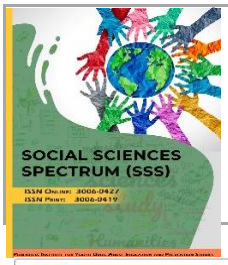

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Mediating Role of Technology (Use Your Own Device) Enhanced Learning on Collaborative Learning and Self-approbation on University Level: A Case Study From Developing Country

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Abstract

The growing integration of digital technologies in higher education has raised important questions about how Bring-Your-Own-Device (BYOD) practices affect both academic and psychological outcomes. This study investigates the differential impact of device use — operationalized as educational use (UYOD-E), use of targeted applications (UYOD-T), and study habits (UYOD-SH) — on collaborative learning (CL) and self-approbation (SA) among university students in a developing country. Using a quantitative, cross-sectional design, data were collected from 366 students at public universities and analyzed through correlation and multiple regression. Results show a clear asymmetry in effects. Study habits and educational device use were the strongest positive predictors of both CL and SA. In contrast, use of specific applications had a significant negative association, suggesting that unstructured digital use may harm learning processes and self-image. General device usage had a comparatively weak effect, indicating that access alone does not guarantee meaningful outcomes. Together, the models explained approximately 48% of the variance in CL and SA, highlighting the central role of behavioral factors in technology-mediated learning. This study contributes to the literature by showing that benefits of digital technologies depend on self-regulated and purposeful use rather than on availability or frequency.

Keywords: E-learning, BYOD, Collaborative Learning, Self-Approbation, Study Habits, Higher Education.

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Introduction

The fast development of digital technologies has drastically changed the environment of higher education on the global level. Integration of e-learning tools, mobile devices, and the targeted applications have facilitated the flexible and student-centered learning environments that are not limited to the conventional classroom setting. In this regard, the phenomenon of the so-called Use Your Own Device (UYOD), also known as Bring Your Own Device (BYOD) has become an increasingly popular cost-efficient and accessible solution to technology-enhanced learning (Siddique, Parveen & Dahar, 2026). Personal digital devices have gained increased acceptance even in educational settings in developing countries, like Pakistan, over the last few years, particularly in state-owned universities where the technological infrastructure may be relatively insufficient (Mhlongo et al., 2023). The use of smartphones, laptops, and internet based applications are increasingly being utilized by students to access learning materials, interact with peers, and perform academic activities. Although this change has also brought new opportunities on how to promote meaningful academic engagement and psychological development, the change also raises some important questions. The current literature focusses the constructive role that digital tools play in promoting group learning, enhancing access to knowledge, and promoting student autonomy. Nevertheless, the previous research literature has mostly centered on technological adoption and academic performance, without much attention to the behavioral and psychological aspects of e-learning, especially in the case of developing economies (Madni et al., 2022). Besides, the differentiated effect of the different elements of e-learning including the use of a device, specific applications and study habits have not been explored sufficiently.

The fact is that another critical gap in the literature is the connection between e-learning practices and self-approbation, a construct related to self-perception, confidence and academic self-worth among students. Although the concept of collaborative learning has been massively researched, the psychological implications of digital learning environments have not been adequately explored, particularly in South Asian settings. To fill these gaps, the current study examines how the use of e-learning devices and targeted use affects collaborative learning and self-approbation among university students in Punjab, Pakistan. In particular, the research paper focuses on the academic collaboration and psychological well-being as the dimensions of e-learning to act on with the help of empirical data and sophisticated statistical analysis. This research has three important contributions to the current literature. First, it incorporates academic and psychological results into one analytical model that offers a more profound appreciation of e-learning effectiveness. Second, it provides empirical evidence in a developing country context since, in this context, the dynamics of digital learning are quite different than in developed countries. Third, it determines the role of study habits as a vital mediating behavioral factor in determining the collaborative as well as psychological outcomes.

