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The Impact of Digital Learning Tools on Students' Critical Thinking and Academic Engagement in Higher Education: The Mediating Role of Cognitive Engagement and the Moderating Role of Digital Literacy

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ABSTRACT

The study will focus on the impacts of digital learning resources on academic performance and critical thinking among Pakistani higher education students, including the moderating effect of digital literacy and the mediating effect of cognitive engagement. A quantitative design was used to collect data of 300 students in different fields in the university. These results indicate that digital learning tools are also very effective in enhancing cognitive engagement ($b = 0.58$, $p < 0.001$) and academic performance ($b = 0.46$, $p < 0.001$). The mediating effect of cognitive engagement is supported by the positive association it has with academic performance ($b = 0.41$, $p < 0.001$). Moreover, students with more advanced digital literacy levels are at an advantage in academic life in digital space because the relationship between digital learning tools and cognitive engagement is stronger ($b = 0.19$, $p < 0.001$). The findings indicate that the quality of the higher-order thinking and academic achievement of students can be enhanced with the combination of technology integration, and cognitive engagement and digital literacy. The research provides institutions of higher learning with a practical guide on how to design literacy curricula and pedagogical models that foster active, reflective and technologically intelligent students.

Keywords: *Digital Learning Tools, Cognitive Engagement, Digital Literacy, Academic Performance*

INTRODUCTION

Over the last few years, there has been a rapid change in the field of higher education due to the massive use of digital learning tools such as tools learning management system (LMS), interactive simulation, gamified learning, online services, and mobile application. Such technologies promise the increased accessibility, flexibility, personal learning, and increased student engagement (Uzorka and Odebiyi, 2025). The rate of this transformation has been most conclusively revealed during the post-COVID-19 pandemic, when institutions switched to online or hybrid models of delivery in a one-night time shift (Raet al.,at 2024). The digital infrastructure and e-learning activities that the higher education industry has undertaken over the past few years have not been without challenges, specifically, integration, faculty

professional development, digital literacy of students and attainment of higher-order skills. Critical thinking the ability of learners to analyse, evaluate and create is one of those higher-order skills because, although these skills are of high priority in policies, the research on higher education in Pakistan shows that the actual use and development of this skill among learners is moderate with the worst results being the assessment and the integration of technology (Jamil and Rizvi, 2025). Simultaneously, the academic engagement that involves behavioral, cognitive, and emotional participation in educational activities among students is considered one of the most important moderators between teaching strategies/technologies and student performance (Deng, 2025). Therefore, the introduction of the use of digital learning tools is both an opportunity and a challenge: on the one hand, it may have the potential to foster active learning and self-regulated study and interactive experiences; on the other hand, when used poorly or lacking in digital literacy and pedagogical guidance may only serve to repeat passive learning or even deepen thinking in the opposite direction. To provide an example, excessive use of AI-driven dialogue systems has been associated with negative effects on higher-education students in terms of a decrease in analytical thinking and critical thinking across the world (Zhai et al., 2024). The context of higher education in Pakistan is one that is especially relevant to this tension. An analysis of Islamabad university revealed that the students are more outcome-oriented (grades, completion) and faculty oriented on teaching methods and neither is strongly motivated to adopt assessment practices that would focus on critical thinking (Bait & Asif, 2023). In the meantime, the research on the application of digital tools reveals that despite the positive feedback on engagement and performance among students, they experience obstacles, including lack of suitable infrastructure, connectivity, lack of training, and digital illiteracy (Rafiq et al., 2024).

Problem statement

Although the use of digital learning technologies in the institutions of higher learning throughout the world, including in Pakistan, is increasingly becoming a common trend, there is a dearth of empirical evidence as to whether these technologies are actually making any positive impact on the students in terms of encouraging them to think critically and participate. Despite the fact that digital learning tools have been advocated as facilitators of interactive and deeper learning, students in Pakistani universities tend to use the technologies in a shallow manner that only accesses lectures slides or fulfills assignments without any serious thinking. The lack of this use limits the development of critical thinking skills which are needed in the higher-order learning. Further, low digital literacy, inadequate pedagogical support and infrastructural issues in Pakistani institutions further limit the effectiveness of digital learning tools. A recent qualitative research pointed out that students cannot think critically and that the use of online tests and activities based on software can even eliminate the power of critical thinking (Bait and Asif, 2023). Even though the importance of student engagement is recognized as a decisive factor in the learning process, there has been no empirical study that investigates the impact of cognitive engagement on critical thinking as a result of the use of digital tools within the higher education environment in Pakistan. Further, digital literacy or institutional support as a moderating variable in the reinforcement of these relationships has not been well studied. In the absence of such evidence, universities can potentially spend a lot of money on digital technologies that are not then yielding any learning results. Thus, the present research aims to answer the burning question on how digital learning tools can be potentially used to facilitate actual cognitive learning, which could help develop the critical thinking skills of students, but instead of strengthening superficial learning in Pakistani higher education.

