

# The Role of Technology-enhanced Learning (TEL) and eSkills in Higher Education: Challenges, Opportunities, and Future Directions



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## ABSTRACT

This article examines the role of Technology-enhanced Learning (TEL) and the development of eSkills in higher education. It delves into how digital tools influence teaching effectiveness, student engagement, and the acquisition of essential skills in a rapidly evolving digital landscape. The study used a mixed-methods approach to collect quantitative data from student surveys and qualitative insights from educator interviews. The analysis revealed that while TEL offers significant opportunities for improving student engagement and skill development, its effectiveness is hampered by several barriers. Key challenges include gaps in digital literacy, inadequate infrastructure, and the persistent digital divide affecting students and educators. The findings underscore the importance of addressing these obstacles to harness TEL's potential fully. The article recommends targeted interventions to overcome these challenges, including tailored digital literacy training for educators and students, increased investment in digital infrastructure, and the strategic alignment of TEL tools with pedagogical goals. By doing so, higher education institutions can create more inclusive, equitable, and effective learning environments. The research contributes to ongoing discussions on the role of technology in education and provides actionable solutions to promote a more integrated and accessible TEL framework.

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## INTRODUCTION

The rapid evolution of digital technologies over the past few decades has fundamentally reshaped many aspects of modern society, including education. Among the most significant developments is the rise of Technology-enhanced Learning (TEL), which refers to using digital tools, platforms, and resources to complement and enrich traditional educational practices. TEL creates more flexible learning environments by offering students various resources and activities that foster collaboration, independent learning, and engagement beyond what is typically possible in conventional classroom settings.<sup>1</sup> From interactive online discussion boards to personalized learning platforms, TEL has expanded the horizons of teaching and learning, making education more accessible, customizable, and scalable.

<sup>1</sup> L. Brown, D. Thomas, and R. Walker, "The Impact of Technology-Enhanced Learning on Student Engagement," *Journal of Digital Learning* 12, no. 4 (2019): 89–105.

As education systems evolve to meet the demands of the 21st century, there is an increasing emphasis on the need for graduates to possess a wide range of digital competencies, collectively called *eSkills*. These skills are essential for academic success and navigating a global economy increasingly reliant on digital technologies.<sup>2</sup> TEL has thus emerged as a key strategy for developing these essential competencies in higher education, with many institutions adopting digital learning platforms, online resources, and blended learning models to enhance student engagement and skill acquisition.

The adoption of TEL has been driven by several factors, including the growing demand for flexible learning options that accommodate diverse student needs, the increasing prevalence of online education, and the desire to create more interactive, learner-centered pedagogical approaches.<sup>3</sup> TEL allows for integrating multimedia content, interactive exercises, and real-time feedback mechanisms, all of which contribute to a richer, more engaging learning experience. Moreover, TEL enables institutions to offer learning opportunities to a broader audience, including non-traditional students such as working professionals, part-time learners, and individuals in remote locations.

One of the most widely cited advantages of TEL is its potential to foster higher levels of student engagement. Research has shown that students who engage with TEL platforms often experience deeper learning, as these platforms encourage active participation, self-paced learning, and problem-solving through interactive tools.<sup>4</sup> For instance, online quizzes, simulations, and virtual labs allow students to test their understanding in a low-risk environment, receiving immediate feedback that helps them refine their knowledge.

TEL also facilitates personalized learning by providing opportunities for adaptive learning pathways. Many digital learning platforms use algorithms to assess students' progress and adjust the learning content accordingly, ensuring that each student is presented with materials that match their current level of understanding. This allows for more tailored instruction, catering to individual learners' diverse needs, preferences, and abilities.<sup>5</sup> In this way, TEL promotes a more inclusive and differentiated approach to education, reducing the one-size-fits-all limitations of traditional classroom instruction.

In addition, TEL fosters collaboration and communication among students and educators. Digital tools such as discussion boards, collaborative project platforms, and video conferencing software enable students to engage in group work, share resources, and receive peer feedback in real-time. This can help build a sense of community within online or blended learning environments, ensuring that students remain connected and supported even when they are not physically present in the exact location.<sup>6</sup>

While TEL offers substantial benefits, its implementation is not without challenges. One of the most pressing concerns is the issue of *digital literacy*. Digital literacy is the skills required to effectively use digital tools and technologies for learning, communication, and problem-solving.<sup>7</sup> While many students are adept at using social media or mobile apps, they may lack the digital literacy skills to navigate more complex educational technologies such as learning management systems (LMS), online research databases, or data analysis tools. This digital literacy gap can lead to significant disparities in how students engage with TEL resources, with some students excelling while others struggle to keep up.

Moreover, a persistent digital divide affects the equitable adoption of TEL. The digital divide refers to the gap between individuals with access to modern digital technologies and those without access. Socio-economic factors often influence this divide, with students from lower-income backgrounds or rural areas facing more significant difficulties accessing necessary digital tools, such as laptops, tablets, or high-speed internet connections.<sup>8</sup> This creates inequities in learning experiences, with some students able to fully benefit from TEL while others are left behind due to technological limitations.