Literature Review

Digital technologies in higher education have reshaped the traditional pedagogical processes into more adaptable and student-centered learning processes. The so-called Use Your Own Device (UYOD) or Bring Your Own Device (BYOD), is one of the cost-effective and scalable solutions in the field of improving access to digital learning resources. Suggestions based on research by Siddique, Parveen & Dahar reveal that UYOD practices can allow students to access course material anytime and anywhere, which contributes to autonomy and personalized learning experiences in (2026). Nevertheless, the success of UYOD is controversial. Though some researchers believe that personal devices make the process more engaging and more accessible,

other researchers note that the following are the troubles that personal devices create: distraction, unequal access to high-quality devices, and inconsistent digital literacy among students (Arhimah, Thompson & Cudjoe Mensah, 2025). This difference implies that the simple presence of devices is not the key factor that can lead to better learning outcomes; instead, it is the way these devices are utilized that matters (Alkureishi et al., 2021). In addition, a lot of the recent literature has been devoted to technological adoption instead of exploring the behavioral patterns that are related to the use of devices. Consequently, no empirical knowledge exists on how various dimensions of UYOD like frequency of use, purpose of use and integration with learning strategies influence the educational outcomes, especially in the context of developing countries (Keino & Eksail, 2023).

Educational applications, online platforms, and collaborative tools are targeted learning applications that are increasingly being used to support academic activities (Rafiq, Iqbal & Afzal, 2024). These applications are made to be efficient in learning through the provision of interactive content, real-time feedback, and peer collaboration opportunities (Maqbool et al., 2024). According to the previous research, these tools can really enhance student involvement and promote active learning among students. However, the usefulness of the targeted applications is not always positive (Martin Somer, Casado & Gomez Pozuelo, 2024). Certain researchers have noted that over-dependence on online applications can result in cognitive overloading, impaired critical thinking, and shallow learning (George, Baskar & Srikaanth, 2024). Also, the application of non-academic applications (e.g., social media) in the name of academic engagement can adversely affect academic performance (Deckker & Sumanasekara, 2025). A weakness of the literature that a critical review of the literature is unable to address is the lack of distinction between productive and unproductive use of digital applications. Most researches consider all types of digital engagement as positive without considering the negative outcomes that may occur because of the abuse or excessive use (Tian & Zhang, 2025). This demonstrates the importance of a subtler approach toward targeted applications, especially when it comes to understanding its effect on both collaborative learning and psychological outcomes (Herrera-Pavo, 2021).

Study habits are one of the important behavioral factors that determine the effectiveness of e-learning environments (Maisha & Shetu, 2023). Study skills, time management, active learning, and making good use of learning resources have been found to be consistently associated with the improvement of academic performance and enhanced learning outcomes (Khoshaim, 2024). Study habits are even more paramount in the circumstances of digital learning, where students are expected to self-regulate their learning in less structured settings. The current literature indicates that students that use digital tools in a coherent, purposeful way are more prone to enjoy the advantages of technology-enhanced learning (Bossman & Agyei, 2022). On the other hand, the students who are poor students are the ones who would have their learning outcomes reduced even with access to advanced technological facilities. Although its significance, study habits are not always viewed as a central element in e-learning research, but as a peripheral variable (Mashroofa et al., 2023). Empirical research on the interaction of study habits with device use and specific applications to affect collaborative learning and self-approbation is limited. This is one of the major gaps that the current study aims to fill.