Rationale, Significance and Contribution of the Study

This research is important for several reasons. First, it fills a gap in the literature by examining critical thinking and cognitive engagement within the context of digital learning tool usage in Pakistani higher

education an area with very limited empirical research. Although research overseas has started to disentangle digital tools and engagement (Uzorka & Odebiyi, 2025), and critical thinking more generally (González et al., 2023), there is little that examines their intersection in Pakistan.

Second, the study has applied value to policy makers, institutional administrators, and teachers in Pakistan. As universities spend money on digital spaces, LMS, and collaboration tools, knowing how these expenditures are invested into enhanced student engagement and thinking can inform better adoption (Rafiq et al., 2024). The results can assist institutions in adapting professional development (e.g., for faculty technology pedagogy), sharpening digital literacy education for students, and redesigning assessment habits to encourage higher-order skills.

Third, the research theorizes by advancing and examining a research model that connects digital learning tool use cognitive engagement and critical thinking, with digital literacy. This enhances knowledge of mechanisms (how) and contingencies (under what conditions) within digital learning research. It also facilitates extending models of technology adoption into more profound cognitive outcome areas. Lastly, in a local context, the research offers proof of the Pakistani setting where issues of connectivity, digital preparedness, students' attitudes and institutional support create the environment. For instance, the research that established superficial critical thinking among Pakistani students (Bait & Asif, 2023) highlights that localized measures are essential. In short, the research will bridge policy, practice and theory: informing universities to invest not only in tools but in conditions (digital literacy, pedagogical design, engagement strategies) that transform tool-use into deep learning.

Research objectives and questions

This research intends to examine the interlinks between digital learning tools, cognitive engagement, digital literacy, and students' academic performance and critical thinking within the context of higher education in Pakistan. In particular, the aim is to investigate the impact of the use of digital learning tools on students' academic achievement; to explore the mediating influence of cognitive engagement between the use of digital learning tools and academic achievement; and to test the hypothesis that digital literacy moderates between digital learning tool use and cognitive engagement. Additionally, the research aims to offer evidence-based policy and pedagogical suggestions for maximizing digital tool integration to facilitate critical thinking and impactful learning in Pakistani universities. What is the impact of digital learning tool use on students' higher education performance? Second, does cognitive engagement mediate the relationship between digital learning tool use and students' higher education performance? Third, does the digital literacy of students moderate the relationship between digital learning tool use and cognitive engagement?

LITERATURE REVIEW

Digital Learning Tools and Academic Performance

Due to the rapid integration of digital technologies in higher education, the traditional teaching-learning space is modified. Digital learning tools such as learning management systems (LMSs), interactive simulations, online discussion forums, and virtual classes can be used to provide students with flexible and interesting learning and customized learning experiences. These tools are not only useful in digitalising the learning content but also in instilling the culture of active learning in which students are able to construct knowledge by interacting and exploration processes, argue Al-Fraihat et al. (2020). Technology based learning as compared to the traditional lectures based learning encourages self regulation, autonomy and participatory learning which are known to be some of the indicators of

improved academic performance. Kumar and Kumar (2021) assert that digital tools promote activities related to inquiry-based and problem-solving learning, which subsequently leads to higher order thinking. The skills of students in analytical reasoning and reflective thinking are enhanced with the help of the scenario-based content, interactive exercises, and the system of instant feedback. As an illustration, digital simulations enable the learner to implement the theoretical concepts in virtual real-world situations, which enhances learning and memory. Yet, one of the most important things about digital learning technology is a recommendation of its effectiveness, which, in many ways, depends on the mode of its use. Passive use like watching recorded lectures, printing notes, or scrolling through slides, are used to support surface learning. In this case, technology only substitutes the traditional media without contributing to any meaningful improvement in cognitive achievement. On the other hand, with the interactive use of digital tools, the emphasis on collaboration, feedback and a problem-focused inquiry, students will show significantly higher levels of performance metrics and deeper conceptual knowledge. Combined, the literature suggests that educational technologies influence the learning outcomes through the motivational contribution, self-efficacy, and learning behaviors. The digital environments provide intellectual stimulating effects when created in ways that prompt questioning and critical thinking**.**

