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Impact of Digital Learning Tools on the Academic Performance of Elementary Students: A Study in the Context of Lahore, Pakistan

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ABSTRACT

This research aims at the effect of digital learning tools on the academic achievement of Grade 1-5 students at private schools of Lahore, Pakistan from the point of view of the classroom teachers. In this regard, a qualitative interpretivist approach was used in which in-depth semi-structured interviews were held with 12 elementary teachers from five private school networks: Lahore Grammar School, Beaconhouse School System, Dar-e-Arqam Schools, LACAS, and The City School. The study uses two theories, namely, Constructivist Learning Theory and Technology Acceptance Model (TAM). Thematic analysis was used in a reflexive way, revealing six overarching themes: (1) a significant improvement in student engagement, (2) using visual and multimodal digital resources to improve conceptual clarity, (3) problems of teacher adaptability and the lack of pedagogically oriented professional development, (4) digital distraction and its mitigation through structured classroom management, (5) infrastructure-related concerns about unreliable internet connectivity and power outages, and (6) moderating effects of parental digital literacy and home learning environments. The results show that the influence of digital learning tools on student learning is mediated by a combination of teacher competence, pedagogical design quality, school support, and context. The study adds original qualitative evidence to the body of knowledge of educational technology in Pakistan and suggests a focus on pedagogical training as a means of sustaining the educational use of technology, and a shift to the pedagogical frameworks of digital learning that prioritize equity.

Keywords: *digital learning tools, elementary education, academic performance, teacher perceptions, constructivism, Technology Acceptance Model, Lahore, Pakistan*

INTRODUCTION

In the last 20 years, education systems globally have undergone extraordinary transformation because of quick developments in digital technologies. Socio-economic inequalities and inadequate infrastructure in developing countries like Pakistan have resulted in uneven impact, which have been prominent but not as

pervasive as in the developed world. Computer and digital media use in classrooms is one of the most significant changes in today's teaching practice from a transmission to a transformative pedagogical model.

The educational digitization process in Pakistan started in early 2000 with several digitization efforts based on ICT in the National Education Policy (NEP) of Pakistan 2009. Technology integration with the objective of enhancing quality and equity was identified as a need in the National Education Policy (2009) at all levels of education. Digital literacy was further highlighted by subsequent policies, such as the National Curriculum for Computing (2007) and Single National Curriculum (2020-2023). This vision was also in the context of Pakistan Vision 2025, with the objective of supporting a knowledge-based economy (Azhar, et al., 2025; Shafiq, et al., 2025; Azhar, et al., 2025).

But policies have been unevenly provided. The knowledge gap in access to technology, in awareness of teachers and availability of facilities between rural and urban Pakistan still exists. The world pandemic COVID-19 in 2020–2021 created an unprecedented opportunity to accelerate the shift to remote and blended learning in education, causing these inequities to become even more apparent. Public-sector schools in rural areas were far from fast to adapt, while private schools in major cities were more successful (Yeasmin, et al., 2026).

Lahore holds special importance in this enquiry as it is the cultural and educational hub of Pakistan and second largest populated city of the country. It has spearheaded integration of technology in learning processes in its private schools, such as Beaconhouse School System, Lahore Grammar School, The City School, LACAS, and Dar-e-Arqam. The effect of digital tools in this socio-cultural and economic environment, however, which is not well represented in international literature, is the main motivation for the present study (Azhar & Imran, 2024).

The elementary years are the building blocks of future learning. This is a critical period in childhood, during which they learn basic cognitive abilities such as literacy, numeracy, reasoning and socio-emotional development (Piaget, 1952; Vygotsky, 1978). Studies of cognitive development and educational psychology have repeatedly suggested that learning currently is more successful when experiential, visual and interactive, which digital learning tools are ideally suited to deliver.

Digital learning tools refer to the use of hardware, software, and online tools, such as interactive whiteboards, tablet computers, LMS, eBooks, simulations, gamified platforms, and digital tutoring systems, that support learning and teaching (Siddiqui & Khan, 2020). These resources have been shown to greatly enhance student motivation, conceptual understanding, and metacognition when used properly (Cheung & Slavin, 2013; Higgins et al., 2012). Digital tools in the context of Pakistan, especially in a highly competitive private school environment in Lahore, could be regarded as both teaching tools and as marketing assets for the institution (Pirzada, Tabassum & Ahmad, 2024). They offer fascinating insights into their ability to tailor learning, increase engagement, and work around the constraints of one-teacher classes, and this is an opportune and relevant time to study them.

Although many private elementary schools are incorporating digital learning tools, there is a lack of systematic and locally based evidence of how teachers and students are using these tools and the mechanisms that may be present between the use of technology and achievement. Quantitative studies from Western and East Asian contexts provide correlational data, but the factors that help to explain these correlations, including teacher beliefs, school context, parental involvement, telecommunications, and regulations and policies, have not yet been investigated in depth in the context of Pakistan. This divide has led to a policy and practice context which is largely technology-hyped and vendor-marketed rather than evidence-based locally. The present study aims to overcome this and qualifies the study by conducting in-depth interviews of teachers in different private school localities of Lahore.