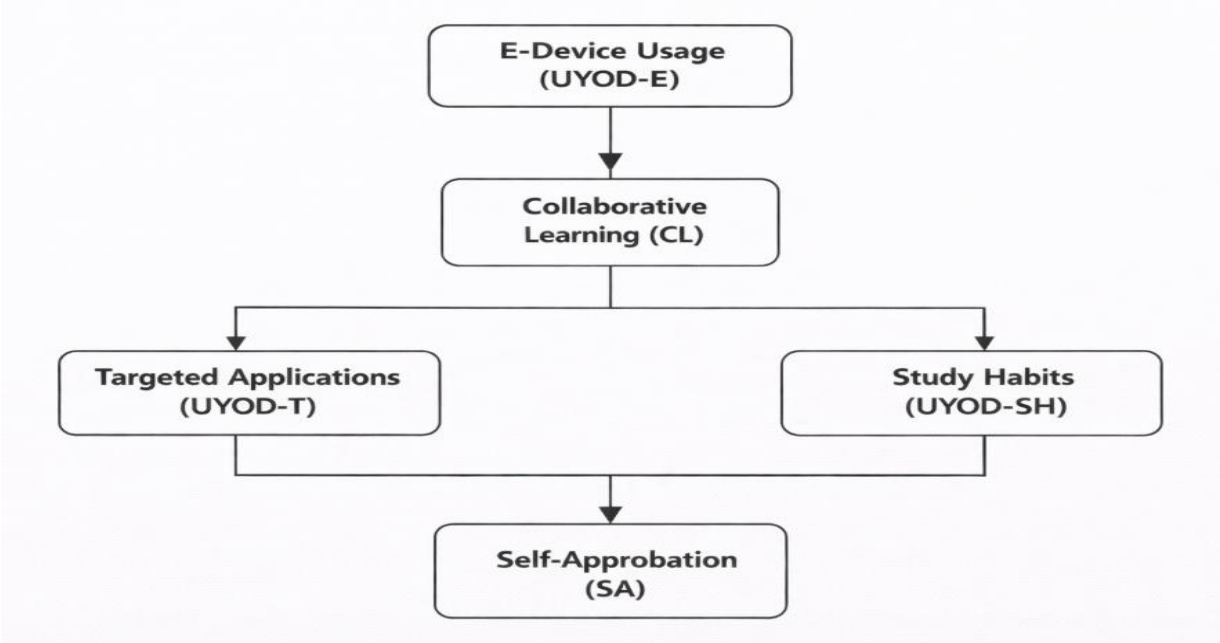
The importance of collaborative learning is widely acknowledged as a vital part of the effective educational process that ensures the sharing of knowledge, critical thinking, and problem-solving skills (Warsah et al., 2021). The digital technologies have broadened the scope of collaborative learning by facilitating communication and interaction even beyond the physical classrooms through online platforms, discussion forums, and shared digital spaces (Su, & Zou, 2022). The positive effect of technology on collaborative learning is typically supported by empirical research,

which implies that digital tools can be used to promote interaction and the construction of knowledge by peers (Bossman & Agyei, 2022). Yet, the level of collaboration is extremely reliant on the manner in which technology is applied. Unstructured online communication can lead to the passive interaction, absence of responsibility, and low learning outcomes (Supena, Darmuki & Hariyadi, 2021). Furthermore, studies that investigate the overall effect of various factors of e-learning (use of devices, the type of application, and the behavior during study) on collaborative learning outcomes are limited in number (Akintayoet al, 2024). The majority of studies are based on the isolated variables, thus, not capturing the complexity of the digital learning environment.

One of the significant psychological outcomes in the field of education is self-approbation, which is often linked with self-esteem and self-perception (Siddique, Ahmed & Sultan, 2021). It indicates confidence of students in their academic skills and in their self-esteem as a whole. Although cognitive outcomes are widely studied in terms of traditional educational research, psychological aspects like self-approbation have received relatively less attention in the context of e-learning (Mashroofa et al., 2023). The positive and negative impacts of digital learning environments on the psychological well-being of students can be both positive and negative (Neagu & Vieriu, 2025). On the one hand, the availability of the information and flexible learning opportunities can promote the confidence and self-reliance of the students. On the other hand, excessive reliance on technology, social comparison, and digital distractions may negatively impact self-perception (Cockerham, Lin, Ndolo & Schwartz, 2021). The current literature does not have an in-depth analysis of how the practice of e-learning affects self-approbation, especially in developing countries where the cultural and socio-economic factors can influence the experience of different students (Barikzai, Bharathi & Perdana, 2024). This is a gap which makes empirical research combining psychological outcomes to the study of digital learning necessary.

The methods used in this study are based on Constructivist Learning Theory and Self-Determination Theory (SDT). According to constructivist theory, learners are active participants in constructing knowledge in an interactive and collaborative way, which conforms to the notion of technology-mediated collaborative learning. This process, through the effective use of digital tools, can be facilitated by enabling communication and shared learning experiences. The Self-Determination Theory, in its turn, focuses on the importance of autonomy, competence, and relatedness to the motivation and psychological well-being. Within the context of e-learning, the power to control their learning processes (autonomy), efficient use of digital tools (competence) and interaction with peers (relatedness) can play a significant role in collaborative learning as well as in self-approbation. Using these theoretical viewpoints in unison, the current study offers a holistic approach to understanding the interaction between the technological, behavioral, and psychological factors in the digital learning settings.