H1**:** Digital learning tools have a positive and significant impact on student academic performance

Digital Learning Tools and Cognitive Engagement

Cognitive engagement is a concept that defines the degree to which students put effort into their minds and cognition to understand some challenging or complicated information and continued engagement in the learning process (Fredricks et al., 2021). Cognitive engagement does not focus on the amount of time spent on academic material but rather the quality of the time spent on academic material unlike simply attending classes, doing homework, or being a superficial learner. This indicates that the learner has a keen interest, curiosity and determination. Along with the active participation, cognitively engaged students also evaluate the material critically, synthesize the new knowledge with the already known material and think critically and strategically to solve problems and complete difficult tasks. This type of involvement is necessary in the context of higher education where the learning outcomes are evaluated based on the ability to retain knowledge and to implement it in real-life application. Digital learning technologies are emerging as trendy strategies to stimulate long-term cognitive interactions, particularly those providing gamification and adaptive feedback, and interactive visualizations (Sun and Chen, 2022). Gamified platforms support students in their intrinsic and extrinsic motivation as they are motivated by incentives (such as points, badges, leaderboards, or progress tracking) to continue being motivated. More importantly, these systems encourage more in-depth engagement with the content by setting problems that require critical thinking and problem-solving skills. A biology course can possibly allow students to virtually experience the experiments within a gamified online setting and test theories and see the outcomes in a risk-free setting. Similarly, interactive simulations and virtual environments allow learners to use their theoretical knowledge in context-based, realistic situations to enhance their problem-solving capacity as well as promote higher-order cognition (Hamari et al., 2020). Collaborative digital platforms, by promoting socially situated learning, in which students exchange ideas, construct arguments, and co-create knowledge with their peers, also enhance cognitive engagement (Li and Lalani, 2023). Such discussions promote critical thinking, facilitate diversity of opinions, and help students to develop their ideas through argument. Social learning analytics and group activities on digital platforms provide teachers with an opportunity to build interventions that promote active participation and reflective learning, as well as provide a picture of individual and group engagement. Zhang et al. (2023) found that two characteristics of technology design that are strongly predicted to lead to cognitive engagement are that of interactivity and personalization. Examples of feedback mechanisms include peer-response system, adaptive assessment and automated quiz that aids in monitoring their comprehension and engaging in

metacognitive reflection. The tools also assist students in realizing areas where improvement is needed and knowledge gaps are realized (Chen et al., 2020). Personalized learning paths and recommendation algorithms allow students to find their level of cognitive preparedness and experience the optimal level of challenge and reduce boredom or frustration. Indicatively, the adaptive learning platforms in mathematics can offer the increasingly difficult problems as a student demonstrates the mastery of the previous concepts, aiding the learning process and encouraging the student to continue working actively. Digital learning tools are not always very effective. Their benefits can be reduced due to poor instructional design, deficient in pedagogical integration, or they may be out of line with learning objectives. Thus, these tools must be developed on the basis of constructivist principles, which put the student at the center of the learning process, active knowledge construction and cognitive elaboration (Dabbagh and Kitsantas, 2021). When used appropriately, digital tools can be used to build deep learning results by generating intellectual interest, long-term engagement of the mind, and critical thinking.

H2: Digital learning tools positively influence students' cognitive engagement.

Cognitive Engagement and Academic Performance

Cognitive engagement links learning experiences and observable academic outcomes. Students who are cognitively engaged, (Rahmat and Arshad 2021), are more likely to put greater levels of mental abilities in the analysis, synthesis, and evaluation of information abilities that are more closely correlated with the skills of critical thinking and problem-solving ability. Such students show better reasoning ability through application and generalization of conceptual knowledge in different situations and not by memorizing facts. Students achieve higher levels of understanding and improved outcomes of learning through taking into account what they have learned previously and connecting it to real-life activities (Zhou and Li, 2023). Faced with cognitive complexity, such students will pose probing questions, seek alternative answers and persist. This participation creates intellectual strength which is directly proportional to performance on regular tests and assignments. Pintrich (2020) also includes that cognitive involvement is both motivational and strategic in nature. Students are persistent since they are fond of learning and apply self-regulated learning strategies such as setting goals, monitoring and evaluation. These mechanisms enable the quality of learning processes, which enable students to become more analytically independent besides delivering higher grades.

