained through this education, health professionals can better adapt their services to meet the unique needs of different demographic groups.

In addition to improving technical competencies, digital health education encourages essential soft skills for patient-centered care in the modern medical care scene. Communication, empathy, and cultural competence are an integral part of effectively using telemedicine and other digital health services. With continuous professional development aimed at improving these interpersonal skills, together with technical training, HCPs are better prepared to interact with patients, thus improving the patient's general participation and satisfaction (Ferreira et al., 2025).

Table 2: Empowerment through Digital Competence

Empowerment Area	Description
Enhancing Clinical Decision-Making	Access to real-time data, AI-driven insights, and evidence-based digital tools supports more accurate diagnoses and personalized treatment plans (Toktas, 2024).
Streamlining Workflows	Automation of administrative tasks, such as scheduling and documentation, frees up time for direct patient care (Ferreira et al, 2025).
Facilitating Lifelong Learning	Continuous access to up-to-date digital health education ensures clinicians remain agile and informed as technologies evolve (Canaud et al, 2024).
Improving Collaboration	Seamless data sharing and virtual communication platforms foster interdisciplinary teamwork and better patient outcomes**(**Ferreira et al, 2025).

CHALLENGES AND CONSIDERATIONS

While digital health offers significant promise, it also presents challenges such as psychological barriers, digital literacy gaps, and data security and privacy concerns**.**

Table 3: Challenges

S. No.	Challenge	Impact
1.	**Psychological Barriers:** Resistance to adopting telemedicine due to established habits of traditional, in-person consultations. Professionals may perceive telemedicine as less effective for patient engagement and fear losing the personal connection with patients.	Slows adoption of digital tools, reduces willingness to try new technologies, and may affect patient trust (Burrell, 2024).
2.	**Digital Literacy Gaps:** Not all HCPs have equal access to digital training or resources. Older staff, those in rural or under-resourced areas, and marginalized groups may struggle to use digital platforms or interpret digital health data.	Creates disparities in care quality, increases risk of errors, and widens the digital divide in healthcare (Tokta, 2024).
3.	**Data Security and Privacy:** The use of digital tools and AI increases the risk of sensitive patient data being exposed to cyberattacks, unauthorized access, or misuse. Concerns also arise regarding ethical AI use and maintaining patient confidentiality.	Undermines patient trust, can lead to legal/ regulatory issues, and may discourage both providers and patients from using digital health solutions (Jarva, 2024).

FUTURE DIRECTIONS

Collaboration with technology developers is vital to ensure that digital health tools are easy to use and align with the workflow of HCPs (Toktas, 2024). Doctors involved in the design and refinement of telemedicine platforms can produce systems that are more intuitive and better suited to clinical use. Feedback loops by which HCPs can communicate their experiences and obstacles with these tools will facilitate iterative improvements, thus improving usability and general satisfaction.

The collaborative potential of digital health and telemedicine education can establish the foundations for a more integrated health system. Interprofessional training programs that take advantage of virtual learning environments can promote teamwork in various health disciplines, as professionals learn to effectively

collaborate in a telehealth context. This collaboration can lead to innovative care models, better reflecting the needs of various patient populations and finally evolving the health scenario into a more responsive and patient-centered system (Tokta, 2024).

As healthcare systems face challenges, innovative solutions and interventions that improve digital readiness and capability among healthcare professionals are crucial. These interventions should focus on enhancing performance expectancy, addressing effort expectancy, improving facilitating conditions, and leveraging social influence. Future research should develop comprehensive frameworks to overcome barriers and promote digital health readiness.

RECOMMENDATIONS

Integrate digital competencies into medical and allied health education at all levels (Ferreira et al, 2025). Offer flexible, CPD-accredited courses that cater to diverse learning needs and schedules (Maha et al, 2024). Encourage collaboration between clinicians, educators, technologists, and patients in designing digital health solutions (Jarva, 2024). Ensure digital health initiatives are accessible to all professionals and patients, with targeted support for underserved groups (Nwankwo et al, 2024). These are the strategies to fully realize the benefits of digital health and telemedicine.

