



Designing Effective Technology-Enhanced Learning Experiences: A Study of Teachers' Instructional Design Practices

Dr. Riffat Ahmad¹, Yasmeen Aman², Syed Zaheer Abbas³, Syeda Naimah Batool⁴, Muhammad Saleem⁵

¹School Education Department, Gujranwala, Punjab, Pakistan. Email: riffatahmad78@gmail.com

²PhD Scholar, Department of Education, The University of Lahore, Punjab, Pakistan

Email: 70183212@student.uol.edu.pk

³PhD Scholar, Department of Education, The University of Lahore, Punjab, Pakistan.

Email: 70183819@student.uol.edu.pk

⁴BS (Education) Department Educational Development, Public School and College and College Skardu, Affiliated with University of Baltistan. Email: syedanaima624@gmail.com

⁵BS Student, Department of Botany, University of Baltistan Skardu, Pakistan. Email: msaleembotanist@gmail.com

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Corresponding Author:

Syed Zaheer Abbas

Email:

70183819@student.uol.edu.pk

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ABSTRACT

The present study aimed to describe the lived experiences of school teachers while designing technology-enhanced learning in classroom settings. The researchers adopted a phenomenological qualitative design and followed an interpretivist paradigm while completing this study. The paper provides an in-depth understanding of teachers' perceptions of designing instruction, using technology, and facing barriers while completing the process. The study was conducted among 18 school teachers who had significant experience using technological tools for pedagogical purposes. The participants were recruited through purposive criterion sampling from both public and private organizations in Lahore, Punjab. The data were collected via semi-structured interviews and transcribed verbatim. In the analytical phase, the authors used reflective thematic analysis, which allowed them to extract the main ideas and generate themes. The final document includes five themes, namely, pedagogy-first instructional planning, purposeful and limited technology use, patterns of student engagement, institutional support as a limiting factor, and professional learning outside formal settings. The findings demonstrated that developing technology-based courses depends primarily on teachers' pedagogical knowledge, professional skills, motivation, and engagement rather than the availability of resources. The participants reported multiple challenges associated with limited professional learning, time, and institutional support. Therefore, the current research contributes to addressing the gaps in the literature on instructional design and technology by providing practical recommendations for teacher educators, designers, and policymakers.



Introduction

The classroom is a place where pedagogical intentions and digital affordances are entangled, with teaching quality in part contingent upon the instructional design choices made before any learning takes place. Educational technologies have transitioned from being peripheral to central features in classrooms, but their presence in a classroom does little to ensure effective learning. The transformation of a technology into a pedagogically productive resource is dictated by instructional design and depends primarily on educators' analyses of their learners, articulations of goals, task designs, classroom orchestration, and evaluations of outcomes. Teaching interventions that entail technologies as integral components are fundamentally shaped by the design work undertaken by teachers, and understanding how teachers engage in this work, as well as the challenges they encounter, has become a research priority (Kirschner, 2015; Timotheou et al., 2023).

Instructional design has traditionally been theorised as a systematic process undertaken by specialists working outside the classroom, producing materials and sequences for others to deliver. In school settings, however, design is an everyday teacher activity, carried out under time pressure, with incomplete information, and in response to immediate classroom realities (Kirschner, 2015; Ajani, 2024). Teachers adapt, improvise, and redesign continuously. This distinction matters because models of instructional design that assume abundant time, technical support, and stable conditions describe poorly the reality of a teacher planning a forty-minute lesson for a class of fifty students in a school with intermittent connectivity (Ajani, 2024; Zunica, 2023).

Technology-enhanced learning refers to learning environments in which digital tools are used intentionally to extend, deepen, or transform what learners can do. A closer examination of the term reveals that the adjective 'enhanced' is subjective and can only be achieved conditionally (Selwyn, 2021). There is a growing body of evidence that technology is a weak contributor to learning gains and that its pedagogical use is a better predictor of learning outcomes. In addition, it was found that the teacher plays a critical role in determining whether and how technology will be used in the classroom to maximize learning outcomes (Timotheou et al., 2023; UNESCO, 2023). Specifically, a teacher's ability to combine pedagogy and content knowledge in accordance with the context and needs of the learners determines their ability to leverage technology to improve learning outcomes. This argument is supported by the concept of technological pedagogical content knowledge (Mishra & Koehler, 2006).

Although a considerable amount of research has been conducted on technology integration, most of them focused on quantitative analysis and investigated various levels of adoption, acceptance, or self-confidence (Lucas et al., 2021; Akram et al., 2022). While this type of study is necessary and provides insightful information on trends and correlations, such research does not adequately explain teachers' reasoning processes, underlying considerations, and design constraints of the decisions they have to make. The processual nature of decision-making, implementation, and design is less understood by experts, despite its crucial importance for adoption at school settings. This is especially true in South Asia, where school systems, examination practices, and class sizes differ drastically from Western contexts, which most design research comes from (Zaman & Anwar, 2024).

This study attempts to fill this research gap by adopting a phenomenological approach toward teachers' instructional design practices in technologically equipped classrooms. Instead of quantifying how often teachers use particular tools, it tries to understand the meaning they attribute to designing with technology: what they plan and prioritise, what they concession on, what they see as facilitating or constraining their work. The study was conducted in Lahore, Punjab, Pakistan, among secondary schools. This area is known for its rapid digitisation of education resulting from local reforms while the readiness of teachers to embrace this paradigm shift was found insufficient (Akram et al., 2022; Ghani et al., 2024).

Statement of the Problem

Schools in Pakistan have invested significantly in educational technology (edtech) over the past decade, from computer laboratories and multimedia classrooms to learning management systems and tablet initiatives. Educational technology is predicated on the expectation that its adoption will lead to enhanced pedagogy, although classroom practice offers little evidence of such innovation. Technology often serves to make traditional teacher-centered instruction more engaging, substituting presentation software for the blackboard, without fundamental pedagogical rethinking (Hamilton et al., 2016; Zaman & Anwar, 2024).

The problem is not that teachers are resistant to edtech innovation but rather that they are ill-prepared to adopt it. Teacher preparation programs do not emphasize the complex analytical and creative processes that go into instructional design; instruction is largely reduced to training, focusing on how to use particular technologies rather than designing learning activities around instructional goals (Norhagen et al., 2024; Amemasor et al., 2025). In addition, teachers' pedagogical choices are influenced by a range of contextual factors, including the amount of planning time available, large class sizes, high-stakes exams, and a lack of institutional resources. Teachers must constantly negotiate these constraints, and their experiences of such negotiations shape their attitudes towards technology-mediated instruction (Zunica, 2023; Ghani et al., 2024).