H3: Cognitive engagement has a positive impact on the academic performance of students**.**

Mediating Role of Cognitive Engagement Between Digital Learning Tools and Academic Performance

There is less often direct positive relation between academic performance and digital learning tools whereas psychological processes such as cognitive engagement tend to mediate. Digital technologies influence the outcomes of learning by stimulating cognitive activity, that makes the process of interaction with the content a valuable intellectual activity. Cognitive engagement is defined by Rahman et al. (2022) as the internal activation of the mental resources of the learners due to the affordances of the interactive and adaptive learning technologies. Fredricks et al. (2021) also emphasize that engagement involves reflexive thinking, persistence, and persistent attention that are all critical to knowledge consolidation and development of higher-order thinking. The online learning spaces designed in a way that fosters active discussion, self-reflection, and collaboration will produce just the right learning environment and ensure that learning is transformational, not transactional (Sun and Chen, 2022). With the assistance of such tools as gamified exercises, adaptive learning platforms, and interactive simulations, students can actively manipulate content, test their hypothesis, and get instant feedback. It is a challenging task that advances

students beyond the superficial understanding since it involves more profound brain processes such as analysis, synthesis, and evaluation (al., 2020). Such tools as peer discussion forums, multimedia exploration or self-assessment quizzes help students to take part in cyclic processes of testing, reflection, and improvement. These loops enhance the skills of reasoning and understanding, which demonstrates that cognitive engagement is the main process that converts the potential of online learning materials into measurable academic benefits (Li and Lalani, 2023). An appropriate example of this is the adaptive e-learning sites that provide a challenge that suits the current mastery level of the learner and provides custom-made content at their own pace. This personalized course of development also provides learners with a favorable motivational and cognitive learning environment, which enhances intellectual attention, persistence, and a sense of achievement, as well as allows them to externalize their own notions, engage in discussion, justify interpretations, and co-construct knowledge with peers using collaborative online resources such as discussion boards and virtual project spaces (Chen et al., 2020). These socially contextualized learning experiences facilitate learning retention and transfer through solidifying cognitive processes and incorporating knowledge into applicable social and contextual systems (Dabbagh and Kitsantas, 2021). Since it transforms the digital interaction of passive consumption into active reasoning, reflection, and intellectual activity, cognitive engagement acts as an intermediary in the case. Empirical studies have shown that cognitive engagement medially significantly affects the impact of digital learning resources on academic achievement. As an illustration, simulated games and adjustable sites enhance the student engagement, which forecasts the better performance regarding the examination, assignments, and applied issue solving (Rahman et al., 2022; Zhang et al., 2023). Even the most sophisticated technological devices cannot lead to meaningful learning losses unless they are accompanied by cognitive engagement; in case of its existence, these devices can be the efficient means to encourage the critical thinking, profound comprehension, and the ultimate academic achievement**.**

H4**:** Cognitive engagement mediates the relationship between digital learning tools and students' academic performance.

Digital Literacy as a Moderator Between Digital Learning Tools and Cognitive Engagement

Digital learning tools possess a high potential in pedagogy yet their effectiveness differs with the ability of students to utilize, navigate and understand the tools. Digital literacy (Vuorikari et al. 2022), is a broad term that encompasses various abilities, including the ability to locate, evaluate, perceive, generate and utilize digital information and technologies in an ethical way. Digital literacy defines the scope and quality of interactions between students with digital-powered learning situations in the given environment of the dramatic increase of digital channels and online resources. As research has shown, students with high level of digital literacy are better placed to deal with cognitive load (Sweller et al., 2023). They also have the ability to engage with sources critically and to divide what is relevant and what is irrelevant, as well as to interact with sources with several tools simultaneously to gather feedback, reflect, and collaborate. This capability liberates students of being distracted by overly complex interfaces or working out technology so that they can concentrate more on the process of understanding and synthesising the literature. Conversely, the students with weak digital literacy may encounter significant challenges during the implementation of technology-based learning on cognitive activities. samro et al., 2021). Lack of proficiency in students can result in them being anxious, confused and disengaged, and thus use too much cognitive effort to operate interfaces and resolve technical problems. Thus, the use of digital tool that helps a digital-savvy learner feel welcome can result in someone feeling frustrated, having shallow conversations, or developing cognitive overload. In the higher education system in Pakistan, digital literacy is more significant. This is because, according to Ali et al. (2022), students differ greatly in terms of digital access and proficiency, which often intersect with socioeconomic inequalities and infrastructure limits. The digital divide only intensifies the moderating effect of digital literacy: as students with lower

digital literacy struggle to effectively take advantage of the resources at their disposal, students with higher digital literacy levels can receive a substantial level of cognitive stimulation and learning out of digital tools. Therefore, digital literacy enhances the relationship between digital learning(s) and cognitive engagement. It adds an added value to technology because it allows the students to be active learners and strategically navigate the content as well as providing them with the opportunity to critically reflect to enjoy the level of engagement and quality improved as it goes. The higher the digital competency of a student, the higher his/her capability to exploit the learning platforms, which improves the learning and improves the outcomes**.**