Research Objectives

This study aims to: (1) investigate teacher perceptions of the effects of digital learning tools on elementary students' academic performance in Lahore's private schools; (2) identify the most common digital tools used in these classrooms and analyses their pedagogical applications; (3) explore challenges encountered in integrating digital tools, including distraction, infrastructure, and digital literacy; (4) examine the role of parental support and home digital environments in moderating academic benefits; and (5) analyze the mediating role of teacher adaptability, professional development, and institutional support.

Research Questions

The following research questions are guided throughout the study:

RQ1: What do teachers think about the impact of digital learning tools on academic achievement at private elementary schools in Lahore?

RQ2: What digital tools are being used most and how do they fit into classroom instruction?

RQ3: What do teachers believe digital tool use has changed in students' engagement, motivation and performance?

RQ4: What are the main challenges of successful integration of digital tools in elementary classrooms?

RQ5: What are the roles of institutional, infrastructural and socio-economic factors in the success of digital tools?

RQ6: What is the effect of parents' involvement and access to digital tools at home on academic value thereof?

LITERATURE REVIEW

Digital Learning Tools in Elementary Education

The research of digital technologies in elementary classrooms has covered about three decades of research on computer-assisted instruction to AI based adaptive learning systems. Cheung and Slavin (2013) in a seminal meta-analysis, found that there was a small but consistent effect size (d = 0.16) between the use of educational technology and student achievement, with greatest effects in mathematics and reading comprehension at elementary school level. The authors pointed out that such effects were dependent upon the quality of instructional design, teachers' competence, and technology exposure.

In a systematic review commissioned by the Education Endowment Foundation, Higgins et al. (2012) discovered that interactive technologies mainly interactive whiteboards and the use of tablets showed significant, positive effects on student engagement and knowledge gained when used as a supplement to the role of the teacher, rather than replace it (Kolachi et al., 2024). Personalized learning platforms were also found to have a positive influence on mathematics achievement with especial benefit to students with below average achievement as reported by Pane et al. (2015) which is directly relevant for the Lahore context (Alam, et al., 2026).

A meta-analysis of 59 studies on mobile device use in K–12 education found that overall, there was a moderate positive effect size (d = 0.52) for academic achievement, and that this was greater at elementary

school than at secondary school, likely due to the match between some of the game-like affordances of mobile learning and developmental features of younger students (Haider, Ahmad, & Ali, 2024). The 'digital determinism' that places the digital tool at the center of the learning process, however, should be resisted, as Selwyn (2011) cautions: The educational value of digital tools is never inherent but is always dependent upon pedagogical choices of the teacher, institutional culture and wider socio-economic conditions.

Academic Performance and Technology Integration

Academic performance in which technology integration is seen is at grade two. The technology-academic performance tie is complicated, non-linear, and strongly mediated with contextual factors. The large number of meta-analyses conducted by Hattie (2009) suggests that technology had a moderate positive impact on student achievement ($d = 0.37$), but that this impact was significantly overshadowed by teacher quality, feedback, and formative assessment. Breaking it down in more detail, OECD (2015) longitudinal data indicated that PISA performance was directly related to moderate and light computer usage (up to two hours per day), but that it decreased and may become negative with heavy usage, and perhaps with excessive usage overall.

In South Asia, Bansode and Kumar (2020) reported that the benefits of using digital tools in elementary schools were found to be statistically significant with conditions; that is, if the teacher is supportive and lesson plans are planned to use the digital tools. Similarly, Siddiqui and Khan (2020) found that while the availability of a tool was important, teacher facilitation and content matching were important moderation factors (Hasan, et al., 2026). There is also a distinction between operational digital skills and higher-order information and strategic skills (Van Deursen and Van Dijk 2014), with higher order skills being most beneficial to students when using digital tools academically. Students should learn about the roles of teachers and how they engage in their professional learning.

Teacher Roles and Professional Development

Teachers are at the heart of technology-mediated learning but are often under theorized. Ertmer and Ottenbreit-Leftwich (2010) describe two types of barriers: external barriers (first order) and internal barriers (second order) such as negative attitudes toward technology, pedagogical beliefs, pedagogical identity, and insufficient hardware and infrastructure. Their research shows that second-order barriers are more stable and that professional learning programs that only target the technical aspects of technology use in the classroom are unlikely to bring about enduring changes in technology use. The TPACK model (Mishra & Koehler, 2006) provides a basic heuristic for integrating technology into education: that it is not enough to integrate technology or pedagogy into education but also it must be integrated with content-specific knowledge (Ali et al., 2023). The present study further investigates the gap in professional development in Pakistani schools, as found by Ahmad et al. (2019), that is, it is usually restricted to operational software training and not pedagogically embedded learning (Ahmad, Sewani & Khoso, 2024).