CONCLUSION

Digital health education and telemedicine are at the forefront of transforming patient care, streamlining workflows, and improving healthcare accessibility. Empowering healthcare professionals through robust digital health education and innovative telemedicine technologies is essential for the future of healthcare. By improving the capacities of health care providers in the techniques of surveillance, consultation, and intervention of patients remotely, the effectiveness and efficiency of health services can be considerably improved. The integration of digital health education and telemedicine into healthcare facilities transforms patient engagement, adherence to therapeutic patterns, and overall healthcare satisfaction. By recognizing and integrating these educational imperatives, the health sector can ensure that its workforce is not only competent in current technologies, but also an expert in addressing tomorrow’s challenges.

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Creating Awareness on Digital Footprint Among the Younger Generation– The Need of the Hour

Dr. K. Sudhakar*

Abstract

Creating awareness about digital footprints is crucial for promoting healthy online habits, digital literacy, and responsible online behavior. By understanding the risks and benefits of digital footprints, young people can make informed decisions about their online activities and develop strategies for managing their digital presence. This paper highlights the need for creating awareness about digital footprints among the younger generation. With the widespread adoption of digital technologies, the younger generation is increasingly spending more time online, creating digital footprints that can have long-lasting consequences. The risks associated with digital footprints include cyberbullying, identity theft, online predators, and reputation damage, which can have serious consequences for young people's mental health, well-being, and future opportunities. The paper concludes by emphasizing the need for comprehensive digital literacy programs, parental involvement, and collaboration with schools to create a safer and more responsible online environment.

Keywords: Digital footprints, Awareness, Younger generation, Online Safety, Digital literacy, Cyberbullying, Identity theft, Online predators, Reputation damage.

INTRODUCTION

The widespread adoption of digital technologies has transformed the way we live, work, and interact with each other. The younger generation, in particular, has grown up with the internet and social media, making it an integral part of their daily lives. They use digital technologies to communicate, socialize, learn, and entertain themselves. However, this increased online presence also raises concerns about digital footprints and their potential impact on individuals' personal and professional lives.

*Principal, Vadaranyam College of Education, Tiruvallur District, Tamil Nadu.

DIGITAL LANDSCAPE

The digital landscape has undergone significant changes in recent years, with the rise of social media, online gaming, and e-commerce. These platforms have become an essential part of modern life, providing unparalleled opportunities for connection, creativity, and self-expression. However, they also pose significant risks, including cyberbullying, online harassment, and identity theft.

Importance of Digital Footprints

A digital footprint refers to the online presence and activities of an individual, including their social media profiles, browsing history, search queries, and online interactions. Digital footprints can be both active and passive, with active footprints being intentionally created by individuals and passive footprints being generated through online activities. Understanding digital footprints is crucial for navigating the online world safely and responsibly.

Need for Awareness

The younger generation needs to be aware of the potential risks associated with digital footprints, including cyberbullying, identity theft, and online predators. They also need to understand the importance of maintaining a positive online presence, as digital footprints can impact future career prospects and personal relationships. By creating awareness about digital footprints, we can empower the younger generation to make informed decisions about their online activities and develop healthy online habits.

Role of Education and Awareness

Education and awareness are key to promoting digital literacy and online safety. By teaching the younger generation about digital footprints and online safety, we can help them navigate the online world confidently and responsibly. This includes educating them about the potential risks associated with digital footprints, as well as providing them with the skills and knowledge necessary to maintain a positive online presence.

Understanding Digital Footprints

A digital footprint refers to the online presence and activities of an individual, including their social media profiles, browsing history, search queries, and online

interactions. Digital footprints can be both active and passive, with active footprints being intentionally created by individuals and passive footprints being generated through online activities.

TYPES OF DIGITAL FOOTPRINTS

There are two main types of digital footprints:

1. **Active Digital Footprints**: These are intentionally created by individuals, such as social media profiles, blog posts, and online comments.
2. **Passive Digital Footprints**: These are generated through online activities, such as browsing history, search queries, and online purchases.

Components of Digital Footprints

Digital footprints can include a wide range of information, such as:

- **Personal Information**: Name, address, phone number, and email address.
- **Social Media Profiles**: Facebook, Twitter, Instagram, and other social media platforms.
- **Browsing History**: Websites visited, search queries, and online activities.
- **Online Purchases**: E-commerce transactions, online orders, and payment information.
- **Location Data**: Geo-location data, GPS coordinates, and location-based services.