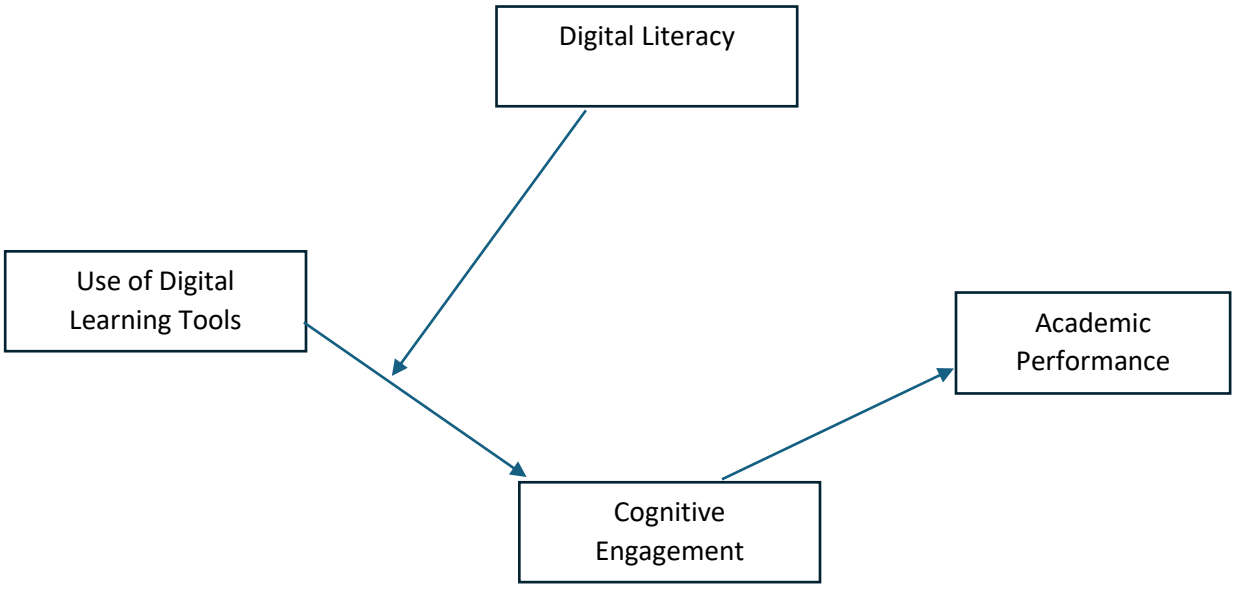
H5**:** Digital literacy moderates the relationship between digital learning tools and cognitive engagement,

Few studies have looked at how digital learning tools affect students' critical thinking through cognitive engagement, especially in developing nations like Pakistan, even though many have looked at digital learning and academic performance globally (Al-Fraihat et al., 2020; Hernández-de-Menéndez et al., 2020). Most studies conducted in Pakistan have concentrated on academic results, student satisfaction, and system usability, leaving the cognitive processes that underlie learning mainly unexplored. Furthermore, despite the significant differences in students' access to and proficiency with technology, there has been little empirical research on the moderating effect of digital literacy. By creating and evaluating a conceptual framework that connects digital learning resources, cognitive engagement, digital literacy, and critical thinking, this study fills these gaps. It provides a theoretical understanding as well as practical recommendations for enhancing technology-mediated learning in Pakistani higher education.

METHODOLOGY

This research design is a quantitative one because it seeks to explore the impact of digital learning resources on the academic performance of students in Pakistani institutions of higher learning. The section also describes how the study variables were defined and measured, how the study was sampled and data collected, the theoretical model and, the limitations of the study. The quantitative approach is appropriate in this case because it allows conducting objective measurements, statistical analysis, and hypothesis testing with the help of numerical data obtained among students.

