

Technology Enhanced Learning and Academic Performance among Postgraduate Students: An Exploratory Study

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Abstract:

Technology Enhanced Learning (TEL) has become integral to higher education, offering postgraduate (PG) students flexible and accessible learning modalities. Despite its widespread adoption, limited research has focused on the role of TEL engagement in influencing academic performance among PG learners. This study examines the relationship between TEL engagement, which comprising emotional, cognitive and behavioural dimensions and self-reported academic performance in a sample of 300 postgraduate students of Management institutions in Telangana state.

Utilizing a cross-sectional survey design, participants completed the validated 7-item TEL engagement scale (TES) alongside demographic measures and reported their current average academic grade percentages. Descriptive analyses revealed moderate to high TEL engagement. These findings underscore that the quality of engagement with TEL and not merely usage frequency is a substantive contributor to academic achievement at the postgraduate level. The study advocates for higher educational institutions to design and implement TEL strategies that actively foster emotional interest, cognitive investment and behavioural participation to enhance PG learners' academic outcomes. Limitations include the reliance on self-reported grades and the study's cross-sectional nature, prompting calls for longitudinal and mixed-methods research to further elucidate TEL's impact.

Keywords: Technology Enhanced Learning (TEL), Academic Performance, Technology Engagement Scale (TES),

Introduction:

The increased adoption of Technology Enhanced Learning (TEL) in higher education offers students access to online lectures, digital resources, learning management systems and collaborative platforms. TEL is particularly valuable for postgraduate's students who may balance study with professional and personal responsibilities, requiring flexible and learner-centered solutions (Beetham & Sharpe, 2013; Kirkwood & Price, 2014). Technology Enhanced Learning (TEL) is transforming higher education by offering flexible and accessible learning environments. However, limited research has focused explicitly on postgraduate students and the impact of TEL engagement on their academic outcomes.

Despite the increasing use of TEL, most research focuses on undergraduate populations, with postgraduate students being understudied. Postgraduate learners often possess distinct motivations and learning approaches, possibly influencing how TEL impacts their academic success. Moreover, prior work has emphasized the difference between TEL usage (frequency

of accessing technology) and TEL engagement (quality of cognitive, emotional and behavioral involvement) with engagement more strongly associated with academic achievement (Xu et al., 2019). The present study narrows the focus to postgraduate students, investigating the extent to which TEL engagement predicts academic performance. Addressing the gap will inform tailored TEL interventions that optimize learning outcomes in postgraduate education.

The incorporation of digital technology has brought about a major transformation in the field of education. Nowadays, both teachers and students have equal access to new technologies, and educational institutions actively encourage students to embrace these advancements (Henderson et al., 2016). They equip learners with all necessary tools to access online learning materials and resources, enabling them to continue their academic and professional pursuits effectively. Education has become universally accessible, removing barriers and making learning available at the click of a button. This digital revolution has also changed the notion of home-schooling. Unlike the 20th century, when informal education relied on devices like tape players, record players, projectors, radios and TVs, modern education requires only a single device with an internet connection to proceed. Even traditional teaching tools such as blackboards and chalkboards are now being replaced by virtual boards.

Technology Enhanced Learning (TEL) is increasingly shaping postgraduate education, offering flexible digital resources and facilitating learner autonomy. However, a clearer understanding of how engagement with TEL relates to academic performance in postgraduate (PG) contexts remains needed. This full-scale study extends prior exploratory work by providing a detailed methodology, advanced data reporting, and visual summaries, focusing explicitly on the relationship between TEL engagement and academic outcomes.

Literature Review:

TEL encompasses diverse technologies and pedagogies, including virtual learning environments (VLEs), multimedia lecture capture, online discussion forums and student-created social media groups. TEL supports autonomous learning and the management of learning schedules, aspects critical to postgraduate success. Studies frequently equate TEL usage – measurable by time spent on platforms or frequency of access with engagement (Khalid, 2020). However, usage reflects only the behavioural component of engagement, omitting cognitive and emotional involvement. Research suggests that academic outcomes correlate more strongly with comprehensive engagement, which includes intellectual investment and positive emotional responses to learning. According to Dunn and Kennedy developed a TEL Engagement Scale (TES) capturing emotional, cognitive and behavioral domains (Dunn & Kennedy, 2019). Their findings with undergraduates reveal engagement as a significant predictor of grades, unlike usage-alone. Postgraduate students may utilize TEL differently due to self-directed learning tendencies, career-focused motivations, and varying technological proficiency. While intrinsic motivation fosters engagement and academic achievement, the relationship between TEL engagement and postgraduate academic outcomes

Recent scholarship highlights that engagement encompassing emotional, cognitive and behavioural dimensions rather than mere usage, is key to realizing the academic benefits of TEL. While undergraduates have been studied extensively, PG students may display different

motivations, TEL use patterns and learning strategies. Thus focused investigation into this cohort is essential (Tahat et al., 2023).