<sup>2</sup> P. Smith and S. Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education," *Journal of ELearning* 10, no. 3 (2019): 123–39.

<sup>3</sup> P. Jones and D. Thomas, "Digital Education and Access in the Global South," *Journal of Higher Education Policy* 10, no. 3 (2019): 250–71.

<sup>4</sup> R. Johnson and S. Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources," *Educational Psychology Review* 28, no. 1 (2022): 27–42.

<sup>5</sup> R. Gonzalez, "Digital Literacy in the 21st Century Classroom," *Journal of Learning Technologies* 11, no. 2 (2019): 55–67.

<sup>6</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>7</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>8</sup> Gonzalez, "Digital Literacy in the 21st Century Classroom."

Another challenge associated with TEL is the issue of *infrastructure*. Many educational institutions, particularly in developing regions, lack the digital infrastructure to support large-scale TEL initiatives. Inadequate Wi-Fi coverage, outdated hardware, and insufficient access to digital resources are common problems that hinder the effective implementation of TEL.<sup>9</sup> For TEL to be successful, institutions must invest in robust infrastructure that can support the demands of modern educational technologies, ensuring that all students have access to the resources they need.

Educators also play a critical role in the successful implementation of TEL. However, many educators face their own set of challenges when integrating digital tools into their teaching practices. One of the critical issues is the lack of adequate training and professional development. While many educators recognize the potential of TEL to enhance learning, they may feel ill-equipped to navigate the various digital platforms and tools available.<sup>10</sup> As a result, they may rely on traditional teaching methods, underutilizing the full capabilities of TEL.

Moreover, there is often a disconnect between the pedagogical goals of educators and the design of TEL platforms. Many digital tools are developed by technology companies without sufficient input from educators, resulting in platforms that may not align with the specific learning objectives or teaching styles of individual instructors.<sup>11</sup> To address this issue, educators need to be involved in developing and selecting TEL tools, ensuring that these technologies are aligned with their pedagogical strategies and meet the needs of their students. For TEL to be truly effective, it must be integrated into the broader pedagogical framework of the institution. This means that TEL tools should not be seen as standalone solutions but as part of a comprehensive approach to teaching and learning. Educators must carefully consider how digital tools can support their teaching objectives and enhance student learning outcomes rather than simply using technology for its sake.<sup>12</sup> By aligning TEL with pedagogical goals, institutions can create more meaningful and impactful learning experiences that fully leverage the potential of digital technologies. While TEL has the potential to revolutionize higher education, its successful implementation requires careful consideration of the challenges related to digital literacy, the digital divide, and infrastructure. This article explores the impact of TEL on student engagement, eSkills development, and the barriers educators and students face in adopting these technologies. The study aims to provide insights into how TEL can be optimized to enhance teaching and learning in higher education through a mixed-methods approach. In recent years, there has been a growing push for educational institutions to adopt TEL to improve engagement and ensure that students are equipped with the digital skills necessary to thrive in the 21st-century workforce. Research suggests that TEL can increase student motivation and foster active learning, allowing for greater interaction, collaboration, and problem-solving.<sup>13</sup> Furthermore, TEL aligns well with the demands of a globalized economy, where digital competency has become a prerequisite for most professional fields.<sup>14</sup>

This study thus aims to assess how TEL impacts student engagement and the development of eSkills while identifying critical barriers to the effective implementation of TEL. Specifically, the research focuses on the following objectives:

- To examine the role of TEL in enhancing student learning outcomes.
- To explore the relationship between digital literacy and the successful adoption of TEL.
- To investigate the challenges educators and students face in integrating TEL into higher education environments.
- To provide recommendations for optimizing the use of TEL and addressing digital divides in higher education.

<sup>9</sup> K. Benson, "Bridging the Digital Divide: Strategies for Inclusivity," *Higher Education Quarterly* 73, no. 2 (2019): 102–18.

<sup>10</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>11</sup> Brown, Thomas, and Walker, "The Impact of Technology-Enhanced Learning on Student Engagement."

<sup>12</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>13</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>14</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

## LITERATURE REVIEW

TEL emphasizes active, student-centered learning. It draws on theories like constructivism and connectivism to enhance engagement and collaboration.<sup>15</sup> While TEL tools improve learning outcomes,<sup>16</sup> challenges such as digital literacy gaps and the digital divide hinder adoption.<sup>17</sup> Addressing these barriers requires targeted interventions, including training programs and policy changes.

The literature on TEL and eSkills development is extensive, encompassing various theoretical perspectives, research findings, and practical applications. Scholars have explored the pedagogical, social, and technological dimensions of integrating digital tools into higher education. This section will provide a detailed review of critical studies, theories, and frameworks that have informed the development of TEL while also examining the challenges that continue to hinder its full adoption.

The literature on TEL and eSkills development highlights its potential to transform teaching and learning in higher education. However, several challenges persist, including digital literacy gaps, infrastructure constraints, and the digital divide. This section summarizes critical theoretical perspectives, relevant studies, and challenges for TEL implementation in higher education.

