Investigating the Dynamic Roles of Educators: A Research-Driven Exploration of Teachers Designing Technology Tools for Enhanced Classroom Experiences in Pakistani Public Schools

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Abstract

Educational innovations, especially digital learning technologies, have often been imposed on teachers to integrate into their teaching practices without accounting for their individual experiences and preferences in designing and implementing these innovations. In educational research, one of the methodologies employed to centre teachers' contextual insights and challenges is the participatory design approach that engages teachers as designers of learning innovations, collaborating with researchers and technological designers. Despite the benefits of participatory research with teachers documented in the literature, its application in developing countries, such as Pakistan, with strained and underfunded public education systems is severely underexplored. To investigate the applicability of this approach in Pakistan, this qualitative study explores the engagement of sixteen public school teachers from four public schools in Islamabad, the capital city, in participatory design workshops. In the study's first phase, teachers discussed their daily teaching challenges, shared their insights on practitioner-led educational research in Pakistan and examined the usefulness of existing learning technologies. The understanding obtained from this first phase informed the second phase, where the teachers collaboratively redesigned their preferred digital innovations in design workshops, adding specific features to alleviate their issues and evaluating their efficacy in under-resourced public schools.

The study's findings highlight that teachers feel marginalised by the country's education system and have limited agency to influence institutional practices and government policies as their perspectives are neglected in educational research, the design of digital tools, and the implementation of digital pilot programs. However, their reflections on participating in design workshops suggest they experience empowerment and professional development while collaboratively designing innovative tools and discussing strategies to minimise their persistent classroom challenges. Moreover, such workshops motivate teachers to seek local opportunities to lead educational research and foster a more optimistic perspective on their professional roles. Thus, the findings from the study's early-stage participatory design process promote involving teachers in longitudinal participatory educational research in Pakistan to advance education technology scholarship and enable continuous teacher professional development by developing their research and design skills.

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1. Introduction

The integration of digital technologies in education is often promoted by influential actors such as education technology companies and policymakers to enhance teachers' capacities, support student learning, and address systemic issues in education (Selwyn, 2016). However, the promotion of technology to improve educational outcomes is not new by any means, with educational film, radio, and television being just a few examples of (digital) technology in classrooms in the twentieth century. Selwyn (2017) documented that despite each technology's hype cycle created around its anticipated transformational impact, their adoption was not nearly as successful, predominantly because teachers only sporadically integrated them into their teaching practices. He mentioned reasons, including recurrent technical issues, inadequate teacher training, and poor fit in the existing school structure (Selwyn, 2017); in short, implementation was 'top-down' without teachers' input, and these technologies were 'hurled at teachers' by 'non-teachers' (pp. 62–63). The practice of ignoring teachers' perspectives is not limited to digital technology design and implementation, as traditionally, academic researchers and technologists have restricted teachers only to be the executors of educational innovations that require training to adopt those innovations effectively (Verloop et al., 2001).

This study challenges the *hurling* of digital technologies at teachers by adopting a participatory design approach, which is a methodology characterised by the democratic participation of primary stakeholders in the development of learning innovations, such as digital tools, curricula, pedagogical practices and learning environments (Bang & Vossoughi, 2016; Tuhkala, 2021). Participatory design processes involving teachers leverage their situated classroom knowledge and teaching expertise to collaboratively design educational innovations tailored to their classrooms, ensuring a good fit with the existing classroom practices (Cober et al., 2015). Moreover, it entails an initial inquiry to establish a shared understanding of teachers' experiences before engaging in design workshops to build trustful relationships with them (Cumbo & Selwyn, 2022), thereby privileging their voices in research. Because teachers get the opportunity to significantly guide the design and implementation of technological artefacts in participatory design research, it can potentially improve learning technologies' adoption (Nicholson et al., 2022) and empower teachers as their perspectives and

insights are valued (Matuk et al., 2016). While this study uses a participatory design approach to explore teachers' design choices in digital technologies, it does not advocate this approach as a comprehensive solution to educational challenges, as a long-term research collaboration with teachers is necessary to evaluate the designed artefacts (Tuhkala, 2021).

Despite these highlighted benefits of participatory design processes in educational research, its application in Pakistan remains underexamined. Public school teachers across Pakistan face an unmanageable workload, receive minimal professional development and experience persistent neglect of their insights in designing and implementing educational innovations (Ali, 2018; M. A. Khan & Afridi, 2017; Tayyaba, 2012). In my professional experience of teaching in an under-resourced public school in a rural area of Islamabad, the capital city of Pakistan, I observed this marginalisation of my colleagues. During our formal meetings and informal discussions, they expressed frustration with the education system, mentioning that policymakers and the federal education directorate do not seek their insights while developing educational initiatives. In my school, it was well known that the government occasionally piloted digital learning programmes and provided technological resources for a year before ultimately suspending them. These programmes inevitably failed because the government never consulted with teachers before planning or developing them. Reflecting on my past teaching experiences and the limited teacher participation in educational research in Pakistan has underscored the importance of this study and motivated me to undertake it. It will invite public school teachers to focus group discussions to discuss their challenges and evaluate the efficacy of existing learning technologies in solving them. Next, it will engage them as collaborative designers in a participatory design process to develop tools they value to assist their teaching and improve student learning outcomes.

Dissertation Overview

In the following chapters, I will present the literature review, research design, data analysis and discussion of findings. Chapter 2 discusses literature exploring the significance of teacher knowledge in educational research, critiques past attempts to predict digital technology adoption in schools quantitatively and highlights the application of participatory design processes with teachers in designing learning

innovations. It concludes by formulating research questions at the nexus of the three research areas. Chapter 3 outlines the qualitative research design within a constructivist paradigm and details the data collection activities conducted in two phases. Chapter 4 presents findings from focus group discussions and participatory design workshops. These findings include teachers' perception of their roles in Pakistan's public education system, their attitudes towards learning technologies and their designed digital tools. Chapter 5 discusses these findings, referring to the literature on public school teachers' struggles in Pakistan and the benefits of teacher engagement in participatory design for education technology research and teacher professional development. Chapter 6 concludes the dissertation by providing the direction for future work and recommendations to researchers, policymakers and technologists to undertake more participatory work with public school teachers.

2. Literature Review

This study is placed at the intersection of three areas to explore the role of teachers in co-designing digital technologies commonly implemented in schools, using their classroom experiences. Firstly, the chapter highlights the importance of teacher knowledge in educational research, which is the underlying motive of the study and argues that teachers, from their situated experiences, possess insights that researchers detached from classrooms often lack. Secondly, it examines past attempts to report how teachers adopt learning technologies. These studies focus on quantitatively measuring the perceived usefulness of digital tools from teachers' perspectives through large-scale surveys and related methodologies, which the chapter problematises as presenting an overly deterministic view of adoption. Lastly, the chapter presents prior studies that use participatory methodologies involving teachers, researchers, and occasionally technologists to centre teachers' experiences and beliefs in designing learning technologies. This bottom-up approach can facilitate teachers' technology adoption and lead to better educational outcomes.

The research situates itself in Pakistan's education system, where the nexus of discussed areas remains underexplored in the literature. It emphasises collaborative design with teachers, valuing their contextual knowledge, and calls for moving beyond merely descriptive reports of technology adoption with teachers at the receiving end. The chapter culminates the discussion in the formulation of research questions.

2.1 Teachers in Education Research

The traditional conception of the knowledge base of teaching is that teachers only execute researchers' theories and insights to achieve better educational outcomes (Rust, 2009; Verloop et al., 2001). Moreover, some academic communities and policymakers consider teacher knowledge rooted in classroom practices, contextual experiences and personal beliefs detached from or even opposed to the academy's theoretical knowledge (Verloop et al., 2001). It is evident from the academy's questioning of practitioner-led inquiries' validity as 'real' research and overlooking their expertise in designing and implementing learning innovations (Rust, 2009, p. 1884). However, this dated conception of teachers has been criticised in the literature for undermining their roles by reducing them to mere technicians who implement scientific findings (Ben-Peretz, 2011; Cochran-Smith & Lytle, 1990; Whitty & Furlong, 2017). Cochran-Smith & Lytle

(1990) highlighted this disenfranchisement of teachers in educational research by outlining two paradigms of research on teaching as 'process-product' and 'interpretive', the former concerned with improving teaching practices in correlation to quantifiable outcomes such as student grades and the latter presenting context-specific experiences of teachers but discussed through researchers' lens, intended for university audiences (pp. 2–3). Since these two paradigms lack subjective teacher voices and knowledge free of researchers' interpretations, I highlight a third broad paradigm in academia and policy which calls to complement the knowledge base of teaching with teachers' practical knowledge and insights, marking a shift from 'knowledge for teachers' to 'knowledge of teachers' (Ben-Peretz, 2011; Fenstermacher, 1994).

Focusing on teacher knowledge can lead to teacher research - a systematic self-critical inquiry teachers undertake to investigate their classroom challenges (Goswami & Stillman, 1987). By initiating this inquiry, teachers can reflect on their practices and connect theory and academic research to their daily work (Rust, 2009). I argue that these teacher-led initiatives and consequent insights combined with academic scholarship are essential for advancing education research. Hammersley (1993, p. 425) supported this conceptualisation of 'teacher-as-researcher' by arguing that teachers have a long-term situated knowledge of the matter under investigation and have established relationships with other participants that are valuable in data collection. Although it necessitates teacher-directed inquiries in research, I argue that they do not substitute or disprove academic educational research, as teacher-led research also has some shortcomings. These include practitioners' biased information, favouritism among participants and valuing practical experiences over theoretical ideas (Hammersley, 1993). Therefore, I argue that collaboration between researchers and teachers is essential to minimise the limitations of both sides (Whitty & Furlong, 2017).

Considering the arguments made above, it might be straightforward to assume that the process of practitioner-led inquiries and complementing academic research findings with contextual knowledge is a convenient solution, yet many studies have highlighted a stark divide between academic education research and teacher research or between academic researchers and teachers (Broekkamp & van Hout-Wolters, 2007; Kempe, 2019; Korthagen, 2007; McIntyre, 2005; Phelps, 2019). Many factors contribute to this divide, including perceptions of both sides that the knowledge produced by the other is inapplicable to them, teachers' scepticism towards academic research due to its

specialised language intended to maintain status in academia, teachers' difficulties engaging with theories that contradict their daily practices, negative portrayal of teachers in research and academics marginalising teacher-produced knowledge by not citing or using it in teacher education programmes (Hirschkorn & Geelan, 2008; Zeichner, 1995). In addition to the stated reasons, which suggest the divide stems from the flaws in the intentions of both sides and is related to how research activities are conducted, McIntyre (2005) introduced another dimension to this divide. He argued that the knowledge teachers require to improve their classroom practices and the research-based knowledge fundamentally fall on the extreme opposite ends of a knowledge continuum, leading to this research-practice divide. He further explained that the pedagogical knowledge teachers find useful is of a 'knowledge how' nature that has to be entirely context-specific to deal with unique problems, and teaching requires quick decision-making in novel situations; conversely, research-based knowledge strives for generalisable findings and prioritises coherent arguments, not concerned by uncertainties of classroom teaching (McIntyre, 2005, pp. 359–361).

After introducing the concept of teacher research and presenting the research-practice gap with its potential causes, the following subsections will explore teachers' interest and engagement in educational research and discuss strategies from the literature to bridge the divide between academic and teacher research.

2.1.1 Teachers' Experiences with and in Research

Several researchers have attempted to explore how teachers engage with and in educational research - their experiences of either participating in research or their views on research findings (Beycioglu et al., 2010; Everton et al., 2000; Leat et al., 2015; Zeichner, 1995). By presenting descriptive accounts of these studies, I challenge the notion that teachers are merely practitioners who apply research findings. Instead, I highlight that teachers actively seek involvement in education research. Everton et al. (2000) presented findings from their two surveys across primary and secondary schools in the United Kingdom, with 572 teachers (ranging from assistant to head teacher) who shared their views on educational research and their involvement thereof. They highlighted that teachers' interest in research increased with postgraduate qualifications, and more importantly, teachers with less experience and lower in the management hierarchy valued personal involvement in research. In contrast, the senior management staff relied predominantly on external educational research to

improve classroom practices. Therefore, those new to teaching wanted to engage *with* research findings and participate *in* it (Everton et al., 2000, p. 392). Similarly, another study exploring teachers' attitudes towards educational research using quantitative surveys in Turkey found that 68% of 250 participant responses signalled interest in research findings; however, it found no significant differences in their views on educational research based on participants' experience (Beycioglu et al., 2010). Therefore, though these systematic surveys reveal different specific trends subject to their context, I argue that they strengthen the case for increased involvement of teachers in research because of the majority interest and the added value of their engagement discussed in the previous section.

After arguing that teachers are interested in engaging with and in research, I advocate that their interest should lead to the construction of new knowledge through effective engagement, and they should experience professional development to make it sustainable and beneficial for them. Leat et al. (2015) reviewed studies across different contexts that centred teachers' experiences in research and argued towards supporting them internally and externally across three levels to ensure successful teacher research. Firstly, institutional support from school leaders to help them navigate contradictions between their research findings and pedagogical practices; secondly, training from external researchers and universities to cultivate agency to lead rigorous research projects; and lastly, policy-level support that allows them to conduct research autonomously and develop as 'multi-dimensional selves' (Leat et al., 2015, p. 283). Newman & Mowbray (2012) shared insights from five practitioner inquiry projects in Australia where academics and early childhood teachers meaningfully collaborated. They reported that teachers with no prior experience or training in research found a sense of belonging in the collegial atmosphere of these projects with academics, developed leadership abilities to mobilise their colleagues and underwent immense professional development by being exposed to diverse ideas and approaches (Newman & Mowbray, 2012). Therefore, if supported appropriately, as argued here, teachers can engage effectively in academic research and develop as teacher-researchers.

2.1.2 Research-Practice Gap

Many approaches have been mentioned in the literature to bridge the research-practice gap, and fundamentally, they all emphasise fostering long-term genuine collaborative partnerships between researchers and practitioners and schools and universities in

effectively integrating research and practice (Hirschkorn & Geelan, 2008; Korthagen, 2007; Phelps, 2019; Zeichner, 1995). The 'Academic Schools' approach combines several collaboration models where education stakeholders work collaboratively in a single school and design educational innovations (Broekkamp & van Hout-Wolters, 2007, p. 214). In a symposium that Broekkamp & van Hout-Wolters (2007) held, education researchers, teachers, policymakers, teacher trainers, research students and technologists shared their views on the research-practice gap. After evaluating the four popular models as solutions for bridging the gap, their participants stressed the combination of all strategies, culminating in the Academic Schools approach. These four models are: the Research Development Diffusion Model (RDD) examines and translates published research findings to diverse educational settings; the Evidence-Based Practice Model (EBP) exclusively recommends teaching strategies that have proved to be majorly impactful through randomised experiments; the Boundary-Crossing Practices Model (BCP) brings together teachers and researchers in collaboratively designing innovations; and the Knowledge Communities (KC) model, similar to BCP model, establishes a network of professionals with heterogeneous expertise to generate new knowledge (Broekkamp & van Hout-Wolters, 2007, pp. 208–210).

This study takes inspiration from the combination of these approaches, which is also related to Hargreaves's radical vision of 'the knowledge-creating school' where transdisciplinary knowledge is produced in a specific context by people immersed in it through collaborative discussions and prototyping educational innovations (Hargreaves, 1999, p. 123). Sharing fundamental principles with the Academic Schools approach, I argue that participatory design-based approaches to educational research also encapsulate essential strategies to complement the researchers' academic expertise with practitioners' practical and contextual insights. Bauer & Fischer (2007) supported this argument by highlighting that, in design-based research activities, interactive and close collaboration occurs between researchers and practitioners.

Influenced by collaborative approaches and the key steps to sustain them discussed in this section, this research focuses on the essential teacher input in designing digital tools. Though engaging teachers is paramount to advancing all areas of education research, their involvement in digital tool design is significantly underexplored in Pakistan, the context of this study; thus, it centres public school teachers on the design

work of digital tools they perceive useful to tackle their challenges. Before extensively discussing co-design and participatory approaches to designing education technology innovations in section 2.3, I will present and critique the past attempts of academics to unidirectionally capture teachers' views and attitudes towards learning technologies using quantitative methodologies.

2.2 Technology Adoption from Teachers' Perspective

Over the past three decades, rapid advancements in digital technologies have led to their widespread application in various fields, including education. Their proponents regard them as solutions to revolutionise and fix the flawed education system, yet their adoption from teachers' perspectives is rarely critically evaluated (Selwyn, 2017). As this study centres teachers' experiences through engaging them in a participatory design process, a prerequisite to design activities is understanding their attitudes and beliefs towards technologies and the barriers they face in adopting them (Cober et al., 2015). This section first examines common barriers to technology integration from teachers' perspectives highlighted in the literature. It then evaluates one of the most cited models of technology adoption, the Technology Acceptance Model (TAM), discussing its use cases and inherent limitations.

2.2.1 First-order and Second-order Barriers

Due to the significant increase in technology integration in classrooms and the consequent radical shift teachers require in their teaching style and daily routine while paying attention to new student problems, Kerr (1996, as cited in Ertmer, 1999) noted early on that teachers face a wide range of intrinsic and extrinsic obstacles. Ertmer (1999) grouped these barriers to technology integration into two categories: 'first-order' (extrinsic) barriers associate integration issues with lack of access to hardware and software equipment, inadequate teacher training and professional support, and school's digital infrastructure (p. 50) and 'second-order' (intrinsic) barriers, less tangible than first-order, are deeply ingrained in teachers' beliefs on technology implementation, its perceived value to the learning process and confidence to adapt to resulting changes in their existing practices (p. 51). From these two categories, some researchers argue that the first-order barriers are more visible and likely to be reduced using technical fixes, such as increased access to technological resources, which has significantly improved in recent decades (Ertmer et al., 2012; Fisher et al., 1996). Ertmer et al. (2012) conducted a study with twelve teachers in the US to provide evidence that a more

effective way of ensuring successful technology integration is through working on changing teachers' attitudes and beliefs towards learning technologies and providing them with relevant knowledge and skills to uplift their confidence, i.e. addressing second-order barriers. After analysing their website blogs and responses in semi-structured interviews, they reported that the participants' pedagogical beliefs aligned with their classroom technology practices. Some even expressed that other teachers did not use technology because they were 'intimidated' by it, concluding that internal factors were 'strongest contributing factors to their abilities to integrate technology' (Ertmer et al., 2012, p. 429).

Though I acknowledge the importance of prioritising the development of teacher knowledge and skills, I argue that its precedence over first-order barriers overlooks that teachers in low-and middle-income countries face a scarcity of technological resources and inadequate teacher professional development opportunities (Abedi & Ackah-Jnr, 2023; Akram et al., 2022; Ghavifekr et al., 2016; Singhavi & Basargekar, 2019). The availability of a superior technological infrastructure in developed countries such as the US might justify prioritising second-order barriers, as Ertmer et al. (2012) argued. However, I present some studies from low-and middle-income countries, including Pakistan where teachers experience a different reality.

A systematic review of studies exploring teachers' perceptions and challenges towards integrating Information and Communication Technologies (ICT) across all educational levels in Pakistan by Akram et al. (2022) found both first-order and second-order barriers that lead to unsuccessful technology integration in teachers' instructional practices. These barriers included uncertain government integration policies or lack thereof, teachers' technological incompetence, inadequate professional development programmes, poor ICT infrastructure and teachers' busy schedules hindering effective technology implementation (Akram et al., 2022). Similarly, another study in Pakistan compared the attitudes of teachers in elite and mediocre schools towards adopting technology and its barriers using qualitative questionnaires and found that teachers in both types of schools did not experience intrinsic obstacles (Zehra & Bilwani, 2016). Their participants substantially believed in the potential of learning technologies to make their teaching and student learning effective; one even considered technology 'a blessing' (Zehra & Bilwani, 2016, p. 10). Instead, teachers reported facing first-order barriers to benefit from technological aids in teaching, such as power outages, limited

internet access and minimal governmental support, especially in mediocre schools (Zehra & Bilwani, 2016).