Research Questions and Hypotheses:

The literature review underscores the transformative impact of Technology-Enhanced Learning (TEL) in higher education, particularly highlighting the shift towards digital platforms that facilitate greater access, flexibility and enriched learning experiences. Building on this foundation, the current study investigates the research question “Does the level of engagement with TEL predict academic performance among postgraduate students?” this enquiry is bounded in the understanding that active and a sustained interaction with TEL tools – such as online learning materials, virtual classrooms, interactive platforms and collaborative technologies, which can significantly influence students’ learning outcomes.

This study tests the hypothesis Higher Levels of TEL engagement predict better academic performance among postgraduate students. The hypothesis theorized by this study is that higher levels of TEL engagement will predict better academic performance among postgraduate students. This is supported by previous findings where increased accessibility to digital resources, ease of use and perceived usefulness of TEL environments contribute to enhanced motivation, knowledge acquisition and academic success (Khalid, 2020). Furthermore, the study recognizes that TEL engagement is not merely about frequency of use but includes the quality of interaction, such as participation in discussions timely submission of assignments, and the ability to leverage technology for deeper understanding. By testing the hypothesis, the study aims to provide empirical evidence that encourages educational institutions to further invest in TEL infrastructure, training and support systems to boost postgraduate students’ academic achievements. Moreover understanding this relationship helps in designing targeted interventions that foster meaningful engagement with digital learning tools, ultimately promoting academic excellence and lifelong learning in an increasingly digital academic environment.

Methodology:

Research Design:

This study investigates the extent to which engagement with Technology-Enhanced Learning (TEL) predicts academic performance among postgraduate students, aiming to deepen understanding of how different dimensions of TEL involvement influence educational outcomes. The research draws on data from a sample of 300 postgraduate students enrolled in various management courses, ensuring a diverse representation of learners actively engaged in higher education. To comprehensively capture student interaction with TEL, the study engaged through three distinct but interconnected dimensions: emotional engagement (students’ feelings toward TEL, such as interest and enthusiasm), cognitive engagement (the level of mental investment and strategy use when interacting with TEL resources), and behavioral engagement (actual participation in TEL activities, such as accessing digital content and contributing to online discussion).

Academic performance was assessed through students’ self-reported measures, reflecting their perceived success and achievement in their academic coursework. The study employed a cross-sectional survey design, collecting data at a single point in time to identify the correlational relationships between TEL engagement and academic outcomes. This approach

allowed for the examination of how variations in emotional, cognitive and behavioral engagement with TEL corresponded with variations in students' academic performance within the context of management education.

Using correlational analysis techniques, the study aimed to determine the strength and direction of the relationship between the extent of TEL engagement and academic success. The findings contribute to the broader discourse on the role of digital technologies in postgraduate learning by highlighting the importance of not only providing access to technology but also fostering meaningful engagement across multiple dimensions. These insights can inform educators, curriculum designers, and policymakers seeking to enhance the effectiveness of TEL interventions and support postgraduate students in achieving better academic results.

Participants:

The sample comprised 300 postgraduate students enrolled across management courses. The mean age was 23.5 years and standard deviation is 4.2, with 60% female and 40% male participants. Convenience sampling technique used to collect data via institutional mails and learning platforms. All were undertaking either taught or research master's programs.

The study sample consisted of 300 postgraduate students enrolled in various management courses, representing a diverse and robust cohort for examining the relationship between Technology-Enhanced Learning (TEL) engagement and academic performance. The participant group had a mean age of 23.5 years with a standard deviation of 4.2, indicating a relatively young and moderately varied age range typical of postgraduate students. Gender representation in the sample was 60% female and 40% male reflecting a balanced demographic composition that allows for potential gender-based analyses within the study.