Figure 1: *Constructivist Learning Theory and Self-Determination Theory (SDT)*



The theoretical framework of the research is premised on the fact that different dimensions of the e-learning practices that include e- device usage (UYOD-E), targeted applications (UYOD-T), and study habits (UYOD-SH) are key predictors of both academic and psychological outcomes. To be more specific, these variables are postulated to have a direct impact on collaborative learning (CL), which is the ability of the students to collaborate in constructing the knowledge, or self-approbation (SA), which is the self-perception and the confidence of the students in their academic success. The framework incorporates the ideas of Constructivist Learning Theory and Self-Determination Theory, where effective use of digital tools, along with positive study behaviors, promote the interaction of learning as well as psychological growth.

The analyzed literature shows that technology-enhanced learning and UYOD/BYOD practices have greatly transformed higher education by enhancing accessibility, flexibility, and collaboration opportunities (Siddique, Parveen & Dahar, 2026). The beneficial impact of digital tools on supporting collaborative learning and improving student engagement is largely supported by previous studies (Hamzat, 2024). The success of these technologies, however, does not seem to be uniform and seems to be heavily dependent on the interaction with these technologies by students (Mchainey, 2023). Specifically, focused learning applications have a dual impact, providing both advantageous academic and possible distracting effects, and learning habits become a critical behavior determinant that affects the results of digital learning (Anwar and Abbas, 2024). Further, despite the fact that collaborative learning is a phenomenon that has been investigated extensively within the framework of the technology-supported learning setting, the psychological aspect of the phenomenon especially the constructs such as self-approbation is a phenomenon that is under-explored (Asad, Qureshi & Almusharraf, 2026). Current studies are more likely to focus on academic success and adoption of technology, at the expense of investigating how the practice of behavior is related to psychological outcomes (Mehrad, Bouzedif & George Rweramila, 2024). Also, most of the empirical data are obtained in the developed countries and this limits the generalizability of the findings to the developing contexts like Pakistan where infrastructural, cultural and educational dynamics offer vastly different results.

Research Methodology

Paradigm and Design of Research

The research is based on a positivist research paradigm, which focuses on objective measurement, hypothesis testing, and statistical generalization. The quantitative, explanatory, and cross-sectional survey design was used to explore the structural relationships between e-learning practices and student outcomes.

The explanatory design is especially appropriate since the study aims at determining causal-predictive relationships between the independent variables (e-learning device usage, targeted applications, and study habits) and the dependent variables (collaborative learning and self-approbation). The cross-sectional method allows one to gather empirical evidence based on a large sample and within a specific time frame, in line with the generally accepted practices in developing educational and behavioral research.

Population, Sampling Strategy and Sample Adequacy

The target population was undergraduate students studying in state sector universities in Punjab, Pakistan, and represented different academic fields. Four hundred and sixty-six respondents were part of the final dataset. The sampling method employed was a non-probability convenience sampling technique because of accessibility constraints but methodological rigor was addressed by:

- Sufficient size of sample to undertake multivariate analysis that is above the minimum size of sample that is recommended to conduct regression analysis.
- Representation in various fields of study in order to strengthen the external validity.
- Sufficient variability in demographic characteristics to ensure generalizability.

Statistically, the sample size meets the requirements of robust parameter estimates since larger sample sizes lower the standard error and improve the stability of the regression coefficients.

Instrument Development and Operationalization of Constructs

Development of Instruments and Operationalisation of Constructs.

The structured, multi-dimensional questionnaire was used to collect the data, which was designed to operationalize latent constructs based on the previous empirical studies.

The instrument contained the following constructs:

- E-learning Device Usage (UYOD-E)
- Targeted Learning Applications (UYOD-T).
- Study Habits (UYOD-SH)
- Collaborative Learning (CL)
- Self-Approbation (SA)

Multi-item reflective measures on a five-point Likert scale were used to measure each construct on a five-point Likert scale, strongly disagree (1), strongly agree (5). Use of reflective measurement models is congruent with the psychometric theory in which the observed variables are presumed to be indicative of underlying latent constructs.