As a result, policy interventions and professional development initiatives often fail to consider the actual practices of teachers and the specific circumstances within which they operate. The issue with this research, therefore, is the need for further investigation into how school teachers navigate and mediate technology-mediated instructional design processes, as well as the limitations and possibilities of such technology in the context of Pakistani secondary education settings (Akram et al., 2022).

Research Objectives

1. To Determine school teachers' perspectives on technology-enhanced learning, particularly their understanding of instructional design
2. To Ascertain how teachers integrate technology into the pre- service, in-service, and assessment stages of instructional design
3. To Determine the challenges faced by teachers in instructional design in technologically enhanced classrooms

4. To Assess teachers' views of organizational and professional learning factors that facilitate or hinder instructional design
5. To Based on the teachers' views and experiences identify recommendations for teacher education, curriculum, and policy.

Research Questions

In accordance with the interpretivist paradigm, the following open-ended questions were developed:

1. How do school teachers describe and discuss instructional design?
2. How do school teachers incorporate technology in teaching, learning, and evaluation?
3. What difficulties do school teachers face when planning technology-assisted instruction?
4. How do school teachers talk about the impact of school's support on instructional design?

Significance of the Study

I think that the value of this study emerges from the emphasis on the reasoning preceding the practice. This study puts the focus on teachers' narratives to unveil the design rationales which are often hidden in quantitative surveys on teachers' technology use practices (Akram et al., 2022; Timotheou et al., 2023).

For teacher education programs, this study can guide the modification of the pedagogical technology courses if the challenges that teachers identified in this study stem mainly from the domain of design reasoning (Timmerman et al., 2022). If my analysis is correct, the courses that focus more on task design, alignment, and assessment will be more beneficial for teachers than technology software training. For school administrators, this study identifies the factors that make specific contexts of technology use possible, thus serving better as the basis for the distribution of limited resources to the areas that produce the best results (Pambudi et al., 2024; Amemasor et al., 2025).

Curriculum designers and policy-makers can use the findings of this study to evaluate the phenomena lying at the intersection of technology-facilitated pedagogy (Abel et al., 2022; Zaman & Anwar, 2024). For me, the most important contribution of our study is methodological, as qualitative studies on teachers' technologies use in the South Asian region are underrepresented (Abel et al., 2022; Zaman & Anwar, 2024).

Review of Related Literature

Instructional Design as a Teacher Practice

Instructional design emerged as a scientific discipline that focuses on designing conditions for learning. Its classical models describe the cyclical process of analysis, design, development, implementation, and evaluation that presupposes the availability of time, resources, and

detachment for the designer. Kirschner (2015) raised the question of whether teachers should be considered designers of technology-enhanced learning, given the special expertise and time this process requires, and this topic became even more relevant with the explosion of technologies in education (Kirschner, 2015; Timotheou et al., 2023). Researchers have started to acknowledge that teachers are designers as well, albeit their design process is less linear, more rapid, and often unconscious than that of professional instructional designers. Scholars have argued that teachers engage in design activities when they transform existing curricular resources, design learning activities, and shape classroom interactions to respond to emerging situations (Ajani, 2024). In other words, the design process occurs in real time and is context-dependent, which makes it distinct from the systematic and documented process of instructional designers. Acknowledging teachers as designers shifts the paradigm of technology integration in education from whether they can use these tools to whether they can adopt them as part of their design process (Kirschner, 2015; Norhagen et al., 2024).

Conceptualising Technology-Enhanced Learning

Technology-enhanced learning refers to the use of digital resources to add value or fundamentally change learning in some way. Selwyn (2021) points out that there is a problematic “celebratory” discourse around technology-enhanced learning that obscures power relations and reproduces dominant social orders. Technology-enhanced learning practices are rarely transformative and are often predicated on particular values. The key is to determine what particular affordance offered by the tool makes it better for learning than an alternative method at a comparable level of cognitive demand (Selwyn, 2021).

The SAMR framework helps sort out the two from the latter two categories by distinguishing between substitution and augmentation (making the existing task easier) from modification and redefinition. Hamilton et al. (2016) critique the framework’s implicit bias towards higher levels as being intrinsically better and its contextual insensitivity. SAMR is a descriptive model that helps to interpret the findings from practice rather than dictate what the practitioners should do. It works reasonably well within the limitations of the context. Zaman and Anwar’s (2024) action research in Pakistani higher secondary education is illustrative. Their findings show that most teachers operate at substitution and augmentation levels because they lack the resources and preparation needed for modification and redefinition. Thus, the tool’s impact is largely dependent on the context in which it is used (Hamilton et al., 2016).

Timotheou et al.’s (2023) global literature review on the impact of technologies on school education highlights that the benefits of technology-enhanced learning are not intrinsic but contextualised in terms of the infrastructure, teacher skills, school leadership, and pedagogy. Similarly, UNESCO’s (2023) GEM Report highlights that the evidence base is inconsistent and mixed that technology, in and of itself, does not contribute to learning outcomes. Both reports conclude that the contextual factors in which technology is used determine its impact above the mere fact of its inclusion (OECD, 2023; UNESCO, 2023).

Teacher Knowledge and the TPACK Framework

Mishra and Koehler (2006) proposed an updated framework, which highlighted the importance of technological pedagogical content knowledge (TPACK) and placed the emphasis on the

interconnections between different types of knowledge. From this perspective, the teacher is expected to have content and pedagogical knowledge, be able to use technological resources, and understand their interrelation (Mishra & Koehler, 2006). However, a teacher might have limited knowledge of how to represent specific content using a certain technology for a specific group of students (Mishra & Koehler, 2006).

The question of how teachers can acquire integrated knowledge has been the subject of numerous studies. The results of these studies suggest that the issue is complex, and there is no simple answer. It was found that integrated knowledge is usually acquired by participating in collaborative activities and rethinking one's experience in a professional community (Tondeur et al., 2017; Norhagen et al., 2024). At the same time, programmes aiming to develop integrated knowledge are more effective when they promote collective design and improvement of technology-enabled lessons rather than focusing on teaching teachers technology (Amemasor et al., 2025).