To collect data, the study employed a convenience sampling technique, which facilitated efficient access to participants through institutional email communications and digital learning platforms commonly used within the university environment. This approach was practical and suitable for reaching a large number of students currently engaged in academic activities, especially amid increasing reliance on online communication channels.

Participants included students enrolled in either taught master's programs or research-based master's degrees, providing a comprehensive overview of postgraduate education modes within management disciplines (Almufarreh, 2023). This inclusion criterion ensured that the study captures a broad spectrum of TEL engagement across different academic pathways, from coursework and seminars to independent research activities. Overall, the sampling and data collection methods ensured the representation of a relevant postgraduate population actively involved in technology-mediated learning environments, thereby supporting the study's objective to access how TEL engagement influences academic achievement (Aguti et al., 2017).

Measures:

The Technology Engagement Scale (TES), adapted from Dunn and Kennedy (2019), was utilized in this study to comprehensively measure postgraduate students' engagement with Technology-Enhanced Learning (TEL). The TES is designed to capture three critical facets

of engagement that together provide a holistic understanding of how students interact with digital learning environments.

Adopted from Dunn and Kennedy (2019), the TES measures three facets of engagement:

- Emotional Engagement: Interest and positive feelings toward TEL content
- Cognitive Engagement: Intellectual effort and Perceived learning gains from TEL
- Behavioural Engagement: Actions like reviewing resources and active TEL participation

Firstly, Emotional Engagement refers to the students' affective responses toward TEL content, encompassing their level of interest, enthusiasm and positive feelings when interacting with online learning materials and platforms. This dimension highlights the importance of learners' motivation and emotional connection to TEL, which can significantly impact their willingness to participate and persist in technology-based learning activities.

Secondly, Cognitive Engagement measures the intellectual efforts that students invest in the learning process facilitated by TEL, it reflects how deeply students think about, process and make sense of the information they encounter through digital resources. This facet also includes the students' perceptions of learning gains attributed to TEL, capturing whether they feel that engaging with technology has enhanced their understanding and mastery of course content.

Thirdly, behavioral engagement assesses the observable actions that students take in relation to Tel, such as regularly reviewing online resources, actively participating in virtual discussions, completing digital assignments and utilizing TEL platforms effectively. This dimension emphasizes the actual usage patterns and proactive behaviours that contribute to meaningful learning experiences.

The TES used in this study consists of 7-items, each rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This scaling allows respondents to express varying degrees of agreement with statements related to each engagement facet, facilitating nuanced measurement of their TEL involvement. The internal consistency reliability of the scale, as indicated by Cronbach's alpha, was 0.77, demonstrating acceptable reliability (Tavakol & Dennick, 2011). This means the TES items are sufficiently correlated to be considered a cohesive measure, ensuring that the tool reliability captures the structure of multidimensional construct of TEL engagement among the postgraduate participants. Overall the TES provides a valid and reliable instrument for assessing how postgraduate students emotionally, cognitively and behaviorally engage with technology in their learning processes (Daramola et al., 2024).

Academic Performance:

Participants in this study reported their current average academic grade as a percentage, utilizing a self-report method consistent with approaches validated in previous educational research. Self-reported academic performance is widely used in studies due to its practicality and demonstrated reliability, with numerous investigations showing strong correlations between self-reported grades and official academic records (Henderson et al., 2016). While some degree of over-reporting or bias can occur, the overall accuracy tends to be sufficiently high for research purposes, particularly when large and diverse student samples are involved. This method allows for efficient data collection regarding academic outcomes without requiring access to institutional records, and has been shown to predict academic success

reliably across various disciplines and educational levels. Incorporating self-reported performance data thus provides a valid and feasible measure to assess how factors such as engagement with Technology-Enhanced Learning relate to students' academic performance (Inamorato dos Santos et al., 2023).

Procedure:

Participants were invited to take part in the study through official university email communications, ensuring that the recruitment process targeted enrolled postgraduate students within the institution. Upon receiving the invitation, participants accessed an anonymous online survey designed to protect their privacy and encourage honest responses. The survey began with an informed consent section, where students' were provided with clear information about the study's purpose, procedures, confidentiality assurances and their rights as participants, including the voluntary nature of participation. Following consent, respondents completed demographic questions capturing key background information such as age, gender, program of study and enrolled status, which allowed for detailed participant characterization and context for data analysis.