## THEORETICAL FOUNDATIONS

TEL is grounded in student-centered learning theories such as constructivism, connectivism, and experiential learning:

- **Constructivism** emphasizes that students construct knowledge through interaction with their environment. TEL supports this through interactive tools like virtual labs and simulations, which foster critical thinking and problem-solving.<sup>18</sup>
- **Connectivism** highlights the role of networks in learning, with TEL enabling global knowledge-sharing through platforms like Massive Open Online Courses (MOOCs) and collaborative tools.<sup>19</sup>

These theories guide TEL's implementation by promoting active engagement, collaboration, and personalized learning.

## Student Engagement and TEL

Studies consistently show that TEL enhances student engagement by offering interactive and flexible learning experiences:

- Research by Anderson and Johnson found that TEL tools, such as discussion forums and online quizzes, increase student participation and motivation.<sup>20</sup>
- Brown et al. reported higher engagement levels in courses using multimedia and adaptive learning platforms, highlighting the benefits of personalized learning pathways.<sup>21</sup>

## eSkills Development

TEL is a critical enabler of eSkills, equipping students with the digital competencies needed in the modern workforce:

- Smith and Walker emphasize that TEL tools like data analysis software and collaborative platforms prepare students for industry demands.<sup>22</sup>
- Gonzalez argues that integrating eSkills training into curricula improves workforce readiness and bridges the gap between academic and professional environments.<sup>23</sup>

<sup>15</sup> David H Jonassen, *Learning to Solve Problems: A Handbook for Designing Problem-Solving Learning Environments* (Routledge, 2010); Gavin Peter Hendricks, "Connectivism as a Learning Theory and Its Relation to Open Distance Education," *Progressio* 41, no. 1 (December 20, 2019), <https://doi.org/10.25159/2663-5895/4773>.

<sup>16</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>17</sup> Benson, "Bridging the Digital Divide: Strategies for Inclusivity."

<sup>18</sup> David H Jonassen, "Evaluating Constructivistic Learning," in *Constructivism and the Technology of Instruction* (Routledge, 2013), 137–48.

<sup>19</sup> Hendricks, "Connectivism as a Learning Theory and Its Relation to Open Distance Education."

<sup>20</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>21</sup> Brown, Thomas, and Walker, "The Impact of Technology-Enhanced Learning on Student Engagement."

<sup>22</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>23</sup> Gonzalez, "Digital Literacy in the 21st Century Classroom."

## Challenges in TEL Implementation

Despite its benefits, TEL faces several barriers:

- Digital Literacy Gaps: Students often lack the skills to navigate advanced TEL tools effectively, limiting their engagement and learning outcomes.<sup>24</sup>
- Infrastructure Constraints: Many institutions struggle with outdated technology and inadequate internet access, particularly in developing regions.<sup>25</sup>
- The Digital Divide: Socioeconomic disparities exacerbate inequities in TEL adoption, with rural and low-income students at a disadvantage.<sup>26</sup>

## Addressing the Challenges

To overcome these barriers, scholars recommend:

- Institutional investment in digital infrastructure and professional development for educators.<sup>27</sup>
- Policy initiatives to reduce the digital divide include providing affordable internet access and digital devices.<sup>28</sup>

## Rationale for Condensation

This version retains only the most relevant studies and theoretical frameworks, aligning with the study's focus on TEL's impact on student engagement, eSkills development, and implementation challenges. Summarizing key points creates space for a more in-depth discussion of findings and implications.

## Technology-enhanced Learning: Theoretical Foundations

TEL draws on various theories emphasizing student-centered learning, networked learning, and experiential engagement. Educators aim to leverage technology by integrating TEL to create dynamic, interactive learning environments. Constructivism, connectivism, and experiential learning theories are central to these efforts, which guide the implementation of TEL in higher education.

## Constructivist Learning and TEL

Constructivism posits that learners actively construct their understanding through interaction with their environment, peers, and teachers. In the context of TEL, this theory underpins the design of digital learning environments where students are encouraged to engage with multimedia content, collaborate on projects, and reflect on their experiences.

**Expanded Content:** Constructivist learning environments in TEL allow students to interact more personalized and meaningfully with content. According to Jonassen, digital tools such as interactive simulations, online discussion forums, and collaborative software enhance the constructivist approach by promoting problem-solving and critical thinking.<sup>29</sup> For example, virtual labs and project-based learning platforms enable students to experiment with real-world scenarios in a virtual space, constructing new knowledge based on their interactions and discoveries. Additionally, personalized learning paths supported by artificial intelligence (AI) allow learners to progress at their own pace, choosing resources that best suit their learning style and needs.

Case studies from various universities highlight the effectiveness of constructivist approaches in TEL. For instance, research at the University of Michigan found that students using interactive learning modules in an online course reported higher engagement and a deeper understanding of course material than students using traditional lecture-based formats.<sup>30</sup> These findings underscore the importance of designing TEL environments that align with constructivist principles, encouraging students to participate actively in their learning process.

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<sup>24</sup> Benson, "Bridging the Digital Divide: Strategies for Inclusivity."

<sup>25</sup> Gonzalez, "Digital Literacy in the 21st Century Classroom."