Reliability and Validity

Reliability and validity of the measurement instrument have been strictly determined, to guarantee strong psychometric characteristics. Cronbach Alpha was used to evaluate internal consistency reliability, and the overall scale was found to have a high level of reliability (Alpha = 0.92) and the level of reliability among the facets was found to range between 0.85 to 0.92 which is higher than the recommended level of 0.70 and indicates high internal consistency. The construct validity was tested through the exploratory factor analysis (EFA) where all the items loaded significantly on the respective constructs with factor loading above 0.60 which is sufficient to confirm adequate item representation. Satisfactory sampling adequacy and large inter-item correlations supported the suitability of the data to factor analysis. A convergent validity has been established by having strong intra-construct correlations, whereas a discriminant validity was achieved through ensuring that inter construct correlations were lower than intra-construct associations. Moreover, expert appraisal was used to establish the content validity, which aimed at assessing the relevance and completeness of the measurement items. Combined, these findings show that the instrument has good reliability and validity and can be considered as having high-impact empirical research.

Data Collection Procedure and Ethical Considerations

Data was collected in the form of physical and online administration of surveys to ensure a wider accessibility and diversity of responses.

The participants were aware of:

- The aim of the research.
- Voluntary participation.
- Confidentiality and anonymity.

Ethical principles were observed in line with the guidelines of academic research, keeping the bias of the response to the minimal and data integrity was guaranteed.

Data Analysis Strategy and Model Specification

The IBM SPSS Statistics (Version 26) was used to analyze data after a rigorous and multi-stage analysis procedure. Data screening of missing values and outliers using standardized z-scores, as well as measurement of normality using Skewness and kurtosis index, which all met acceptable thresholds to use in parametric analysis. The main assumptions of regression, namely, linearity, homoscedasticity, and non-existence of multicollinearity, were checked with the help of residual plots, and Variance Inflation Factor (VIF) statistics. Descriptive statistics (frequencies, percentages, means and standard deviations) were calculated to profile sample characteristics and variable distributions. Pearson product-moment correlation was used to conduct inferential analysis to assess the strength and direction of relationships among variables, followed by multiple linear regression modelling, to estimate the predictive effects of e-learning device usage (UYOD-E), targeted applications (UYOD-T) and study habits (UYOD-SH) on collaborative learning (CL) and self-approbation (SA). Two regression models were specified, and the adequacy of the models were assessed using R2, adjusted R2, and F-statistics, with the individual parameter estimates interpreted using standardized and unstandardized coefficients, corresponding t-values, p-values and 95% confidence intervals, ensuring robust and statistically defensible inference.

Methodological Rigor and Limitations

Although the research has a high methodological rigor, it has some limitations that should be considered:

- Convenience sampling can also reduce the generalizability.
- Cross-sectional design limits the ability to draw causal conclusions.
- Self-reported data can create bias in the response.

Research Hypotheses

H^{01}: There is no significant impact of e-learning device usage on students' collaborative learning.

H^{02}: There is no significant impact of e-learning device usage on students' self-approbation.

Results

Table 1: *Demographic Distribution*

Variable	Category	Frequency	Percentage
Gender	Male	196	53.6%
	Female	170	46.4%
Age	18-20	154	42.1%
	21-25	199	54.4%
	26-30	4	1.1%
	31+	9	2.5%
Department	Education	174	47.5%
	Sociology	69	18.9%
	Economics	75	20.5%
	Anthropology	48	13.1%
Semester	1-2	121	33.1%
	3-4	102	27.9%
	5-6	69	18.9%
	7-8	61	16.7%
	>8	13	3.6%
CGPA	≤2.5	28	7.7%
	2.6-3.0	75	20.5%
	3.1-3.5	159	43.4%
	3.6-4.0	104	28.4%

The sample has a balanced gender distribution with slight male majority. The majority of the respondents are of the undergraduate age group (21-25), which represents normal undergraduate population. The high concentration of Education students is an indicator of disciplinary

concentration, which can impact learning behaviours. Also, most students indicate that they have a CGPA of above 3.0, meaning that they have rather good academic achievement.

Device Usage and Learning Behaviour

Table 2: *Digital Device Usage Patterns*

Variable	Category	Percentage
Device Type	Smartphone	60.9%
	Others	22.7%
	Laptop	3.3%
	Tablet	2.7%
Internet Speed	Fast	40.1%
	Moderate	53.6%
	Slow	5.4%
Technical Issues	Never	29.2%
	Sometimes	48.9%
	Often	21.9%

Smartphones are the most common learning device, which confirms the key role of mobile technology in higher education. Despite the fact that most students report moderate to fast internet access, almost 70% encounter technical problems at least occasionally, which suggests infrastructural and usability challenges that can impact learning outcomes.