Pedagogical Beliefs, Self-Efficacy, and Technology Use

Teachers' beliefs about knowledge, learning, and their own role act as a filter through which they interpret technological possibilities. Ertmer and Ottenbreit-Leftwich (2010) define first-order barriers to technology integration as external and resource-related, while second-order barriers are internal and related to beliefs about teaching and learning, arguing that overcoming the first type does not necessarily address the second type. A teacher who views learning as the acquisition of knowledge from others will be more inclined to use technology to deliver this knowledge more effectively, despite opportunities for collaborative and constructivist learning that the technology affords (Ertmer & Ottenbreit-Leftwich, 2010).

Tondeur et al. (2017) provide a synthesis of the research on pedagogical beliefs and technology integration, highlighting the reciprocal relationships between the two, while also underscoring the importance of teachers' self-efficacy beliefs in this context. The latter concept is closely related to teachers' beliefs about their teaching and learning, influencing their willingness to engage in novel practices (Bandura, 1997). Lucas et al. (2021) report that in-service teachers' digital competence was predicted by personal factors, such as self-confidence and receptiveness to innovations, as well as contextual variables, including the level of contextual support. In turn, motivational and leadership factors appear to moderate the relationships between teachers' competencies and their practice (Pambudi et al., 2024).

Student Engagement in Technology-Enhanced Classrooms

Engagement has often been considered as a multidimensional concept comprising behavioral, affective, and cognitive aspects (Fredricks et al., 2004). Digital tools have been rationalized in terms of their capacity for enhancing motivation, but it is critical to distinguish between engagement with the means of instruction and content. Novelty may be associated with the former type of engagement without contributing to the latter process (Fredricks et al., 2004). According to Bond et al. (2020), who conducted their study based on the analysis of engagement with technology, different tools, task structures, and discipline-specific contexts reported varying levels of effects on students' behavioral, emotional, and cognitive responses. Overall, the study

indicates that the technology-mediated task structure plays a far more significant role in terms of enhancing cognitive engagement compared to the type of instructional technology used (Bond et al., 2020).

Institutional Conditions and Barriers to Integration

Institutional conditions determine the design possibilities actually available to the teacher. Infrastructure, devices, connectivity, and electricity define spatial and material limitations. Timetabling, group sizes, curricular coverage, and assessment regimes impose organizational constraints. Leadership priorities then narrow the scope for innovation (Pambudi et al., 2024; Zunica, 2023).

The DigCompEdu framework (Redecker, 2017) identifies the competence areas for teachers to navigate digital practice, embedded in a supportive institutional ecology of resources and relational conditions conducive to their development. Where such an ecology is absent, individual competency has limited purchase. The OECD's (2023) report on the educational use of information technologies confirms that the environments in which technology is most effective in terms of student outcomes are those where it is embedded in a continuum of support and complementary strategies. For the Pakistani context, Akram et al. (2022) highlight the findings of a five-year research study, noting that slow Internet, load shedding, lack of infrastructure, and training inhibit digital adoption in schools. Ghani et al. (204) report similar findings for secondary schools in Punjab. Abel et al.'s (2022) literature review on teachers' perceptions of the integration of information communication technologies reveals that local conditions, combined with international trends, affect educators' understanding and willingness to embrace technology-enabled change. The time factor further constrains the possibilities for innovation, with Zunica (2023) arguing that teachers facing high-workload environments and syllabus constraints are unlikely to adjust their practice despite being encouraged by leadership due to the pressures overriding immediate incentives.

Professional Development for Digital Pedagogy

The features of high-quality professional development are well established in the literature: content focus, active learning, collaboration, modelling, coaching, feedback, and sustained timeframe (Darling-Hammond et al., 2017). Professional development for digital pedagogy tends to ignore these principles, typically taking the form of brief, stand-alone workshops, delivered by external agencies, with no follow-up. Amemasor et al.'s (2025) review of studies on the impact of professional development on teachers' incorporation of digital instruction confirms that programs need to be sustained, embedded within settings, and include follow-up for teachers if they are to shift practice. Their findings confirm that isolated, short-term professional development has limited impact on design practice, regardless of content (Ajani, 2024).

Norhagen et al.'s (2024) review of teacher education programs and professional development on teachers' professional digital competence concluded that education programs focus on self-assessment and building generic digital skills, rather than preparing teachers to integrate technology into their subject-specific practice. Ajani (2024) arrives at a similar conclusion from the perspective of professional development, asserting that teachers need professional development in supporting pupils to engage with digital content rather than building their own competencies with tools. The result, according to Redecker (2017), is that teachers are

‘technology literate’ but unable to make sound pedagogical decisions about when and how to use digital resources.

The Research Gap

Three gaps emerge from this literature. First, instructional design is extensively theorized as a formal process but poorly documented as a practice in the context of resource-constrained schooling environments. Second, the extensive quantitative literature on technology acceptance and competence reveals reported behaviors but says little about the underlying reasoning. Third, the literature is overwhelmingly based on teachers operating within highly resourced settings, raising questions about generalizability to South Asian public and low-fee private schools. The current study aimed to contribute to addressing these gaps by employing a phenomenological approach to exploring instructional design practices in technology-intensive classrooms (Akram et al., 2022; Zaman & Anwar, 2024).

Theoretical Framework

The study is informed by three theoretical frameworks. Technological pedagogical content knowledge (Mishra & Koehler, 2006) provides the discussion of teacher knowledge, focusing on interactions between knowledge areas rather than individual facets of technology, pedagogy, and content. Social constructivism (Vygotsky, 1978) informs the discussion of learning, emphasizing the role of mediating artifacts, including technology, in learning processes. Social cognitive theory (Bandura, 1997) directs the analysis of teacher agency, explaining how personal factors influence the choices that teachers make when designing instruction. The three areas of knowledge, learning, and agency inform the design process, interacting with each other (Bandura, 1997; Mishra & Koehler, 2006; Vygotsky, 1978).

Taken together, the three frameworks highlight the role of mediated instruction mediated by mediated teaching and teacher agency shaped by institutional factors. In other words, teachers bring knowledge and personality traits to the design process. They configure these facets of teaching in a cyclical process that involves analyzing the context and objectives, selecting tools and tasks, and evaluating learning outcomes. Institutional factors facilitate the process or make it more difficult, depending on available resources and opportunities. Effective technology-mediated learning experiences, in turn, influence teachers’ knowledge and traits through reflective practices. This iterative loop is depicted in Figure 1 below.