Changing the context, an empirical study in India surveyed 515 teachers across English and Regional language medium schools to understand ICT integration barriers from their perspective (Singhavi & Basargekar, 2019). They used rank order analysis to identify that the most persistent obstacles faced by teachers were extrinsic, similar to the above-discussed studies, including limited availability of educational software and online content in regional languages. In contrast, teachers gave a low ranking to intrinsic barriers such as lack of interest, unclear benefits of ICT integration and low confidence in using tools, proving that they wanted to integrate technology with their teaching practices (Singhavi & Basargekar, 2019). Furthermore, González-Sanmamed et al. (2017) highlighted by surveying 1,222 teachers across schools in four levels of increasing ICT integration that school context significantly affects the success of ICT use in classrooms as teachers in level four schools that had IT managers, training programmes, fast internet and good technical equipment demonstrated most favourable attitude to ICT integration.

Based on the discussed studies, I maintain that their findings necessitate minimising both first-order and second-order barriers teachers face for effective technology adoption in schools. In this regard, Bingimlas (2009) analysed the literature on teachers integrating ICT in learning environments and highlighted that the most common barriers are teachers' lack of access to resources, ineffective training and lack of confidence and competence; thus, both intrinsic and extrinsic. I argue that one of the conclusions from this meta-analysis (Bingimlas, 2009) and other studies presented in this subsection is that since teachers reveal these barriers, they should be engaged in designing education technology initiatives and teacher training programmes to minimise highlighted barriers.

2.2.2 Perceived Usefulness and Ease of Use of ICT Tools

Based on the discussion above, teachers' attitudes, beliefs, and extrinsic factors play a substantial role in determining the extent or success of technology adoption in schools. Though many adoption models have been developed and discussed in the literature, the Technology Acceptance Model (TAM) is one of the most widely cited models to explain teachers' behavioural intentions of technology use, combining external

variables with perceived usefulness and perceived ease of use to predict technology integration (Davis, 1989; Granić & Marangunić, 2019; Legris et al., 2003; Scherer et al., 2019). Although this study does not directly use TAM as a theoretical framework, I argue that its core variables, perceived usefulness and ease of use, add to the account of intrinsic and extrinsic barriers in explaining technology adoption from the teachers' perspective. Davis (1989), who constructed TAM, defined 'perceived usefulness' as 'the degree to which a person believes that using a particular system would enhance his or her job performance' and 'perceived ease of use' as 'the degree to which a person believes that using a particular system would be free of effort' (p. 320). In education, usefulness pertains to teachers' increased productivity, time-saving, and effective teaching practices; ease of use encapsulates how easily they can understand and recall ICT tools' usage (Ghavifekr et al., 2016). *Figure 1* shows the original diagram of TAM (Davis et al., 1989, p. 985).

To operationalise the model and predict technology acceptance using these measures, researchers often use sophisticated statistical techniques on data collected through quantitative large-scale surveys, as reported in reviews (Granić & Marangunić, 2019; Legris et al., 2003). TAM fundamentally explains how teachers perceive technology and is relatively straightforward to implement in studies (Ajibade, 2018). But, as I will explain next, TAM has inherent limitations due to which this study does not use it as a theoretical framework; instead, it employs its core variables solely to understand teachers' design decisions in participatory workshops as they decide which tool would be potentially more convenient and helpful in their teaching.

Figure 1: *Technology Acceptance Model (Davis et al., 1989, p. 985)*

Despite its widespread application in predictive education technology studies, TAM has numerous inherent shortcomings. A systematic review of the model applied with

various modifications and extensions of external variables to increase its predictive validity in educational contexts from 2003 to 2018 concluded that although studies have proven TAM to be a credible paradigm and found a positive correlation between its core variables and technology acceptance, it lacks measures to report the actual usage of learning technologies (Granić & Marangunić, 2019). Furthermore, a meta-analysis of 114 empirical studies operationalising TAM to determine pre-service and in-service teachers' technology adoption also highlighted the earlier listed limitation that studies often do not examine the actual use of technology beyond self-reported intentions (Scherer et al., 2019). And as discussed above, these intentions are collected and analysed in an objectivist quantitative paradigm, skewing individual teacher opinions (Legris et al., 2003). Adding to the critique, Ajibade (2018) outlined several limitations of the model, demonstrating that researchers often use it as a theoretical model due to its simplicity rather than its suitability in institutional contexts. He argued that user behaviour cannot be statistically measured or quantified as several subjective factors influence it, such as societal norms, hidden personality traits and other similar personal attributes. Additionally, in an educational context, external pressures like mandatory organisational policies and professional goals can dictate willingness to accept technology (Ajibade, 2018).

TAM's Application in Pakistan

To minimise these inherent limitations, researchers adopt TAM with modifications to predict teachers' technology adoption in diverse educational contexts, including Pakistan (Rafique et al., 2023; Waris & Hameed, 2023). Although these studies have demonstrated the importance of TAM in predicting the acceptance and use of learning technologies, there is a need to move beyond mere adoption towards a more interpretive paradigm that qualitatively values each teacher's experience. This study aims to address this gap by centring teacher input in the design of technology. The following section will explore the literature on co-design and participatory approaches in developing educational innovations.

2.3 Teachers as Co-designers of Learning Innovations

Section 2.1 discussed the research-practice gap and presented teacher-researcher collaboration models to bridge it, highlighting the significance of teacher participation in educational research. Section 2.2 presented several barriers teachers face while

adopting learning technologies and critiqued TAM, one of the most widely used technology prediction models, for statistically portraying a deterministic account instead of privileging individual teacher perspectives. This section extends the discussion to review the literature on participatory and co-design approaches involving teachers in designing learning innovations, particularly technology-enhanced tools. Roschelle & Penuel (2006) define co-design as a highly facilitated and collaborative process that brings researchers, teachers, and technology specialists together to solve specific educational challenges by prototyping innovations, including curriculum and assessment materials, learning environments and learning technology tools. They highlighted several characteristics of a co-design process, which include working towards a tangible innovation in 'design workshops', 'taking stock' of classroom practices and teachers' perspectives, and well-defined roles of all stakeholders involved (Roschelle & Penuel, 2006, p. 607). In educational research, both co-design and participatory design approaches prioritise the active involvement of teachers in the design processes; however, a nuanced distinction that some researchers make between the two is that in a co-design process, the responsibility and accountability for the project's success rests primarily with the principal investigator and its end goal is a tangible educational artefact (Cober et al., 2015; Nicholson et al., 2022; Roschelle & Penuel, 2006). Despite these distinctions, both approaches share the fundamental principles of engaging teachers in the design and evaluation process, and consequently, many studies use these approaches interchangeably without drawing a clear boundary (Matuk et al., 2016; Spikol et al., 2009; Tuhkala, 2021). Hence, I will review studies that use these methodologies, either synonymously or exclusively, to highlight the importance of teachers as co-designers or participatory designers of educational innovations.

In the literature, several case studies adopt collaborative approaches underscoring teachers' pedagogical practices in co-designing learning tools (Cober et al., 2015; Li et al., 2022; Matuk et al., 2016; Musaeus et al., 2024; Nicholson et al., 2022; Roschelle & Penuel, 2006; Spikol et al., 2009), curricula (Peters & Slotta, 2009; Reiser et al., 2000; Zhang et al., 2010) and instructional environments (Lingnau et al., 2007). I argue that these studies highlight different ways of engaging teachers in design activities of diverse learning innovations, presenting evidence to necessitate teacher input in education research. Musaeus et al. (2024) conducted design workshops involving

teachers, researchers and developers to co-design learning activities and test the proof-of-concept of CoTinker, a learning tool to improve computing education in Danish high schools. Through participatory workshops, cooperative prototyping of learning modules, and their successful implementation in classrooms, they found that teachers identified challenges in students' knowledge transfer that researchers overlooked. Teachers also experienced professional development through design workshops and felt a sense of ownership by developing prototypes with developers (Musaeus et al., 2024, pp. 906–907). Peters & Slotta (2009) discussed their two-year iterative co-design experiment in a Canadian high school that emphasises the importance of teacher involvement in developing an inquiry-based curriculum, which fosters collaborative knowledge construction among students. They found that the newly developed curriculum units significantly improved students' scores and enabled them to construct a community knowledge base, leading to better learning outcomes.

However, most participatory studies with teachers in the literature are short-term exploratory experiments rather than longitudinal ones to evaluate the designed artefacts (Tuhkala, 2021). Carroll et al.'s (2000) five-year design collaboration with public school teachers in the US highlighted that as the cooperative engagement of teachers, researchers, and developers in the development and implementation of a virtual school continued over a significant period, teachers' roles evolved from 'practitioner-informants' with passive involvement in the design (pp. 241–242) to 'analysts' and 'designers' by reflecting on classroom activities and then designing technology-oriented prototypes (pp. 243–245) and ultimately into 'coaches' training their colleagues (p. 246). They reported that in the beginning, teachers were sceptical if the researcher required their genuine participation beyond merely testing their designed products, but later became increasingly autonomous in designing and evaluating the virtual school product (Carroll et al., 2000). These findings establish that the role of participatory designers evolves with time, and more efforts are required to document it.

Throughout these studies, in addition to arguing towards the added value of teacher participation in designing educational innovations for more effective implementation and improved student learning outcomes, practical limitations and tensions are also necessary to highlight because teachers and researchers usually have different priorities and commitments. Reiser et al. (2000) conducted collaborative design activities termed 'work circles' with teachers to design project-based technology-infused science

curricula in US middle schools (p. 342). By analysing field notes from work circle meetings, they highlighted notable tensions between researchers and teachers. Researchers were more concerned with building a widely scalable end-product and pushed teachers to explain their rationale behind proposed activities; conversely, teachers prioritised developing students' background knowledge for each activity instead of focusing on the final product (Reiser et al., 2000). Additionally, Peters & Slotta (2009) reported practical challenges in engaging teachers in design meetings during school time and concluded that lengthier and more frequent meetings were difficult for teachers to sustain. These findings necessitate the inclusion of teacher voices in educational design activities as they prioritise students' learning over other aspects of product design and implementation. And their participation should be sustainable in the long term.

Some studies present novel co-design approaches to deal with the discussed limitations of conflicting teacher-researcher priorities and sustainable teacher participation (Lingnau et al., 2007; Nicholson et al., 2022). Nicholson et al. (2022) proposed 'Co-teaching' as a method particularly suitable for the participatory design of education technology tools and their implementation in classrooms by inviting 'design-researchers' in the classroom environment to not only observe teachers but co-teach using designed digital tools (p. 5). During classroom teaching, teachers and researchers reflect on the designed features and engage in a co-generative dialogue to evaluate its efficacy. Consequently, researchers understand the complexities of teachers' world, and the process centres teachers' pedagogical expertise to bridge the gap between teacher-researcher perspectives (Nicholson et al., 2022), discussed in section 2.1. Lingnau et al. (2007) also proposed a novel participatory approach, 'Complementary Action Design' in which teachers assume the central role and pedagogical responsibility in designing educational tools, instructing developers with their contextual ideas and assisting researchers with the evaluation of designed tools (pp. 107–108). They operationalised it in a funded project to design software tools for German secondary schools, highlighting that partially hiring teachers improves their research engagement (Lingnau et al., 2007).

While these approaches empower teachers by allowing them to plan, implement, and evaluate educational innovations within their familiar classroom contexts and offering financial incentives for sustained engagement, I argue that implementing them in

understaffed and overcrowded public schools in developing countries like Pakistan would be challenging (Saeed et al., 2013). The subsequent subsection discusses this in Pakistan's context.

2.3.1 Participatory Design Activities in Pakistan

From the literature review in this chapter, it is evident that engaging teachers as co-designers of educational innovations ensures that their contextual experiences and pedagogical practices inform the design and adoption of technology in classrooms. This process also supports them in understanding students' thinking, which can lead to a transformational enhancement of teacher knowledge (Matuk et al., 2016). However, I emphasise that every study discussed in section 2.3 originates from a developed country, including the United States (Carroll et al., 2000; Li et al., 2022; Reiser et al., 2000), Germany (Lingnau et al., 2007), Singapore (Zhang et al., 2010), Canada (Peters & Slotta, 2009), and Denmark (Musaeus et al., 2024). In contrast, there are only limited empirical studies conducted in Pakistan centring teacher beliefs and practices in designing educational technology tools, which I observed while searching the literature. As presented in section 2.2.2, the focus of education technology research in Pakistan is predominantly on quantitatively predicting technology adoption, overlooking teachers' subjective experiences and potential to be involved in design research.

Nonetheless, it is possible to achieve teacher participation in designing products in Pakistan's educational context. Though not for the design of digital tools, Nawab (2023) explored teacher-led professional development activities in a higher secondary school in Pakistan by gradually engaging and empowering teachers to plan and deliver professional development sessions. He noted that as the researcher expressed appreciation and respect towards their input and started giving them more responsibility, they increasingly became confident and autonomous in leading sessions. They even taught him innovative uses of digital technology throughout their participation (Nawab, 2023). Inspired by such studies, this research addresses the significant gap in the literature on participatory design research with teachers in Pakistan, as guided by the research questions discussed in the following section.

2.4 Research Questions

This research emphasises the importance of teacher input in educational research by engaging public school teachers in Pakistan in design workshops. These workshops

enable teachers to discuss daily challenges while designing digital tools to address them. In addition to studying their adoption of learning technologies, this research centres on their design decisions and the functionalities of digital tools they value. The literature shows that teacher-led design activities for education innovations, particularly learning technologies, are underexplored in Pakistan compared to developed countries. Therefore, this study addresses the following research questions to explore the nexus of educational research, digital technology adoption, and teachers as participatory designers in Pakistan:

Research Question 1 (RQ1): How do teachers in Pakistan's public education system perceive their roles, and what classroom and systemic challenges do they face in daily activities?

Research Question 2 (RQ2): What are the Pakistan public school teachers' beliefs and attitudes towards adopting learning technology tools to address the stated challenges?

Research Question 3 (RQ3): In what ways can the engagement of public school teachers as participatory designers of digital tools contribute to educational research and knowledge in Pakistan?

3. Methodology

In this chapter, I will outline the underlying philosophical perspectives of this empirical study, its qualitative design and the methods used to answer the research questions formulated in the preceding chapter. I will also discuss the sampling design, analysis techniques, my positionality, quality of research and ethical considerations.

3.1 Philosophical Perspectives

Given the nature of the research aims and questions – to explore how public school teachers perceive their roles and engage in potentially redesigning digital tools to address their daily challenges, the study is conducted from a constructivist paradigm that foregrounds the construction of meaning by participants from their lived experiences, which researchers interpret in a particular context, instead of discovering meaning from participant responses prevalent in positivist and postpositivist paradigms (Daka et al., 2020). In the constructivist paradigm, the underlying ontology offers a dynamic perspective of different worldviews socially constructed by participants as they engage in research activities (Clark et al., 2021). Although ontological assumptions of naïve realism and absolute relativism are often contested and critiqued for associating truth to one discoverable reality or infinite possibilities of subjectively unique realities without any knowable world, respectively (Braun & Clarke, 2013, pp. 27–28), this research is underpinned predominantly by the relativist side of the continuum. This ontological position supports the core aim of focusing on teachers' experiences rather than searching for predefined truths or imposing a reality on them.

However, I argue that choosing a paradigm is more nuanced than associating this research absolutely with one of the two opposing paradigms. Pring (2015) has extensively argued on rejecting the 'false dualism' of positivist and constructivist paradigms that oversimplifies one's ontological and epistemological assumptions in a way that rejecting the naïve realism of positivist paradigm, automatically subscribes to absolute relativism of constructivist paradigm, rejecting the notion of any shared reality (pp. 67–70). Supporting this argument, though a constructivist paradigm underpins this research, its ontological and epistemological foundations do not reject the idea of a shared reality beyond personal beliefs and instead assume that there are subjective interpretations of that reality (Pring, 2015). The qualitative participatory elements of research design explained next necessitate such subjective epistemological

heterogeneity where teachers construct knowledge (Bang & Vossoughi, 2016) as they reflect on their (dis)advantage and (under)representation in Pakistan's education system. Therefore, as discussed, I argue that heterogeneity in knowledge production and co-construction of meaning is crucial in this study, where teachers are not merely subjects researched but collaborative designers of digital tools. Moreover, they exist in the reality of the country's education system, and this research explores their perceptions of it.

3.2 Research Design

The philosophical underpinnings of this research guide the research design, which is purely qualitative in nature, including the type of data collected and methods and analysis techniques most suited to answer research questions, presented in section 2.4. Although qualitative research encompasses various techniques, pinpointing what defines a research design as strictly qualitative can be challenging. I argue that research qualifies as qualitative if it involves an iterative process of deep inquiry, close engagement with participants in a specific context, and interpreting meaning from the data rather than seeking predefined answers (Small, 2021). Thus, a researcher's behaviour, from approaching the participants to analysing their data, defines whether the research is qualitative (Small, 2021). In this research, I followed the guidelines of Braun & Clarke (2013, pp. 9–10) in developing 'qualitative sensibility' while doing research within the qualitative paradigm. It is characterised by questioning the process of meaning-making, being reflexive by critically reflecting on my role and place within the participants' communities and establishing trust with them (Braun & Clarke, 2013). Since this research aims to invite public school teachers to share their unfiltered views on their struggles, analyse different learning technologies, and redesign them collaboratively, the discussed qualitative paradigm is best applicable in facilitating their engaged participation in a design-based approach.

While the spirit of the participatory approach is emancipatory and inclusive (Edwards & Brannelly, 2017), I remain cautious about making grand claims given the study's scope and acknowledge the significant efforts and longitudinal participation required to achieve such outcomes, as highlighted in section 2.3. The succeeding sections will detail the qualitative participatory design methodology used to select public schools in Islamabad, recruit volunteers and teachers from chosen schools, and collect data in two phases. In phase one, teachers, in focus groups, discuss their challenges, potential of

learning technologies and opportunities to lead educational research. In phase two, they collaborate in pairs to design digital tools, targeting their highlighted issues and evaluating the tools' efficacy in public schools.

3.2.1 Participatory Design Methodology

The study's research design incorporates a participatory approach, inviting teachers to highlight their classroom challenges and broader systemic issues, thereby constructing a comprehensive narrative of public school teaching in Pakistan. Additionally, teachers engage as co-designers to design digital tools, prioritising their pedagogical practices and contextual experiences in technology design (Cober et al., 2015). As argued in section 2.3, this approach involves stakeholders in designing innovative technologies, privileging their insights in decision-making that can potentially cultivate transformative agency among them (Bang & Vossoughi, 2016). To emphasise the need for a participatory design approach in this study, I highlight that more than half of the studies in Tuhkala's (2021) review are from Western countries. It is similar to what I identified in section 2.3.1, that teacher participation in design activities is severely underexplored in developing countries like Pakistan.

Although it will require multiple iterations of design workshops and long-term engagement of teachers to evaluate the designed innovations in their classrooms (Tuhkala, 2021), this exploratory study embodies the fundamentals of inclusive and contextually driven participation of teachers in an initial stage participatory design approach. To ensure this, I followed practical guidelines from Cober et al.'s (2015) paper, which discusses two case studies involving teachers in designing digital learning innovations in Canada and Singapore in a three-year research partnership. They highlight three essential steps for successful participatory work with teachers: conduct early-stage meetings with them where they can share their experiences to establish a common understanding of research aims, cultivate honest and respectful relationships and then prioritise their contextual knowledge through collaborative prototyping in design workshops (Cober et al., 2015).

Extending the first step from above, one of the core principles of the originally conceptualised participatory design approach is an understanding of contextual challenges and practices of participants, requiring an initial inquiry before participatory workshops (Cumbo & Selwyn, 2022). Focus group discussions with teachers in phase

one revolve around this, presented in section 3.3. To implement the second step, I recruited volunteers to leverage their friendly relationships with participants, facilitating their participation by ensuring they felt respected in a trustful environment. Lastly, following the third step, participatory workshops in phase two engage teachers in collaboratively prototyping educational innovations through group work. As RQ3 revolves around the role of teachers in research, these workshops can potentially develop a 'knowledge network' between participants or strengthen an already existing one where they can share professional development resources, pedagogic insights and opportunities to take part in local education research (Ebersohn et al., 2012, p. 463).