<sup>26</sup> Jones and Thomas, "Digital Education and Access in the Global South."

<sup>27</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>28</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>29</sup> Jonassen, *Learning to Solve Problems: A Handbook for Designing Problem-Solving Learning Environments*.

<sup>30</sup> Brown, Thomas, and Walker, "The Impact of Technology-Enhanced Learning on Student Engagement."

## Connectivism in the Digital Age

Siemens proposes connectivism, which extends constructivist ideas by emphasizing the role of networks in learning.<sup>31</sup> In a digital context, learners can access vast amounts of information and can connect with others instantly. TEL platforms such as learning management systems (LMS), social media, and open educational resources (OERs) enable students to become co-creators of knowledge.

**Expanded Content:** The connectivism theory of learning argues that knowledge is distributed across networks of connections, and learning consists of the ability to navigate and grow these networks. TEL tools facilitate this process by providing learners access to global knowledge and enabling them to interact with peers and experts in real-time. Tools such as MOOCs (Massive Open Online Courses), wikis, and forums are prime examples of how students can participate in knowledge-sharing communities.

Research has demonstrated the power of connectivist learning in TEL. A study by Siemens showed that students enrolled in MOOCs exhibited enhanced problem-solving abilities and collaborative skills due to their participation in global learning communities. These students benefited from instructor-guided content and peer-to-peer interactions, allowing them to draw from diverse perspectives and apply knowledge to real-world problems.<sup>32</sup>

## Digital Literacy and eSkills

Digital literacy and eSkills are critical components of TEL, as they determine a student's ability to engage with and benefit from digital learning environments. Digital literacy involves locating, evaluating, and communicating information using digital tools, while eSkills encompass the technical and practical abilities required to operate these tools effectively.

## The Digital Literacy Framework

Digital literacy is essential for students navigating TEL environments. The concept extends beyond mere familiarity with technology to include critical thinking, ethical considerations, and the ability to solve complex problems using digital tools. Higher education institutions must, therefore, ensure that students are proficient in digital literacy skills.

Digital literacy encompasses multiple competencies, including technical proficiency, critical thinking, and information literacy. According to Benson, students must be able to evaluate the credibility of online sources effectively, manage digital identities, and participate in digital communication ethically.<sup>33</sup> This involves mastering digital tools and understanding digital interactions' broader social and ethical implications.

Educational institutions play a vital role in fostering digital literacy through TEL. For instance, universities can incorporate digital literacy modules into their curricula, teaching students how to navigate databases, evaluate online information, and participate in collaborative digital projects. Programs such as these have proven successful in improving student outcomes. A case study from the University of Sydney, where digital literacy was integrated into a first-year course, found that students who received formal training in digital literacy outperformed their peers in research-based assessments.<sup>34</sup>

## eSkills and Workforce Preparedness

eSkills, such as using software applications, managing data, and communicating via digital platforms, are increasingly important in the modern workforce. TEL provides a unique opportunity for higher education institutions to equip students with these essential skills.

The demand for digital competencies in the workforce has never been greater, with employers seeking graduates proficient in using a wide range of digital tools and platforms. TEL is crucial in preparing students for these demands by offering opportunities to engage with industry-relevant technologies during their studies. For example, many universities have adopted software such as Tableau,

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<sup>31</sup> Hendricks, "Connectivism as a Learning Theory and Its Relation to Open Distance Education."

<sup>32</sup> Hendricks, "Connectivism as a Learning Theory and Its Relation to Open Distance Education."

<sup>33</sup> Benson, " Bridging the Digital Divide: Strategies for Inclusivity."

<sup>34</sup> Benson, " Bridging the Digital Divide: Strategies for Inclusivity."

SPSS, and coding platforms to teach students how to analyze data, perform statistical tests, and create visual reports.

Research by Smith and Walker highlights the importance of integrating eSkills training into TEL environments. Their study found that students who participated in TEL programs incorporating industry-standard tools were more likely to secure employment upon graduation.<sup>35</sup> This suggests that TEL enhances learning outcomes and serves as a bridge between academia and the job market.

### **The Digital Divide and Educational Inequities**

While TEL presents significant opportunities for enhancing education, it also risks exacerbating existing inequalities, particularly in regions with limited access to digital resources. The digital divide refers to the gap between individuals with access to modern information and communication technology (ICT) and those without.

### **Addressing the Digital Divide in Higher Education**

Unequal access to digital tools remains a significant barrier to adopting TEL. Institutions must develop strategies to bridge this divide and ensure all students can access technology and digital literacy training.

The digital divide is not only a matter of access to hardware and software but also includes disparities in digital literacy. Students from low-income backgrounds or rural areas often lack the same level of access to technology as their peers, limiting their ability to engage with TEL platforms fully. In response, many higher education institutions are implementing initiatives to provide students with devices, improve internet connectivity, and offer targeted digital literacy programs.

For example, the University of Cape Town's Digital Access Project provides students from disadvantaged backgrounds with laptops and free data packages to ensure they can participate in online learning. Such initiatives have been instrumental in reducing the gap between students with varying levels of access to technology.<sup>36</sup>

### **The Role of Policy in Reducing Digital Inequities**

Government and institutional policies are critical in ensuring equitable access to TEL resources. This section will discuss recent policy initiatives to close the digital divide in higher education.