The core of the survey included the Technology Engagement Scale (TES), measuring emotional, cognitive and behavioural engagement with Technology-Enhanced Learning (TEL), alongside self-reported academic grade items that gauged students' perceived current academic performance. The online format facilitated convenient access and enabled data collection from a geographically diverse group of students without logistical constraints, increasing participation rates and data quality.

Data collection was conducted over a three-month period within the academic term, allowing sufficient time to reach a substantial number of postgraduate students' and accommodate their varying schedules. The timing ensured that participants had meaningful recent experience with TEL, improving the relevance and accuracy of their responses regarding engagement and academic outcomes. This systematic and ethically sound data collection process underpinned the study's objective to explore the relationship between TEL engagement and academic performance in a rigorous and participant friendly manner. Participants were invited to participate in the study via official university email communications, targeting postgraduate students across management courses. Upon receiving the invitation, students accessed an anonymous online survey designed to ensure confidentiality and encourage truthful responses. The survey began with an informed consent section, where participants were informed about the study's objectives, their rights, and the voluntary nature of participation. Following consent, students provided demographic information such as age, gender, and program details to contextualize the findings. The survey included the Technology Engagement Scale (TES) to measure emotional, cognitive, and behavioral engagement with TEL, along with items for self-reporting their current academic grades as percentages. Data collection was carried out over a three-month period during the academic term, ensuring ample time to gather a representative sample and reflection of students' recent experiences with TEL. The online approach facilitated convenience and accessibility, increasing response rates while protecting participant anonymity. This procedure supported the study's goal to explore the predictive relationship between TEL engagement and academic performance in postgraduate management education comprehensively and ethically.

Data Analysis:

Using SPSS v26, descriptive statistics assessed TEL engagement and academic grades. Pearson correlation examined associations between TEL engagement and grade. A linear regression model tested the predictive power of TEL engagement on academic performance, controlling for age and gender.

Results:**Descriptive Statistics:**

Variable		Mean	SD	Range
TEL Engagement Scale		3.85	0.68	1-5
Academic Performance (%)		72.4	8.5	55-90
Gender	Male	24.1	4.5	----
	Female	23.2	3.9	
Age		23.6	4.2	----

The above table provides descriptive statistics for key variables in the study involving postgraduate students. The TEL Engagement Scale has a mean score of 3.85 with a standard deviation (SD) of 0.68, on a scale ranging from 1 to 5. This indicates that, on average, students reported moderately high engagement with technology-enhanced learning, with some variation around this average. Academic Performance is reported as a percentage, with a mean score of 72.4% and an SD of 8.5, spanning a range from 55% to 90%. This suggests that the average academic performance was in the low to mid-70s, with a reasonably wide spread of grades among students.

For Gender, the table reports the mean age separately by group. Male students have a mean age of 24.1 years (SD = 4.5), while female students have a mean age of 23.2 years (SD = 3.9). The range is not specified here, but the ages suggest a typical postgraduate population. The overall Age of the sample has a mean of 23.6 years with an SD of 4.2, summarizing the age profile of all participants regardless of gender.

Relationship between TEL engagement and Academic Performance

TEL engagement correlated positively with academic grades ($r = 0.45$, $p < 0.001$), suggesting students more engaged with TEL tend to achieve higher academic scores.

Predictive model:

Linear regression analysis showed that TEL engagement significantly predicted academic performance ($\beta = 0.42$, $p < 0.001$), explaining 18% of the variance after controlling for age and gender.

Linear Regression predicting Academic Performance

Predictor	β	SE	t	p
TEL Engagement	0.42	0.05	8.40	< 0.001
Age	0.06	0.03	1.8	0.07
Gender (M/F)	0.03	0.04	0.75	0.45

Model R^2 : 0.18

The above table presents the results of a regression analysis predicting academic performance from several variables: TEL Engagement, Age, and Gender. TEL Engagement has a standardized beta coefficient (β) of 0.42, indicating a strong positive relationship with

academic performance. This means that higher engagement with Technology-Enhanced Learning is associated with better academic outcomes. The standard error (SE) is 0.05, and the t-value is 8.40, which is highly significant with a p-value less than 0.001. This shows that TEL engagement is a statistically significant predictor of academic performance.

Age has a smaller positive beta coefficient of 0.06, with an SE of 0.03 and a t-value of 1.8. The p-value of 0.07 indicates that age is not a statistically significant predictor at the usual 0.05 threshold, though it trends toward a weak positive association with academic performance.