3.2.2 Sampling Design

In qualitative research, defining research aims, 'purposefully selecting' research sites and participants, and interpreting data are inevitably tied to the researcher's past academic and professional experiences, culture, ethnicity and socioeconomic status (Creswell & Creswell, 2023, pp. 187–189). As I argued in Chapter 2 regarding the significance of obtaining a richer sense of teachers' experiences on the grassroots level in educational research, access to public schools is thus crucial to answering the research questions. Since I had taught in an Islamabad public school for two years as a fellow of Teach For Pakistan (https://iteachforpakistan.org/our-approach/), I leveraged my professional network to choose specific schools as research sites. This subsection will explain the rationale and sampling techniques used to purposefully select schools, fellows as volunteers, and teachers as research participants according to the inclusion criteria stemming from the research questions.

Choosing Schools and Volunteers

Before describing the sampling technique used to recruit schools and volunteers, it is necessary to reflect on two factors that justify the role of volunteers in this research. As discussed earlier, close relationships with the participants are paramount to the success of participatory design workshops and genuine teacher participation (Cober et al., 2015). Therefore, fellows with over a year of teaching experience have already established trust with their colleagues, which helped me build relationships more quickly, given the study's time constraints. Though other factors, which I will address in the positionality statement, facilitated this relationship-building, fellows functioned as catalysts. Secondly, from my experience of working in the federal education system,

I was aware of schools' poor digital infrastructure. And because data collection activities would be virtual, fellows were needed to schedule and host online meetings on their laptops, communicate emergency school closures, and help participants with their queries in real-time during participatory workshops.

Initially, I contacted Teach For Pakistan executive leadership to obtain a list of public schools I could access as research sites. From that list of eleven schools, all situated in Islamabad's different rural areas, I used purposive sampling (Sharma, 2017) to shortlist seven schools to optimise the sample of schools based on participants' gender, access to learning technologies such as piloted digital projects and labs, number of volunteers, school location and grade levels. Although this qualitative study does not strive for 'generalisability' to prove its quality (Creswell & Creswell, 2023, p. 201), I aimed to include as much diversity as possible in the school sample to explore heterogeneous teachers' perceptions of their roles relative to differing school characteristics. After selecting these schools, I emailed fellows teaching there to interview and recruit them as volunteers (see this call for volunteers in Appendix A). Ultimately, I finalised four schools that maximised heterogeneity among the sample. *Table 1* lists the characteristics of these schools. The varying levels of technology integration in schools offer opportunities to investigate how teachers with frequent digital tool usage perceive and redesign learning technologies compared to those with limited exposure.

Table 1: *Schools Information*

School	Grades	Gender	Volunteers	Technology Exposure
1	1 – 10	Female	2	None
2	6 – 12	Female	3	High
3	6 – 10	Male	1	Moderate
4	1 – 5	Male	2	Low

Purposive Sampling of Teachers

After recruiting volunteers and thoroughly explaining the research aims and design, I asked them to nominate up to six teachers per school based on the inclusion criteria, which are that these teachers should have at least two years of experience in public schools, be eager to share their experiences of technology adoption and be willing to participate in a design workshop. The sampling approach is non-probability purposive

sampling, which selects participants most likely to provide rich insights in exploring the research questions (Douglas, 2022). In addition to my judgement and vision of engaged participation, practical constraints also affected this process. Many teachers had exam invigilation duties in addition to their regular workload; thus, in each school, on average, five to six teachers out of twenty exhibited an interest in participating.

From the available population, I recruited four participants from each school, sixteen in total, to participate in focus group discussions and design workshops. *Table 2* contains participants' pseudonyms, their associated schools, teaching experience, highest educational qualifications and subjects they regularly teach. In qualitative studies, many theoretical and practical factors influence sample size, including researcher judgement and analytical workload (Robinson, 2014). Another consideration is saturation, beyond which new data or codes add minimal benefit to meaning-making or answering research questions. Though its application in determining sample sizes is slightly controversial regarding epistemological views and quality of research design (read the paper by Sebele-Mpofu (2020) for detailed discussion), I argue that it is helpful when contextualised to the design as there is no one rule to determine sample size. Thus, combining the findings from Hennink et al.'s (2019) work on code saturation in focus group discussions, discussion with my supervisor and practical considerations, I limited my sample size to sixteen participants.

Table 2: *Participants Information*

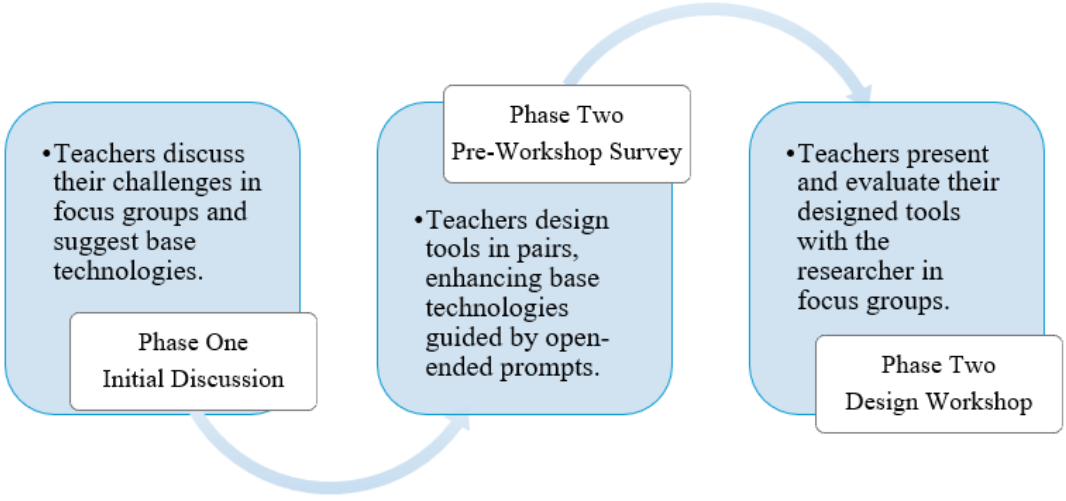
Name	**School**	**Experience (years)**	**Educational Qualification**	**Subjects**
Urwa	1	2	MSc Microbiology	Biology, Chemistry
Saima		6	MSc Information Security	Computer Science
Sania		10	MA English	English
Asma		16	MSc Political Science	English, Mathematics, Science
Aisha	2	30	BSc Chemistry, Botany & Zoology	Biology, Chemistry
Fatima		12	MSc Economics	Computer Science, Physics
Maryam		15	MA English Literature	English
Parveen		18	MEd	English, Education

Mubashir	3	2	BSc Organic Chemistry	Chemistry
Iqbal		6	PhD Biotechnology	Chemistry, Biology
Faizan		15	MEd	Islamic Studies, Urdu, Pakistan Studies
Farid		2	MPhil Mathematics	Mathematics
Abdullah	4	20	MA Urdu & MEd	Urdu, Islamic Studies
Masood		4	MA Linguistics	English, History, Geography, Science
Habib		4	MSc Computer Science	Science, General Knowledge, Mathematics
Kamran		20	BEd	Pakistan Studies

3.3 Methods and Data Collection

I conducted data collection activities in two phases. The first centred around an initial discussion with participants to communicate research aims and establish a contextual understanding of their challenges and practices. As highlighted earlier, this initial inquiry is one of the core principles of the participatory design approach (Cumbo & Selwyn, 2022). The second phase focused on participatory design, inviting participants to imagine and redesign digital tools, informed by their responses from the previous discussion. All communication was in Urdu, Pakistan's national language. *Figure 2* presents an overview of the research design and data collection activities.

Figure 2: *Research Design Overview*



3.3.1 Phase One: Focus Group Discussions

The focus group method involves collecting data from participants in a group of typically four or more through a guided discussion on specific topics. It enables a deep exploration of how participants collectively construct meaning as they communicate with each other and the moderator, often the researcher (Bryman, 2016, pp. 501–502). A key differentiating aspect of focus groups from qualitative interviews is the natural social interaction among group members through which they negotiate the meaning of several issues among each other and behave as if they are having a normal conversation that potentially elicits more genuine responses (Wilkinson, 1998). This process can empower underserved participants and is particularly applicable in participatory methodologies (Braun & Clarke, 2013, pp. 110–111). The possibility of knowledge co-construction and combined reflection on classroom practices using this method can facilitate the development of a 'knowledge network' (Ebersohn et al., 2012), as already discussed in section 3.2.1.

Considering these benefits, I used the focus group method to understand participants' experiences in Pakistan's public education system. In this phase, I conducted and voice-recorded an hour-long synchronous focus group discussion in each school. I hosted these meetings on Microsoft Teams, with all participants in a focus group sharing a volunteer's laptop. Volunteers were only responsible for scheduling and coordinating meetings and providing their laptops and internet connection; they were not involved in the discussion. These semi-structured discussions spanned three topics, starting from discussing classroom and systemic challenges, then expressing thoughts on the integration of digital technology in teaching and, finally, discussing the importance of teachers' insights in educational research (phase one questions are in Appendix E, mapped to the three research questions). Because the researcher's influence and power are relatively reduced and spread among the participants in focus groups compared to other research methods where the researcher imposes a particular framework and ways of being on them, they are more likely to interactively discuss other topics important to them, as Wilkinson (1998) highlighted with examples. However, though the participants possess relatively more power during data collection activities, an imbalance of power still exists because the researcher remains in charge of analysing data and publishing findings from it (Wilkinson, 1998). Nonetheless, during this study's focus groups, participants talked, passionately at times, about several other issues in

addition to the predefined topics that presented a deeper insight into their experiences. Chapter 4 presents these findings in detail.

3.3.2 Phase Two: Participatory Design Workshops

Following the principles of participatory design methodology, this research design combines participants' insights and experiences at every data collection stage (Islam, 2022, pp. 296–297). Hence, the preliminary analysis of qualitative data from phase one focus groups directly informed participatory design workshops. Phase two has two components: a pre-workshop activity and the design workshop. Combining the ideas of all participants from the first phase on digital tools and their views on integrating them in their teaching, I identified technologies that would be valuable to focus on in phase two, as graphically explained in F*igure 2*. Then, I designed a qualitative survey with open-ended questions to facilitate their design thinking and collaboratively add new features to an existing technology of their choice. The base learning technologies are Smart LCD System, Teacher Assistant and Automatic Tutor (Chatbot) (survey in Appendix F). Like the design workshops conducted by Demırbas & Ogut (2020), this activity's desired outcome is not a tangible tool but design principles, collaborative design processes and specific tool features that public school teachers in Pakistan value.

Pre-Workshop Survey

In the pre-workshop activity, teachers formed pairs to collaboratively discuss and design their tools, guided by the open-ended prompts in the survey. Because of their busy school schedules, teachers' pairs independently filled out the hard copies of surveys in their free time. To assist them in real-time with their queries, I trained the volunteers, emphasising that each group has creative freedom and autonomy to share their perspectives in response to the questions. Though surveys are typically employed to collect large amounts of responses in a standardised manner (Braun & Clarke, 2013, p. 137), their administration in an open-ended format appropriates their use in a qualitative paradigm. Teachers completed the tool design surveys within one to two days, after which I scheduled design workshops.

Design Workshop

In design workshops, I conducted focus group discussions in each school in a format similar to phase one, except these sessions were thirty minutes long. In these workshops, teachers (in pairs) presented their designed tool, discussed its limitations

and efficacy in their school's context and reflected on their experience of creatively designing their educational products. While explaining their design choices, teachers highlighted their priorities and attitudes towards learning technologies, directly responding to RQ2. Furthermore, these discussions generated data in response to RQ3, exploring the role of teachers in participatory research while leading the design of digital tools. Lastly, these workshops also allowed teachers to evaluate and comment on the design choices of other groups.

3.4 Reflexivity and Ethics

Being reflexive is essential throughout qualitative research, as it entails acknowledging subjectivity in knowledge production and questioning the role of personal experiences and assumptions in shaping research (Braun & Clarke, 2013, pp. 36–37). I practise a form of reflexivity, 'recognition of self', to highlight how my identity and past professional experiences influence this research through a positionality statement (Pillow, 2003, p. 181). I do not intend to present this self-reflexivity in a celebratory manner to claim that the findings are truthful. Instead, I aim to acknowledge personal biases and subjectivity while critically reflecting on them.

3.4.1 Positionality Statement

I acknowledge that my professional experience of teaching in an under-resourced public school in Islamabad and what I learned from my senior colleagues influenced my interest in this research to highlight the worldviews and experiences of similar teachers, particularly on learning technologies. Because of my professional network, I had privileged access to schools and recruited participants according to the inclusion criteria. Moreover, my first language is Urdu, and because of a similar lived experience of working in a public school, I recognise myself as an insider to the teaching community to an extent, which helped me establish connections quickly with the participants. Thus, I acknowledge that I am an outsider in many aspects because I did not experience many challenges as persistently as the participants highlighted. Based on my affinity with the teaching community, I acknowledge that I am subjectively biased in teachers' favour, and I critically reflected on it while analysing the research data. Additionally, I am aware that posing as a research student from the University of Oxford, which holds the status of hosting and fostering the intellectual elites of the world in Pakistan, I come from a place of privilege, and an imbalance of power exists among us.

3.4.2 Ethical Considerations

The University of Oxford Central University Research Ethics Committee approves this research, reference EDUC_C1A_24_023 (approval document in Appendix D). The volunteers facilitated participants in signing consent forms after providing a detailed information sheet (information sheet in Appendix B and consent form template in Appendix C). After collecting the consent forms, I assigned pseudonyms to all participants and replaced identifiable school names with numbers to anonymise teachers' identities. Though I would have liked to credit their tool designs in the spirit of participatory research (Islam, 2022), they felt more comfortable sharing openly with anonymity. Following the university's ethical guidelines and the British Educational Research Association [BERA] (2024) standards for informed consent, the volunteers and I engaged participants in a dialogic process to explain the research aims, emphasising their autonomy to participate or withdraw at any time. Given Pakistan's research environment and the absence of local ethics review committees, participants often consider informal oral consent sufficient and are wary of official written documents (Shamim & Qureshi, 2013). Hence, the volunteers communicated with teachers extensively to explain the research project using the information sheet. Only after signing the written document were the participants engaged in research activities.

Additionally, Eynon et al. (2016) highlighted several ethical concerns in digitally mediated research, including the use of third-party services that can access participant data and automatically collect digital trace data. This practice may compromise participant anonymity beyond what was anticipated and communicated during the informed consent process (Eynon et al., 2016). To address them in the research design, I only used a preapproved video conferencing software, Microsoft Teams, and volunteers circulated information sheets and qualitative surveys physically to minimise the collection of digital trace data. While volunteers were crucial for data collection, their involvement raised concerns about participants' data privacy. After data collection concluded, I requested them to delete all digital files and recycle any paper documents containing research information.

3.5 Data Analysis

The analysis began by transcribing six hours of voice-recorded data in Roman Urdu script because NVivo 14 provides limited support to languages in Arabic script. An example of this manual transcription is:

English: How are you? *Roman Urdu: Aap kaise hain?* اردو :آپ کیسے ہیں؟

Since a transcript is a 'representation' of the spoken words and greatly depends on the researcher's subjectivity (Braun & Clarke, 2013, p. 162), it helped that Urdu is my native language, and that enabled me to preserve most information, and subtext in participant responses, subject to my interpretation. However, a limitation is that the quotes in Chapter 4 are translated into English. Due to the subjective nature of translation, I acknowledge there may be subtle nuances that are not fully captured as participants would have liked.

Based on the epistemological assumptions highlighted earlier in the chapter and remaining within the qualitative interpretive paradigm, I adopted a reflexive Thematic Analysis (TA) approach to analyse the focus group transcripts and survey responses (Braun & Clarke, 2021). Quality reflexive TA centres the researcher's subjectivity in a cyclical process of generating codes and themes and calls for a continuous reflection on the personal underlying analytic interests and theoretical assumptions (Braun & Clarke, 2023). After getting familiarised with the data while making transcripts, I started coding inductively using the 'bottom-up' approach to construct meaning from the participant responses instead of being tied by predetermined codes or searching for specific themes (Braun & Clarke, 2006, p. 83). However, I am aware that analysis does not occur in a vacuum free of the researcher's agenda as questions that elicit responses stem from predetermined research questions (Terry et al., 2017); hence, the construction of predominantly inductive codes and grouping them into themes has a deductive element as well here. Appendix G presents these codes grouped in themes.

3.6 Quality of Research

This study rejects the realist ontological worldview that disqualifies the application of conventional criteria of validity and reliability, usually applied to quantitative research, to assess its quality. Instead, it adopts several overlapping criteria of quality in qualitative research introduced by Lincoln & Guba (1985) and Tracy (2010) while remaining in a constructivist paradigm. These criteria are credibility, resonance, sincerity and ethical considerations (Tracy, 2010, p. 840). To ensure the credibility of this research, I employ method triangulation to collect data from the participatory workshops in phase two using an open-ended survey filled in pairs and then individually explaining subjective views and design choices in the following focus group

discussions, depicted through *Figure 2*. Though I acknowledge that the use of triangulation questions my ontological stance (Ellingson, 2009), I do not present its application to get closer to 'truth' but to get an in-depth understanding of participants' design decisions and valued features in digital tools (Braun & Clarke, 2013, p. 286). The study also attempts to invite readers to explore similar questions in different contexts by providing a 'thick description' of research processes and telling an evocative story of its unique context (Bryman, 2016, p. 384), thereby showing resonance through transferability. Moreover, an account of positionality demonstrates self-reflexivity and transparency to achieve sincerity in research (Creswell & Creswell, 2023). Lastly, ethical considerations have been discussed in section 3.4.2.

4. Findings

This chapter presents findings from focus group discussions and participatory design workshops with sixteen teachers in four public schools in Islamabad Capital Territory, Pakistan. These findings are distributed across three sections: teachers' experiences and perceptions of the country's education system, their attitudes and beliefs towards integrating learning technologies in daily teaching, and their limited exposure to educational research and engagement in the participatory design workshops. In the first section, teachers articulate their experiences as public school teachers in Pakistan by explaining the plethora of classroom and systemic challenges they face. It directly addresses the first research question (RQ1). The second section presents teachers' overwhelmingly positive attitudes towards learning technologies in response to RQ2. The final section is situated at the intersection of teacher knowledge in education research and digital technology by presenting insights from the participatory design of digital tools, centring their voices. It corresponds to RQ3. All findings stem from thematic analysis of the qualitative data, and Appendix G presents graphical illustrations of codes grouped in themes.

Before the main findings, an overarching preliminary finding is that despite the varying school characteristics in the sample, there were no significant differences between participants' views based on their school. Thus, the chapter presents findings across themes rather than categorising by schools. Chapter 5 discusses these findings with reference to the literature.

At the end of the design workshop in school three, Mubashir expressed his thoughts on participating in this research, which sets the tone for this chapter and elegantly captures the essence of the study:

> We have observed many people doing education research … They bring us questionnaires and Google forms to fill, MCQs to just tick and all that. But this is the first time we are experiencing such research that provides us an opportunity to express ourselves through open-ended questions. Above everything else, we are addressing our own issues, including those while using technology. And how we can handle them within limited resources.

4.1 Challenges of Public School Teachers

In the first focus group discussions, I inquired about the challenges teachers most commonly face in their teaching activities and broadly in their roles while dealing with other stakeholders, such as education policymakers and the federal education directorate. Their responses culminated in a narrative of continuous disadvantage and frustration that they experience in their jobs. While analysing the data, I divided their description of challenges into two main themes: Classroom and Systemic Challenges. These findings are essential to the study because, during the participatory design workshops, teachers added several features in their designed tools specifically targeting these issues, which I will present in section 4.3.

I will preface these findings with a well-known poetic verse that Abdullah, one of the participants from school four, quoted, highlighting how the various desires of public school teachers are often neglected or crushed by the education system:

ہزاروں خواہشیں ایسی کہ ہر خواہش پہ دم نکلے

It loosely translates to: *I have thousands of ambitions and each ambition could consume my life.* I interpret it as symbolising the helplessness Abdullah experienced throughout his twenty-year teaching career. It necessitates investing in long-term collaboration with public school teachers to understand their struggles and bring their insights to the fore.