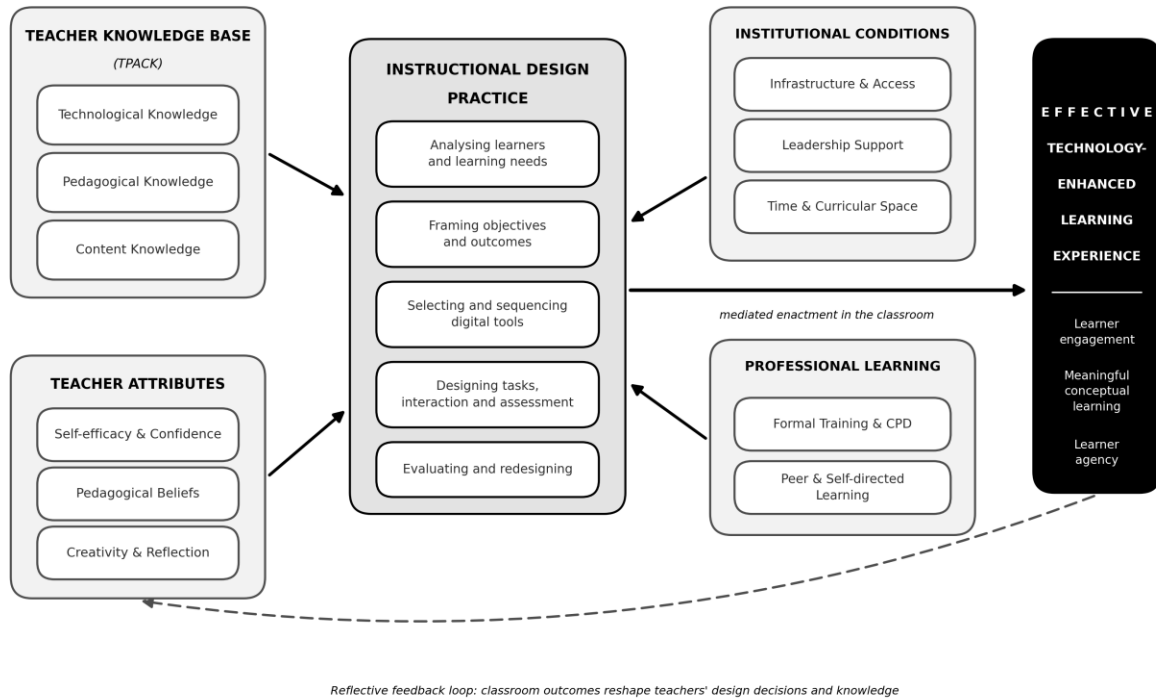
Research Methodology

Research Paradigm

The paper was conducted under the interpretivist paradigm. The philosophy assumes that social reality depends on the meaning individuals give to their experiences, and a researcher’s role is to understand and interpret these meanings and not to develop law-like statements. This study’s ontology is based on multiple realities created by people. Regarding epistemology, the study is based on the idea that knowledge is generated through a researcher’s engagement with the phenomena. Finally, the study’s axiology is that the researcher’s values are inherent in the

research process and should be acknowledged rather than concealed (Creswell & Creswell, 2023).

Figure 1 Conceptual Framework of Teachers' Instructional Design Practice in Technology-Enhanced Learning



Note. The framework positions instructional design practice as the mediating mechanism between teachers' knowledge and attributes on one side, and institutional and professional learning conditions on the other. The dashed pathway represents the reflective feedback through which classroom outcomes reshape subsequent design decisions.

Research Design

A phenomenological design was adopted for this study because the research question falls under the category of problems of description of the meanings of a shared experience. Specifically, phenomenology aims to understand, from the perspective of those who experienced it, the shared structures of a phenomenon. The study takes an hermeneutic rather than a transcendental approach since, as Smith et al. (2022) note in their discussion of interpretative phenomenological analysis, the study acknowledges the role of the interpreter's structures.

The design was appropriate for the research questions because they asked how the teachers negotiated and dealt with design issues, as well as how they experienced such work. A survey could identify what practices were common among participants; however, only through discussion could their interpretations of these practices be uncovered.

Population, Sampling, and Participants

The population of this study was secondary school teachers who used digital technologies for instruction in Lahore, Punjab. Purposive criterion sampling was implemented for this research. The subjects selected had to meet the following inclusion criteria: working in secondary schools, having at least three years of experience, and using digital technologies for teaching for a minimum of one academic year. The recruitment pool aimed to maximize variation in terms of gender, subject, school sector, and years of experience to ensure the diversity of design contexts.

Eighteen teachers were recruited for this study. The sample size was determined by the analytic depth of the information provided rather than by a specific number as a stopping point or by reaching saturation, as suggested by Braun and Clarke (2021b). Saturation is incompatible with the reflexive thematic analysis approach, thus recruitment continued until interviews began generating thick descriptions across the range of contexts desired for analysis. Table 1 below provides a demographic description of the participants.

Table 1: Demographic Profile of Participants (N = 18)

Code	Gender	Qualification	Experience	Subject Area	School Sector
T1	Female	M.Phil. Education	9 years	English	Private
T2	Male	M.Sc. Physics, B.Ed.	14 years	Physics	Public
T3	Female	M.A. English, B.Ed.	6 years	English	Public
T4	Male	M.Sc. Mathematics	11 years	Mathematics	Private
T5	Female	M.Phil. Chemistry	7 years	Chemistry	Private
T6	Male	M.A. Education	17 years	Social Studies	Public
T7	Female	M.Sc. Biology, B.Ed.	5 years	Biology	Public
T8	Male	M.Sc. Computer Science	8 years	Computer Science	Private
T9	Female	M.A. Urdu, B.Ed.	12 years	Urdu	Public
T10	Male	M.Phil. Education	10 years	Mathematics	Public
T11	Female	M.Sc. Physics, B.Ed.	4 years	Physics	Private
T12	Male	M.A. History, M.Ed.	15 years	Social Studies	Public
T13	Female	M.Sc. Chemistry	6 years	Chemistry	Public
T14	Male	M.A. English, M.Ed.	13 years	English	Private
T15	Female	M.Phil. Biology	8 years	Biology	Private
T16	Male	M.Sc. Mathematics, B.Ed.	20 years	Mathematics	Public

Code	Gender	Qualification	Experience	Subject Area	School Sector
T17	Female	M.A. Education	5 years	Islamiat	Public
T18	Male	M.Sc. Computer Science, B.Ed.	9 years	Computer Science	Private

Note. Codes T1–T18 are pseudonymous identifiers assigned to protect participant anonymity. Experience refers to total years of school teaching at the time of interview.