Gender (Male/Female) shows a very small beta of 0.03, SE of 0.04, and a t-value of 0.75, with a p-value of 0.45. This indicates no significant effect of gender on academic performance in this model.

In summary, the regression results demonstrate that among the variables tested, only TEL engagement significantly predicts academic success in postgraduate students, while age and gender do not show significant predictive power.

Relationship between TEL Engagement and Academic Performance

TEL Engagement	Academic Performance Mean (%)	SD
1-2	64.2	7.2
2-3	69.1	7.5
3-4	73.8	8.1
4-5	77.9	7.4

*Linear Trend observed: higher TEL Engagement aligns with higher self-reported grade.

The above table illustrates the relationship between levels of Technology-Enhanced Learning (TEL) engagement and corresponding academic performance among postgraduate students, expressed as mean academic grades in percentages with their standard deviations (SD). For students with TEL engagement scores between 1 and 2, the average academic performance is 64.2%, with a standard deviation of 7.2, indicating moderate variability in grades within this group. Those with TEL engagement scores between 2 and 3 show an increased mean academic performance of 69.1%, with an SD of 7.5, suggesting a positive trend where greater engagement corresponds with higher grades.

Students scoring between 3 and 4 on TEL engagement have a further improved mean academic grade of 73.8%, alongside a slightly higher SD of 8.1, indicating continued academic gains with increased engagement. Finally, participants with the highest TEL engagement scores between 4 and 5 achieve the highest average academic performance of 77.9%, with a standard deviation of 7.4, demonstrating that the highest level of TEL involvement aligns with the best academic outcomes. Overall, the table shows a clear positive association between greater TEL engagement and higher academic performance, suggesting that increased involvement with technology-enhanced learning correlates with improved grades among postgraduate students.

Reliability Statistics:

The table titled TEL Engagement Cronbach's α is 0.77, which indicates the internal consistency reliability of the scale measuring Technology- Enhanced Learning (TEL)

engagement in the study. Cronbach's alpha (α) is a statistic used to assess how closely related a set of items are as a group, which reflects the scale's reliability. A value of 0.77 suggests acceptable reliability, meaning the items in the TEL engagement scale consistently measure the same underlying construct. Generally, α values above 0.70 are considered acceptable for social science research, indicating that the scale items have a good degree of correlation and the measure is sufficiently reliable for research purposes. However, it is not excellent or very high, so while reliable, there may be room for improvement in scale consistency (Tavakol & Dennick, 2011).

Scale	Cronbach's α
TEL Engagement	0.77

The Cronbach's α value of 0.77 for the TEL engagement scale means measurement tool is reasonably reliable and provides consistent results across the included items, supporting the trustworthiness of data collected with this scale.

Discussion

This study provides empirical evidence that higher engagement with Technology Enhanced Learning predicts superior academic performance in postgraduate students. These findings align with broader educational engagement literature, emphasizing that emotional and cognitive involvement in TEL is crucial beyond mere usage metrics (Fredericks et. al., 2004; Dunn & Kennedy, 2019). The results further suggest the need for postgraduate TEL resources and pedagogical designs that actively foster meaningful emotional and cognitive engagement. Educational institutions should encourage not only access to digital learning materials but also strategies promoting intrinsic interest and intellectual challenge through TEL environments.

Limitations of this study include reliance on self-reported academic grades, which may introduce bias, cross-sectional design, which restricts causal conclusions, and also convenience sample may not reflect all PG populations (Elumalai et al., 2019). Future research should incorporate objective performance data and longitudinal approaches to track TEL engagement and academic outcomes overtime. Qualitative studies could also explore postgraduate students' specific experiences and strategies with TEL. This study highlights the importance of fostering meaningful engagement with TEL to improve postgraduate learning outcomes and provides recommendations for educators and institutions aiming to optimize TEL strategies.

Conclusion:

The Present Study highlights that the quality of postgraduate students' engagement with Technology Enhanced Learning significantly influences their academic success. As universities continue to integrate TEL in postgraduate curriculum, it is imperative to prioritize strategies that promote emotional and cognitive engagement alongside behavioral participation. Doing so many maximize the transformative potential of TEL in enhancing postgraduate learning and achievement (Chowdhry et al., 2014). Active engagement with TEL encompassing emotional, cognitive and behavioural components, which significantly benefits academic performance in post graduate education, institutions should prioritize strategies that foster such engagement, moving beyond access provision to enhance learning quality.

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