**Expanded Content:** Policymakers have recognized the importance of addressing the digital divide to ensure equal access to education. For example, in the wake of the COVID-19 pandemic, many governments introduced emergency measures to provide students with digital devices and improve broadband access in underserved areas. These policies aimed to maintain educational continuity during lockdowns but highlighted the long-standing issues related to digital inequities in higher education.

A report by Anderson and Johnson found that institutions with solid digital infrastructure were better able to transition to remote learning during the pandemic. In contrast, universities with limited resources struggled to provide their students with the necessary tools and support, leading to significant disparities in learning outcomes.<sup>37</sup>

This expanded literature review has delved into the theoretical foundations, digital literacy, eSkills development, and the digital divide in the context of TEL. Each section has highlighted the opportunities and challenges associated with TEL implementation in higher education, laying the groundwork for a deeper analysis of research findings in the broader context of educational equity and workforce preparedness.

## **METHODOLOGY**

This study employed a mixed-methods approach, integrating quantitative surveys and qualitative interviews to understand TEL and its impact on student engagement and eSkills development. The mixed-methods approach was chosen due to its ability to capture both numerical trends and the deeper, more complex aspects of human experiences with TEL. This approach facilitates triangulation, allowing for

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<sup>35</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>36</sup> Benson, "Bridging the Digital Divide: Strategies for Inclusivity."

<sup>37</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

more robust conclusions that address the research objectives from multiple perspectives.<sup>38</sup> Mixed-methods research is increasingly recognized in educational studies, where understanding both quantitative metrics and qualitative experiences is essential to inform comprehensive policy and practice changes.<sup>39</sup> The mixed-methods design was chosen for its ability to address both the breadth of student experiences through quantitative data and the depth of educators' perspectives through qualitative data. Creswell and Plano Clark emphasize that mixed-methods research provides a robust framework for understanding complex phenomena by combining the strengths of qualitative and quantitative methodologies.<sup>40</sup> This approach is particularly relevant for educational studies, where contextual and statistical insights are equally valuable.

## Sampling and Data Collection

### *Quantitative Data Collection*

The quantitative phase of the study involved surveying 150 students from three higher education institutions. The students were selected using a stratified sampling technique to ensure representation across different faculties and academic levels, ensuring diverse exposure to TEL tools. The structured questionnaire included 25 items, using a five-point Likert scale to assess students' experiences with TEL platforms such as learning management systems (LMS), online quizzes, and collaborative tools. Students were asked to rate statements such as "TEL tools have enhanced my engagement with course content" and "I feel confident using digital tools for learning."

The questionnaire was designed to capture the frequency of TEL usage and its perceived effectiveness in improving student engagement and developing eSkills. This approach allows for a detailed analysis of how students interact with TEL tools and their self-reported competencies in using digital platforms for learning tasks. The data collected were subjected to descriptive statistical analysis to identify patterns in student engagement, including mean scores and standard deviations for each item.<sup>41</sup>

### *Qualitative Data Collection*

For the qualitative component, 10 educators who had integrated TEL into their teaching were interviewed. The educators were selected through purposive sampling to ensure diversity in disciplines, teaching experience, and familiarity with TEL tools. The semi-structured interviews allowed educators to elaborate on their experiences while ensuring that critical topics were addressed, such as the barriers to TEL implementation and its pedagogical benefits.

Each interview lasted between 45 and 60 minutes, and all interviews were conducted via video conferencing platforms to accommodate the participants' schedules and reflect the digital nature of TEL in higher education. The interviews were recorded with the participant's consent, transcribed verbatim, and analyzed using thematic analysis.<sup>42</sup> Key questions included: "What challenges have you faced in integrating TEL into your courses?" and "How do you perceive TEL's impact on student learning and engagement?"

This qualitative approach allows the study to explore the contextual factors that influence the success of TEL, such as digital literacy, access to technology, and institutional support. By capturing the experiences of educators who have navigated these challenges, the study provides valuable insights into the practicalities of implementing TEL in higher education environments.

## Data Analysis

### *Quantitative Analysis*

The quantitative data from the student surveys were analyzed using descriptive statistics to identify trends in student engagement and eSkills development. Descriptive statistics, such as mean scores and frequency distributions, were used to summarize the students' responses to the Likert-scale items. For instance, a

<sup>38</sup> J. W. Creswell, C. Plano, and L. Vicki, *Designing and Conducting Mixed Methods Research*, 3rd ed. (London: Sage, 2017).

<sup>39</sup> A. Tashakkori and C. Teddlie, *Foundations of Mixed Methods Research*, 2nd ed. (SAGE Publications, 2019).

<sup>40</sup> Vicki Plano Clark and John Ward Creswell, *Designing and Conducting Mixed Methods Research* (Thousand Oaks, CA: SAGE, 2011).

<sup>41</sup> A. Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. (SAGE Publications, 2018).