Research Instrument

A semi-structured interview guide was designed based on the research questions and the theoretical framework. The guide consisted of mostly open-ended questions grouped into five domains with several follow-up probes for exploring emergent issues in depth. Using a semi-structured guide enabled consistent coverage of interview topics while providing flexibility for discovering unplanned issues and giving voice to the participants.

The interview guide was reviewed by three experts in educational technology and qualitative research methods. As a result, two of the leading questions were removed, and probes exploring assessment design issues were added. In addition, the guide was pilot tested with two teachers who met the inclusion criteria but were excluded from the final sample. During the pilot testing, several terms were changed to address the participants' confusion. Table 2 below represents the relationship between research questions and interview domains.

Table 2: Alignment of Research Questions with Interview Protocol Domains

RQ	Interview Domain	Representative Question
RQ1	Conceptions of instructional design	When you sit down to plan a lesson that will use technology, what does that planning look like for you?
RQ2	Technology integration in planning and delivery	Can you walk me through a recent lesson in which you used a digital tool, from planning to delivery?
RQ2	Assessment and feedback practices	How, if at all, does technology change the way you assess or give feedback to your students?
RQ3	Challenges and constraints	Tell me about a time when a technology-supported lesson did not go the way you had planned. What happened?
RQ4	Institutional support and professional learning	What kind of support have you received from your school or through training, and what has been missing?

Data Collection Procedure

Permission to conduct the research was obtained from the administration of the selected schools. Teachers who agreed to participate were sent an information sheet giving details of the study's aims and procedures and asking for permission to interview them. Individual interviews were conducted in a place and time of the participants' choosing, mostly in the school staff room during the hours outside teaching. Interviews were held in English or Urdu, with informants usually switching between the languages when responding; these were transcribed verbatim. Each interview, which lasted between 45 and 75 minutes on average, was audio-recorded with the informants' consent.

Field notes were made after each interview to record observations, thoughts, and reflections on the discussion right after the interview. Recordings were transcribed verbatim, and Urdu segments were translated into English by the first researcher and then translated back by a colleague to check for accuracy. The transcripts were sent to the participants for their comments and approval. In particular, four informants provided additional information requested by the researchers.

Data Analysis

Data were analyzed using reflexive thematic analysis as described by Braun and Clarke (2021a; 2022). The choice of this particular method was motivated by the fact that it prioritizes the role of the researcher in interpreting the meaning behind the data rather than coding it by using codebooks or assessing coding reliability. Furthermore, this method considers themes as patterns of meaning rather than simply topics.

The analysis was conducted using the six-phase framework proposed by Braun and Clarke. Within these phases, the coding was done both at semantic-conceptual and latent level following the example of Byrne (2022) illustrated by Table 3. Initially, semantic coding was applied inductively on the raw data and then coding was extended to incorporate latent ideas. The data were analyzed using NVivo 14. However, it is important to note that the researcher made the decisions about coding rather than using the built-in options of the software.

Table 3: Application of the Six Phases of Reflexive Thematic Analysis

Phase	Analytic Activity	Application in This Study
Familiarisation	Immersive reading and note-making	Transcripts read three times; audio replayed alongside text; familiarisation notes written for each interview
Coding	Systematic generation of codes across the dataset	412 initial codes generated inductively; codes revised across successive passes
Generating initial themes	Clustering codes into candidate patterns of meaning	Codes collated into 11 candidate themes using visual mapping
Reviewing themes	Testing candidate themes against coded extracts and dataset	Candidate themes reduced to 5 through merging and collapsing; two discarded for insufficient support

Phase	Analytic Activity	Application in This Study
5. Defining and naming	Articulating the analytic scope and central concept of each theme	Theme definitions written; names revised to convey interpretive claim rather than topic
Producing the report	Weaving extracts into an analytic narrative	Extracts selected for vividness and representativeness; analysis written against research questions

Trustworthiness

Trustworthiness was established by adhering to credibility, transferability, dependability, and confirmability as put forth by Lincoln and Guba (1985). These were achieved by using the strategies put forth by Nowell et al. (2017), while also referring to the ideas of Braun and Clarke (2021a) regarding the best practices in the reflexive thematic analysis. Table 4 below provides a detailed look at the strategies employed.

Table 4: Strategies for Establishing Trustworthiness

Criterion	Strategy Applied
Credibility	Prolonged engagement with participants; member checking of transcripts; peer debriefing with two qualitative researchers; use of verbatim extracts to ground interpretive claims
Transferability	Thick description of the school contexts, participant characteristics, and conditions of practice, enabling readers to judge applicability to their own settings
Dependability	Maintenance of a decision trail documenting coding choices, theme revisions, and analytic rationale; independent coding of four transcripts by a second researcher followed by discussion of divergences
Confirmability	Reflexive journalling throughout data generation and analysis; explicit statement of researcher positionality; retention of raw data, coded extracts, and analytic memos for audit

Ethical Considerations

Ethical approval was obtained from the Departmental Research Ethics Committee of the Department of Education, The University of Lahore. All participants were assured of their right to withdraw from the study at any time and participants gave written informed consent prior to being interviewed.

Anonymous written consent was obtained and identities were concealed using pseudonyms. References to schools, colleagues and students were removed from verbatim transcripts. Audio

files were kept confidential and only accessible to the research team who had undertaken encryption of all files in order to ensure confidentiality. Particular attention was paid to the fact that participants discussed school related issues and sometimes raised criticism of school authorities. As such, special care was taken to ensure that extracts taken from interviews could not be used to identify participants indirectly.