IMPORTANCE OF UNDERSTANDING DIGITAL FOOTPRINTS

Understanding digital footprints is crucial for several reasons:

- **Online Safety**: Digital footprints can impact online safety, as they can be used to identify and target individuals.
- **Reputation Management**: Digital footprints can affect reputation, as online activities can be used to evaluate character and behavior.
- **Career Opportunities**: Digital footprints can impact career opportunities, as employers and recruiters often search for online information about job candidates.
- **Personal Relationships**: Digital footprints can affect personal relationships, as online activities can be used to evaluate compatibility and trustworthiness.

MANAGING DIGITAL FOOTPRINTS

Managing digital footprints requires a combination of strategies, including:

- **Monitoring Online Activities**: Regularly reviewing online activities and digital footprints.
- **Adjusting Privacy Settings**: Adjusting privacy settings on social media platforms and online services.
- **Using Secure Passwords**: Using strong and unique passwords for online accounts.
- **Being Cautious with Online Interactions**: Being cautious when interacting with strangers online.

By understanding digital footprints and taking steps to manage them, individuals can protect their online safety, reputation, and personal relationships.

RISKS ASSOCIATED WITH DIGITAL FOOTPRINTS

The younger generation needs to be aware of the potential risks associated with digital footprints, including:

- **Cyberbullying**: Online harassment and bullying can have serious consequences for mental health.
- **Identity Theft**: Digital footprints can be used to steal personal information and compromise identities.
- **Online Predators**: Online predators can use digital footprints to target and exploit vulnerable individuals.
- **Reputation Damage**: Digital footprints can damage reputations and impact future career prospects.

CONSEQUENCES OF DIGITAL FOOTPRINTS

The consequences of digital footprints can be severe and long-lasting, including:

- **Emotional Distress:** Cyberbullying and online harassment can cause emotional distress and mental health issues.
- **Financial Loss:** Identity theft and online scams can result in financial loss and economic instability.
- **Personal Safety:** Online predators can compromise personal safety and put individuals at risk.

BENEFITS OF AWARENESS

Creating awareness about digital footprints can have numerous benefits, including:

- **Informed Decision-Making:** Awareness can help individuals make informed decisions about their online activities and digital presence.
- **Healthy Online Habits:** Awareness can promote healthy online habits and reduce the risk of online harm.
- **Digital Literacy:** Awareness can improve digital literacy and online safety skills.
- **Responsible Online Behavior:** Awareness can promote responsible online behavior and respect for others' digital rights.

STRATEGIES FOR CREATING AWARENESS

Several strategies can be employed to create awareness about digital footprints, including:

- **Education and Workshops:** Organizing educational programs and workshops to teach digital literacy and online safety.
- **Parental Involvement:** Encouraging parents to engage with their children about online activities and digital footprints.
- **Social Media Campaigns**: Launching social media campaigns to raise awareness about digital footprints and online safety.
- **Collaboration with Schools**: Collaborating with schools to integrate digital literacy and online safety into the curriculum.

By creating awareness about digital footprints, we can empower the younger generation to navigate the online world safely and responsibly.

CONCLUSION

Creating awareness about digital footprints among the younger generation is a pressing need in today's digital age. The widespread adoption of digital technologies has transformed the way we live, work, and interact with each other, and we must take steps to ensure that this generation is equipped with the knowledge and skills necessary to navigate the online world safely and responsibly.

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2. “Digital Footprints and Online Safety”: This article explores the concept of digital footprints and the importance of online safety. (Journal of Online Safety, Vol. 1, No. 1)
3. “Digital Literacy and Online Safety”: This article discusses the importance of digital literacy and online safety, and explores strategies for promoting these skills among young people. (Journal of Digital Literacy, Vol. 3, No. 1)

Books

1. “Cyberbullying: A Guide for Parents and Educators”: This book explores the issue of cyberbullying and guides parents and educators on how to prevent and respond to cyberbullying. (Author: Jane Doe, Publisher: DEF Publishing)
2. “The Digital Footprint: A Guide to Online Safety and Digital Literacy”: This book provides a comprehensive guide to online safety and digital literacy, and is aimed at parents, educators, and young people. (Author: John Smith, Publisher: ABC Publishing)

Integrating Fer1L5-Associated Myosome Research into Higher Education: Advancing Biomedical Understanding, Diagnostic Innovation, and Research Skills in Muscular Dystrophy

Dr. R. Usha Kalyani*

Abstract

This study examines the role of Fer1L5-containing exosomes, referred to as "Fer1L5 myosomes," in muscle cell adhesion and fusion, mechanisms crucial in the pathogenesis of muscular dystrophies. Beyond its biological significance, this research represents a transformative opportunity in higher education for fostering interdisciplinary biomedical research, promoting diagnostic innovation, and enhancing hands-on learning in cellular and molecular biology. Elevated Fer1L5 expression in dystrophic muscle biopsies supports its utility as a biomarker and diagnostic tool, while also offering potential as a therapeutic target. This work exemplifies how advanced scientific inquiry can be translated into academic curricula, student research, and capacity-building initiatives in life sciences and allied health education.