4.1.1 Classroom Challenges

Teachers described challenges they regularly experience while teaching in their classrooms, signalling that they perceive their roles as infused with unsolvable difficulties. These challenges include a high student-teacher ratio, severe learning gaps in students' knowledge base due to their disadvantaged socioeconomic backgrounds and language barriers while teaching subjects in English. As detailed in section 3.2.2, all public schools in this study are situated in rural areas, exacerbating these challenges, which participants highlighted as well.

High Student-Teacher Ratio

Among all the challenges, dealing with overcrowded classrooms is the most repeatedly listed by teachers. They explained that in a room that can only accommodate thirty-five students, they have to teach anywhere from fifty to eighty students in a single period of

forty minutes. It restricts them from providing individual attention to students and adapting their teaching methods to individual learning needs. It results in significantly less effective teaching and has implications for learning outcomes (Blatchford et al., 2011). Among many that talked about this challenge, Parveen, from school two, highlighted:

> Our biggest challenge is that we have huge student strength … in a short lecture of 40-45 minutes, we have to teach 60, 65, 70 students in a single class, so we cannot provide individual attention!

Teachers also mentioned that due to this problem, they miss a vital chance to build relationships with students and discuss their learning gaps with parents. Saima, from school one, recalled her difficulties in Parent-Teacher Meetings (PTMs):

> I find PTMs very challenging … during a PTM, sometimes I cannot even map a student's face from her name while discussing with her mother … if you see 50 new faces after each period, it is impossible to retain that, we talk about students' knowledge retention, yet we do not have our retention.

Apart from the inability to provide individual instruction, teachers highlighted the difficulty of managing student behaviours in an overcrowded environment, which adds to their exhaustion while teaching. Mubashir explained:

> During the class, students start fighting and complaining that another student teased them or forcefully took their pen. … All these issues are because of high student numbers, as an ideal class does not have 50-60 students. … We even try to manage up to 40 students. Beyond that, it gets very hard because room sizes are small.

Saima also gave an example of student conflict arising from this issue:

> My computer lab has 20 systems, so when I ask 50 students to share them, they do not, which disturbs the entire environment.

Severe Student Learning Gaps

Teachers across all four schools complemented the challenge of unmanageable student-teacher ratio with substantial learning gaps in students' knowledge base while highlighting classroom challenges. They explained that they have to spend most of the

teaching time going through the fundamentals instead of the actual topic, even in higher grades, because students cannot grasp new knowledge without bridging previous learning gaps. Moreover, they highlighted the inability to implement innovative teaching methods, specifically the flipped classroom model, because of time shortages and the efforts required to teach basics. In the flipped classroom model, instead of teacher-led instruction, learning is student-centred, as students can review educational content at home and then engage in different classroom activities facilitated by teachers to construct knowledge (Zengin, 2017). Asma and Mubashir separately elaborated on the severity of this challenge by giving examples:

> Asma: When we have to teach a student in 9th or 10th class how to pronounce words in Urdu literature, then how can you imagine that we prepare them for exams.
>
> Mubashir: Students in middle to high grades have no base. A student in 6th class cannot even write his name in Urdu or English.

Most teachers linked these severe learning gaps to students' disadvantaged backgrounds and low socioeconomic status. Iqbal, from school three, explained this:

> Students face these issues because of poverty and their socioeconomic conditions, so we have to do extra work with them. Many teachers, like my colleagues Mubashir and Faizan, spend extra time teaching them outside of regular teaching periods.

Furthermore, they explained this connection of weak student knowledge base with socioeconomic status by highlighting that because of their limited access to quality educational resources at home with the added pressure of supporting their parents financially by working odd jobs from a young age, they usually do not find the time to study at home and actively participate in class activities. Tayyaba (2012) highlighted this as well, comparing rural and urban schooling conditions, that most students in rural areas are severely marginalised and have no educational support at home. In Iqbal's description:

> One of the significant challenges in the public sector, in our experience, is that 80-85% of the students here belong to families that fall very close to the poverty line. … They feel responsible for helping their parents while studying, so they

> work. It makes them lethargic inside the classroom. … Thus, the big issue is that they lack sufficient time at home to review the topics taught in class.

Language Barriers

Teachers extended the challenges of weak student knowledge to language barriers in the classroom as students cannot understand academic terms in English, which teachers also linked to their marginalised backgrounds. It has been documented in the literature as well that students from lower socioeconomic backgrounds have limited exposure to English (Manan et al., 2015) Participants reported that this issue adds to their already exhausting teaching activities, as students require them to translate all scientific terms into Urdu. Among many examples that teachers quoted to explain this problem, the following by Saima stands out:

> One day in my 10th-grade period, I sarcastically told the students that I wished their English literature were in Urdu, to which they seriously replied that they wished the same.

4.1.2 Systemic Challenges

This subsection will present an in-depth preview of teachers' mounting frustration because of a disconnect between schools' realities and the output expected from them by Pakistan's Federal Education Directorate.

Inadequate Investment in Human Capital

Teachers expressed their disapproval of the continuous professional development (CPD) opportunities they are required to attend as they believed that these workshops are always disorganised and have no effective outcomes other than restricting their time. Almost all participants felt inadequately supported by the government to solve the classroom challenges highlighted in section 4.1.1. Maryam, from school two, summarised her experience of CPD workshops in her school:

> There was no professional training in our CPD sessions. No one had charted out a plan or areas to work on … we were just bound daily without any output, and it had only one thing: gossip. … We learn everything alone and then apply it. And if we fail, we learn from that too.

Additionally, they mentioned that it is high time for the government to start training teachers in digital skills along with much-needed pedagogical training. Due to the government's lack of interest in teacher capacity building, they highlighted that many newly inducted teachers struggle to perform under marginalising circumstances, resulting in poor student learning outcomes.

Abdullah added another dimension to this issue by highlighting the lack of incentives for teachers to improve professionally, commenting:

> I have two Master's degrees and 20 years of experience, yet my monthly salary is barely above 80 thousand Rupees (*approximately £227*). … It's almost like we are teaching for free but still trying our best.

Teachers' Struggles in a Results-Oriented System

Another systemic challenge teachers emphasised is the country's results-oriented education system that measures students' academic achievements by exam marks, promoting the trend of rote learning among students. They argued that this standardised examination system limits them from teaching to build conceptual understanding. Instead, it forces them to dedicate their efforts solely towards improving students' grades through repetitive memorisation tasks. Teachers in other regions of Pakistan, such as Khyber Pakhtunkhwa, also highlight this issue (Ali, 2018). Iqbal and Mubashir, in a discussion, stressed the detriment it causes to student learning and pointed out that this hyper-fixation on improving marks also impedes the successful implementation of technology tools in teaching as the government evaluates their performance from students' annual results:

> Iqbal: Emphasis is on marks and cramming. … There is a quote in a Batman movie that *structures become shackles*. These shackles restrict us to only produce better results instead of aiming for concept development. … Teachers can implement technology only when we remove this hanging sword of better results from their necks.
>
> Mubashir: You can teach technology lessons all week, but when the principal walks in, he will ask students how many book chapters they have written in their notebooks.

Due to these persistent demands of the system, teachers reported being frequently overworked from consecutive lectures without any scheduled free periods. Saima put it as:

> When our results are low, it indicates that we are unable to teach effectively, but the higher officials ignore this. It must be difficult for anyone to sustain this much mental pressure.

Disregard for Teacher Perspectives in Decision Making

Teachers attributed most of their challenges to the government's education policies, developed and implemented in a top-down manner. Furthermore, they noted that the policymakers responsible for these initiatives often lack awareness of the issues in public schools. Participants recalled attempting to communicate their concerns to them during training seminars, only to have their voices neglected. Expressing this, Faizan, from school three, said:

> Our government takes decisions in boardrooms, and the people behind them belong to the upper class of society, happily unaware of the challenges of the lower class. Resultantly, all projects fail.

They presented sudden curriculum changes without teacher representation as the most critical example of this problem. They emphasised that, due to a lack of communication with curriculum makers about students' severe learning gaps, revisions in the old curriculum introduce increasingly complex topics that students struggle to grasp. Urwa, from school one, explained:

> We suddenly get a notification that the curriculum has been changed … we do not know who changed it and how. Most teachers I talk to, young and senior both, none are consulted. … Suddenly a team of 5-10 people decides that it's now time to change curriculum.

4.2 Digital Technology Adoption in Schools

After discussing their classroom and systemic challenges, I invited the teachers to reflect on their experiences of integrating digital tools in their classrooms and analyse their benefits or drawbacks in addressing the mentioned issues. Despite varying levels of technology integration in their schools, all sixteen participants viewed technology positively and provided examples of how it currently or has the potential to enhance

their teaching effectiveness. However, they listed several flaws in learning technology implementation that limit their usefulness. This section will present the perceived usefulness of technology from the teachers' perspective and the barriers to its implementation.

4.2.1 Usefulness of Technology

Even though most teachers only had access to basic technology tools such as LCDs, projectors or personal laptops, they reported a substantial increase in student interest in learning with audiovisual aids. They also recalled several examples of technology facilitating them in their daily activities. I will present these themes in this subsection.

Captivating Digital Natives

While highlighting the advantages of integrating digital technologies in classroom teaching, teachers strongly argued that their students, irrespective of their socioeconomic backgrounds, belong to a generation of digital natives and are innately drawn to technology-infused teaching more than traditional methods. Prensky (2001) coined the term 'Digital Natives', which refers to the children born after 1980 who grew up surrounded by digital technologies. Teachers provided examples of their students and even their children attracted to anything with a *touch* of technology, as they put it. In Iqbal's words:

> We have 21st century learners, and regardless of their background, they are all aware of how the Internet world works and are more keen to learn when we use digital tools.

There was a consensus among participants that due to this natural inclination towards digital technology, students find traditional teaching boring; conversely, learning with audiovisual educational resources enriches students' concept development and sparks their imaginations, leading to higher classroom engagement. Hence, teachers supplemented their lectures with graphical animations and video demonstrations of scientific experiments. They shared their experiences, such as Urwa using a projector to demonstrate scientific experiments to make up for the lack of a science lab, Masood teaching climate change through videos, and Iqbal regularly using GIFs to illustrate human anatomy. Masood, from school four, explained the reason behind the benefits of incorporating audiovisual resources in teaching:

> Students are interested in tools because, according to the learning theories, their learning happens in various ways. So different sources enhance chances of learning like learning by seeing, listening and doing.

Reducing Teachers' Workload

As presented above, teachers advocated for integrating digital tools into teaching, emphasising their necessity to enhance student learning. Additionally, they recalled its several uses that lower their workload by facilitating them in teaching tasks, complementing the student benefits. These tasks included managing student data, composing and grading assessments, and using audiovisual content in effectively teaching overcrowded classrooms. A common theme in their examples is that they considered technology beneficial more if they had control over it. Fatima and Maryam discussed this together with an example:

> Fatima: Technology is very effective if we do not have technical issues. In overcrowded classrooms, teachers do not have to speak very loudly as we can increase the volume of educational videos, show concepts and then answer students' questions …
>
> Maryam: And this is teacher-centred as the teacher is in control of the digital environment. All assessments and lectures are set up inside the classroom, and students learn.

Abdullah also expressed his views on the topic:

> Digitisation is a very good thing. I save time by making assessments digitally and giving papers to students instead of writing on the whiteboard. … I often wish to have a (*school-issued*) laptop and projector to teach students digitally.

Teachers also highlighted that now they have access to education technology applications, such as TeleSchool and Taleemabad, which provide lesson plans according to their curriculum. It further evidences their inclination towards teacher-facing learning technologies, and they were confident in their irreplaceability, seeing digital tools as supplementary to their teaching rather than substitutes.

4.2.2 Barriers to Successful Technology Integration

After recounting the usefulness of digital technology in education for students and teachers, the participants raised several concerns that limit the effective implementation of government-led EdTech projects in public schools. I grouped these concerns into two categories: lack of access to resources and misguided and short-lived top-down implementation of pilot programmes.

Limited Resources of Students and Schools

Though schools two and three had government pilot programmes such as TeleTaleem and Robotmea Makerspace, and schools one and four only had access to a projector and LCD system in one classroom, all teachers cited facing first-order barriers of limited tools accessibility and technical faults in the provided hardware. Teachers from the latter category of schools said that as much as they would like to use technology in teaching, their schools have limited technological resources, and even if they rely on personal laptops and phones, their devices lack storage to download all educational applications. Abdullah highlighted the extent of the scarcity of digital resources:

> In this remote area, we had to use a personal setup for (*these*) online meetings. There is no contribution from the school …

Alternatively, in schools with pilot projects, teachers referred to the earlier discussed challenges of high student-teacher ratio and economically disadvantaged backgrounds of students as barriers to efficient technology integration. They believed the technological resources in these pilot projects did not cater to their classroom sizes; consequently, their time would get wasted on logistical issues. Aisha, from school two, recalled her experience:

> Because our student enrolment is high, it would take so much time just to give clickers to students that the whole period would go by.

Lastly, an issue common across all schools is students' lack of access to digital tools at home due to their socioeconomic status. Teachers expressed that whenever they tried to engage students virtually by sharing recorded lectures and notes through WhatsApp, their limited accessibility of mobile phones and the internet would restrict the potential of digital learning. Thus, teachers mainly reported extrinsic barriers to technology adoption in schools.

Failures of Pilot Programmes

As mentioned at the start of section 4.2.2, the federal education ministry has been piloting education technology projects in chosen public schools to test the efficacy of technology in classroom teaching. However, participants' responses demonstrate that teachers are not involved in their design and implementation; consequently, these programmes are detached from the realities of public schools. Aisha and Mubashir separately highlighted two issues because of the absence of their input in the design of educational innovations and piloted programmes:

> Aisha: The provided modules did not have videos on all topics, and the included videos had follow-up assessments, which were challenging for our students to solve.
>
> Mubashir: Sir Iqbal[1] and I went to attend training for our pilot project, TeleTaleem, and during the training, we thought that this was very easy … but when we applied it practically in school, many parts were lagging. … Technology projects should be from bottom to top, not the opposite.

Thus, teachers urge the significance of their engagement in design activities of digital tools for successful implementation. Rather than attempting to improve the pilot programmes on teachers' feedback, the higher authorities would discontinue them in their infancy. Participants gave examples of such projects, which the government implemented with full effect but shut down after one or two years of operation because of resource constraints and budget cuts. They expressed frustration over this issue, noting that after spending a substantial amount of time incorporating digital technologies, they have to revert to conventional teaching methods when pilot programmes shut down. Consequently, they distrust the government's promises now and are wary of new projects enforced on them. Maryam and Fatima humorously summarised this issue together:

> Maryam: In my fifteen years of teaching experience, I have never seen any pilot programme continued beyond the initial testing phase …
>
> Fatima: They dismiss it as a *pilot* and let it fly away!

[1] In Pakistan, it is customary to address all teachers using "Sir", which is a sign of respect associated with the teaching profession.

4.3 Teachers as Participatory Designers of Digital Tools

Despite the frustrations of dealing with persistent classroom and systemic challenges and the flawed top-down implementation of learning technologies, all participants recognised the value of their input in research, and some even recalled their past experiences leading research activities. At times, their responses revealed pessimism due to their marginalising circumstances; however, their participation in design workshops and insights from focus group discussions demonstrate confidence in their ability to engage with and contribute to educational research. In this section, I will present their opinions on the significance of teacher involvement in research and reasons for lack thereof in Pakistan, digital tools they collaboratively designed and lastly, their reflections on the participatory design process that directly pertains to RQ3.

4.3.1 Engagement and Aspirations in Education Research

During the group discussions, many participants emphasised that although they aspire to initiate and lead research to investigate issues embedded in their classrooms, most academic researchers and the federal education directorate do not genuinely seek their perspectives. It is evident from many teachers conveying that in their extensive teaching experience and helping academic researchers with data collection through surveys, this is the first time they engaged in an open discussion of their problems and undertook design work. Nevertheless, some participants had prior individual experience conducting research that I will briefly present before highlighting their opinions on underlying issues for lack of teacher engagement in education research.

Masood recalled his research experience comparing local and Cambridge English textbooks to inquire which is more engaging and reader-oriented. He presented his abstract at the Linguistics Association of Pakistan conference and listed the benefits of taking part in research as a practitioner:

> In that conference, teachers from different corners of Pakistan shared their diverse perspectives and the challenges of teaching multilingual learners. … You get to learn from other's experiences and get feedback on your work.

Urwa and Saima discussed that as part of their ongoing Bachelor of Education programme, they conducted action research together in their classrooms by designing questionnaires for students to explore the benefits of semantic mapping. They highlighted that this process allowed them to analyse their teaching methods with real-

time student data and revealed many insights beyond their preconceived notions of student engagement. Thus, it provides evidence to support the argument that public school teachers in Pakistan can contribute to education research.

Systemic Neglect of Teacher Input in Research

Similar to their views on curriculum and lack of teacher input in its development, teachers stated, in absolute agreement with each other, that the government systematically suppresses and disregards their perspectives in policy-making, examination creation and, by extension, education research. Apart from individual small-scale research projects that teachers undertake, as presented above, higher authorities neither ask nor support them to either engage with or lead research. Asma expressed her pessimism on the matter:

> Research is very far-fetched; I do not think we will ever be involved. They (*government officials*) just like to take our feedback!

Masood presented that one of the key reasons behind a visible lack of teacher representation in research is that in Pakistan, respect and prestige are not associated with the profession and education research is an afterthought for the government. He highlighted that the Pakistan Institute of Education (https://pie.gov.pk/) has never published a call for research papers from teachers or invited them to discuss their challenges. Despite these disadvantageous circumstances, I found teachers able and willing to engage as researchers in this study and beyond.

Extractive Research by Academic Researchers

Teachers commented that although they receive minimal opportunities to lead education research, academic researchers frequently visit them in schools, requesting their input in questionnaires that they oblige to advance education research. However, teachers asserted that research conducted from an external perspective without their genuine participation in its design rarely captures their realities. They mentioned several reasons for this disconnect between their reality and collected research data. The discussion between Urwa and Saima below presents some of the reasons:

> Urwa: We will be hesitant giving (*external researchers*) real-time information because they are not a part of our team …

> Saima: Why would we tell them what is truly happening in our school?
>
> Urwa: And we will think that they are judging us, but when we are part of the research, we will own it because it will be with our students, and we will benefit from it.

It necessitates enabling teacher-led action research and participatory work, which centres their perspectives while setting the research agenda, formulating research questions, collecting and analysing data and publishing findings. This research attempts to report findings of teacher-led design of digital tools to establish the significance of their insights in broader research and practice.

Lastly, teachers emphasised that since they are ultimately responsible for implementing policies, curricula, and research outcomes, it is logical and essential for them to take a leading role in these activities. Summarising the discussion, Maryam said:

> For instance, someone writing a book on education cannot do so effectively without firsthand teaching experience, which teachers gain daily.

4.3.2 Designed Technologies and their Limitations

As explained in section 3.3.2, teachers formed pairs and collaboratively designed their learning technologies while discussing pre-workshop surveys. After their asynchronous group work, they presented their tools and explained their design choices in phase two workshops. Six groups chose Teacher Assistant technology as their preferred tool with features, including automatic assessment creation and marking and individual student insights. The remaining two groups chose Smart LCD technology with AI-enabled translation and voice typing. The popularity of teacher assistants' technological features aligns with teachers' views of technology as a tool to facilitate their daily challenges and improve student learning outcomes. Moreover, none of the groups chose Automatic Tutoring Technology, mentioning that they are entirely student-centred, which undermines the significance of human connection in teaching. I will present these design choices in this section, complemented by design and implementation concerns teachers highlighted in workshops.

Teacher Assistant

Referring to their substantial classroom challenges of student learning gaps and lack of differentiated instruction because of overcrowded classrooms, twelve teachers across

all schools opted for a teacher assistant to ease their workload. They designed features of automated formative assessment creation with their input, diagnostic tests to determine students' grade level and analyse their learning gaps, automatic grouping of students based on their results to maximise collaborative learning, automated attendance to reduce administrative burden and automated instant feedback to reduce marking backlog and diminish teacher bias in marking. The broader goal of these features embedded in a teacher-centred tool is to facilitate themselves in minimising classroom challenges and enabling their efforts to provide individualised attention and instruction to students that can potentially improve their severe learning gaps (Blatchford et al., 2011). Fatima highlighted these benefits that other teachers agreed with:

> This solves our biggest challenge, overcrowded classrooms. … By doing things automatically, it will save our time, and we can spend significantly more time planning our lessons and delivering them effectively.