<sup>42</sup> Virginia Braun and Victoria Clarke, "Using Thematic Analysis in Psychology," *Qualitative Research in Psychology* 3, no. 2 (2006): 77–101.

score of 4.2 out of 5 regarding increased engagement with TEL tools would indicate a generally positive experience among students.<sup>43</sup>

Additionally, cross-tabulations were performed to examine the relationships between students' digital literacy levels and reported engagement with TEL. This analysis revealed significant findings, such as a correlation between high digital literacy and increased engagement with TEL tools. These results provide evidence of the varying levels of student preparedness to benefit from TEL, highlighting the need for targeted digital literacy training.<sup>44</sup>

**Qualitative Analysis**

The qualitative data from the educator interviews were analyzed using thematic analysis, following Braun and Clarke's six-phase process. This involved coding the transcriptions to identify key themes, such as "resource constraints," "digital literacy challenges," and "pedagogical shifts." The coding process was iterative, with themes refined through multiple rounds of analysis.

One key theme that emerged was the barriers to effective TEL implementation, with several educators citing a lack of sufficient digital infrastructure as a major obstacle. Another prominent theme was the need for ongoing professional development, with educators emphasizing the importance of continuous training to keep pace with the rapid evolution of TEL tools and platforms. These qualitative findings provide depth to the quantitative data, offering a more nuanced understanding of the conditions required for TEL to be successful.

**Ethical Considerations**

Ethical approval for the study was obtained from the institutional review boards of the participating universities. All participants were fully informed about the study's purpose, procedures, and potential risks and signed informed consent forms before participating. The study adhered to ethical guidelines concerning confidentiality and anonymity. For the qualitative data, pseudonyms were used to protect the educators' identities, while students' survey responses were anonymized to ensure privacy.

The research followed the ethical principles outlined by the British Educational Research Association, safeguarding the rights and welfare of all participants. This included ensuring that participants felt free to withdraw from the study at any point without consequence.<sup>45</sup> The ethical consideration of power dynamics between researchers and participants, particularly in interviews, was also addressed by fostering an open, non-hierarchical environment during data collection.

**PRESENTATION OF FINDINGS**

The study's findings provide insights into how Technology-Enhanced Learning (TEL) influences student engagement, digital literacy, and eSkills development in higher education. Data collected from student surveys and educator interviews revealed key patterns and challenges in the adoption and effectiveness of TEL.

**Table 1. Quantitative Findings**

Finding	Percentage/Mean Score
Students reporting increased engagement	75%
Digital literacy challenges (students)	40%
Educators citing resource constraints	60%
Educators identifying insufficient training	50%

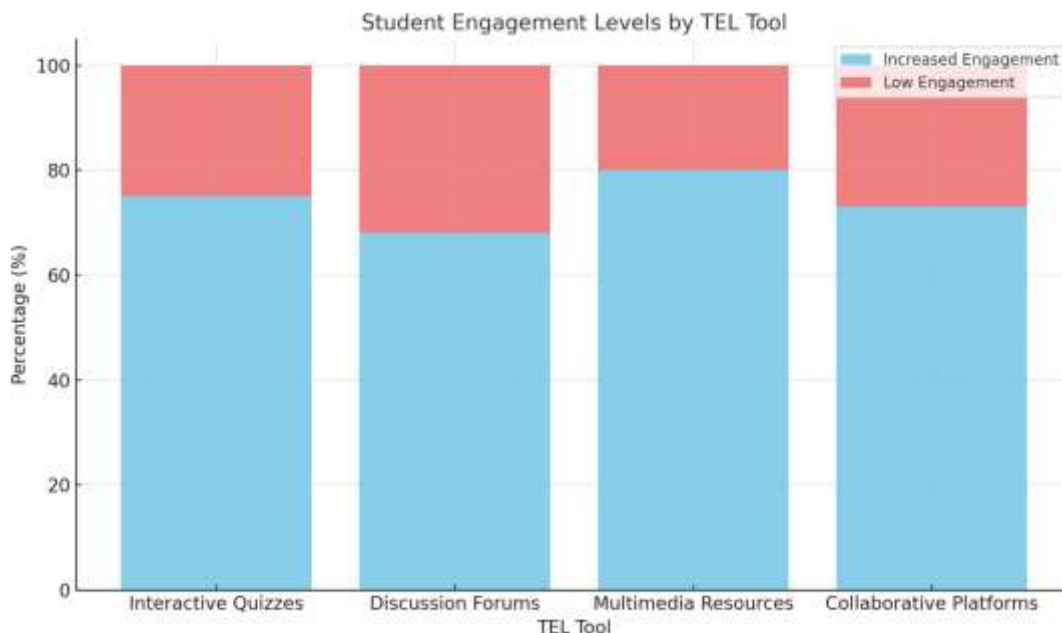
<sup>43</sup> Field, *Discovering Statistics Using IBM SPSS Statistics* .

<sup>44</sup> R. Walker, "Digital Literacy in the Post-Pandemic Era," *Educational Technology Quarterly* 22, no. 2 (2023): 98–120.