Researcher Positionality and Reflexivity

The researchers are doctoral students in education who have experience in teaching in the classroom and have an interest in the field of educational technology. This knowledge may well have assisted in gaining the confidence of the participants as they were researching the same topic and had considerable experience in the area. At the same time, such closeness to the subject of research may well have introduced bias, which could lead to the imposition of assumptions on participants' responses. The researchers used reflexive journaling to explore their own biases, and during interviews, they specifically asked participants to elaborate on responses that the researchers felt were too self-evident. During analysing responses, the researchers evaluated if themes identified represented participants' viewpoints correctly or reflected the researchers' expectations, revising themes if necessary.

Findings

The findings of the study represent the information obtained from the analysis of themes that emerged from participants' responses. Table 5 below displays the themes and subthemes with corresponding codes.

Table 5: Thematic Structure Constructed from the Dataset

Theme	Subthemes	Illustrative Codes
Pedagogy-first instructional planning	1.1 Objectives before tools 1.2 Designing for the concept, not the class period 1.3 Planned improvisation	starting from the learning outcome; asking what the students find hard; keeping a fallback plan
Purposeful and constrained technology integration	2.1 Making the invisible visible 2.2 Substitution as a rational default 2.3 Tool choice under infrastructural limits	showing a process they cannot see; projector as an efficient board; choosing what will actually load
Shifting patterns of student engagement	3.1 Participation from quieter learners 3.2 Novelty that fades 3.3 Attention divided by the device	students who never spoke started responding; the excitement wore off; they drift to other things
Institutional support as enabling and limiting condition	4.1 Infrastructure that cannot be relied upon 4.2 Time as the scarcest resource 4.3 Leadership vision and its absence	the electricity decides my lesson; no planning period; the principal wants results not experiments

Professional learning as a self-directed pursuit	5.1 Training that teaches the button, not the pedagogy	one-day workshop on the software; a colleague showed me; the third time I was comfortable
	5.2 Learning from peers and platforms	
	5.3 Confidence built through repeated attempts	

Note. Themes are presented in the order in which they map onto the research questions and do not reflect a hierarchy of analytic importance.

Theme 1: Pedagogy-First Instructional Planning

Participants described instructional design as beginning with pedagogical concerns rather than technological ones. Within the dataset, teachers who were generally regarded by their colleagues as technologically proficient nevertheless described technology as a consideration which came late in the design process.

Objectives Before Tools

The most consistent pattern in the data concerned the ordering of planning decisions. Participants repeatedly described starting with what they wanted students to be able to do and only afterwards asking whether a digital resource could help.

The first question is never which app I will use. The first question is what I want them to understand by the end of forty minutes. Once that is clear in my mind, then I ask myself, is there something that will make this clearer than my explanation alone. Sometimes the answer is no, and then I do not use anything. (T2, Physics, 14 years)

This ordering was described as something learned through experience rather than acquired through training. Several participants contrasted their current practice with an earlier phase in which the tool had led the planning.

In the beginning I was excited. I found a nice animation and then I designed the whole lesson around that animation. Now I think that was backwards. The lesson became about the animation instead of about the topic. (T5, Chemistry, 7 years)

Designing for the Concept, Not the Class Period

Participants distinguished between planning a period and designing for a concept. Where a concept was known to be persistently difficult, teachers described investing disproportionate design effort and reserving technological resources for those points.

There are four or five topics in the whole year where students always get stuck. Electric field, for example. For those topics I will spend two hours preparing. For the rest I follow the textbook sequence because there is no time to design everything. (T11, Physics, 4 years)

This selective investment represented a pragmatic response to time scarcity rather than a lack of design ambition, and it recurred across subject areas and both school sectors.

Planned Improvisation

A distinctive feature of participants' design practice was the deliberate preparation of contingencies. Because technological failure was routine, teachers built alternatives into their plans rather than treating them as departures from the plan.

Every lesson has two versions in my mind. The version with the projector and the version without it. If I do not have the second version ready, I have lost the period. This is not pessimism, it is just how it is here. (T6, Social Studies, 17 years)

Teachers described this dual planning as an additional design burden that is invisible in formal accounts of instructional design, and one that consumed preparation time that might otherwise have been spent on the lesson itself.

Theme 2: Purposeful and Constrained Technology Integration

The second theme concerns how technology was actually incorporated. Participants articulated clear rationales for integration, but their enacted practice was shaped as much by infrastructural reliability as by pedagogical intent.

Making the Invisible Visible

The most frequently articulated pedagogical rationale concerned representation. Teachers valued digital resources for their capacity to make visible processes and structures that are inaccessible to direct observation.

How do you explain mitosis with chalk? You draw four stages and the students memorise four pictures. When they see the actual movement, they understand that it is one continuous process. That is a different kind of learning. (T7, Biology, 5 years)

In geography I can show them the actual satellite view of the river system. Before, they were memorising a map from the book. Now they can see why the cities are where they are. (T12, Social Studies, 15 years)

This rationale corresponds closely to what the SAMR framework would characterise as modification: the task changes in kind, not merely in efficiency. Notably, participants articulated the rationale without reference to any framework, describing it instead as a response to observed student difficulty.

Substitution as a Rational Default

Alongside these transformative uses, participants described a great deal of substitution, in which technology performed an existing function more conveniently. Importantly, teachers did not describe this as failure but as a reasonable allocation of limited effort.

Yes, most of the time the projector is just a better blackboard. I have the notes ready, I do not waste ten minutes writing, and the students get more time to work. If that is the lowest level of integration, fine, but it gives me ten minutes. (T16, Mathematics, 20 years)

This finding qualifies the normative reading of integration hierarchies. Participants exercised judgement about where transformation was worth the design cost and where efficiency was the more valuable gain, particularly under syllabus completion pressure.

Tool Choice Under Infrastructural Limits

Tool selection was described as constrained by reliability rather than by pedagogical preference. Teachers reported maintaining a repertoire of resources chosen for their tolerance of poor conditions.

I download everything the night before. I do not depend on the internet in the classroom, ever. So my choice is limited to what I can save on a USB. There are better interactive things online but I cannot use them. (T3, English, 6 years)

We have thirty tablets for a school of eight hundred children. So any activity I design has to work in groups of five or it cannot happen at all. That decides the task before I decide it. (T13, Chemistry, 6 years)

Participants thus described a design process in which material conditions functioned as prior constraints, narrowing the option space before pedagogical reasoning began.

Theme 3: Shifting Patterns of Student Engagement

Participants offered nuanced accounts of student response, distinguishing carefully between attention to the tool and engagement with the content.