Teachers emphasised diagnosing students' learning difficulties and grade/literacy levels over automatic assessment creation and marking features. They noted that distinct learning gaps in each student often go undiagnosed throughout the academic year, leading to poor learning outcomes and end-of-year grades. Having a teacher assistant will give them access to individual student profiles to identify areas needing improvement and facilitate discussions about their performance with parents. Urwa and Saima incorporated two features of adaptive assessment creation and insights from attendance in their tool design to individualise classroom instruction:

> If we are developing a tool, it will be a valuable addition if we have a feature that assesses student level and then gives them assessments adapted to their level. When the student improves, the difficulty of assessments increases too. … The feature of linking student attendance to their performance in class is also valuable for teachers because it can tell us how the presence of a student inside the class affects their overall grades and how they respond (*to our teaching)*.

Moreover, teachers highlighted that the tool could use these individual student insights to suggest mixed groups that can promote student leadership and healthy competition within groups. They mentioned that generally, they adopt these teaching strategies manually, but automating them seems more convenient and efficient.

Smart LCDs

Two groups from schools three and four selected Smart LCD as their preferred learning technology. They cited two reasons behind the choice: solving the challenge of language barriers in classroom instruction and using audiovisual content to maximise student learning in a large classroom. As highlighted in section 4.1.1, one of the significant challenges teachers face is students' inability to comprehend educational content in English, which makes up most of the standard curriculum in public schools. Secondly, these groups preferred it also because of its familiarity and ease of implementation, as smart LCD systems are available in many schools in Islamabad. Iqbal and Faizan added an AI-enabled translation feature in their LCD that converts syllabus content from English into Urdu and narrates it to students. They designed a voice-typing feature as well:

> For our older teachers that cannot use it mechanically, it has an option of voice typing so they can give their opinions right on the screen (*in their preferred language*).

After explaining their design, the teachers in school three shared that, inspired by the student learning benefits from an existing smart classroom, they all had made financial contributions to self-fund the installation of LCDs in four more classrooms. This initiative indicates their positive beliefs regarding digital technology adoption, and outlining it, Mubashir said:

> We installed four LCDs with our funds to enable technology-based learning for younger students in grades four, five, and six. We are getting them to practise things and take assessments to help them gain familiarity with using these technologies effectively in their studies.

Limitations in Design and Implementation

After teachers presented their designed tools, I prompted them to identify challenges that could arise while implementing them in their respective schools and ethical or cultural concerns of using these tools, if any. They recognised several limitations in the design of Teacher Assistant and Smart LCD technologies and practical implementation challenges in their under-resourced schools, which I will present respectively.

Despite the convenience of automatic creation and marking of assessments, teachers were aware that it diminishes their control over the assessments' design because sometimes they have to adapt them to different groups of students. Mubashir proposed the following to ensure teacher input plays a role in assessment creation:

> The teacher will review the questions developed by the software because it creates questions according to its parameters. However, depending on the students' mental level, which only their teacher can best understand, the teacher can make some amendments to questions and then proceed.

Thus, they were wary of over-relying on technology to take over their core teaching responsibilities. Next, teachers expressed data privacy concerns for both technologies, mentioning that because the designed tools would deal with student data, privacy protocols should be of the highest standard in their technical design. Lastly, the two groups that preferred LCD systems emphasised that their educational content should be appropriately filtered to ensure it aligns with society's religious and cultural norms.

In addition to concerns about the design and use of digital tools, teachers outlined implementation challenges they anticipated. The most cited challenge is the lack of financial and technological resources and technical expertise to realise their design choices in a tool. This chapter has extensively presented this limitation in earlier sections, and similar to the discussion of extrinsic barriers to effective technology integration in section 4.2.2, teachers noted that their schools lack the budget to design and maintain these tools. They added that even without the budget constraints, they cannot plan and implement these tools without a long chain of approvals from the education directorate, which is a long and slow process.

One of the key takeaways from the focus group discussions and design workshops is that despite these limiting circumstances and minimal possibility of implementing their designed tools, teachers engaged in the collaborative design of their tools and revealed their potential to contribute to education research.

4.3.3 Reflection on Participatory Design Process

Reflecting on the collaborative design process, teachers expressed enjoying discussing their challenges with their colleagues and designing features that can make their teaching more effective. Specifically, they highlighted that in their hectic daily workload, they rarely find the time to analyse their challenges and devise teaching

strategies to minimise them. But while engaging in the design workshops, they reflected on various teaching strategies they can incorporate to deal with their classroom challenges, even without the tool itself. Urwa shared her reflections:

> We are thinking about problems that we are facing, but we do not really focus on them much, right? While talking to you, I realised that grade levels are one aspect where we do not focus enough on assessing each student separately. This idea clicked in my mind: even without a tool, I can divide them into different grade levels and conduct assessments accordingly. … Also, working on it motivated us that even if we do not have a teaching assistant, we can tweak our teaching strategies.

Similarly, Masood shared his reflections:

> This activity has given us an idea to group students based on results. We should reinforce student collaboration by making groups in our teaching methodology. It has also given us ideas for further research.

Moreover, teachers commented that the study's emphasis on the significance of teachers in research, combined with their reflection, motivates them to actively seek out local opportunities to contribute to education research. Masood expressed his newfound motivation:

> You asked an excellent question last time about whether we have ever been part of education research, and our answer was no. It motivated me because anyone could ask me that … but now, I will try to voluntarily attend any activities or training happening around me, or at least search for them.

These responses demonstrate that engagement in participatory design activities encourages them to adapt their teaching strategies according to their challenges and search for future opportunities to be involved in education research. Even with a small-scale exploratory study, the findings are promising; thus, the government should focus more on fostering teacher leadership and encouraging collaboration in research within Pakistan.

5. Discussion

This study aimed to highlight the perspectives of public school teachers in Pakistan on their roles broadly and digital technologies specifically. Moreover, it explored how their engagement in the participatory design of digital tools can lead to the inclusion of their insights in education research and potentially pave the way for teacher research in Pakistan to empower them. The findings from focus group discussions and design workshops with sixteen teachers in Islamabad's public schools reveal that their classroom challenges are compounded extensively by the federal education directorate's systemic neglect of their contextual insights in all decision-making processes. Despite facing these issues in an overburdened education system, they were eager to report their experiences while engaging in this research. Because of their obstacles-ridden teaching activities, they unanimously view learning technologies as their potential facilitators to reduce their workload in overcrowded classrooms, provide individual instructional support and enhance students' interest in learning using audiovisual educational resources.

Teachers engaged in collaborative digital tool design workshops, highlighting the significance of their insights in technology design, which can improve its adoption. Their design choices also reflect their positive attitudes towards learning technologies. Findings from this participatory design process highlight teachers' two-fold contributions to educational research and knowledge in Pakistan. Firstly, contextually designed tools can guide future education technology research, which centres teachers' insights in their development, implementation and evaluation (Carroll et al., 2000). Secondly, teachers can experience professional development by developing research and design skills (Musaeus et al., 2024), motivating them to explore avenues of engagement in education research. In this chapter, I will discuss these findings guided by the research's aims and questions.

5.1 Barriers to Teacher Research in Pakistan

In this study, discussing general teaching challenges in public schools with participants was initially only necessitated by the participatory design process, aiming to foreground their contextual experiences (Cumbo & Selwyn, 2022). While establishing this shared understanding of their practices and research aims to build researcher-participant meaningful relationships (Phelps, 2019) and facilitate their engagement in the design

activities (Cober et al., 2015), I uncovered a deeper issue. In summary, all participants argued that their challenges stem from the government's disregard for teachers' professional development (M. A. Khan & Afridi, 2017) and its expectations of teachers to thrive in public schools, most of which are severely under-resourced and situated in rural areas (Tayyaba, 2012). I argue that it festers into disempowerment, demoralisation and persistent frustration among teachers. It answers the study's RQ1, which explored how teachers perceive their roles in Pakistan's public education system. Lack of professional development and teacher disempowerment also reveal the underlying reasons for the teachers' underrepresentation in educational research, the lack of opportunities for participatory work, the failure of digital technology projects in schools, and the allure of learning technologies to alleviate teachers' classroom challenges, as reported by the participants. In the following subsections, I will validate these findings using literature on teacher challenges in schools across different regions of Pakistan.

5.1.1 Challenges Across Public Schools

Classroom and systemic challenges that participants highlighted, as presented in section 4.1, are not limited to their public schools in Islamabad. Teachers across different regions of Pakistan with independent provincial education ministries report similar disadvantages and dissatisfaction with their working environment, including Punjab (Andrabi et al., 2012; Siddiqui & Shaukat, 2021), Khyber Pakhtunkhwa (Ali, 2018; Saeed et al., 2013), Balochistan (Çoşkun, 2023), and Azad Jammu and Kashmir (Farooq & Kai, 2017). Situating participants' voices articulating issues of high student-teacher ratio, inadequate training opportunities, results-oriented system and consistent dismissal of their perspectives in education policies in the cited literature, I will argue that Pakistan's education system marginalises its teachers by design.

Andrabi et al. (2012) analysed school characteristics and student achievement data from 48 randomly selected public schools in Punjab. They identified that the average student-teacher ratio was 56, and in 10% of the sample schools, there were more than 100 students per teacher, which they argued was by design because 62% of schools had only a single teacher position dedicated for every two grades (Andrabi et al., 2012). In these severely under-resourced schools, similar to this study's sample, teachers struggled to improve students' grades and the researchers found a significant correlation between student-teacher ratio and students' academic performance. Instead of acknowledging

teachers' disadvantages, the district education officers told them that student learning would improve only when teachers dedicate more time to planning lessons and teaching with motivation (Andrabi et al., 2012). I argue that it is the adverse working conditions that lead to teacher dissatisfaction and lower teacher retention in public schools, not vice versa, as evidenced by the literature and this study's findings. Siddiqui & Shaukat (2021) found that teachers changed schools because of their discontentment with the school environment and did not even factor the salary progression in their decisions. The findings from the literature support my findings because, except for Abdullah, participants did not discuss their salaries and instead expressed dissatisfaction with their working conditions.

Adding to these quantitative findings of teacher challenges in Punjab, a qualitative study presented Khyber Pakhtunkhwa public school teachers' perceptions of their roles and professional development needs from focus group discussions and classroom observations (Ali, 2018). The researcher highlighted that most participants reported having no agency to change institutional practices and governmental policies, making their teaching efforts inconsequential in the face of their circumstances (Ali, 2018), similar to those discussed above and in Chapter 4. As documented in the previous chapter, my participants noted that they cannot be expected to perform optimally under disadvantageous circumstances and do not believe the government will ever seek their insights. Similarly, Ali (2018) noted that because of teachers' unmanageable workload and neglected professional development needs, they were predominantly pessimistic about a systemic change that could improve their teaching effectiveness and student learning. I also observed similar pessimistic sentiments in the subtext of discussions, specifically from responses presented in sections 4.1.2 and 4.3.1. Participants frequently highlighted their lack of agency in response to most questions, particularly their engagement with education research.

However, the underlying pessimism in their discussions shifted to a sense of hope for a better future as they engaged in design workshops. I argue that this finding underscores the importance of teacher involvement in research. At the end of a design activity in School 3, Urwa expressed:

> We will have something like this (*designed tool*) one day in the long run, so it feels good to imagine it. It gives us more motivation that it can be made by us.

5.1.2 Professional Development and Teacher Research

In addition to vehemently criticising the education system that has marginalised them and overlooked their struggles for the entirety of their extensive experience, the study's participants highlighted the significance of 'knowledge of teachers' over 'knowledge for teachers' in education research (Fenstermacher, 1994). Discussing the value of practitioner-led contextual inquiries in educational research, they argued that they possess situated knowledge and can collect real-time, unfiltered data in schools that academic researchers, being outsiders, cannot. The education research literature also advocates for teacher research, which can lead to the professional development of teachers (Hammersley, 1993; Leat et al., 2015; Newman & Mowbray, 2012; Rust, 2009), as established in section 2.1. However, as Leat et al. (2015) argued, teachers need support from their school administration, academic researchers and policymakers to undertake self-directed inquiries effectively. When I prompted teachers to reflect on their lack of engagement and underrepresentation in local education research studies, they argued that the education directorate suppresses their insights and that academic researchers usually use quantitative surveys rather than collaborative and qualitative research methods to report their views. Furthermore, even though they understood the significance of teacher research, they had minimal time and capacity to lead it amidst their regular teaching activities because of substandard professional development workshops, which Maryam recalled as only *gossip*, as presented in section 4.1.2.

Syed (2020) interviewed fifteen university lecturers in public universities in Sindh to explore their perceptions of teacher research. Much like my findings, his participants highlighted that in addition to their overwhelming workload, their professional development activities do not inculcate research skills in them, and there is no academic culture around supporting teachers' involvement in research, even if they want to investigate their classroom challenges (Syed, 2020). I note from the cited study that even university lecturers, crucial to the academic community, receive inadequate research support. Consequently, it is understandable why public school teachers feel disadvantaged in accessing research opportunities, as highlighted by my participants. Thus, teachers in Pakistan require substantial development support from the government's education departments and academic researchers to develop research skills and navigate the complexity of balancing the dual role of practitioner-researcher (Halai, 2011; Mohammad & Kumari, 2007).

Similar to the participants' reported ineffectiveness of professional development activities in their schools in section 4.1.2, several research studies have noted that the professional development programmes in Pakistan neglect teachers' input in their design and are implemented without a proper strategy and support mechanism to help them solve their challenges (Ali, 2018; Aslam, 2014; M. A. Khan & Afridi, 2017; Nawab, 2020). M. A. Khan & Afridi (2017) argued that teacher professional development is not among the government's priorities, and the country lacks coherent national policies on providing continuous development support to teachers, while NGOs organise and finance most training sessions. Additionally, they presented that the annual budget allocated to public education is severely disproportionate to the scale of challenges and improvement required (M. A. Khan & Afridi, 2017), which F. Khan et al. (2016) also highlighted.

In an earlier cited study, teachers emphasised that they aspire to have a cooperative and research-oriented environment in their schools where they can collaboratively reflect on teaching practices, discuss educational research, attend conferences, and invite academic scholars to learn from them for their professional development (Ali, 2018). Moreover, Mohammad & Kumari (2007) concluded from their empirical study of supporting teachers to conduct action research in Pakistan's rural schools that given the resources required to develop teachers as independent researchers, it is more sustainable to conduct collaborative research with them. Though I contest the notion of deprioritising independent teacher research given financial and structural constraints, I argue that initiating teacher engagement in collaborative education research in Pakistan would be a step in the right direction. This study opted for a similar approach involving teachers as participatory designers, which proved effective even in a limited scope. I will discuss participatory design workshops and teacher professional development in section 5.3.

5.2 Learning Technologies as Teacher Facilitators

The burden of classroom and systemic issues influenced teachers' attitudes towards learning technologies. They optimistically perceived these tools as facilitators in a system where they felt neglected by the federal education directorate and the government. It is evident from their responses that they do not face any second-order (intrinsic) barriers, such as a lack of confidence and negative beliefs about digital technology adoption. It answers the study's RQ2, which investigated the attitudes of

public school teachers towards integrating digital technologies in their teaching. They believe that learning technologies will reduce their workload in addition to feeling confident in their ability to implement them, provided they do not experience first-order barriers (Ertmer, 1999). The first-order (extrinsic) barriers they mentioned include limited access to technological resources, inadequate digital training support, and unpredictable scaling plans of pilot projects. These findings contest the argument that teachers' attitudes and efforts primarily provide the impetus for effective technology integration, and second-order barriers are 'the true gatekeepers' to facilitate adoption (Ertmer et al., 2012, p. 433). However, this is not to suggest that simply supplying more technological tools will ensure successful technology adoption in under-resourced public schools. Instead, it emphasises that developing teacher digital expertise and establishing a reliable ICT infrastructure must go hand in hand for effective technology integration (M. S. Khan et al., 2022).

Studies investigating teachers' perceptions of learning technologies and barriers to their sustainable adoption in Pakistan support these findings that though teachers believe digital learning tools will enhance their instructional strategies and engage learners in an exciting learning process, first-order barriers limit the potential of technology integration (Abbasi et al., 2022; Akram et al., 2022; Salam et al., 2017; Zehra & Bilwani, 2016). They report power outages, an underfunded education system, poor digital infrastructure, inconsistent ICT policies and insufficient teacher training as key first-order barriers that obstruct technology adoption in schools (Akram et al., 2022; Salam et al., 2017; Zubairi et al., 2022). Furthermore, Zubairi et al. (2022) highlighted that digital learning solutions in Pakistan fail to scale past pilot implementations because of their minimal evaluation and ineffective partnerships between government agencies and private EdTech companies. Thus, the extrinsic barriers that participants outlined are observed across Pakistan and should be minimised collaboratively with teachers to achieve meaningful technology integration.

In addition to reporting these discussed barriers, participants highlighted the usefulness of integrating learning technologies in their teaching practices during initial focus group discussions and while designing their tools in participatory workshops. Their listed benefits include engaging students' interest in classrooms using audiovisual aids, effectively managing overcrowded classrooms, addressing individual student learning needs and automating administrative tasks to save time, as extensively presented in

section 4.2.1. I argue that these observed and anticipated benefits of technology adoption signal teachers' perceived usefulness of learning technologies, one of the core variables of the Technology Acceptance Model to predict technology use (TAM) (Davis, 1989). As argued in section 2.2.2, TAM has several limitations, such as quantifying user behaviour from self-reported intentions and not considering societal norms and subjective personal traits in predictions (Ajibade, 2018; Scherer et al., 2019).

Nonetheless, it has been used extensively in studies to quantitatively determine a positive correlation between perceived usefulness and teacher technology adoption across various settings (Granić & Marangunić, 2019; Hu et al., 2003), including Pakistan (Aurangzeb et al., 2024; Rafique et al., 2023; Waris & Hameed, 2023). While these studies predict that teachers are likely to adopt technology if they perceive it as *useful*, they fail to report the underlying reasons behind teachers' attitudes and beliefs. This study addresses this gap by revealing that teachers view learning technologies as facilitators due to their daily experiences of disadvantage. They hope that technology can alleviate their workload, improve student engagement, and enhance the overall effectiveness of their teaching activities. This nuanced understanding of teachers' perspectives on technology adoption highlights the necessity of considering their unique challenges and aspirations in the design and implementation of educational technologies and acknowledging fundamental structural constraints.

5.3 Contributions to Educational Research and Practice through Design Workshops

The overwhelmingly positive conceptualisation of learning technologies by the teachers in this study, for reasons discussed above, directly influenced their design choices in design workshops as they engaged in collaborative discussions around selecting and designing digital tools with specific features. Referring to the argument made in section 2.3 and methodological choices discussed in section 3.2.1, ideally, studies with dedicated funding should integrate the participatory design process longitudinally, employing teachers as co-designers in schools to collaboratively prototype learning innovations and evaluate them to address practical shortcomings (Carroll et al., 2000; Tuhkala, 2021). Despite being limited by time and financial resources to do this, this early-stage participatory design process suggests that the engagement of public school teachers in Pakistan in design workshops can contribute

to education research and practice in two ways, which I will discuss next. It corresponds to the study's RQ3, which examined the benefits of a participatory design process involving teachers for educational research.

Firstly, several research studies have concluded from their participatory design processes with teachers that by valuing teachers' ideas and experiences in designing and implementing learning technologies, the field of education technology advances towards establishing a deeper understanding of the intersection of technology, pedagogy and students' learning (Carroll et al., 2000; Matuk et al., 2016; Musaeus et al., 2024; Nicholson et al., 2022). As Matuk et al. (2016) further highlighted, privileging teachers' ideas in prototyping educational innovations does not require training teachers beforehand because their situated knowledge and vested interests in improving their students' learning elicit genuine participation. It aligns with my observation that participants were able to design Teacher Assistant and Smart LCD technologies by discussing the prompts in pre-workshop surveys (attached in Appendix F). Thus, even with minimal design training, teachers can make significant pedagogical contributions that facilitate students' knowledge construction, and they can experiment with the tools to guide contextual implementation (Cober et al., 2015), potentially inspiring future education technology research (Carroll et al., 2000).