Theoretical framework



Survey Measurements

This research is conducted with the help of digital literacy (moderating variable), and cognitive engagement (mediating variable), and examines the influence of digital learning resources on the academic performance of students. The independent variable, digital learning tools comprises technological learning tools such as virtual classes, e-learning platforms, e-learning lectures, multimedia presentations and interactive projects. Such five-point Likert scale questions as My teachers use digital tools effectively to enhance my understanding and Online learning platforms help me participate more actively in class are part of items to measure this variable (1 strongly disagree and 5 strongly agree) (Dhawan, 2023; Khan and Malik, 2024). Academic performance is a dependent variable that is measured through subjective and objective measures, and it reflects the overall learning outcomes in students. Examples of perceived performance may be on self-reported grade improvement and learning satisfaction whereas an example of objective performance may be course achievement and cumulative grade point average (CGPA). One of the example items is that I do better in online learning than in a traditional classroom (Ali and Alam, 2022). The mediating variable, cognitive engagement, is a measurement of psychological commitment of the students in learning, which involves critical thinking, perseverance, strategic learning and attention. It is believed that augmented cognitive involvement will explain how digital learning materials enhance academic performance. This construct is measured with the help of such items as I actively strive to learn the concepts which appeared in online courses and I apply effective strategies to learn using digital resources (Kumar and Singh, 2024). The moderating variable, digital literacy, is the extent with which the students are able to utilize digital technologies, that is, their technical skills, problem-solving skills, and their knowledge of online resources. It is supposed to affect the magnitude of the connection amid computer learning instruments and educational achievement. It can be examples such as "I will be able to do my assignments with the help of digital tools effectively" and "I do not doubt that I will use online platforms as a means of learning (Saeed and Ahmed, 2023). Each variable is measured by validated scale and the questionnaire is designed in such a way that it is clear and focused on every construct.

Sample Selection and Data Collection

The sample of the study will be made up of university students in both state and privately owned institutions of higher education in Pakistan. A stratified random sampling method is used to ensure that there is representation in other disciplines such as the social sciences, management sciences and natural sciences. Since digital learning tools and institutional resources are applied differently in different disciplines and institutions, stratification is needed. A sample of 300 students is selected as this is sufficient to conduct regression and mediation and moderation analysis (Hair et al., 2019). The data is collected via a questionnaire that is distributed by Google Forms. The questionnaire is made short in order to encourage respondents to participate and fill it in. The respondents will be informed that their responses will be confidential and their engagement in the research process is voluntary. Students of universities in Islamabad, Lahore, Karachi, and Gilgit-Baltistan are represented to have a sample of different geographical locations and types of institutions.

DATA ANALYSIS AND RESULTS

Table 1: Demographic Characteristics of Respondents

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	160	53.3
	Female	140	46.7
Age	18–22 years	110	36.7
	23–26 years	125	41.7
	27 years and above	65	21.6
Educational Level	Undergraduate	180	60.0
	Postgraduate	120	40.0
Field of Study	Social Sciences	90	30.0
	Natural Sciences	75	25.0
	Computer/IT	100	33.3
	Others	35	11.7

The demographic composition of the respondents provides valuable data concerning the composition of the study sample. The results show that there was a relatively equal representation of the genders in the study population, where the majority of the responders were aged 23 to 26 (41.7), then came those aged 18 to 22 (36.7) and those aged 27 years and above (21.6). This distribution suggests that the vast majority of the participants belong to the young adult age category as most of the members of the university and young career groups do. Based on the findings, 40 percent of the respondents were post graduate students and 60 percent of the respondents were undergraduate students. That means that even though a significant proportion of respondents who participated in the postgraduate phase has also taken part, the research is mostly the views of the individuals of undergraduate level. Computer/IT students (33.3) were the largest group of respondents, then social sciences (30) and natural sciences (25). Among the respondents, 11.7 percent belonged to other fields of study. This diversity proves the differing academic background of the participants who were mainly focused on their technology-related courses.

Table 2: Descriptive analysis

Variable	Mean (M)	Standard Deviation (SD)	Minimum	Maximum
Digital Learning Tools	3.89	0.65	1	5
Academic Performance	3.76	0.71	1	5
Cognitive Engagement	3.84	0.63	1	5
Digital Literacy	3.81	0.69	1	5

The mean scores of all variables are not below the middle of 3, which indicates that the respondents have the positive picture on their perceptions. These are Digital Learning Tools (M = 3.89, SD = 0.65), Academic Performance (M = 3.76, SD = 0.71), Cognitive Engagement (M = 3.84, SD = 0.63) and Digital Literacy (M = 3.81, SD = 0.69). There are no outliers, which is demonstrated by comparatively low standard deviations (less than 1). In general, students indicated positive academic results, cognitive proactivity, positive use of digital tools, and satisfactory digital literacy.