Challenges: Distraction, Infrastructure, and Equity

Distraction, infrastructure and equity are the focus of the 2.4 challenges. Digital distraction is a constant theme in literature as a major problem in technology-rich classrooms. In a recent study, Rosen et al. (2013) determined that students use devices for much of the class time in ways that are not on task. In elementary-level settings, Hembrooke and Gay (2003) found, through experiments, that simultaneous processing of lecture content and digital stimuli resulted in dual-task interference, which reduced information retention. Along with this there is a parallel challenge of infrastructure constraints in the Pakistani setting. The factors that have been consistently identified as challenges to the effective adoption of technology are unreliable internet connectivity, power outages, lack of sufficient number of devices and lack of dedicated IT support

(Memon et al., 2010; Ullah et al., 2021). However, Warschauer and Matuchniak (2010) warn that even in more well-resourced private schools, the unequal distribution of technology without efforts to consider pedagogical quality can perpetuate inequality (Ali et al., 2023).

Pakistani Context

A complex mix of policy intent, limitations, cultural values and institutional diversity defines the Pakistani digital education landscape. The concept of digital Pakistan was introduced by the federal government (2018) and the provincial government began to come up with an e-Learn Punjab program (2018) but the implementation at school level is irregular (Ullah et al., 2021). Despite the above, Hussain (2018) has pointed out that there are several structural issues that continue to be a problem today these include the absence of a clear national digital pedagogy framework, weak technical infrastructure, and lack of teacher training. In the private school sector, digital tools have been used for some time in the interest of prestige signaling, not as evidence-based design of instruction (Ahmad et al., 2019; Dilshad, Shah, & Ahmad, 2023). Pedagogical use is often superficial, pedagogical software is used instead of traditional teaching and learning, but not the use of pedagogical software that is used in an interactive way as research indicates is the most productive. Cultural and religious aspects are also significant: Schools with Islamic orientations like Dar-e-Arqam are faced with the challenge of incorporating digital tools into contexts where moral education, Quranic literacy and traditional values are paramount (Ali, 2020).

THEORETICAL FRAMEWORK

Constructivist Learning Theory

Constructivist Learning Theory is the one derived from this study; it was based on the researcher's study of Piaget (1952) and Vygotsky (1978). Constructivism learning theory is a learning theory where it is assumed that learning occurs it is not a passive process when receiving information, but learning is a process of building constructed by the learner as a result of paying attention to the environment of the surrounding, learning is the process of making meaning by experiencing a situation. Theories of cognitive development (Piaget) and socio-cultural constructivism (Vygotsky) emphasize the importance of action and interaction as well as the use of culturally situated tools as mediators in children's learning. Theories of digital learning see the tools as more than just information providers, but as a scaffolding for building knowledge through an experiential, collaborative and hands-on approach. Papert (1980) has a major tenet of constructionism, that is, to build and manipulate external representations to gain depth of understanding. This lens can help to understand the animated simulations, dynamic diagrams and interactive platforms that were described in the study by teachers. In this study, the animated simulations, dynamic diagrams and interactive platforms, which are seen here as modern versions of constructionist pedagogy, were described by teachers.

Technology Acceptance Model (TAM)

Understanding teacher adoption of digital tools from a complementary theoretical focus is the Theory of Reasoned Action (Ajzen & Fishbein, 1980) that traverses the prism of the Technology Acceptance Model (TAM) (Davis, 1989; Venkatesh & Davis, 2000). Perceived Usefulness (PU) is the perceived benefit of the technology to the user, and Perceived Ease of Use (PEOU) is how easy it is to use the technology, and TAM assumes that these two factors influence the motivation to use technology. These constructs mutually influence each other and affect the attitudes toward the use of technology, behavioral intention, and actual use behavior.

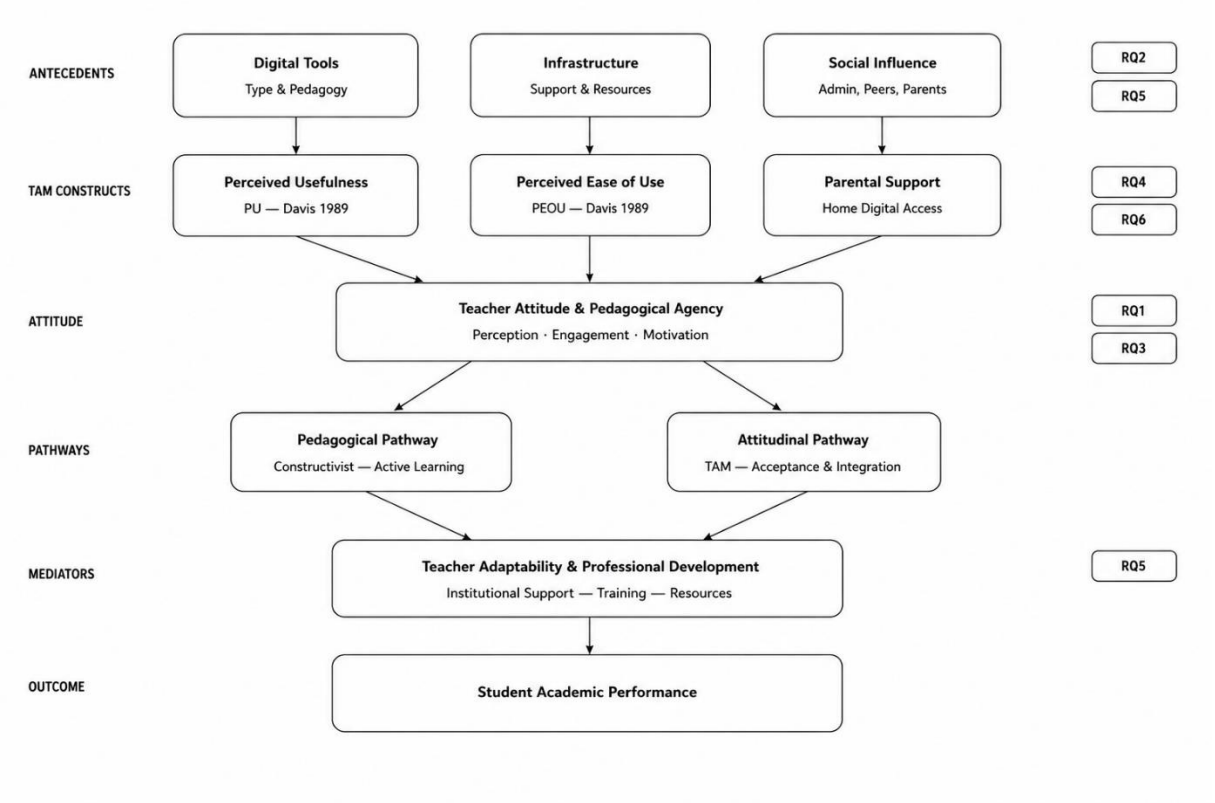
The extended UTAUT model (Venkatesh et al., 2003) also adds to the model the social influence that is, the extent to which significant other individuals (colleagues, administrators, parents) think that teachers