Particularly in Pakistan, digital learning tools and school-wide initiatives predominantly target students as their primary users and require high technological resources for effective implementation, as reported in a report mapping the country's EdTech landscape (Zubairi et al., 2022). Conversely, teachers acting as participatory designers suggested that designing technologies to serve as teacher assistants, which are less resource-intensive and have teachers as the primary users, would be more suitable for adoption in public schools. Since the design and implementation of such tools are currently underexplored in Pakistan (Zubairi et al., 2022), it presents an opportunity for researchers to evaluate their efficacy in local contexts.

Secondly, given the scarcity of professional development opportunities available to teachers in Pakistan's underfunded education system, as presented in section 5.1.2, their involvement in participatory design activities presents an opportunity for capacity building (Carroll et al., 2000). Though it would take continued and targeted efforts to sustain professional development among teachers working in under-resourced contexts

(Mohammad & Kumari, 2007), participants identified new teaching strategies, as outlined in section 4.3.3, while reflecting on design workshops. Studies employing participatory design methodologies have similarly highlighted that post-participation, teachers exhibit a profound understanding of pedagogical issues (Reiser et al., 2000), analyse patterns in student learning to make informed instructional decisions (Matuk et al., 2016) and experience empowerment by solving classroom challenges (Musaeus et al., 2024). Thus, researchers argue that the benefits of participatory design strategies involving teachers are two-fold: teachers' continuous professional development and evaluation of digital learning innovations in classrooms (Nicholson et al., 2022; Zhang et al., 2010), just as I have argued in this section and reflected through RQ2 and RQ3. Lastly, a potential long-term contribution of design workshops to educational research is that teachers, with their newfound confidence and motivation, as also reported by participants, can pave the way for future action research with teachers as independent researchers, provided they receive academic, financial and policy support (Leat et al., 2015).

6. Conclusion

This research proposes centring the perspectives of public school teachers in Pakistan by engaging them collaboratively as designers of digital tools in participatory design workshops, a research area severely underexplored in Pakistan. It broadly adds to the literature on the nexus of teacher knowledge in research, learning technologies' adoption in schools and teacher participation in designing context-specific digital tools. To underscore the significance of teacher input in educational research through this research, I first aimed to discuss and understand their struggles in an under-resourced education system and their attitudes towards integrating digital tools in their teaching practices. Based on the initial discussion in focus groups, I prompted participants to engage in a participatory design process to discuss and design digital tools specifically targeted to alleviate their highlighted challenges. From the phase one focus group discussions and phase two design workshops, I identified three overarching findings, each corresponding to one of the three research questions. Firstly, teachers outlined their classroom and systemic challenges, emphasising that they operate within an education system that marginalises them by design rather than supporting them to address their issues. These issues include unmanageable student-teacher ratio, substantial learning gaps in students' knowledge base, inadequate professional development opportunities, promotion of rote learning in a results-oriented system, and disregard for teachers' perspectives in educational research, policymaking, curriculum development and pilot projects implementation in schools. Secondly, due to minimal governmental support in solving their persistent problems, they developed predominantly promising perceptions of learning technologies and listed their benefits for their teaching activities, preferring teacher-centred tools over others. Notably, they justified their optimistic beliefs by recounting examples of enhanced student engagement in technology-infused learning and anticipating that digital tools, if designed and implemented with their input, could reduce their workload.

Lastly, teachers' positive attitude towards digital technologies directly influenced their design choices in participatory workshops. Most participants opted for teacher assistant technology with the proposed benefits of facilitating their daily teaching and administrative tasks in overcrowded classrooms, such as creating and marking formative assessments, diagnosing individual learning needs, and grouping students to maximise collaborative learning. Despite being exceedingly hopeful of their designed

tools' potential to support their teaching practices in achieving better student learning outcomes, they critically evaluated their applicability in resource-constrained schools. Additionally, they highlighted data privacy issues of learning technologies concerning student data, urging the importance of ethical data practices while designing them. Interpreting their reflections on participating in this study and the discussed findings, I argue that participatory design workshops involving public school teachers can serve two purposes in Pakistan's educational landscape. These are: inculcate design and research skills in teachers for their continued professional development and direct future education technology research by highlighting teachers' contextualised insights required for effective learning technologies' design and implementation.

6.1 Recommendations and Future Research

When I reflect on all data collection activities in this research with teachers overburdened with their workload, the most remarkable observation is the depth of their investment with which they engaged with my questions without any financial incentives. Despite the disempowering working conditions that they highlighted, they thoroughly discussed their perspectives and collaboratively designed digital tools without extensive training. This observation alone suggests that teachers are elemental to reforming Pakistan's education system, of which successful digital technology integration is an aspect. Thus, I recommend that the federal education directorate, provincial education ministries, policymakers and private education technology companies seek feedback from teachers and enable their active participation in decision-making processes so that the decisions are grounded in the realities of public schools. Research studies support this recommendation, as when teachers develop the agency to make decisions and lead research activities, they undergo professional development and feel empowered (Z. Khan et al., 2023; Mohammad & Kumari, 2007; Nawab, 2023). Moreover, educational researchers in Pakistan should explore participatory design methodologies in their research studies, as this research showcases that teachers are eager to share their experiences and perspectives in participatory workshops, potentially bridging the research-practice gap discussed in section 2.1.

Inspired by the study's findings and teacher engagement in the early-stage participatory design process, a future direction for this work would be to explore the longitudinal involvement of teachers as co-designers of tangible digital tools, collaborating with developers and academic researchers. Ideally, I would like to investigate the application

of ‘co-teaching’ design methodology in Pakistan, which entails planning, prototyping and evaluating learning technologies in a specific classroom context (Nicholson et al., 2022, p. 4). In that longitudinal study, I aim to explore the dynamics of being a researcher within the teaching environment and the evolving role of practitioners in participatory research, discussing its benefits and challenges in Pakistan’s context. In conclusion, this work has highlighted the significance of incorporating teachers’ insights in designing learning innovations instead of *hurling* them at teachers.

References

Abbasi, W. T., Ibrahim, A. H., & Ali, F. B. (2022). Perceptions About English as Second Language Teachers' Technology Based English Language Teaching in Pakistan: Attitudes, Uses of Technology and Challenges. In M. Al-Emran, M. A. Al-Sharafi, M. N. Al-Kabi, & K. Shaalan (Eds.), *Proceedings of International Conference on Emerging Technologies and Intelligent Systems* (pp. 314–325). Springer International Publishing. https://doi.org/10.1007/978-3-030-82616-1_28

Abedi, E. A., & Ackah-Jnr, F. R. (2023). First-Order Barriers Still Matter in Teachers' Use of Technology: An Exploratory Study of Multi-Stakeholder Perspectives of Technology Integration Barriers. *International Journal of Education and Development Using Information and Communication Technology*, *19*(2), 148–165. https://zenodo.org/doi/10.5281/zenodo.8330046

Ajibade, P. (2018). Technology Acceptance Model Limitations and Criticisms: Exploring the Practical Applications and Use in Technology-related Studies, Mixed-method, and Qualitative Researches. *Library Philosophy and Practice (e-Journal)*, *9*. https://digitalcommons.unl.edu/libphilprac/1941/

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' Perceptions of Technology Integration in Teaching-Learning Practices: A Systematic Review. *Frontiers in Psychology*, *13*, 1–9. https://doi.org/10.3389/fpsyg.2022.920317

Ali, T. (2018). Raising teachers' voices: An in-depth qualitative inquiry into teachers' working conditions and professional development needs in Khyber Pakhtunkhwa, a province of Pakistan. *Teacher Development*, *22*(1), 78–104. https://doi.org/10.1080/13664530.2017.1308432

Andrabi, T., Khan, S., Khan, Y., & Naseer, M. F. (2012). *Learning in Public Schools* (Working Paper 12/0390). International Growth Centre. http://developyst.jellyfish.com.pk/app/webroot/files/article/27/Andrabi%20et%20al_Learning%20in%20public%20schools_Final_0.pdf

Aslam, H. D. (2014). Analysis of Professional Development Practices for School Teachers in Pakistan: A Comparative Case Study of Public and Private Schools of Pakistan (Punjab). *International Journal of Human Resource Studies*, *3*(4), 311–326. https://doi.org/10.5296/ijhrs.v3i4.6251

Aurangzeb, W., Kashan, S., & Rehman, Z. U. (2024). Investigating Technology Perceptions Among Secondary School Teachers: A Systematic Literature Review on Perceived Usefulness and Ease of Use. *Academy of Education and Social Sciences Review*, *4*(2), Article 2. https://doi.org/10.48112/aessr.v4i2.746

Bang, M., & Vossoughi, S. (2016). Participatory Design Research and Educational Justice: Studying Learning and Relations Within Social Change Making. *Cognition and Instruction*, *34*(3), 173–193. https://doi.org/10.1080/07370008.2016.1181879

Bauer, K., & Fischer, F. (2007). The Educational Research-Practice Interface Revisited: A scripting perspective. *Educational Research and Evaluation, 13*(3), 221–236. https://doi.org/10.1080/13803610701626150

Ben-Peretz, M. (2011). Teacher knowledge: What is it? How do we uncover it? What are its implications for schooling? *Teaching and Teacher Education, 27*(1), 3–9. https://doi.org/10.1016/j.tate.2010.07.015

Beycioglu, K., Ozer, N., & Ugurlu, C. T. (2010). Teachers' views on educational research. *Teaching and Teacher Education, 26*(4), 1088–1093. https://doi.org/10.1016/j.tate.2009.11.004

Bingimlas, K. A. (2009). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature. *Eurasia Journal of Mathematics, Science and Technology Education, 5*(3), 235–245. https://doi.org/10.12973/ejmste/75275

Blatchford, P., Bassett, P., & Brown, P. (2011). Examining the effect of class size on classroom engagement and teacher–pupil interaction: Differences in relation to pupil prior attainment and primary vs. secondary schools. *Learning and Instruction, 21*(6), 715–730. https://doi.org/10.1016/j.learninstruc.2011.04.001

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2013). *Successful Qualitative Research: A Practical Guide for Beginners*. SAGE.

Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology, 18*(3), 328–352. https://doi.org/10.1080/14780887.2020.1769238

Braun, V., & Clarke, V. (2023). Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a knowing researcher. *International Journal of Transgender Health, 24*(1), 1–6. https://doi.org/10.1080/26895269.2022.2129597

British Educational Research Association [BERA]. (2024). *Ethical Guidelines for Educational Research (5th ed.)*. www.bera.ac.uk/publication/ethicalguidelines-for-educational-research-2024

Broekkamp, H., & van Hout-Wolters, B. (2007). The gap between educational research and practice: A literature review, symposium, and questionnaire. *Educational Research and Evaluation, 13*(3), 203–220. https://doi.org/10.1080/13803610701626127

Bryman, A. (2016). *Social research methods* (5th ed.). University Press.

Carroll, J. M., Chin, G., Rosson, M. B., & Neale, D. C. (2000). The development of cooperation: Five years of participatory design in the virtual school. *Proceedings of*

the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques, 239–251. https://doi.org/10.1145/347642.347731

Clark, T., Foster, L., Sloan, L., & Bryman, A. (2021). *Bryman's social research methods* (6th ed.). Oxford University Press.

Cober, R., Tan, E., Slotta, J., So, H.-J., & Könings, K. D. (2015). Teachers as participatory designers: Two case studies with technology-enhanced learning environments. *Instructional Science*, *43*(2), 203–228. https://doi.org/10.1007/s11251-014-9339-0

Cochran-Smith, M., & Lytle, S. L. (1990). Research on Teaching and Teacher Research: The Issues That Divide. *Educational Researcher*, *19*(2), 2–11. https://doi.org/10.2307/1176596

Çoşkun, H. C. (2023). Reflection of the Iceberg: Key Issues and Challenges of Education in Balochistan. *Culture, Education, and Future*, *1*(1), 47–65. https://doi.org/10.5281/ZENODO.8010469

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE.

Cumbo, B., & Selwyn, N. (2022). Using participatory design approaches in educational research. *International Journal of Research & Method in Education*, *45*(1), 60–72. https://doi.org/10.1080/1743727X.2021.1902981

Daka, H., Chipindi, F. M., & Serenje-Chipindi, J. (2020). An Analysis of Epistemological Considerations in Educational Research. *Journal of Lexicography and Terminology*, *4*(2), 105–118.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*, *35*(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982

Demırbas, D., & Ogut, S. T. (2020). Re-Designing the Design Brief as a Digital Learning Tool with Participatory Design Approach. *Turkish Online Journal of Distance Education*, *21*(1), Article 1. https://doi.org/10.17718/tojde.690356

Douglas, H. (2022). Sampling Techniques for Qualitative Research. In M. R. Islam, N. A. Khan, & R. Baikady (Eds.), *Principles of Social Research Methodology* (pp. 415–426). Springer Nature. https://doi.org/10.1007/978-981-19-5441-2_29

Ebersohn, L., Ferreira, R., & Beukes, J. (2012). An Attractive Choice: Education Researchers' Use of Participatory Methodology. *South African Journal of Higher Education*, *26*(3), 455–471.

Edwards, R., & Brannelly, T. (2017). Approaches to democratising qualitative research methods. *Qualitative Research*, *17*(3), 271–277. https://doi.org/10.1177/1468794117706869

Ellingson, L. L. (2009). *Engaging Crystallization in Qualitative Research*. SAGE Publications, Inc. https://doi.org/10.4135/9781412991476

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47–61. https://doi.org/10.1007/BF02299597

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, *59*(2), 423–435. https://doi.org/10.1016/j.compedu.2012.02.001

Everton, T., Galton, M., & Pell, T. (2000). Teachers' Perspectives on Educational Research: Knowledge and context. *Journal of Education for Teaching*, *26*(2), 167–182. https://doi.org/10.1080/02607470050127081

Eynon, R., Schroeder, R., & Fry, J. (2016). The ethics of learning and technology research. In *The SAGE Handbook of E-learning Research* (2nd ed.). SAGE Publications Ltd. https://doi.org/10.4135/9781529716696

Farooq, M. S., & Kai, Y. T. (2017). A Review of Pakistan School System. *Journal of Education and Practice*, *8*(4), 97–101.

Fenstermacher, G. D. (1994). The Knower and the Known: The Nature of Knowledge in Research on Teaching. In L. Darling-Hammond (Ed.), *Review of Research in Education* (Vol. 20, pp. 3–56). American Educational Research Association. https://doi.org/10.3102/0091732X020001003

Fisher, C., Dwyer, D. C., & Yocam, K. (1996). *Education & Technology: Reflections on Computing in Classrooms*. Jossey-Bass Publishers.

Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Anthony, A. (2016). Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. *Malaysian Online Journal of Educational Technology*, *4*(2), 38–57.

González-Sanmamed, M., Sangrà, A., & Muñoz-Carril, P.-C. (2017). We can, we know how. But do we want to? Teaching attitudes towards ICT based on the level of technology integration in schools. *Technology, Pedagogy and Education*, *26*(5), 633–647. https://doi.org/10.1080/1475939X.2017.1313775

Goswami, D., & Stillman, P. (1987). *Reclaiming the Classroom: Teacher Research as an Agency for Change*. Boynton/Cook Publishers, Inc.

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology*, *50*(5), 2572–2593. https://doi.org/10.1111/bjet.12864

Halai, N. (2011). How teachers become action researchers in Pakistan: Emerging patterns from a qualitative metasynthesis. *Educational Action Research*, *19*(2), 201–214. https://doi.org/10.1080/09650792.2011.569213

Hammersley, M. (1993). On the Teacher as Researcher. *Educational Action Research*, *1*(3), 425–445. https://doi.org/10.1080/0965079930010308

Hargreaves, D. H. (1999). The Knowledge-Creating School. *British Journal of Educational Studies*, *47*(2), 122–144. https://doi.org/10.1111/1467-8527.00107

Hennink, M. M., Kaiser, B. N., & Weber, M. B. (2019). What Influences Saturation? Estimating Sample Sizes in Focus Group Research. *Qualitative Health Research*, *29*(10), 1483–1496. https://doi.org/10.1177/1049732318821692

Hirschkorn, M., & Geelan, D. (2008). Bridging the Research-Practice Gap: Research Translation and/or Research Transformation. *Alberta Journal of Educational Research*, *54*(1), Article 1. https://doi.org/10.11575/ajer.v54i1.55207

Hu, P. J.-H., Clark, T. H. K., & Ma, W. W. (2003). Examining technology acceptance by school teachers: A longitudinal study. *Information & Management*, *41*(2), 227–241. https://doi.org/10.1016/S0378-7206(03)00050-8

Islam, M. R. (2022). Participatory Research. In M. R. Islam, N. A. Khan, & R. Baikady (Eds.), *Principles of Social Research Methodology* (pp. 291–311). Springer Nature. https://doi.org/10.1007/978-981-19-5441-2_20

Kempe, U. R. (2019). Teachers and researchers in collaboration. A possibility to overcome the research-practice gap? *European Journal of Education*, *54*(2), 250–260. https://doi.org/10.1111/ejed.12336

Khan, F., Fauzee, O., & Daud, Y. (2016). Teacher Training, Problems and The Challenges: A Comparative Study Between India and Pakistan. *Gomal University Journal of Research*, *Special Issue II*, 1–12.

Khan, M. A., & Afridi, A. K. (2017). Professional Development of Teachers and its Future Needs. *The Dialogue (Pakistan)*, *12*(2), 211–228.

Khan, M. S., Waqar, Y., Cheema, I. U., & Butt, I. H. (2022). Attitudes Of Public-School Teachers Towards Using Technology And Its Effect On Their Teaching And Student Learning. *Journal of Positive School Psychology*, *6*(9), Article 9.

Khan, Z., Saeed, S., & Naseem, A. (2023). Exploring the Teacher Empowerment Strategies of School Heads at Secondary Level in Punjab, Pakistan. *Journal of Contemporary Teacher Education*, *6*(1), 87–100. https://doi.org/10.58444/jcte.v6i1.729

Korthagen, F. A. J. (2007). The gap between research and practice revisited. *Educational Research and Evaluation*, *13*(3), 303–310. https://doi.org/10.1080/13803610701640235

Leat, D., Reid, A., & Lofthouse, R. (2015). Teachers' experiences of engagement with and in educational research: What can be learned from teachers' views? *Oxford Review of Education*, *41*(2), 270–286. https://doi.org/10.1080/03054985.2015.1021193

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191–204. https://doi.org/10.1016/S0378-7206(01)00143-4

Li, T., Creer, S. D., Arner, T., Roscoe, R. D., Allen, L. K., & McNamara, D. S. (2022). Participatory Design of a Writing Analytics Tool: Teachers' Needs and Design Solutions. *Companion Proceedings of the 12th International Conference on Learning Analytics & Knowledge LAK22*, 15–18. https://eric.ed.gov/?id=ED628199

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Lingnau, A., Harrer, A., Kuhn, M., & Hoppe, H. U. (2007). Empowering Teachers to Evolve Media Enriched Classroom Scenarios. *Research and Practice in Technology Enhanced Learning*, *2*(2), 105–129. https://doi.org/10.1142/S1793206807000312

Manan, S. A., David, M. K., & Dumanig, F. P. (2015). Disjunction between language policy and children's sociocultural ecology – an analysis of English-medium education policy in Pakistan. *Language and Education*, *29*(5), 453–473. https://doi.org/10.1080/09500782.2015.1046882

Matuk, C., Gerard, L., Lim-Breitbart, J., & Linn, M. (2016). Gathering Requirements for Teacher Tools: Strategies for Empowering Teachers Through Co-Design. *Journal of Science Teacher Education*, *27*(1), 79–110. https://doi.org/10.1007/s10972-016-9459-2

McIntyre, D. (2005). Bridging the gap between research and practice. *Cambridge Journal of Education*, *35*(3), 357–382. https://doi.org/10.1080/03057640500319065

Mohammad, R. F., & Kumari, R. (2007). Action research—a means of continuous professional development in a rural context: Possibilities and challenges. *Quality in Education: Teaching and Leadership in Challenging Times*, 367–388.