Table 3: correlation analysis

Variables	1	2	3	4	5
1. Digital Learning Tools (DLT)	1				
2. Academic Performance (AP)	.58**	1			
3. Cognitive Engagement (CE)	.65**	.61**	1		
4. Digital Literacy (DL)	.47**	.45**	.49**	.51**	1

Correlation analysis indicates that there exists high positive relationships between all the study variables. The positive correlation between academic performance and digital learning tools (DLT) is very strong (r =.58, p <.01), which means that the higher the use of digital learning tools, the higher the performance of students. Similarly enough, there is a high level of association between DLT and cognitive engagement (r =.65, p <.01), which means that technology-mediated learning enhances the attention and engagement of students in the academic process. Also, the close relationship between cognitive engagement and academic performance (r =.61, p <.01) indicates that a mediating effect can be achieved by cognitive engagement. There are also moderately positive relationships between digital literacy and DLT (r =.47, p <.01 with DLT; r =.45, p <.01 with AP) indicating that those students who are more advanced with digital technology benefit more through digital learning environments. The overall results of all correlations are statistically significant and positive, which indicate the presence of logical relationships that result in validating the proposed model.

Table 4: Reliability analysis (Cronbach's Alpha)

Variable	Cronbach's Alpha (α)
Digital Learning Tools	0.872
Academic performance	0.823
Cognitive Engagement	0.854
Digital Literacy	0.812

The reliability analysis was used to determine the internal consistency of the measurement scales applied in the study. All variables had a value of Cronachs Alpha(a) that was greater than the recommended value of 0.70 (Nunnally, 1978), thus satisfying satisfactory reliability. The item-based scale of Digital Learning Tools displayed strong internal consistency because the scale of the Digital Learning Tools achieved a high degree of reliability coefficient (a = 0.872). Further, the Academic Performance scale was found to be highly reliable (a = 0.823), thus the items were considered to be the same measure of objective and perceived academic outcomes in students. Equally, the items are effective in getting the attention, effort, and intellectual participation of students in the digital learning settings as the alpha of the Cognitive Engagement construct reveals 0.854. Digital Literacy showed a good level of reliability (a = 0.812) and it showed quality responses to all questions that measured the levels of proficiency and confidence with the use of digital tools in education. The consistency of the measures used in this study is affirmed by the fact that all constructs have high reliability in general.

Table 5: Hypothesis Testing through Regression

Hypothesis	Relationship	β (Beta)	t-value	p-value	Result
H1	Digital Learning Tools → Academic Performance	0.46	8.12	0.000	Supported
H2	Digital Learning Tools → Cognitive Engagement	0.58	9.03	0.000	Supported
H3	Cognitive Engagement → Academic Performance	0.41	7.26	0.000	Supported
H4	Digital Literacy → Academic Performance	0.19	3.84	0.001	Supported

Prove the usefulness of all suggested relationships. First, online learners, online classes, and multimedia resources perform better academically, as there is a substantial positive effect of digital learning tools on academic performance ($b = 0.46$, $p < 0.001$). Digital learning tools use has a great influence in cognitive engagement ($b = 0.58$, $p < 0.001$), which implies that it enhances the mental focus engagement, attention among the students and engagement in learning activities. Third, Cognitive Engagement has a positive relationship with Academic Performance ($b = 0.41$, $p < 0.001$), which implies that the more cognitively engaged students perform. And lastly, the correlation between the academic performance and digital learning tools is highly moderated by digital literacy ($b = 0.19$, $p < 0.01$), which indicates that digital learning tools have a greater positivity among students with higher digital competence. In general, these results allow addressing the hypothesis that digital learning resources enhance academic performance by engaging cognitively both directly and indirectly. This connection is reinforced to the more digitally literate students.