Table 3: *Learning and Usage Behaviour*

Variable	Category	Percentage
Daily Usage	1-2 hours	44.0%
	7+ hours	16.1%
	Others	Remaining
Usage Purpose	Social Apps	46.4%
	Study	12.0%
	Gaming	17.2%
Learning Method	Online Search	55.7%
	Notes Software	19.1%
	E-learning Software	4.9%

Students are the main users of digital devices in social interaction, and not in academic activities. Nevertheless, to learn, online searching is the prevailing approach, and in this regard, there is a transition towards informal learning and self-directed learning. The minimal use of the formal e-learning platforms implies that there is underutilization of formal digital learning resources.

Correlation Analysis

Table 4: *Correlation with Self-Approbation (SA)*

Variable	r	Sig.
UYOD-E	0.563**	0.000
UYOD-T	0.079**	0.000
UYOD-SH	0.617**	0.000
CL	0.689**	0.000

There are strong positive correlations between the study habits (UYOD-SH), collaborative learning (CL) and self-approbation. The relationship (r = 0.689) between collaborative learning and the psychological outcomes of students is the strongest. Technological aspects (UYOD-T), on the contrary, do not demonstrate any significant relationship, indicating that access alone will not promote self-perception.

Table 5: *Correlation with Collaborative Learning (CL)*

Variable	r	Sig.
UYOD-E	0.350**	0.000
UYOD-T	-0.010	0.000
UYOD-SH	0.400**	0.000
SA	0.689**	0.000

Collaborative learning is moderately influenced by educational usage and study habits. The insignificant but negative correlation with technological variables is an indication that technical obstacles can be a barrier to collaboration. There is high correlation between collaborative learning and self-approbation, which supports the psychological significance of peer interaction.

Regression Analysis

Predicting Collaborative Learning

Table 6: *Regression Results (Dependent Variable: CL)*

Predictor	β	Sig.	95% CI
UYOD-E	0.039	0.000	[-0.039, 0.117]
UYOD-T	-0.544	0.000	[-0.733, -0.355]
UYOD-SH	0.212	0.000	[0.146, 0.278]

Model Fit: $R^2 = 0.481, F = 36.413$

The model has an explanatory power which is strong because it can explain 48.1% of the variance in collaborative learning. The study habits can be identified as a strong positive predictor, and technological aspects have a negative influence on collaborative learning. This implies that the successful utilization of equipment increases the collaboration, and the technical issues hinder it.

Predicting Self-Approbation

Table 7: *Regression Results (Dependent Variable: SA)*

Predictor	β	Sig.	95% CI
UYOD-E	0.259	0.000	[0.090, 0.429]
UYOD-T	-1.602	0.000	[-2.014, -1.189]
UYOD-SH	0.730	0.000	[0.586, 0.874]

Model Fit: $R^2 = 0.482, F = 112.18$

The regression model accounts 48.2% of the variation in self-approbation. The strongest predictor is study habits, which have a significant impact on students and their confidence and self-evaluation. In contrast, technological issues have a significant negative impact, which means that negative technological experiences can negatively affect the psychological performance of students.

Discussion

In this study, the authors have used the impact of the use of e-learning devices (UYOD-E) and the targeted applications of the e-learning devices (UYOD-T) and the study habits (UYOD-SH) on collaborative learning (CL) and self-approbation (SA) among university students. The results show that there is a consistent and theoretically significant pattern: behavioral engagement, in particular, study habits, prove to be the most significant positive predictors of both academic and psychological outcomes, whereas technological engagement, especially through targeted applications demonstrates a negative or a limited effect. These results support recent studies which highlight that the effectiveness of digital learning environments is fundamentally determined by whether students have the ability to control their learning processes or not (Çakiroglu, Kokocev & Atabay, 2024). The descriptive findings, which show the prevalence of smartphones and the use of social applications, are in line with the current literature that emphasizes the growing dependence on mobile technologies in higher education. Nonetheless, the propensity of students to adopt social as opposed to academic use, supports the emerging fear that uncontrolled digital use can impair the effectiveness of learning and control of attention. Recent studies in the field of online learning environments indicate that the absence of guided learning structures can make students unable to implement effective self-regulated learning strategies that will lead to suboptimal academic performance (Du, Liu & Zhao, 2025).