Musaeus, L. H., Petersen, M. G., & Klokmose, C. N. (2024). Bringing Teachers and Researchers Together through Participatory Design and Cooperative Prototyping in Computing Education. *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*, 902–908. https://doi.org/10.1145/3626252.3630796

Nawab, A. (2020). Monitoring and Accountability in Professional Development of Teachers in Rural Pakistan. *Journal of International and Comparative Education*, *9*(2), 77–89. https://doi.org/10.14425/jice.2020.9.2.1205

Nawab, A. (2023). Using action research to initiate school-based teacher development activities: Insights from Northern Sindh, Pakistan. *Educational Action Research*, *31*(2), 285–305. https://doi.org/10.1080/09650792.2021.1898430

Newman, L., & Mowbray, S. (2012). 'We were expected to be equal': Teachers and academics sharing professional learning through practitioner inquiry. *Teachers and Teaching*, *18*(4), 455–468. https://doi.org/10.1080/13540602.2012.696046

Nicholson, R., Bartindale, T., Kharrufa, A., Kirk, D., & Walker-Gleaves, C. (2022). Participatory Design Goes to School: Co-Teaching as a Form of Co-Design for Educational Technology. *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–17. https://doi.org/10.1145/3491102.3517667

Peters, V. L., & Slotta, J. D. (2009). Co-designing curricula to promote collaborative knowledge construction in secondary school science. *Proceedings of the 9th International Conference on Computer Supported Collaborative Learning - CSCL'09*, *1*, 204–213. https://doi.org/10.3115/1600053.1600084

Phelps, D. (2019). The Challenges of Bridging the Research–Practice Gap through Insider–Outsider Partnerships in Education. *Teachers College Record: The Voice of Scholarship in Education*, *121*(12), 1–28. https://doi.org/10.1177/016146811912101202

Pillow, W. (2003). Confession, catharsis, or cure? Rethinking the uses of reflexivity as methodological power in qualitative research. *International Journal of Qualitative Studies in Education*, *16*(2), 175–196. https://doi.org/10.1080/0951839032000060635

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. *On the Horizon*, *9*(5), 1–6. https://doi.org/10.1108/10748120110424816

Pring, R. (2015). *Philosophy of Educational Research* (3rd ed.). Bloomsbury Academic. https://doi.org/10.5040/9781474228596

Rafique, H., Islam, Z. U., & Shamim, A. (2023). Acceptance of e-learning technology by government school teachers: Application of extended technology acceptance model. *Interactive Learning Environments*, 1–19. https://doi.org/10.1080/10494820.2022.2164783

Reiser, B. J., Spillane, J. P., Steinmuller, F., Sorsa, D., Carney, K., & Kyza, E. (2000). Investigating the Mutual Adaptation Process in Teachers' Design of Technology-Infused Curricula. In B. J. Fishman & S. F. O'Connor-Divelbiss (Eds.), *Fourth International Conference of the Learning Sciences* (pp. 342–349). Mahwah, NJ: Erlbaum. https://doi.org/10.4324/9780203763865-73

Robinson, O. C. (2014). Sampling in Interview-Based Qualitative Research: A Theoretical and Practical Guide. *Qualitative Research in Psychology*, *11*(1), 25–41. https://doi.org/10.1080/14780887.2013.801543

Roschelle, J., & Penuel, W. R. (2006). Co-design of innovations with teachers: Definition and dynamics. *Proceedings of the 7th International Conference on Learning Sciences*, 606–612. https://dl.acm.org/doi/abs/10.5555/1150034.1150122

Rust, F. O. (2009). Teacher Research and the Problem of Practice. *Teachers College Record*, *111*(8), 1882–1893. https://doi.org/10.1177/016146810911100807

Saeed, M., Ahmad, I., Salam, M., Badshah, R., & Ali, S. (2013). Critical Analysis of Problems of School Teachers in Pakistan: Challenges and Possible Solutions. *Journal of Education and Practice*, *4*(4), 169–175.

Salam, S., Jianqiu, Z., Pathan, Z. H., & Lei, W. (2017). Strategic Barriers in the Effective Integration of ICT in the Public Schools of Pakistan. *Proceedings of the 2017 International Conference on Computer Science and Artificial Intelligence*, 169–172. https://doi.org/10.1145/3168390.3168422

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, *128*, 13–35. https://doi.org/10.1016/j.compedu.2018.09.009

Sebele-Mpofu, F. Y. (2020). Saturation controversy in qualitative research: Complexities and underlying assumptions. A literature review. *Cogent Social Sciences*, *6*(1), 1838706. https://doi.org/10.1080/23311886.2020.1838706

Selwyn, N. (2016). *Is Technology Good for Education?* Polity Press. http://ebookcentral.proquest.com/lib/oxford/detail.action?docID=4547494

Selwyn, N. (2017). *Education and Technology: Key Issues and Debates* (2nd ed.). Bloomsbury Academic. https://research.monash.edu/en/publications/education-and-technology-key-issues-and-debates-2

Shamim, F., & Qureshi, R. (2013). Informed consent in educational research in the South: Tensions and accommodations. *Compare: A Journal of Comparative and International Education*, *43*(4), 464–482. https://doi.org/10.1080/03057925.2013.797729

Sharma, G. (2017). Pros and cons of different sampling techniques. *International Journal of Applied Research*, *3*(7), 749–752.

Siddiqui, N., & Shaukat, S. (2021). Teacher Mobility in Punjab, Pakistan: Stayers and Movers within the Public and Private Schools. *Education Sciences*, *11*(7), 358. https://doi.org/10.3390/educsci11070358

Singhavi, C., & Basargekar, P. (2019). Barriers Perceived by Teachers for Use of Information and Communication Technology (ICT) in the Classroom in Maharashtra, India. *International Journal of Education and Development Using Information and Communication Technology*, *15*(2), 62–78.

Small, M. L. (2021). What is “Qualitative” in Qualitative Research? Why the Answer Does not Matter but the Question is Important. *Qualitative Sociology*, *44*(4), 567–574. https://doi.org/10.1007/s11133-021-09501-3

Spikol, D., Milrad, M., Maldonado, H., & Pea, R. (2009). Integrating Co-design Practices into the Development of Mobile Science Collaboratories. *2009 Ninth IEEE International Conference on Advanced Learning Technologies*, 393–397. https://doi.org/10.1109/ICALT.2009.175

Syed, H. (2020). Factors Preventing in-service University English Language Teachers from Becoming Action Researchers in Pakistan. *Journal of Language and Education*, *6*(1), 120–133. https://doi.org/10.17323/jle.2020.9697

Tayyaba, S. (2012). Rural-urban gaps in academic achievement, schooling conditions, student, and teachers’ characteristics in Pakistan. *International Journal of Educational Management*, *26*(1), 6–26. https://doi.org/10.1108/09513541211194356

Terry, G., Hayfield, N., Clarke, V., & Braun, V. (2017). Thematic analysis. In *The SAGE Handbook of Qualitative Research in Psychology* (pp. 17–36). SAGE Publications Ltd. https://doi.org/10.4135/9781526405555

Tracy, S. J. (2010). Qualitative Quality: Eight “Big-Tent” Criteria for Excellent Qualitative Research. *Qualitative Inquiry*, *16*(10), 837–851. https://doi.org/10.1177/1077800410383121

Tuhkala, A. (2021). A systematic literature review of participatory design studies involving teachers. *European Journal of Education*, *56*(4), 641–659. https://doi.org/10.1111/ejed.12471

Verloop, N., Van Driel, J., & Meijer, P. (2001). Teacher knowledge and the knowledge base of teaching. *International Journal of Educational Research*, *35*(5), 441–461. https://doi.org/10.1016/S0883-0355(02)00003-4

Waris, I., & Hameed, I. (2023). Modeling teachers acceptance of learning management system in higher education during COVID-19 pandemic: A developing country perspective. *Journal of Public Affairs*, *23*(1), e2821. https://doi.org/10.1002/pa.2821

Whitty, G., & Furlong, J. (Eds.). (2017). *Knowledge and the study of education: An international exploration*. Symposium Books.

Wilkinson, S. (1998). Focus groups in feminist research: Power, interaction, and the co-construction of meaning. *Women’s Studies International Forum*, *21*(1), 111–125. https://doi.org/10.1016/S0277-5395(97)00080-0

Zehra, R., & Bilwani, A. (2016). Perceptions of Teachers Regarding Technology Integration in Classrooms: A Comparative Analysis of Elite and Mediocre Schools. *Journal of Education and Educational Development*, *3*(1), 1–29.

Zeichner, K. M. (1995). Beyond the Divide of Teacher Research and Academic Research. *Teachers and Teaching*, *1*(2), 153–172. https://doi.org/10.1080/1354060950010202

Zengin, Y. (2017). Investigating the Use of the Khan Academy and Mathematics Software with a Flipped Classroom Approach in Mathematics Teaching. *Journal of Educational Technology & Society*, *20*(2), 89–100.

Zhang, B., Looi, C.-K., Seow, P., Chia, G., Wong, L.-H., Chen, W., So, H.-J., Soloway, E., & Norris, C. (2010). Deconstructing and reconstructing: Transforming primary science learning via a mobilized curriculum. *Computers & Education*, *55*(4), 1504–1523. https://doi.org/10.1016/j.compedu.2010.06.016

Zubairi, A., Khalayleh, A., Baloch, I., Mazari, H., Kaye, T., & Groeneveld, C. (2022). *Pakistan Digital Learning Landscape Analysis* [Technical Report]. EdTech Hub. https://doi.org/10.53832/edtechhub.0093

Appendix A – Information Sheet for Volunteers

Project Title

Investigating the Dynamic Roles of Educators: A Research-Driven Exploration of Teachers Designing Technology Tools for Enhanced Classroom Experiences in Pakistani Public Schools

Research Ethics Reference: EDUC_C1A_24_023

Project Purpose

This research aims to understand how experienced teachers in Islamabad's public schools deal with challenges in their classrooms. Teachers often don't have much say in decisions about technology and policies. This study aims to show how these teachers can take on the roles of both teachers and researchers. We want to see how they handle classroom issues, use digital tools, and reflect on their experiences. By looking at this, we hope to highlight the importance of including teachers in decisions about education in Pakistan.

Research Assistant Role

For this project, we are seeking Teach For Pakistan fellows in 4-5 schools to help with the following:

1. Shortlist teachers in their schools as potential research participants for the project.
2. Help with onboarding of teachers and getting consent forms signed.
3. Answer any questions from teachers during the project.
4. Arrange a laptop with working internet connectivity for focus group discussions with teachers and help with note-taking.
5. Provide insights about the ICT infrastructure of the school and all Education Technology projects implemented in the school (past, present and probable in future).

Essential Requirements

1. Excellent working relations with school staff, especially the senior teaching and administrative staff.
2. Knowledge of digital teaching activities in the school.

3. A laptop with working webcam and microphone.
4. Good internet access.
5. Good communication skills (both Urdu and English).
6. Ability to maintain the anonymity of research participants and details of the project for ethical reasons.

Time Commitment

You are only expected to assist during the data collection phase of the project. Depending on how fast the participants are recruited, the data collection can start from the end of February'24 till the end of March'24. In number of hours, fellows will be expected to work no more than four hours, in total, over the course of a month.

Benefits

1. You will gain experience in assisting with focus group discussions and surveys for the collection of qualitative textual data, in empirical social science research.
2. You can ask questions related to research design, formulate research questions, choose between positivist and interpretivist paradigms and between different analysis techniques.
3. You can get advice on post-fellowship plans e.g. pursuing graduate studies, working in the industry etc.

Appendix B – Participant Information Sheet

Central University Research Ethics Committee Approval Reference:

EDUC_C1A_24_023

1. **Introductory paragraph**

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

2. **Why is this research being conducted?**

This research aims to understand how experienced teachers in Islamabad's public schools deal with challenges in their classrooms. Teachers often don't have much say in decisions about technology and policies. This study aims to show how these teachers take on the roles of both teachers and researchers. We want to see how they handle classroom issues, use digital tools, and reflect on their experiences. By looking at this, we hope to highlight the importance of including teachers in decisions about education in Pakistan.

3. **Why have I been invited to take part?**

This study requires as participants teachers who have taught in public schools in Pakistan for over two years and are currently in public service. 15-20 participants are being recruited for this study.

4. **Do I have to take part?**

No. It is up to you to decide whether to take part. If you do decide to take part, you can later withdraw yourself from the research, without giving a reason, by advising us of this decision. If you wish to withdraw to have your data deleted, please tell us before 1st June 2024 and we will delete all data that we have collected from you. After that date it will not be possible for us to withdraw your data as all the data will be anonymised.

5. **What will happen to me if I take part in the research?**

In all the activities, your consent is important. We will not include you in any activity without your consent.

- The research will be conducted online through Microsoft Teams. No physical visits are required.
- Consent will be obtained at the beginning of the research.
- Involvement will occur in two phases.
- Phase One: One-hour online discussion in a group.
- Phase Two: 30 minutes online discussion in a group 1-2 weeks after Phase One.
- Phases One and Two involve discussions on classroom challenges and the design of digital tools.
- Discussions will be in Urdu.
- Online meetings will be recorded on by the MS Teams platform. They will later be translated by the main researcher, Usman Khawar, and after translation, the recordings will be permanently deleted. The recording can either include just audio or audio and video- it is up to you if you want to turn on your camera.
- Overall involvement will last for 3 hours, spread over 5 weeks.

6. **What are the possible disadvantages and risks in taking part?**

There are no potential risks associated with the research.

7. **Are there any benefits in taking part?**

Although there are no material immediate benefits, however through this research, I aim to highlight the process through which experienced teachers can be included in research of educational tools to be used in classrooms. I hope that findings may help to support a mindset shift in the public education space in Pakistan, away from a culture of criticising teachers incompetence to recognition of the value they can add.

8. **What information will be collected and why is the collection of this information relevant for achieving the research objectives?**

The researcher and supervisor will have access to the research data.

Consent records will be stored for 3 years on secure Nexus365 OneDrive for Business.

Audio and Video Recordings: Recordings from Teams meetings will be stored on Nexus365 OneDrive for Business and will be deleted permanently after transcribing.

Transcript: Transcripts will be stored on Nexus365 OneDrive for Business for at least three years.

Surveys: These will be physically filled by teachers and all paper copies will be shredded after the data analysis.

9. Will the research be published? Could I be identified from any publications or other research outputs?

The findings from the research will be written up in a dissertation and names will be pseudonymised. You won't be identifiable directly from the data.

We would like your permission to use direct quotations but without identifying you in any research outputs.

A copy of my thesis/ dissertation will be deposited both in print and online in the Oxford University Research Archive where it will be publicly available to facilitate its use in future research.

10. Data Protection

The University of Oxford is the data controller with respect to your personal data, and as such will determine how your personal data is used in the research. The University will process your personal data for the purpose of the research outlined above. Research is a task that is performed in the public interest. Further information about your rights with respect to your personal data is available from the University's Information Compliance web site at https://compliance.admin.ox.ac.uk/individual-rights.

11. Who has reviewed this research?

This research has received ethics approval from a subcommittee of the University of Oxford Central University Research Ethics Committee. (Ethics reference: **EDUC_C1A_24_023)**.

12. Who do I contact if I have a concern about the research or I wish to complain?

If you have a concern about any aspect of this research, please contact Usman Khawar at usman.khawar@education.ox.ac.uk, and we will do our best to answer your query. We will acknowledge your concern within 10 working days and give you an indication

of how it will be dealt with. If you remain unhappy or wish to make a formal complaint, please contact the Chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter as soon as possible:

13. **The Chair, Department of Education Research Ethics Committee; Email: elizabeth.wonnacott@education.ox.ac.uk; Address: Department of Education, University of Oxford, 14 Norham Gardens, OX2 6PY Further Information and Contact Details**

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

Usman Khawar
Department of Education
OX2 6PY
University email: usman.khawar@education.ox.ac.uk

Appendix C – Participant Consent Form

Consent to take part in **"Investigating the Dynamic Roles of Educators: A Research-Driven Exploration of Teachers Designing Technology Tools for Enhanced Classroom Experiences in Pakistani Public Schools"**

Central University Research Ethics Committee (CUREC) approval reference: **EDUC_C1A_24_023**

Purpose of Study: This study aims to show how public school teachers take on the roles of both practitioners and researchers. We want to see how they handle classroom issues, use digital tools, and reflect on their experiences.

	Please initial each box if you agree with the statement
I confirm that I have read and understand the information sheet for the above research. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
I understand that my participation is voluntary and that I am free to withdraw at any point until **01/06/24**, without giving any reason.	☐
I understand who will have access to my personal data, how the data will be stored and what will happen to the data at the end of the project.	☐
I understand the extent to which I could be identifiable from any publications.	☐
I consent to being audio recorded.	☐
I consent to being video recorded.	☐
Use of quotations: Please indicate your preference (select *one* option):	☐

a) I do not wish to be quoted. **or**

b) I agree to the use of quotations in research outputs if I am not identifiable. ☐

I give permission for you to contact me again to clarify information. ☐

I understand how to raise a concern or make a complaint. ☐

I agree to take part. ☐

_____	_____	_____
Name of Participant	Date	Signature

_____	_____	_____
Name of person taking consent	Date	Signature

Appendix D – CUREC Approval Document

18 February 2024

Research title:

Investigating the Dynamic Roles of Educators: A Research-Driven Exploration of Teachers Designing Technology Tools for Enhanced Classroom Experiences in Pakistani Public Schools

Research ethics reference: EDUC_C1A_24_023

The above application has been considered on behalf of the Education Departmental Research Ethics Committee (DREC) in accordance with the University's procedures for ethical approval of all research involving human participants.

I am pleased to confirm that, on the basis of the information provided to the DREC, ethics approval has now been granted for this study. Please note the following:

Personal data: It is the responsibility of the PI to ensure that all personal data collected during the project is managed in accordance with the University's guidance and legal requirements.

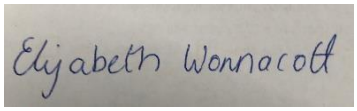
In-person activities: Any data collection involving in-person interactions with participants must have an up-to-date fieldwork risk assessment in place; further guidance is available from the Safety. Office's website.

Amendments: Please notify the committee if you intend to make any amendments to the information in your ethics application as submitted at date of this approval, as all changes must receive ethical approval prior to implementation. The amendment form is available on the SSH IDREC webpage.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to staff.curec@education.ox.ac.uk / student.curec@education.ox.ac.uk or ethics@socsci.ox.ac.uk.

Yours sincerely

Elizabeth Wonnacott, DREC Chair



cc: Prof Rebecca Eynon

Appendix E – Phase One Focus Group Discussion Questions

The **purpose** of this focus group discussion is as follows:

a. Get to know teachers briefly, introduce myself and explain the purpose of this research.
b. Understand the classroom experiences of teachers and specifically the issues they face related to pedagogy, administration and student learning outcomes.
c. Probe them to reflect on their experiences of using digital technologies in their teaching. This can include the use of digital labs, multimedia for lecture delivery and other tools.
d. Introduce what we will do in Phase Two, and in light of that, choose a technology that either already exists in the school or ask them what technology they are interested in.
e. Lastly, the discussion will aim to capture the role of teachers as researchers in the participatory design process of digital technologies.

Following are the **interview questions** grouped according to the broader **research questions**:

Research Question 1: How do teachers in Pakistan's public education system perceive their roles, and what classroom and systemic challenges do they face in daily activities?
1. Can you briefly introduce yourself, sharing your name, subjects taught, and years of teaching experience? 2. What are the most significant challenges you face in your classroom on a day-to-day basis? 3. How do these challenges impact your teaching methods and student engagement? 4. In what ways do you try to address these challenges in your classroom?   a. Why are your efforts successful/ unsuccessful?

Research Question 2: What are the Pakistan public school teachers' beliefs and attitudes towards adopting learning technology tools to address the stated challenges?
5. How, if at all, digital technologies currently assist or hinder in addressing these challenges? 6. Can you share your experience with integrating technology into your teaching in detail? 7. What tools or devices do you currently use, and how have they impacted your teaching methods? 8. How do you perceive the impact of digital tools on student engagement in your classroom?