Participation from Quieter Learners

A frequently reported effect concerned the redistribution of classroom participation. Teachers observed that digitally mediated tasks altered who spoke and who contributed.

There are girls in my class who will not speak in front of forty students. But when I used the quiz application where the responses are anonymous, they participated fully. I could finally see what they knew. That changed how I think about assessment. (T1, English, 9 years)

Several participants described this as the most significant change technology had produced in their practice, more consequential than any gain in efficiency or presentation quality.

Novelty That Fades

Participants were consistently sceptical of engagement claims based on initial enthusiasm, reporting that motivational effects attenuated with repetition.

The first month, they were very excited. By the third month, the video is just another thing happening in the class. So I stopped thinking that the technology is motivating them. What motivates them is when the task is interesting. (T15, Biology, 8 years)

This observation led several teachers to relocate their design attention from the resource to the task, a shift that maps onto the distinction between engagement with the medium and cognitive engagement with content.

Attention Divided by the Device

Where students had individual access to devices, participants reported difficulties of attentional management that required additional design work.

Give a child a tablet and half the class is somewhere else within five minutes. Now when I plan, I have to plan the monitoring also. What will they submit, by when, how will I see it. Otherwise, the device works against me. (T8, Computer Science, 8 years)

Teachers described this as an additional design layer specific to technology-enhanced environments, rarely addressed in the training they had received.

Institutional Support as an Enabling and Limiting Condition

The fourth theme captures the institutional conditions that participants experienced as decisive for their design practice.

Infrastructure That Cannot Be Relied Upon

Infrastructural unreliability was reported across both sectors, though with differing severity. The issue participants emphasised was not absence but unpredictability.

It is not that we have nothing. We have a multimedia room. But the load shedding does not consult my timetable. So sometimes I have prepared for two hours and the period is gone. (T9, Urdu, 12 years)

Unpredictability, participants explained, is more corrosive of design practice than known limitation, because it prevents the accumulation of reliable routines and imposes the dual planning described under Theme 1.

Time as the Scarcest Resource

Time emerged as the constraint participants named most often and most emphatically. Teachers described full teaching loads with negligible protected planning time.

I teach six periods. I have one free period and in that period I am checking one hundred and twenty notebooks. When exactly am I supposed to design an innovative lesson? I do it at home, at night, and only for the topics that really need it. (T10, Mathematics, 10 years)

Design work was thus displaced into personal time, which participants identified as the principal reason that ambitious design was reserved for a small number of lessons each year.

Leadership Vision and Its Absence

Participants distinguished sharply between administrative permission and pedagogical leadership. Schools in which leadership articulated a purpose for digital practice were described very differently from those in which technology was treated as equipment.

Our coordinator sits with us once a month and we discuss what worked. That one hour is worth more than any workshop I have attended. In my previous school nobody asked. The equipment was there and nobody asked what we did with it. (T14, English, 13 years)

The management's interest is the result. If the board result is good, nobody asks how you taught. So the safe thing is to teach the way that gets marks, and that is not always the way that gets understanding. (T17, Islamiat, 5 years)

Examination accountability thus operated as a structural disincentive to design experimentation, particularly in the terminal years of secondary schooling.

Theme 5: Professional Learning as a Largely Self-Directed Pursuit

The final theme concerns how participants had developed their capacity for design with technology.

Training That Teaches the Button, Not the Pedagogy

Formal training was near-universally described as technically oriented and pedagogically thin.

They taught us how to make slides. Nobody told us when a slide is a bad idea. That is the thing I needed to know and I had to find it out myself, by doing it badly for two years. (T4, Mathematics, 11 years)

Participants also criticised the episodic structure of provision, noting the absence of follow-up, classroom observation, or feedback on their own design attempts.

Learning from Peers and Platforms

In the absence of adequate formal provision, participants had constructed their own learning pathways through colleagues, online video tutorials, and informal messaging groups.

Whatever I know, I learned from YouTube and from one colleague who is very good at this. We have a WhatsApp group where we share resources. That is my real training. (T18, Computer Science, 9 years)

Peer learning was valued particularly because it was situated: colleagues understood the same students, the same syllabus, and the same infrastructural conditions.

Confidence Built Through Repeated Attempts

Participants located the source of their confidence in accumulated experience of attempting, failing, and revising, rather than in instruction.

The first time I tried the group activity with the tablets it was chaos. The second time it was better. By the third time I knew exactly what instructions to give before I distributed the devices. Nobody could have told me that. I had to fail twice. (T15, Biology, 8 years)

This account positions design competence as an experientially constructed capability, and it suggests that professional learning structures which do not accommodate failure and revision are poorly matched to the way the capability actually develops.

Discussion

The findings both confirm and extend the core argument. The participants who were perceived as using technology proficiently reported designs that incorporated technology late and conditionally in the learning process after objectives and obstacles were identified. This corroborates the TPACK account of integrated knowledge (Mishra & Koehler, 2006) while also providing evidence on the planning sequence, specifically, that reflects the interplay between the domains as theorized.

The analysis of substitution is equally important as a finding because it problematizes an assumed hierarchy within integration frameworks. Hamilton et al. (2016)'s critique of progressive substitution has been informed by the idea that higher levels of SAMR are more desirable, but the excerpt provides evidence that supports substitution as a choice rooted in context and time constraints. The participants justified the use of technology as a substitute for conventional methods and materials by explaining how it bought them time which was redirected into learners' work. Interpreted in the light of the proposed hierarchy, substitution would be lower-level design, but when viewed through the lens of TPACK planning, it emerges as responsive to the conditions of capacity. The implication is that the quality of design depends on the resource conditions and should not be judged by the vertical levels.

The engagement findings both echo and extend the literature on design and learner participation by situating behavioral engagement within the constraints of design choices while also reporting that these constraints influenced cognitive aspects of engagement. The participants' accounts confirmed the distinction between behavioral and cognitive forms of engagement that Fredricks et al. (2004) identified in their framework: behavioral reactions were immediate but short-term while cognitive interest was sustained through the design. This supports the conclusion reached by Bond et al. (2020) that variation in engagement was driven by design with the mediating role of resources. The difference that emerged from the findings is in the mechanism by which digital response options influenced participation which informs the broader understanding of dynamic constructs by emphasizing the importance of specific design choices.