One of the main contributions of this research is that the study habits can be considered a critical behavioral mediator. The robust positive correlation between study practices, collaborative learning, and self-approbation is consistent with recent empirical and review-based studies that have shown that self-regulated learning (SRL) is a key determinant of success in digital and online learning situations (Hemmler & Ifenthaler, 2024). Modern research also highlights the idea of SRL which includes planning, monitoring, and self-reflexivity processes that help learners effectively navigate intricate digital environments (Çakiroglu, Kokuci & Atabay, 2024). SRL is even more essential in collaborative contexts, where students will have to orchestrate cognitive and social activities in order to meet shared learning objectives (Chen et al., 2024). Conversely, the correlation between targeted applications and both dependent variables was negative indicating that not every kind of digital engagement is educationally productive. This observation can be corroborated by this finding in recent literature that suggests that digital tools and especially those that combine social and academic capabilities may add to cognitive overload, distraction, and

fragmented attention unless used strategically. Research on the topic of online learning interactions also point out that technological proficiency by itself does not guarantee successful learning because the advantages of technology are moderated by the ability of students to engage in a meaning with digital platforms (Hashmi et al., 2025).

Moreover, the relatively minor impact of general device usage (UYOD-E) further supports the claim that access to technology alone is not sufficient to have a significant learning or psychological impact. Recent systematic reviews confirm that the effects of digital learning environments are greatly contingent on factors related to learners, especially motivation, metacognition, and self-regulatory behaviors (Gambo & Shakir, 2021). This confirms the argument that technology is more a facilitative tool whose success depends on the intentional and systematic application of this technology. The positive correlation between collaborative learning and self-approbation is also strong thus indicating the social-psychological aspect of digital learning environments. Recent studies show that collaborative and interactive learning environments can not only improve academic achievement but also enhance self-efficacy and confidence of students, as it leads to meaningful interaction between peers and supports the building of shared knowledge (Wang, 2023). This is to indicate that collaborative learning is a cognitive and psychological process, which strengthens the feeling of competence and relatedness among students.

In general, the results of this study build on the existing literature by showing that the effectiveness of e-learning is behaviorally mediated and context dependent and depends on the interaction of technological access and self-regulated learning practices. In line with recent empirical and theoretical developments, the findings highlight that the quality of engagement especially building effective study habits is the determining factor as to whether digital technologies enhance or hinder both collaborative learning as well as self-approbation in the context of higher education (Xue, Khalid & Karim, 2025).

Findings

The research shows that there are a few significant findings:

- Empirical results of the study give clear evidence about the various levels of influence of the dimensions of usage of e-learning devices on collaborative learning and self-approbation. Descriptive analysis shows that the most commonly used device among students is the smartphone (60.9%), with social applications representing the most commonly used category of digital engagement (46.4%), indicating that non-academic digital engagement is the most prevalent among students.
- Pearson correlation analysis showed statistically significant positive correlations between study habits (UYOD-SH) and both collaborative learning ($r = 0.400$, $p < 0.01$) and self-approbation ($r = 0.617$, $p < 0.01$). Likewise, collaborative learning was strongly positively correlated with self-approbation ($r = 0.689$, $p < 0.01$), which means that the higher the level of engagement in collaborative learning, the higher the level of academic self-perception. Conversely, targeted applications (UYOD-T) showed no or negative correlation with collaborative learning ($r = -0.010$, $p < 0.01$), indicating that technological activity alone is not likely to produce any meaningful learning outcomes.
- These relationships are further supported by the results of multiple regression analysis. In Model 1, which predicted collaborative learning, the model was statistically significant ($R2 = 0.481$, $F = 36.413$, $p < 0.001$). Study habits (= 0.212, p = -0.001) turned out to be a significant

positive predictor, whereas targeted applications showed a significant negative outcome (= -0.544, p = -0.001). The use of educational devices (UYOD-E) had a relatively weak and non-substantial contribution.

- In Model 2, predicting self-approbation, the model explained 48.2% of the variance ($R^2 = 0.482$, $F = 112.18$, $p < 0.001$). Once again study habits proved to be the strongest predictor (2 = 0.730, p = 0.001), followed by educational usage (2 = 0.259, p = 0.001) but targeted applications displayed a pronounced negative impact (2 = -1.602, p = 0.001).
- Taken together, the existing evidence shows that the most influential determinant of both collaborative learning and self-approbation is behavioral engagement, as reflected in study habits, whereas unstructured technological engagement can have a detrimental impact. The fact that these effects are similar when comparing the two models, is an indication of the strength of the findings and the core role of the self-regulated learning behaviors in the educational setting mediated by technology.