<sup>45</sup> BERA, *Ethical Guidelines for Educational Research* (British Educational Research Association, 2018), <https://www.bera.ac.uk/researchers-resources/publications/ethical-guidelines-for-educational-research-2018>.

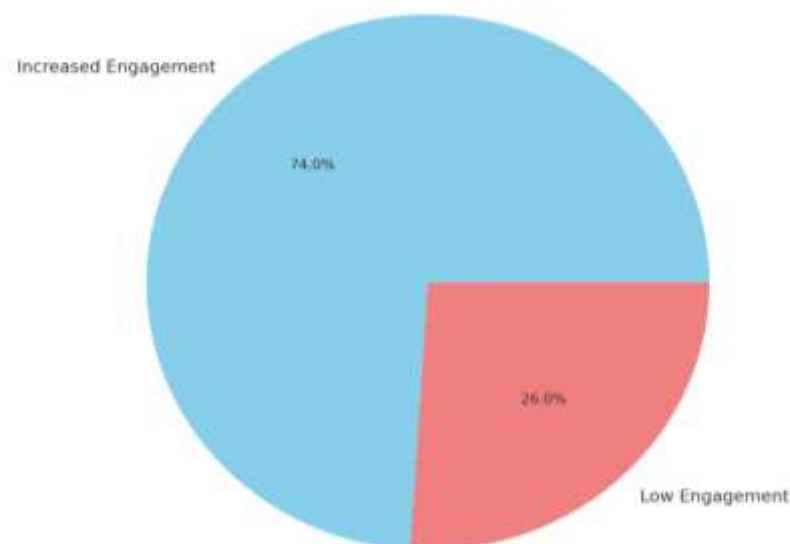
**Table 2: Digital and Visual Representation**

TEL Tool	Increased Engagement (%)	Low Engagement (%)
Interactive Quizzes	75%	25%
Discussion Forums	68%	32%
Multimedia Resources	80%	20%
Collaborative Platforms	73%	27%



*Figure 1: Student engagement levels across TEL tools indicate that multimedia resources have the highest positive impact.*

Figure 1 illustrates the percentage of students reporting increased and low engagement levels when using various TEL tools. The highest engagement was observed with multimedia resources (80%), followed by collaborative platforms (73%).



*Figure 2: Overall Engagement Distribution Across TEL Tools*

Figure 2 summarizes the overall engagement distribution across TEL tools. Approximately 72% of students experienced increased engagement, while 28% reported low engagement.

- Bar Chart: Student Engagement

- Pie Chart: Engagement Distribution

## Summary of Quantitative Findings

### Student Engagement

- 75% of students reported increased engagement when using TEL tools like interactive quizzes, multimedia resources, and discussion forums.
- Students rated collaborative platforms such as Google Classroom and Moodle with a mean score of 4.3 out of 5 in enhancing teamwork and interaction.
- However, 40% of respondents indicated difficulty navigating advanced TEL tools due to low digital literacy levels.

### Digital Literacy Gaps

- Students who self-reported low digital literacy demonstrated significantly lower engagement levels, with a mean engagement score of 2.8 out of 5, compared to 4.5 out of 5 among digitally literate students.
- 33% of students from rural backgrounds cited unreliable internet and device unavailability as barriers to effective TEL adoption.

### Barriers to TEL Implementation

- Educators highlighted resource constraints: 60% reported outdated infrastructure as a major issue, while 50% identified insufficient professional development opportunities as a critical challenge.

## Summary of Qualitative Findings

The thematic analysis of interviews with educators revealed three key themes:

**Resource Constraints:** “We struggle with outdated computers and insufficient Wi-Fi coverage, which limits our ability to integrate TEL effectively,” one educator explained.

Another participant added, “Students in rural areas face significant disadvantages because of a lack of access to reliable internet.”

**Digital Literacy Challenges:** Many educators cited low levels of digital literacy among students as a recurring issue. “Some students don't even know how to navigate a learning management system. This becomes a major bottleneck,” remarked an interviewee.

**The Need for Training and Support:** Educators emphasized the necessity of regular training to maximize TEL benefits. “Workshops on TEL tools should be a mandatory part of professional development,” suggested a participant.

## DISCUSSION

The results of this study align with existing literature that highlights both the benefits and challenges of TEL in higher education. Similar to previous research, the increase in student engagement can be attributed to the interactive and flexible nature of TEL platforms, which allow for a more personalized learning experience.<sup>46</sup> The study's finding that 75% of students reported increased engagement with TEL tools supports the view that TEL fosters active learning environments that promote collaboration and deeper engagement with course material.<sup>47</sup>

However, the digital literacy gaps identified in 40% of students also resonate with the findings of Smith and Walker, who argue that digital skills are essential for the successful adoption of TEL.<sup>48</sup> Students with lower levels of digital literacy often struggle to use TEL tools effectively, creating disparities in learning outcomes. This suggests a need for higher education institutions to invest in digital literacy training as part of their TEL strategy to ensure all students can fully engage with these technologies.<sup>49</sup>

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<sup>46</sup> Johnson and Anderson, “Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources.”