The institutional findings add to the discussion of first- and second-order barriers by reporting the conditions under which technology was used as a primary influencing factor. The participants' accounts revealed that infrastructure and time constraints remained first-order barriers while beliefs about technology were considered a second-order barrier. This conforms to the findings of Akram et al. (2022) and Ghani et al. (2024) who report similar experiences

among Pakistani secondary school teachers but not to the findings of well-resourced systems where the emphasis is on beliefs. The analysis of unpredictability expands on the conceptualization of first-order barriers by introducing an additional consideration of reliability as a design factor. Resources that are unavailable consistently do not affect planning directly, but their intermittent absence creates a design burden by requiring contingency planning. This is different from the constant presence of an unavailable resource. The implication is that teachers working in under-resourced systems are constantly engaged in contingency planning which may account for the hesitance to adopt ambitious designs unless under favorable conditions.

Examination accountability emerges as a significant contextual factor that influences engagement by shaping teachers' professional decision-making. The findings suggest that the design choices that accounted for technology use were dependent on the extent to which institutional leadership evaluated teachers' performance based on examination results. This conforms to the findings of Timotheou et al. (2023) who report that the interplay between infrastructure, competence, leadership, and pedagogy shaped engagement, and supports their assertion that improving one area while leaving examination systems untouched will yield limited results.

The professional learning findings conform to the existing literature on effective professional development by identifying sustained and embedded approaches that have the potential to improve educators' capacities to plan technology-integrated designs. The emphasis on iterative cycles of practice that the participants associated with increased confidence corroborates the findings of Darling-Hampton et al. (2017) on the characteristics of high-quality professional learning while also providing support for the argument advanced by Norhagen et al. (2024) that technology competencies are frequently compartmentalized from didactics. The analysis of confidence also provides an extension to Bandura's (1997) framework of self-efficacy since mastery experiences were achieved through repeated cycles of practice that involved teachers' testing their designs, identifying what worked and what did not, and building on their successes. The implication is that professional development that does not include such iterative cycles will have limited effect on educators' ability to plan technology-integrated instruction regardless of the content delivered.

The findings contribute to the body of evidence on technology integration in education by identifying key factors that influence the design and implementation of integrated pedagogy. They confirm the limitations imposed by institutional conditions and support the contention that capacity to plan integrated instruction is contextualized within these conditions. The implication is that effective responses to the low level of integration in many participating schools require concomitant investment in capacity and resources.

Conclusion

This study aimed to describe teachers' lived experience of designing and implementing learning with technology. The five themes identified in this study highlight the finding that effective instructional design in technology-enhanced learning is dictated not by availability of tools but by teachers' pedagogical knowledge, design judgment, confidence, and opportunity.

The participants discussed planning learning experiences before choosing instructional media, using technology as a means to an engaging end, substituting when necessary, being mindful of limited institutional resources, and relying on informal professional learning to acquire the skills needed in teaching.

This study builds on survey-based research on teachers' use of technologies in education by introducing the design thinking process and situating technology-enhanced learning in formal public education. Teachers in this study were not opposed to using technology in their practice, and they were aware of the pedagogical benefits it could bring; however, they had to make trade-offs in limited time when introducing new media. Their decisions in the absence of support were informed by professional judgment, which makes their voices particularly valuable for informing recommendations. Enhancing technology-enhanced learning in this context will benefit from recognizing teachers' capacity to make appropriate design judgments and support their professional learning.

Recommendations

For Teacher Education Institutions

embed digital pedagogy within subject-specific methods courses, rather than as a technology-specific module, in order to scaffold design reasoning and content knowledge simultaneously, require teaching practicum tasks in which student teachers design, enact, and formally revise a technology-supported lesson, with supervision focusing on design rationale,

rather than on the use of particular tool sand build in explicit instruction in contingency design so that student teachers learn to plan for infrastructure failures as a routine design consideration.

For School Leaders

carve out and defend planning time as instructional infrastructure, create regular opportunities for teachers to interrogate each other's design choices and outcomes

- prioritize pedagogical experimentation in teacher appraisal, so that design innovation is not penalized in performance reviews and recognize the value of design reliability in the face of infrastructural uncertainty as a pedagogical constraint in curriculum design.

For Curriculum Designers

- identify within each curriculum area the concepts that teachers most frequently report struggling to teach and provide targeted digital resources for those areas (aligning with the design priorities that teachers actually use),
- design curriculum materials that specify a pedagogical rationale and task structure while leaving room for variation in infrastructural capability, and build in formative assessment experiences that harness the engagement afforded by the anonymity of digital response options that teachers in our study reported valuing.

For Educational Policymakers

- rebalance investments in digital education from procurement to school-level professional learning with follow-up and coaching,
- attend to the reliability of the electricity and technology infrastructure underpinning instructional technology use, rather than treating it as an ancillary concern, revisit high-stakes examinations and teacher appraisal practices that currently penalize innovative practice at the secondary level, and consider designating provincial repositories for teacher-designed digital resources, building on the informal networks that teachers have already created.

Limitations and Directions for Future Research

Several limitations should be noted when interpreting the results of the study. The research was conducted among eighteen secondary school teachers working in one city, and the results are based on that specific group of participants. Qualitative research does not claim to have universal applicability; however, it is recommended to approach the use of the results in other contexts (rural areas, primary school, provinces with different levels of infrastructure development) with caution.

The data obtained are based on the verbal responses of participants, with no objective evaluation of the consistency of the stated information with actual practice. Additionally, although the study used retrospective design, teachers may have described the implementation of the design process in a way that reflects ideal intentions rather than actual events. The study examined participants who had chosen to adopt technology in their teaching practice. There is no information about the beliefs of those who were unwilling or incapable of adopting new methods and how their views might differ in relevant aspects from those of the participants. The opinions of students were not considered; thus, it is unknown whether the descriptions of engagement correspond to reality.

Further research directions can be organized around four themes. First, the congruence of the described design reasoning with design practice can be validated using a lesson observation with post-observation interviews. Second, it may be informative to examine the differences between urban and rural contexts, as processes in the two settings involve many different factors. The third direction will consider teachers' development processes, exploring how design ability emerges through training courses. Fourth, student perspectives, which the current study did not analyze, should be examined to determine whether teachers' perceptions of their students' engagement accurately represent reality.

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