Conclusion

This research explored how the e-learning devices usage (UYOD) dimensions educational usage, targeted applications, and study habits affect collaborative learning and self-approbation among university students. The results have given a clear indication that the effectiveness of e-learning is not necessarily predetermined by the availability of digital technologies, but by the quality and aim of their use. Among all the predictors, study habits proved to be the most significant factor, which has a significant positive effect on collaborative learning and self-perception of students. Conversely, unstructured or non-academic digital engagement had a negative effect on academic interaction and psychological outcomes (targeted applications, however, demonstrated a negative influence on both academic interaction and psychological outcomes). These findings point to the fact that digital learning environments are essentially behavior-based, with the capacity of the students to regulate their learning, manage their time efficiently, and engage purposefully with the digital learning tools as the determinants of educational success. Moreover, the well-related correlation between collaborative learning and self-approbation also adds to the significance of social interaction in strengthening the confidence and academic identity of students. On the whole, the study contributes to the body of knowledge by showing that technology is a facilitative, not a determinant resource of learning outcomes, and that behavioral engagement is the most important mediating process.

Integrated Implications, Limitations, and Future Research

The implications of the findings of this study are far reaching in design and governance of technology enhanced learning in higher education. Most importantly, the fact that study habits are dominant predictors of not only collaborative learning but also self-approbation means that behavioral regulation, rather than technological provision is the primary lever towards achieving better learning outcomes. Based on this, institutions ought to go beyond access-based policies to behaviorally based instructional design. This may be operationalized through instantiating self-regulated learning (SRL) scaffolds in Learning Management Systems (LMS), such as mandatory weekly planning logs, progress dashboards, and prompts to reflection directly embedded within course structures. The teachers can also reinforce these behaviors by matching the evaluation framework with process-based evaluation (e.g., graded participation, peer collaboration metrics), so that they encourage disciplined engagement as opposed to passive use of technology.

Simultaneously, the disadvantages linked with targeted applications indicate the necessity to strategically govern digital ecosystems in the academic context. Institutions ought to introduce guided usage procedures such as curated academic app collections, task-specific digital environments, and controlled collaboration channels, instead of banning or restricting technology. In practice, this can consist of institutional deployment of LMS based communication tools in lieu of external social platforms, and instructor-mediated interaction. These would minimize the cognitive fragmentation, and would retain the collaborative affordances of technology.

Regardless of these contributions, there are a number of limitations which should be critically considered. The cross-sectional design limits causal inference since the observed relationships may represent a reciprocal or changing relationship between the variables. This weakness may be overcome by using longitudinal panel designs that would monitor behavioral and psychological changes over time especially in response to planned interventions. Also, the use of self-reported measures implies the presence of the common method bias and social desirability effects. This should be alleviated in future research by incorporating multi-source data, such as LMS trace data, peer evaluation metrics, and performance-based indicators. Convenience sampling within one regional context also contributes to the limitation of the external validity; hence, the study should be repeated in other institutional types and different cultures to see how stable the relationships are.

Based on the limitations, the future research would be more model refinement and theoretical extension. In particular, the current results indicate that the study habits should be considered as a behavioral mediator between technology use and outcomes, however, this mediation process should be formally tested using a structural equation modelling (SEM) to measure mediation and moderation effects. Moreover, constructs that can be included in future research to create a more elaborated explanatory model are the following: digital literacy, cognitive load, and quality of instructional design. Both experimental and quasi-experimental designs would also allow the researcher to assess the causal effect of SRL based interventions and digitally structured learning environments. These would both enhance internal validity but also help in developing predictive and generalizable models of e-learning effectiveness. Critical paradigm shifts: the success of digital learning environment depends on how behavioral engagement and target-oriented technology use is structured. To take this line of inquiry further, it will be necessary to move beyond descriptive analyses towards theory driven, methodologically rigorous and intervention-oriented research paradigms, capable of informing practice, as well as policy, at scale.

Conflict of Interest

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