should use digital tools as a predictor of adoption. In Lahore's competitive private school landscape, social influence is tremendous in managerial directives and high expectations from parents. TAM thus offers a multi-scalar approach that links individual teacher cognition to support for the teacher in the institutional level, as well as to infrastructural conditions at the macro level.

Figure 1

Theoretical Framework & Research Questions conceptual

(Constructivist Learning Theory+ Technology Acceptance Model + Students Academic Performance)



The conceptual model of this study is depicted in the figure below which is a multi-layered conceptual model consisting of the Technology Acceptance Model (TAM) and Constructivist Learning Theory (CLT). The model has six levels, each of which represents a different conceptual level. The uppermost level, Antecedents, includes three different types of inputs: Digital Tools (type and pedagogy, related to RQ2 and RQ5), Infrastructure (support and resources), and Social Influence (administrators, peers, and parents). These represent the structural and contextual conditions that facilitate technology use in classrooms. The TAM Constructs layer focuses on the cognitive and affective factors that influence teacher technology acceptance, including Perceived Usefulness (PU, Davis, 1989), Perceived Ease of Use (PEOU, Davis, 1989) and Parental Support (home digital access), which are relevant to RQ4 and RQ6. The three constructs of TAM merge into the Attitude layer (Teacher Attitude and Pedagogical Agency including perception, engagement and motivation), which is associated with RQ1 and RQ3 and places the teacher as the central mediator in the model. The two orientations of the study, theoretical and attitudinal, are evident in this

attitudinal core, which splits into an Attitudinal Pathway, based on the logic of acceptance and integration of TAM, and a Pedagogical Pathway, based on the principles of Constructivist theory and active learning. Both pathways lead to one of the key intervening mechanisms, the Mediators layer (Teacher Adaptability and Professional Development) that includes institutional support, training, and resources (RQ5), and which serves as the link between theoretical pathways and observed classroom practice. Lastly, this mediated process symbolizes the Outcome: Student Academic Performance, which serves as the last dependent variable of the study and is located at the bottom of the model. The model together makes an important visual statement about the complex, multi-layered, and indirect nature of the impact of digital learning tools on academic performance; an impact that is examined empirically through the six research questions that are embedded in the model.

RESEARCH METHODOLOGY

A qualitative interpretivist research design is used in this study. Interpretivism is the view that social reality is created through the experience, making meaning and interaction of humans and that social enquiry is to understand the meanings of those who experience social reality (Creswell, 2014; Lincoln & Guba, 1985). Since the research questions are about the process, perception and meaning of the study and there are no quantitative instruments calibrated to the Pakistani socio-cultural context, therefore a qualitative approach is methodologically appropriate.

The data collection technique was in-depth semi-structured interviews. The technique has proven to be good for obtaining comprehensive and contextually embedded descriptions of subjects' experiences, beliefs, attitudes and interpretations (Kvale & Brinkmann, 2009). The interview protocol included six thematic areas: (1) professional background and experiences with the digital tools; (2) digital tools used in elementary classrooms; (3) perceived effects on student engagement and academic learning; (4) challenges in integrating digital tools; (5) institutional and infrastructural factors; and (6) parental support for digital learning.

The interviews took place, with the full consent of the researcher, in isolation, in a private environment at each participant school/personnel place. The sessions lasted between 30 minutes and 1 hour, were audio-recorded and transcribed verbatim. When participants opted to respond in Urdu or code switching, the researcher facilitated them and used back translation technique when transcribing their responses to ensure accuracy.