Research Question 3: In what ways can the engagement of public school teachers as participatory designers of digital tools contribute to educational research and knowledge in Pakistan?
9. Have you ever considered participating in educational research as active researchers? a. If no, why not? b. If yes, what were the benefits of participating? 10. Are there any obstacles or concerns that you foresee in taking an active role in research activities?

Appendix F – Participatory Design Workshop Survey for Tool Design

Please **tick** the technology you want to base your tool on:

براہ کرم اس ٹیکنالوجی پر نشان لگائیں جس پر آپ اپنے ٹول کی بنیاد رکھنا چاہتے ہیں

Technology #1: Smart LCD System	**Technology #2: Teacher Assistant**	**Technology #3: Automatic Tutor**
Optional Features: • Internet connection • Touch screen • Online classes • Educational content • Clickers • Multi-lingual content	Optional Features: • Automatic assessment marking • Automatic assessment creation • Grouping students based on results • Student diagnostic insights • Automatic attendance	Optional Features: • Personalisation • Helping students with homework • Instant Feedback

Questions to build your tool: آپ کے ٹول ڈیزائن کی رہنمائی کے لیے سوالات

1) Why did your group choose this technology over other categories?
آپ کے گروپ نے اس ٹیکنالوجی کو دیگر زمروں پر کیوں چنا؟

2) In your opinion, what are the positive/strong features of the technology you chose?
آپ کی رائے میں، آپ کی منتخب کردہ ٹیکنالوجی کی مثبت/مضبوط خصوصیات کیا ہیں؟

3) What are the current limitations of this technology? Can you explain why?
اس ٹیکنالوجی کی موجودہ حدود کیا ہیں؟ کیا آپ وضاحت کر سکتے ہیں کیوں؟

4) What specific new features does your tool have?
آپ کے ٹول میں کون سی مخصوص نئی خصوصیات ہیں؟

5) How easy or difficult would it be to integrate your designed tool it in your resource constrained school?
اپنے ڈیزائن کردہ ٹول کو اپنے وسائل سے محدود اسکول میں ضم کرنا کتنا آسان یا مشکل ہوگا؟

6) How would students in your school benefit from this tool? Would their engagement increase?
آپ کے اسکول کے طلباء اس ٹول سے کیسے فائدہ اٹھائیں گے؟ کیا ان کی دلچسپی بڑھے گی؟

7) To what extent would this tool assist teachers in solving their challenges?
یہ ٹول اساتذہ کو ان کے چیلنجوں کو حل کرنے میں کس حد تک مدد کرے گا؟

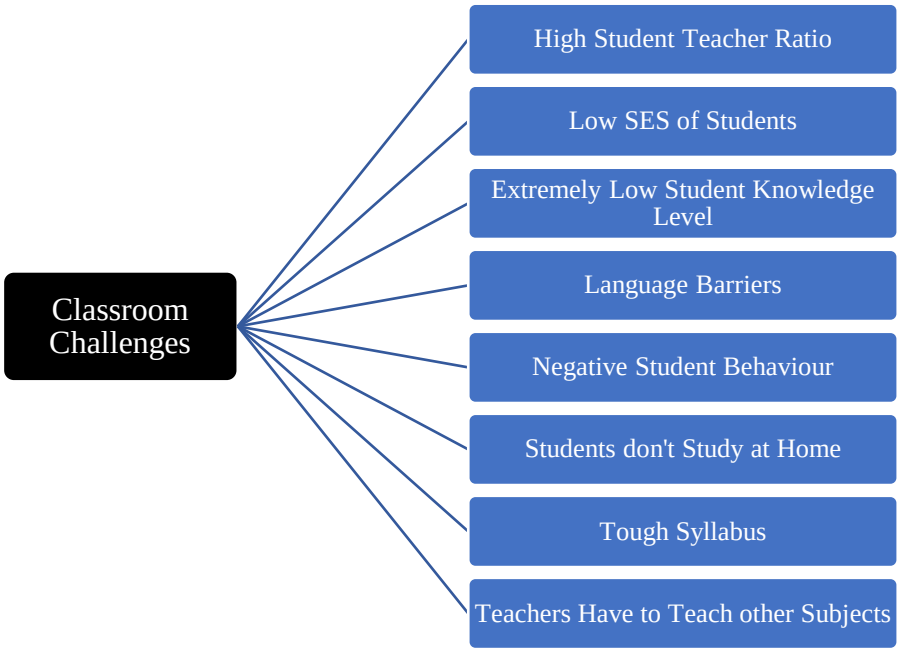
8) What are ethical or cultural concerns of using this tool?
اس ٹول کو استعمال کرنے کے اخلاقی یا ثقافتی خدشات کیا ہیں؟

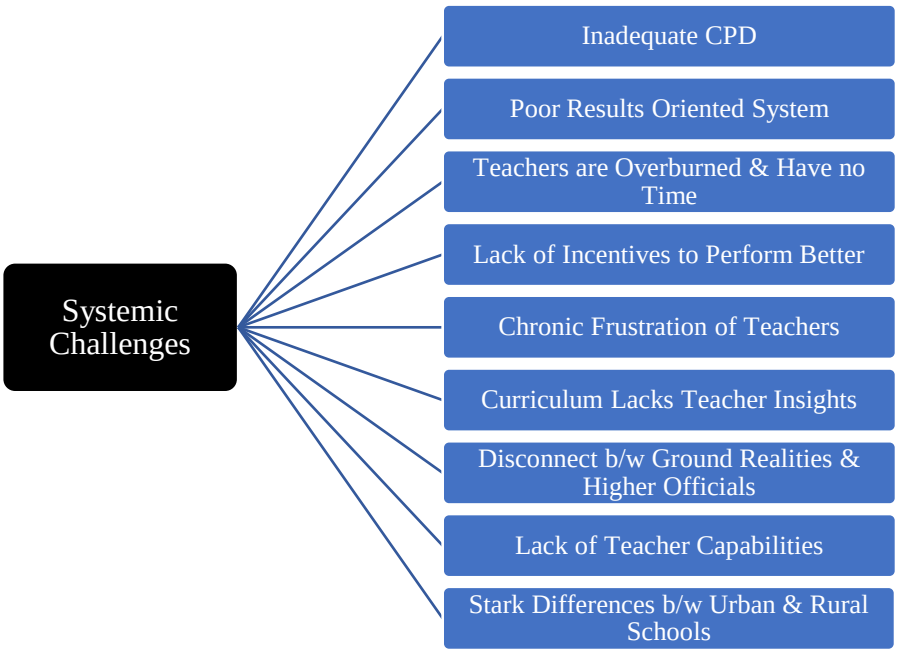
9) Did participation in this design workshop help you get interested in education research?
کیا اس ڈیزائن ورکشاپ میں شرکت کرنے سے آپ کو تعلیمی تحقیق میں دلچسپی پیدا ہوئی؟

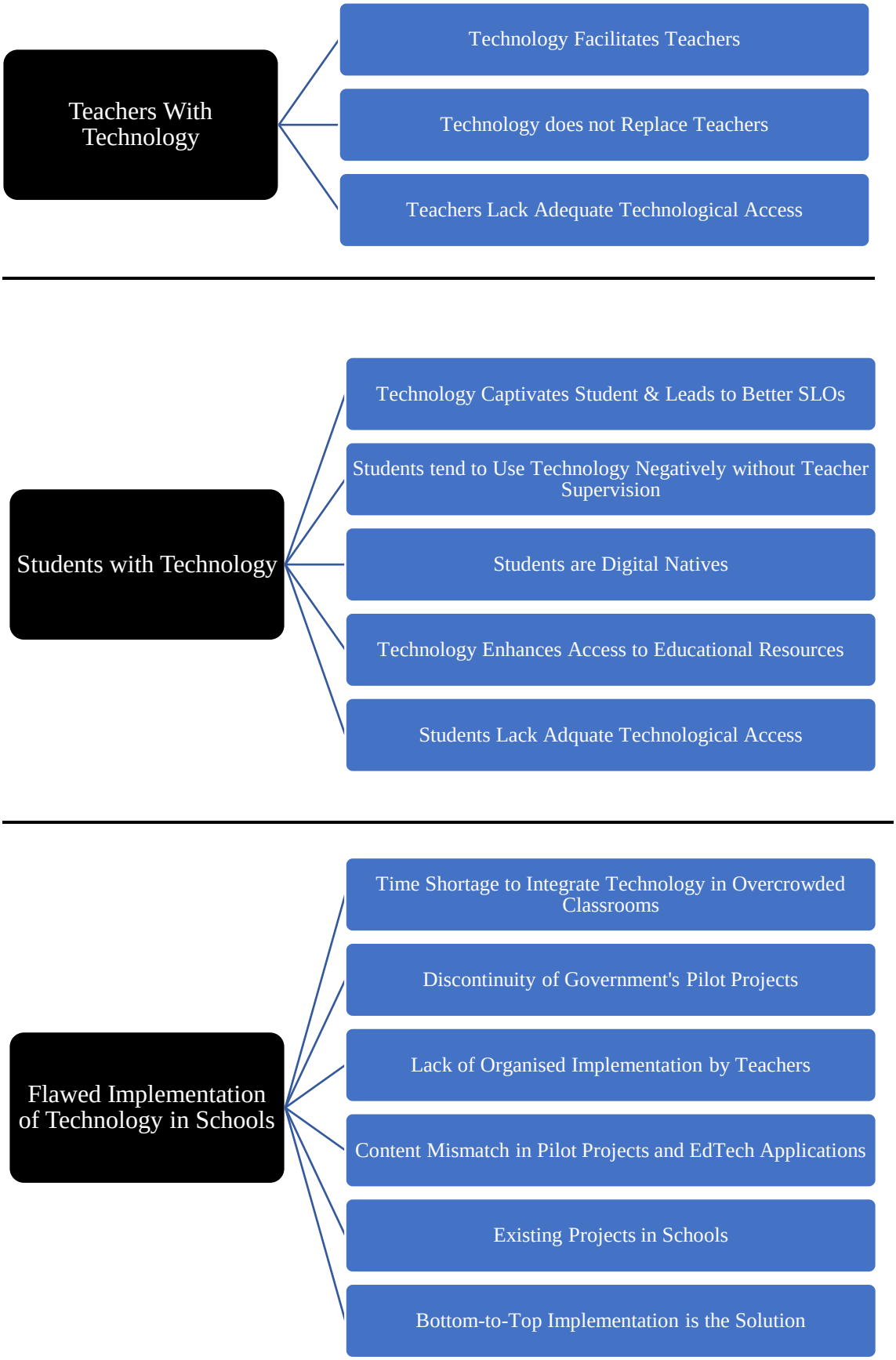
10) Please reflect on your engagement in this research and share the reflection.
براہ کرم اس تحقیق میں اپنی شمولیت پر غور کریں اور اپنے تاثرات شیئر کریں

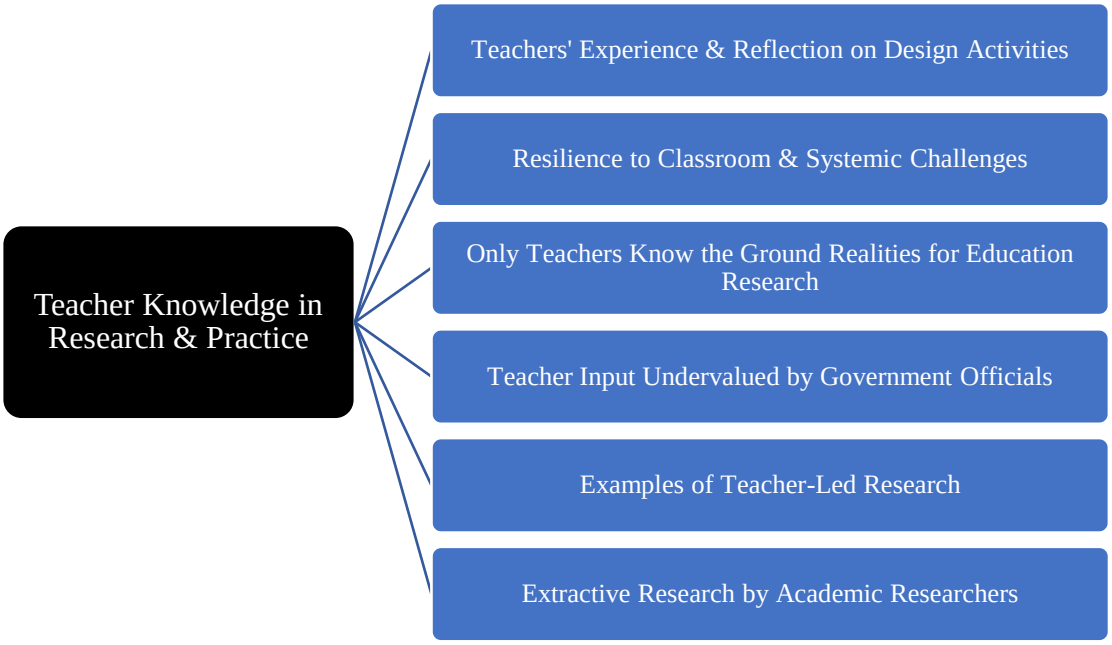
Appendix G – Codes and Themes

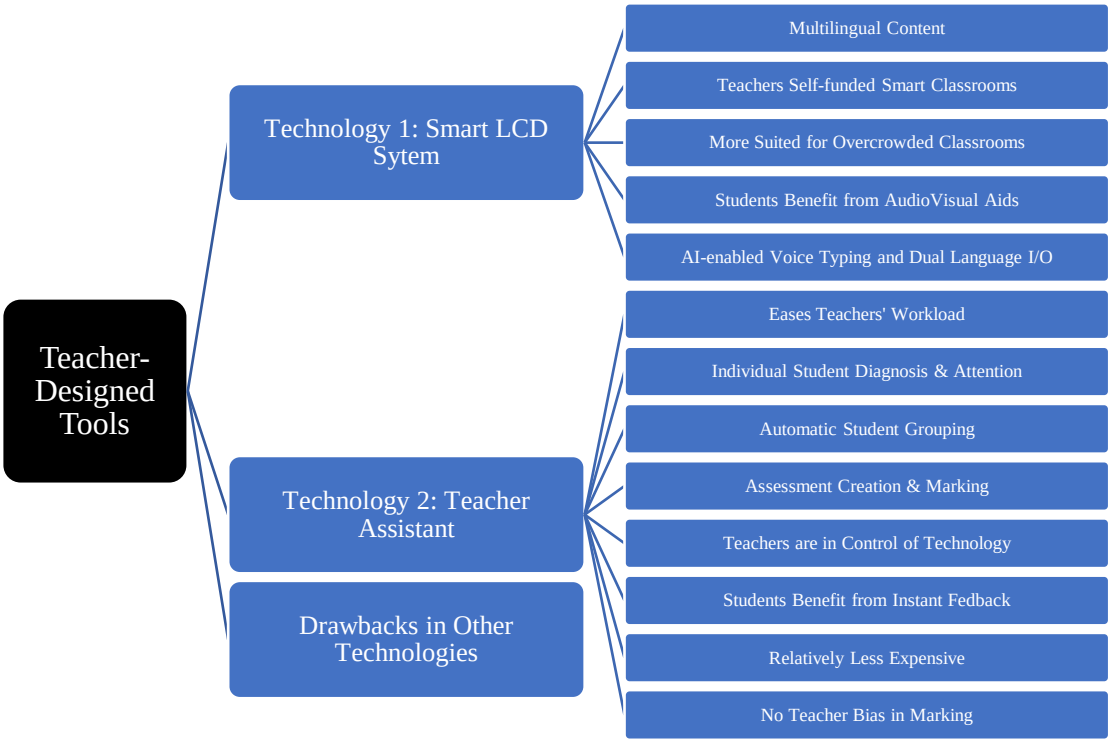
Following are the themes and codes I constructed to analyse the collected data:

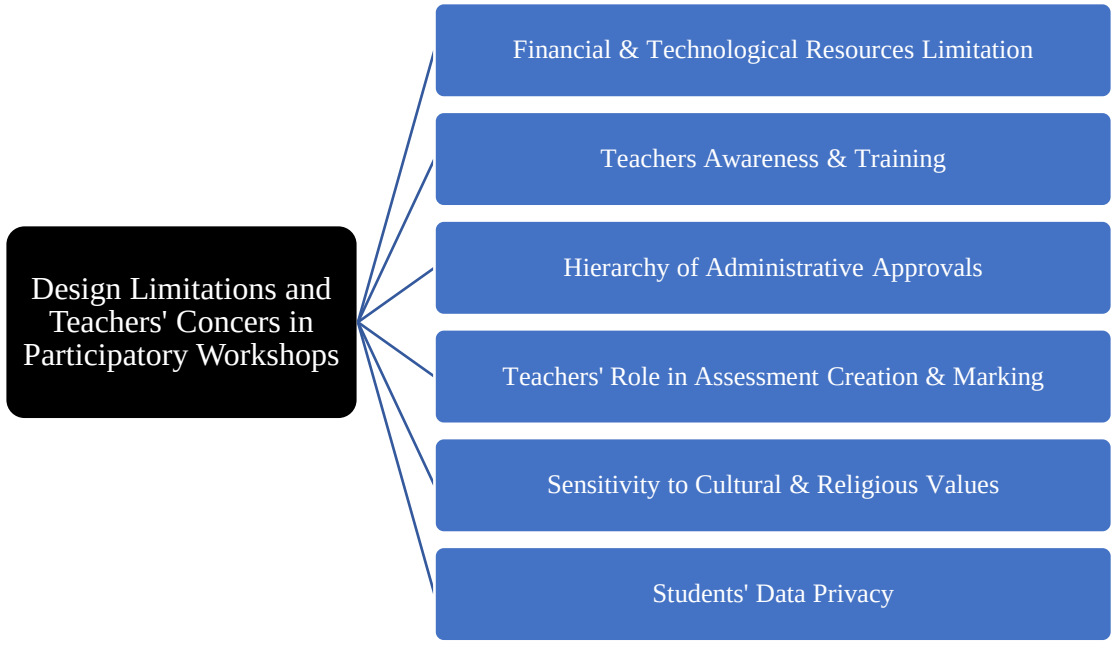





Teachers With Technology
Technology Facilitates Teachers
Technology does not Replace Teachers
Teachers Lack Adequate Technological Access
Students with Technology
Technology Captivates Student & Leads to Better SLOs
Students tend to Use Technology Negatively without Teacher Supervision
Students are Digital Natives
Technology Enhances Access to Educational Resources
Students Lack Adquate Technological Access
Flawed Implementation of Technology in Schools
Time Shortage to Integrate Technology in Overcrowded Classrooms
Discontinuity of Government's Pilot Projects
Lack of Organised Implementation by Teachers
Content Mismatch in Pilot Projects and EdTech Applications
Existing Projects in Schools
Bottom-to-Top Implementation is the Solution


Teacher Knowledge in Research & Practice
Teachers' Experience & Reflection on Design Activities
Resilience to Classroom & Systemic Challenges
Only Teachers Know the Ground Realities for Education Research
Teacher Input Undervalued by Government Officials
Examples of Teacher-Led Research
Extractive Research by Academic Researchers


Teacher-Designed Tools
Technology 1: Smart LCD Sytem
Multilingual Content
Teachers Self-funded Smart Classrooms
More Suited for Overcrowded Classrooms
Students Benefit from AudioVisual Aids
AI-enabled Voice Typing and Dual Language I/O
Technology 2: Teacher Assistant
Eases Teachers' Workload
Individual Student Diagnosis & Attention
Automatic Student Grouping
Assessment Creation & Marking
Teachers are in Control of Technology
Students Benefit from Instant Fedback
Relatively Less Expensive
No Teacher Bias in Marking
Drawbacks in Other Technologies


Design Limitations and Teachers' Concers in Participatory Workshops
Financial & Technological Resources Limitation
Teachers Awareness & Training
Hierarchy of Administrative Approvals
Teachers' Role in Assessment Creation & Marking
Sensitivity to Cultural & Religious Values
Students' Data Privacy