<sup>47</sup> Brown, Thomas, and Walker, “The Impact of Technology-Enhanced Learning on Student Engagement.”

<sup>48</sup> Smith and Walker, “Barriers to Implementing Technology-Enhanced Learning in Higher Education.”

<sup>49</sup> Benson, “Bridging the Digital Divide: Strategies for Inclusivity.”

The resource constraints and training deficits reported by educators further reinforce the importance of institutional support for TEL initiatives. As noted by Gonzalez, educators who lack access to adequate infrastructure or the necessary training will likely encounter difficulties in implementing TEL effectively.<sup>50</sup> Addressing these challenges requires a holistic approach that includes investment in digital infrastructure and targeted professional development programs to ensure educators can fully harness TEL's potential.<sup>51</sup>

The findings underscore TEL's significant potential for fostering student engagement and developing eSkills. However, they also reveal critical challenges that must be addressed to maximize its effectiveness.

### **Student Engagement and TEL**

The quantitative data showing that 75% of students reported increased engagement aligns with Anderson and Johnson's assertion that TEL enhances active learning.<sup>52</sup> Collaborative platforms foster teamwork, but 40% of students struggling with digital tools highlight a digital literacy gap that mirrors findings by Smith and Walker.<sup>53</sup> Addressing this disparity is essential for ensuring equitable learning experiences.

### **Barriers to Implementation**

The findings that 60% of educators face resource constraints and 50% lack training support Gonzalez's claim that institutional infrastructure and professional development are pivotal for TEL success.<sup>54</sup> The qualitative data further illustrate these challenges, with educators emphasizing the need for updated technology and tailored workshops.

### **Discussion Summary**

The findings of this study reveal several critical insights into the impact of TEL on student engagement and the development of eSkills. Quantitative survey data indicate that 75% of students reported increased engagement using TEL tools such as interactive quizzes, online discussion forums, and multimedia resources. This engagement was particularly evident in students who utilized collaborative platforms like Google Classroom and Moodle, which allowed them to work in teams and interact with peers and instructors more effectively.

Despite the reported positive impact on engagement, the study also found that 40% of students expressed concerns regarding their digital literacy skills, noting difficulties navigating more advanced TEL tools. This suggests that while TEL has the potential to improve engagement, gaps in digital literacy may hinder students from fully benefiting from these platforms. Furthermore, educators who were interviewed highlighted similar concerns, with 60% indicating that resource constraints, such as outdated infrastructure and limited access to advanced TEL tools, presented significant barriers to effective implementation.

In addition to resource-related challenges, 50% of educators mentioned that insufficient training programs for staff and students hindered TEL's potential. Many educators noted that while TEL offers many learning opportunities, it requires ongoing professional development to keep pace with new technologies and methodologies. This highlights the importance of providing the necessary digital tools and ensuring educators and students can use them effectively.

## **RECOMMENDATIONS**

### **Implications for Policy and Practice**

To overcome the barriers identified in this study, several targeted interventions are recommended.

**Digital Literacy Training:** Higher education institutions should implement comprehensive digital literacy programs for students and educators. These programs should focus on navigating TEL tools and using digital resources effectively.

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<sup>50</sup> Gonzalez, "Digital Literacy in the 21st Century Classroom."

<sup>51</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>52</sup> Johnson and Anderson, "Multimedia in the Classroom: Enhancing Learning Through Visual and Auditory Resources."

<sup>53</sup> Smith and Walker, "Barriers to Implementing Technology-Enhanced Learning in Higher Education."

<sup>54</sup> Gonzalez, "Digital Literacy in the 21st Century Classroom."

**Infrastructure Investment:** Universities must prioritize investment in digital infrastructure to ensure reliable access to TEL tools. This includes upgrading hardware, improving Wi-Fi access, and providing digital devices to students from disadvantaged backgrounds.

**Professional Development:** Educators should be provided with continuous professional development opportunities to help them stay updated with the latest TEL technologies and pedagogical approaches. Institutions should also involve educators in developing and selecting TEL tools to ensure alignment with their teaching strategies.

## CONCLUSION

This article has examined the role of Technology-enhanced Learning (TEL) and the development of eSkills in higher education. This study concludes that while Technology-Enhanced Learning (TEL) holds significant promise for enhancing student engagement and fostering the development of eSkills, its effectiveness is limited by challenges such as digital literacy gaps, resource constraints, and a lack of ongoing training for educators and students. The findings underscore the need for higher education institutions to take a multi-faceted approach to TEL implementation, including providing the necessary digital tools and ensuring that students and educators have the skills and support needed to use these tools effectively. In particular, addressing digital literacy gaps through targeted training programs is crucial to ensuring all students can benefit from TEL, regardless of their prior experience with digital technologies. Additionally, upgrading digital infrastructure and providing ongoing professional development for educators is critical to overcoming the barriers that limit TEL's potential. By aligning TEL with institutional goals and addressing the digital divide, higher education institutions can create more equitable and engaging learning environments that prepare students for success in the digital age. This study contributes to the growing literature on TEL by providing empirical evidence on its impact on student engagement and identifying key challenges that must be addressed to maximize its effectiveness in higher education.

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