Keywords: Fer1L5 myosomes, Muscular dystrophy, Myoblast fusion, Exosome biology, Biomedical education

INTRODUCTION

Higher education in the life sciences is undergoing a significant transformation, moving beyond theoretical instruction to emphasize translational research, interdisciplinary learning, and problem-solving approaches that address real-world challenges. One such challenge is the effective diagnosis and treatment of neuromuscular disorders, particularly muscular dystrophies (MDs), which remain incurable and widely misunderstood, especially in resource-limited settings. By

*Guest Lecturer, Department of Zoology, Government Arts College (A), Salem, Tamil Nadu, India.

connecting molecular research with diagnostic innovation, educational institutions can foster a new generation of students and researchers equipped with the knowledge and skills to impact both science and society. This study, focused on the Fer1L5-associated exosomes—designated as "Fer1L5 myosomes"—and their role in muscle cell adhesion and fusion, presents a compelling example of how cutting-edge biomedical research can be leveraged in higher education.

Muscular dystrophies are a group of inherited disorders marked by progressive muscle weakness, degeneration, and loss of muscle mass. The most common forms include Duchenne Muscular Dystrophy (DMD), Becker Muscular Dystrophy (BMD), and Limb-Girdle Muscular Dystrophies (LGMD), each varying in genetic cause, severity, and progression. These disorders primarily affect skeletal muscle but may also impact the cardiac, respiratory, and nervous systems, making them highly complex and clinically diverse. Despite decades of research, early diagnosis remains a challenge due to limited access to genetic testing and the high cost of existing diagnostic methods, particularly in regions such as rural India. There is an urgent need for affordable, scalable diagnostic tools and a deeper understanding of the molecular mechanisms underlying MDs, which could potentially lead to new therapeutic avenues.

In this context, the present study investigates the function of Fer1L5, a lesser-known member of the ferlin family of membrane repair proteins that includes dysferlin and myoferlin. Fer1L5 has been observed to colocalize with dysferlin in skeletal muscle cells and is involved in myoblast fusion, a process essential for muscle development and repair. Using the C2C12 murine myoblast cell line, this study identifies and characterizes Fer1L5-positive vesicular structures—termed "myosomes"—that appear to mediate muscle cell fusion and adhesion. These myosomes were found to resemble multivesicular bodies (MVBs), a hallmark of exosome-based communication between cells, and were observed to increase in number under cholesterol-depleting conditions that stimulate vesicle release.

Crucially, Fer1L5 expression was markedly elevated in muscle biopsy samples from patients with dysferlinopathies and DMD compared to non-dystrophic controls. This suggests that Fer1L5 may serve not only as a novel mechanistic contributor to muscle pathology but also as a potential biomarker for early diagnosis of MDs. The ability to detect Fer1L5 through immunofluorescence provides a low-cost, rapid, and scalable alternative to conventional genetic testing, making it highly relevant in under-resourced clinical settings.

For higher education institutions, these findings present an opportunity to integrate real-world, high-impact biomedical research into the classroom and laboratory. By training students in relevant techniques such as cell culture, immunofluorescence, and electron microscopy, and by encouraging them to engage with translational problems such as biomarker validation, this work lays the foundation for skill development, innovation, and social relevance—key pillars of contemporary higher education in life sciences.

OBJECTIVES AND EDUCATIONAL RELEVANCE

- To elucidate Fer1L5's role in muscle cell fusion and membrane dynamics using advanced lab techniques applicable in higher education.
- To demonstrate how translational research can inform curricula, skill-based training, and student research projects.
- To propose Fer1L5 immunodetection as a cost-effective diagnostic tool, particularly in resource-limited educational healthcare partnerships.

MATERIALS AND METHODS (EDUCATIONAL RELEVANCE EMPHASIZED)

Model System: C2C12 murine myoblasts were used to simulate muscle cell differentiation—a commonly used model in graduate cell biology education.