Using purposive sampling (Patton, 2002), twelve (12) elementary teachers were selected in five private school networks of Lahore namely Lahore Grammar School (LGS), Beaconhouse School System, Dar-e-Arqam Schools, LACAS and The City School / United Charter School. Participants had to be teaching at the elementary level (Grades 1-5) and to have at least two years' experience in teaching, and to be using at least one digital learning tool at least weekly in their classroom. The sample included a variety of subject specializations (English, Mathematics, Science, Social Studies, General Studies), experience ranges (2–19 years) and age groups (24–52 years). The sample size was based on a theoretical saturation where no new themes were identified in the 12th interview.

The reflexive thematic analysis method (Braun & Clarke, 2006, 2019) was used as the main analytical technique. The six-phase process involved the following: (1) familiarization, by repeated reading and note taking on meaningful units of data; (2) initial coding of data into candidate themes; (3) collation of codes into candidate themes; (4) review and refinement of themes against the full dataset; (5) definition and naming of themes; and (6) writing the analytic report. During the initial coding phase, 87 open codes were produced, which were then grouped into 14 higher order codes and six overarching themes.

Multiple strategies ensured rigor: member checking with three participants for thematic accuracy; detailed reflexive memos which documented analytical decisions; and peer de-briefing with research supervisor. These measures include those related to the trustworthiness criteria of credibility (Lincoln & Guba, 1985) as well as those of transferability, dependability and confirmability. All ethical principles used in human subject's research were followed. The participants gave informed written consent and were informed that they had the right to quit at any time without any consequences. The audio recordings were kept on password protected devices, which were the only devices the researcher can access. All transcripts and reporting documents were anonymized and participant identities and school identifying information were not disclosed. Interviews were scheduled at convenient times and were kept confidential by the school administrators.

DATA ANALYSIS AND FINDINGS

The 12 interview transcripts were analyzed thematically, using the reflexive approach, which resulted in six themes summarizing the multi-faceted relationship between digital learning tools and the academic performance of the elementary students as seen by classroom teachers.

Theme 1: Enhanced Student Engagement

Digital learning tools were the most common conclusion from all twelve interviews: a positive effect on student engagement. Across all schools involved teachers stated that there were qualitative changes in classroom dynamics after digital tools were introduced, with increased focus, attentiveness, and enthusiasm. The interactive whiteboards and animated videos were the most strongly engaged response right away and the learning apps and gamified platforms were engaged longer. Specifically, teachers saw increased interest from students who were previously disengaged in traditional teaching and learning environments.

*"*The moment I switch on the smart board and bring up an animated diagram or a short video clip, you can literally see the children sit forward. Their eyes widen. They want to see what is going on. (Participant, Beaconhouse, Grade 3 Science Teacher)"

Participants' responses were consistently related to academic participation and engagement as a steppingstone to deeper learning, which was consistent with constructivist theory (Piaget, 1952; Vygotsky, 1978). The contrast between the forms of engagement appeared to be of particular significance, with only one form, substantive engagement (the cognitive effort involved), linked with lasting academic outcomes, as Selwyn (2011) warned in his discussion of entertainment value versus academic value.

Theme 2: Concept Clarity Through Visual and Multimodal Representation

The second theme was about the potential of digital tools for conceptual clarity, via visual and multimodal materials. The animated diagrams, interactive simulations, video demonstrations and dynamic infographics were noted as especially helpful for breaking down abstract or complicated material for elementary students.

"With the water cycle, when I show them animated evaporation, condensation, and precipitation, they have a different level of understanding. The visual makes the abstract concept concrete for them. (Participant, LGS, Grade 5 Science Teacher)".

Dynamic visual tools were especially welcomed by math teachers, especially in the work of fractions, geometry and place value. Moving visual components (or "tiles") around on a screen using a mouse, and demonstrating this manipulation, was reported to promote conceptual understanding much more than static

diagrams. Similarly, literacy teachers reported positive impact for students who were reading challenged or dyslexic with the use of digital storytelling tools and text to speech. The focus on these accounts is on the constructionist emphasis of Papert (1980) on learning through the active manipulation of representational artefacts at the center of the learning process.

Theme 3: Teacher Adaptability and Professional Development

One theme emerged as a major topic, the challenge of teacher adaptability. Participants generally had positive attitudes towards the educational potential of digital tools, but they expressed different levels of digital competence and recognized high learning curves with new technologies. The majority had received technical training from the school, and in most cases, this training had been provided by an ICT coordinator or a software vendor, but they were usually asked about the pedagogical depth and relevance of this training.

"The training we receive is mainly on how to use the application. How to log in and how to use features. But no one explains how to incorporate it pedagogically, how to plan a lesson so that it supports a learning goal. That we work out for ourselves, by trial and error. (Participant, LACAS, Grade 3 Teacher)"

This is consistent with the notion of pedagogical identity as a second-order barrier to technology integration, which cannot be overcome with one-time training (Ertmer & Ottenbreit-Leftwich, 2010), and with the finding that sustained, classroom-integrated professional learning is more effective than one-time training (Darling-Hammond et al., 2017).

Theme 4: Digital Distraction and Classroom Management

The fourth theme tackled the issue of digital distraction. When participants were allowed to use their devices in an unrestricted way, some reported that students quickly moved towards off-task activities such as games, YouTube, and other non-academic browsing, once the device was given to them without structured protocols. The results are consistent with the inverted-U curve between technology use intensity and academic outcomes observed by Rosen et al. (2013) and the OECD (2015).