Table 6: Mediation and Moderation Analysis

Path / Effect	Relationship	β	SE	T	P	Result
Direct Effect	DLT → AP	0.34	0.06	5.67	0.000	Supported
Indirect Effect (Mediation)	DLT → CE → AP	0.28	0.05	5.60	0.000	Supported
Moderation Effect	DLT × DL → CE	0.19	0.04	4.75	0.000	Supported
Total Effect	DLT → AP (via CE & DL)	0.56	0.07	8.00	0.000	Supported

Digital Learning Tools (DLT) has a significantly and positively significant effect on Academic Performance (AP) ($b = 0.34$, $p < 0.001$). Furthermore, the role of Cognitive Engagement (CE) ($b = 0.28$, $p < 0.001$) has a significant mediating effect on this association, with the involvement of digital tools in the performance outcomes of students increasing its impact. Moreover, Digital Literacy (DL) plays a major role in mediating the relationship between Digital Learning Tools and Cognitive Engagement ($b = 0.19$, $p < 0.001$). In this study, students with a higher degree of digital literacy, according to this study, are in a better position to make adequate use of digital tools that increase their engagement and academic performance. The overall effect is highly backed by the combination of effects of digital learning resources, cognitive engagement, and digital literacy on the overall academic performance of students ($b = 0.56$, $p < 0.001$).

DISCUSSION

The results of the study prove the presented model as the digital learning resources are demonstrated to have a significant positive impact on the academic achievement of students both directly and indirectly, due to the improved cognitive engagement. Previous studies (Al-Fraihat et al., 2020; Kumar and Kumar, 2021) emphasized that technology-enhanced learning creates a favorable environment with self-regulation,

interactivity, and flexible learning experience, which leads to better outcomes, and this large positive correlation of digital learning tools and academic performance is agreeable with the previous studies. Learners who participated in this research indicated greater levels of understanding and performance by actively engaging online, virtual classrooms and multimedia tools. The influence of the digital learning tools on the cognitive engagement is strong and positive, which means that gamified learning, feedback systems, and technological interaction influence students to pay more attention to their studies. They are consistent with the findings of Zhang et al. (2023) and Sun and Chen (2022), who found that interactive experience and adaptive feedback in online learning make students more motivated and persevere. The application of these tools helps the students shift to an active engagement in Pakistani context where traditional teaching is still very common. Cognitive engagement was discovered to have a positive effect on academic performance (H3), a fact that proved that the perseverance, introspection, and cognitive processes among students lead to better understanding and better results. This supports the arguments that Rahmat at,.al (2021) puts forward that encouraged students to employ self-regulated strategies to sustain attention and trigger critical thinking. With respect to Rahman et al. (2022), mediation analysis also shows that cognitive engagement is an essential process whereby digital utilities are converted into academic benefits. The moderate analysis further improved the relationship between digital learning resources and cognitive engagement as a result of digital literacy. This study highlights how better-digitally literate students have the ability of using, navigating and enjoying the fruits of using online resources. It is consistent with the results of (Vuorikari et al,.2022) and Ali et al. (2022) who reported that low digital competency could reduce the possible benefits of digital learning and hinder engagement. Digital literacy is thus a very important facilitator that promotes interaction and education results in technologically advanced educational systems such as the one in Pakistan. On the whole, the results indicate that the incorporation of technology in higher education should be conducted side by side with the support of the digital literacy and engagement of the mind in order to attain meaningful learning and improved academic performance.

CONCLUSION

The findings of the study, based on captured data, indicate that digital learning resources positively, and indirectly, enhance academic performance in higher education through promoting cognitive engagement. Students who are more engaged in thought tend to have a higher level of understanding, motivation, and problem solving abilities all of which resulted in an improved grade. Also, through increasing the role of digital tools in interaction, digital literacy critically moderates. The findings reveal that digital competence and cognitive investment among students should be available alongside technology. To achieve the potential of technology-enhanced learning in Pakistan, higher education institutions need to promote digital literacy, pedagogical creativity, and teaching strategies based on engagement.

LIMITATIONS

This research has its limitations even though it makes some contributions. To begin with, the fact that the students may not have a true picture of their academic performance may result in response bias since the self-reported questionnaire is used. Second, the design is cross-sectional and makes it harder to assume about the causal relationships between performance, engagement, and digital learning tools in the long term. Third, the sample was not generalizable to other educational and cultural settings since it was only restricted to a small number of universities in Pakistan. Finally, the paper did not consider other forms of engagement, such as emotional or behavioral engagement; this would have given a more detailed picture of the researcher.

FUTURE DIRECTIONS

The present study can be extended in the future when mixed-methods or longitudinal method is carried out to explore the impact of long-term use of digital learning materials on critical thinking and cognitive engagement. Researchers might also consider using behavioral and emotional engagement variables to gain a more in-depth insight into the process of engagement. Comparison of different countries or regions can highlight the influence of socioeconomic status or institutional infrastructure on the outcome of digital learning. The research on the future must also be conducted on the design of pedagogy and teaching digital competencies as the complementary factors that influence the academic performance and engagement among students.

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