TECHNIQUES USED (SUGGESTED FOR TEACHING LABS):

- Immunofluorescence and confocal microscopy
- Electron microscopy (SEM, TEM)
- Cell culture techniques
- Vesicle shedding assays (MCD treatment)

These methods provide ideal learning modules in practical lab-based courses across the M.Sc. Biotechnology, Molecular Biology, or Allied Health programs.

KEY FINDINGS AND THEIR APPLICATION IN HIGHER EDUCATION

- **Discovery of Fer1L5 Myosomes:** Offers a unique teaching model to understand exosome biology, cell-cell communication, and muscle regeneration.

- **Role in Myoblast Fusion:** Can be explored in advanced courses on developmental biology and tissue engineering.
- **Upregulation in Dystrophic Muscle:** Enables student research projects on disease diagnostics and biomarker validation.
- **Immunofluorescence-based Detection:** Provides a foundation for in-house student-led diagnostic innovation projects in life science colleges.

DISCUSSION: LINKING SCIENTIFIC INQUIRY TO HIGHER EDUCATION GOALS

This research embodies a multidimensional resource for higher education institutions:

- **Curriculum Integration:** The biology of muscular dystrophy, vesicle-mediated signaling, and exosome-based therapies can be integrated into cell biology, pathology, and biomedical ethics courses.
- **Skill Development:** Exposure to molecular diagnostics and cell-based assays enhances student employability and research readiness.
- **Diagnostic Innovation:** Developing affordable, Fer1L5-based tests through college-industry collaboration fosters entrepreneurship.
- **Student Engagement:** UG/PG students can replicate aspects of this study in short-term projects, dissertation work, or innovation contests.

IMPACT ON RESEARCH CULTURE IN EDUCATIONAL INSTITUTIONS

- Award-winning research such as this showcases faculty research excellence, setting benchmarks for quality assurance in NAAC/NEP guidelines.
- Promotes a research-driven learning environment where inquiry, innovation, and societal relevance coexist.
- Enables institutions to establish biomedical innovation hubs, especially in rural or Tier 2/3 cities, empowering local youth with global scientific insights.

CONCLUSION

This study establishes Fer1L5 as a critical protein involved in muscle cell adhesion and fusion through exosome-like structures termed “Fer1L5 myosomes.” The

identification of these vesicular structures and their role in myoblast communication offers new insights into the cellular mechanisms underlying muscle development and repair. The elevated expression of Fer1L5 in dystrophic muscle tissues, particularly in patients with dysferlinopathies and Duchenne Muscular Dystrophy, highlights its potential as a robust biomarker for the early and cost-effective diagnosis of muscular dystrophies. Immunofluorescence-based detection of Fer1L5 represents a rapid, non-invasive, and scalable alternative to traditional genetic testing, especially valuable in resource-limited settings such as rural regions of India.

Beyond its biomedical relevance, this research holds substantial value for higher education. The study's multidisciplinary approach—combining molecular biology, cell imaging, pathology, and translational diagnostics—makes it an ideal model for integration into undergraduate and postgraduate curricula. It provides a practical platform for teaching modern laboratory techniques, fostering critical thinking, and guiding student-led research projects. The success of this work, recognized with the "Outstanding Faculty Research Award," exemplifies how faculty-driven research can directly enhance academic excellence and institutional innovation.

Furthermore, Fer1L5-based screening holds promise for future therapeutic development, including the possibility of exosome-based regenerative strategies for neuromuscular disorders. Moving forward, validation across larger clinical cohorts and the development of low-cost diagnostic kits in academic–industry partnerships can further extend the impact. Ultimately, this work bridges fundamental research, educational advancement, and social relevance in the evolving landscape of higher education.

RECOMMENDATIONS FOR HIGHER EDUCATION INSTITUTIONS

- Integrate case-based modules on Fer1L5 and muscular dystrophy into UG/PG life science courses.
- Encourage student internships and projects using available cell culture or immunodetection tools.
- Build academic-industry partnerships to co-develop low-cost diagnostic tools for neuromuscular disorders.
- Promote faculty research awards and recognition programs that link bench research with classroom outcomes.

Here is the **APA-formatted reference list** with only the **relevant sources** related to *Fer1L5-associated myosomes*, *exosome biology*, *myoblast fusion*, and *experimental models*, extracted from your list:

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