"If we give them tablets without proper instructions and monitoring, they will be involved in games or YouTube within minutes. What makes these tools powerful also makes them a distraction risk. (Participant, LGS, Grade 4 Mathematics Teacher)"

Teachers at schools that had a clear technology management plan in place, including clear procedures for handling technology in the classroom, a sequence of tasks, and a clear timeline for technology and off-technology instructional time, reported significantly fewer challenges related to distraction in the classroom. Participants also recognized the difference between commercially available applications that focused on entertainment rather than depth in learning and required a longer cognitive effort and yielded ‘deep engagement’ versus ‘shallow engagement'.

Theme 5: Infrastructure and Accessibility Constraints

A fifth thematic cluster covered infrastructural barriers. While private schools in this study were better resourced than government schools, they were certainly not untouched by major technical issues. The most common hurdles reported were unreliable Internet connections, which occurred mid-lesson, causing instructional disruptions and burdening teachers in preparing lessons. An issue that frequently occurred was that electricity supply was unavailable, commonly referred to as load shedding, especially in the schools lacking backup power facilities.

"We have a smart board, but the internet is not working well. The connection disconnects mid-lesson, and you lose the flow. You always must have a backup plan, and that is an extra burden on the teacher. (Participant, Dar-e-Arqam, Grade 5 Teacher)"

Further limiting pedagogical possibility was the scarcity of devices. Teachers stated that in classrooms with the insufficient 1:1 ratio, the amount of individual exploration was reduced to group demonstration to fulfill the 1:1 ratio, ultimately lowering the educational value of the digital devices. The results of this study are like the findings of Memon et al. (2010) and Ullah et al. (2021) since infrastructural problems continue to exist even in the relatively privileged private school environment in Lahore.

Theme 6: Parental Support and Home Learning Environments

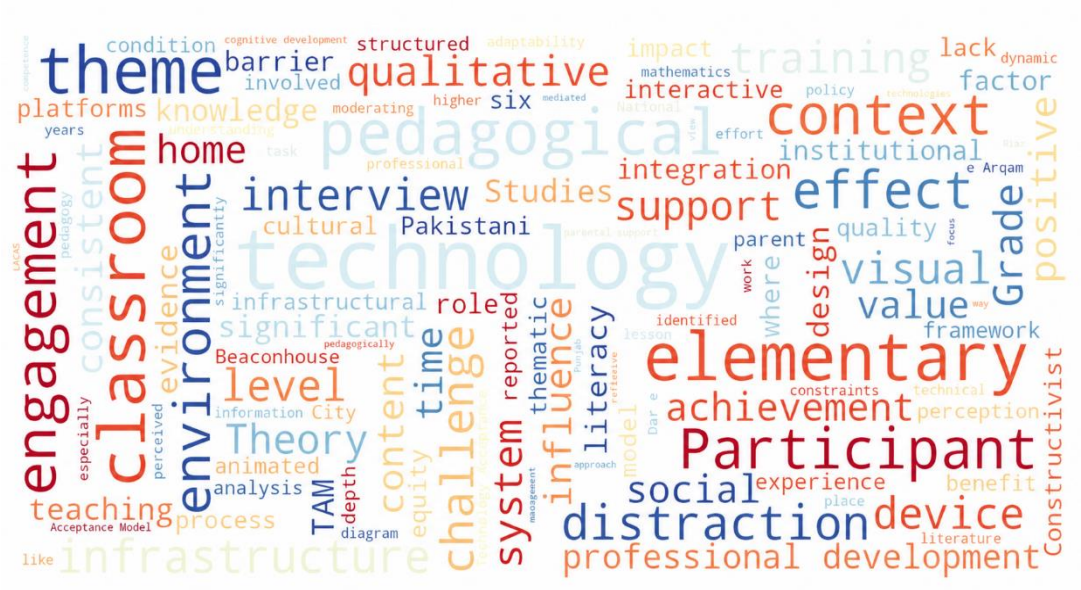
The moderating effect of parental involvement in and home digital environments was the final and sixth theme identified. All the participating schools identified parental support as an important factor in their students' academic benefits from classroom digital tools. Children with parents who were very involved in their child's digital activities, actively engaged in talking with their child about learning platforms and involved in school communication channels showed significantly greater progress.

"The digital tool opens a door, but someone needs to walk through it with the child. (Participant, Beaconhouse, Grade 5 English Teacher)"

There was very wide variation in digital support provided at home even amongst private schools. Where parents were digitally literate, they could reinforce and extend the digital learning in the classroom; where parents were not, they could not. As several teachers pointed out, this differential could potentially mean widened achievement gaps between learners with high and low home-learning environments, providing empirical support for Warschauer and Matuchniak's (2010) argument against conceptions of digital equity that focus on access.

Figure 2

Word Cloud Impact of Digital Learning Tools and Academic Performance



The word cloud above is a visual frequency analysis of the combined textual data that was collected from 12 semi-structured teacher interviews from private elementary schools in Lahore, Pakistan. Each term's size reflects the proportion of the total interview transcripts that the term appeared in, thus giving an overview of the most prevalent concepts and themes from the qualitative data. The most salient terms engagement, classroom, environment, technology, elementary, pedagogical, qualitative, context, and Participant are those that became central to the conceptual language of the study and that occurred in all contexts and subject specializations. The second tier of high-frequency terms, such as challenge, distraction, infrastructure, professional development, support, integration, training, visual, influence, and literacy, represent the principal evaluative and experiential aspects of teacher accounts, both positive and challenging, related to the use of digital tools. A third layer of relatively common terms parent, home, achievement, perception, constructivist, TAM, equity, content, animated, and cultural indicate the contexts and mediation that influence digital learning outcomes in the context of the Lahore private school environment. The spatial distribution and chromatic variation of the word cloud further highlight that teacher conversations about digital learning revolve around the themes of engagement and distraction, pedagogy and infrastructure, institutional support and personal adaptability, and other themes closely aligned with and confirming the six themes of the study.

DISCUSSION & CONCLUSION

The most consistent and dominant theme is "enhanced student engagement", which is in line with the constructivist expectation that active student engagement is a necessary condition for cognitive development (Piaget, 1952; Vygotsky, 1978; Ahmad, Noorani, & Channa, 2025). The results obtained in Lahore corroborate with international literature (Cheung & Slavin, 2013; Higgins et al., 2012) which showed that engagement is the most common route by which edtech influences academic improvement. The difference between performative and substantive engagement, however, is an original contribution: It emphasizes pedagogical (as opposed to just technological) influences on the sustainment of academic gains from digital tools.

The view of the concept-clarifying role of visual digital content expressed by teachers is consistent with Papert's (1980) constructionist theory, and with research on virtual manipulatives in elementary mathematics (Pane et al., 2015; Ahmad & Rizvi, 2026). This study builds upon the work of those who have offered contextually specific evidence for pedagogically effective visual digital content, which is the focus of this research, and for pedagogically effective conditions for the content to be perceptually accessible to learners during Piaget's concrete operational stage of cognitive development.

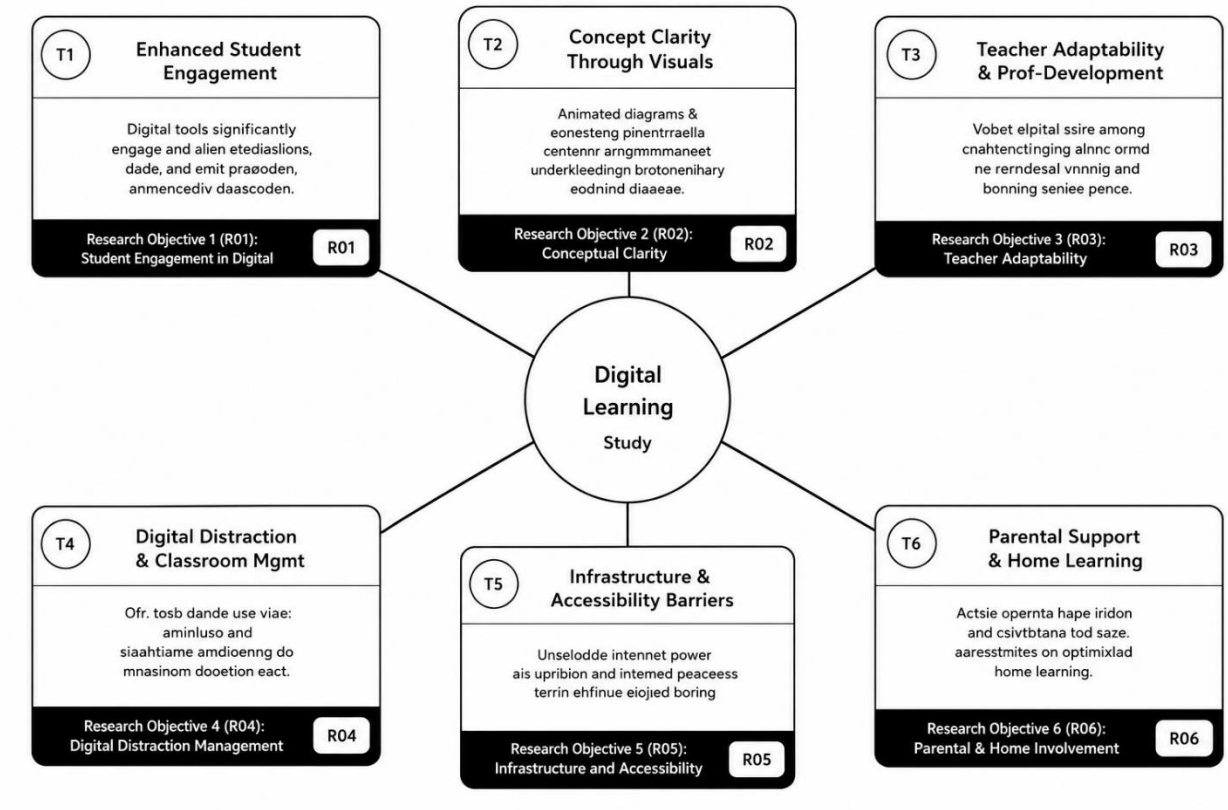
The teacher participants show a general consistency with the Technology Acceptance Model (TAM) (Davis, 1989) with the higher values of perceived usefulness and ease of use corresponding to higher values of creativity and consistent use of technology. The data also show the moderating role of institutional culture, which was underdeveloped in the original TAM model, and that schools with a clear digital learning vision had higher attitudes toward ease of use and more positive attitudes among teachers. The discovery is like Venkatesh et al (2003) who emphasized the importance of social and organizational factors in UTAUT model. This separation between technical training and pedagogical integration also resonates with Ertmer and Ottenbreit-Leftwich (2010) who discussed "second order barriers," and with Darling-Hammond et al. (2017) who argued for the need for continued, continuous professional learning.

The distraction theme adds much needed critical nuance to the overall positive picture: it is consistent with the OECD's (2015) inverted-U findings, and with the finding by Rosen et al. (2013) that off-task device use occurs in K-12 classroom settings. Given that the result was that distraction is significantly reduced in schools with structured classroom management systems, this is not just a behavioral issue, but a pedagogical one and has implications for teacher professional development (Faheem, Gulab, & Ahmad, 2025). The

infrastructural findings contribute to prior research (Memon et al., 2010; Ullah et al., 2021; Ahmad, Sewani, & Fatima, 2025), building upon their evidence that structural constraints continue to exist in the private school sector, but also offer original and context-specific evidence of the critical role of home learning environments in the academic impact of classroom use of digital tools (Oad et al., 2024).

Figure 3

Six Themes Brief Description



The figure shows a conceptual mapping diagram of the 6 thematic findings obtained from reflexive thematic analysis of 12 teacher interviews from 12 private elementary schools in Lahore, Pakistan. The middle card is the Digital Learning Study as this is the overall theme of the study and is connected to six theme cards that are connected to the respective research questions (Shah, Ali & Ahmad, 2024). Theme 1 (T1) is Enhanced Student Engagement where digital tools are having an impact on student attention and engagement in classrooms. Theme 2 (T2) uses the concept of Concept Clarity Through Visuals to explore how the use of animated diagrams and interactive simulations allowed elementary children to deepen their conceptual understanding. Theme 3 (T3) is dedicated to Teacher Adaptability and Professional Development, and digital competency of teachers is multifaceted; training is largely missing and not pedagogically oriented. In Theme 4 (T4) it was identified that Digital Distraction and Classroom Management were key theme where devices were not well organized and some off-task behavior was a challenge that needed managing. Theme 5 (T5) explores Infrastructure and Accessibility Barriers and their impact as structural barriers to effective digital learning, such as lack of reliable internet access, power outages, and limited devices (Thomas, Khan & Ahmad, 2022). Finally, in Theme 6 (T6), Parental Support and Home Learning Environments is examined and the moderating effect of parental digital literacy and

parental active supervision on increasing or decreasing the academic benefits of digital tools' use in the classroom is discussed (Ahmad, Sewani, & Channa, 2025). The figure suggests that the effect of digital learning resources on the learning outcomes is not linear but multidimensional, depending on pedagogical, institutional, infrastructural and socio-contextual circumstances.

CONCLUSION AND RECOMMENDATIONS

This study investigated teacher perceptions of the impact of digital learning tools on the academic performance of elementary students in Lahore's private schools. Qualitative interviews with 12 teachers revealed six thematic findings: increased engagement, increased conceptual clarity by visual content, challenges of adaptability by teachers, digital distraction, infrastructure constraints and moderating effect of parental support. All in all, these findings confirm that the connection between the use of digital tools and academic outcomes is not direct but is mediated by the teacher's competence and attitude (TAM), pedagogical design quality (Constructivist Theory), and contextual factors of the Lahore private school context.

The teacher is not a mere facilitator of technology, but a key pedagogical designer whose knowledge, attitudes and professional development are essential to the education that any digital tool can bring. The insight is not limited to the Lahore context but extends to the more general problem of providing sufficient and long-term, educationally focused support systems for the investment in educational technology.

Recommendations

The following recommendations are made based on the findings. First, investment in education needs to move away from purchasing hardware and instead center on using pedagogy to implement the technology to meet clearly stated learning goals, provide good professional development, and ensure equity. Secondly, private schools in Lahore should be adopting formal DL models and teacher techno-learning communities as well, and not merely the most popular techno lovers, but the tools which will help achieve learning goals. Thirdly, on the policy level, the Punjab Curriculum and Textbook Board, in collaboration with the School Education Department, should develop a comprehensive Digital Pedagogy Framework with teacher competency benchmarks, parent digital literacy programs, and student curriculum and textbooks based in the local context in Urdu. Such a system is crucial to making sure that the advantages of digital learning are not limited to the best resourced schools.

Limitations and Future Research

The study has limitations as it is conducted within the private school context of only one city and is of a qualitative nature, thus not allowing for generalizations in the statistical sense. The findings here would benefit from further studies using mixed method designs that combine the qualitative findings with quantitative measures of academic performance, and from a further exploration of the public-school sector and rural contexts in Pakistan. Longitudinal designs would also allow for investigation of whether academic improvements for student engagement with digital tools persist over time.

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