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Creating Culturally Responsive Human AI Complementarity Frameworks for Pakistani Public Schools

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Abstract

The challenges have come as a setback to Pakistan's public schools. From one side, there is pressure from the policy makers and international development groups to introduce AI in classes. From the other side, there are increasing pressures on the policy makers and international development groups to introduce AI in classrooms. Conversely, the show on the ground is far from the impressive pilot programmes and conference presentations. The majority of schools have no stable electricity or internet. Teachers are underpaid, overworked, and are not given time or support to try out new tools. But the discussion around AI in the classroom continues, disregarding those who will be most impacted. This article suggests that the current vision for the use of AI in Pakistani schools is not well suited to the context in which they are situated. Current approaches to integrating AI have been designed to fit the needs of affluent, English-speaking, well-funded school systems in the Global North. If those frameworks are simply imported into Pakistan without serious adaptation, then they not only do not assist, but they may actually aggravate current disparities between the classes. This research is based on the findings of a concurrent mixed-methods study that explored how teachers and administrators in public schools from various regions in Pakistan feel when facing the convergence of theory with practice in the classroom. Surveys charted the infrastructural landscape, and it was apparent how severe the digital divide is. Qualitative interviews then provided teachers with the time to describe how it is really felt to be instructed to use tools that are not supported by their school, not trained, not part of their school policy, and for which they have no idea how to apply it to their students. The main argument presented in this article is that there should be a Human-AI complementarity framework for the sustainable adoption of AI in public schools in Pakistan where AI serves as a tool that complements, does not supplant, teacher judgment, and relationships. This framework should be culturally responsive, and should take into consideration the linguistic diversity that exists in Pakistani classrooms, the importance of education through community trust, and pedagogical traditions that already exist in classrooms. It should

also acknowledge the constraints and take into account what schools can achieve now and not what they might in an ideal world.

Keywords: Artificial Intelligence in Education, Human–AI Complementarity, Public Schools, Culturally Responsive Education, Digital Divide, Teacher Agency, Pakistan.

1. Introduction

In today's educational context, where the use of digital systems in learning is becoming more independent and autonomous, the need of the hour has become the conceptualization of Artificial Intelligence literacy which goes beyond the technical and focuses on local sociopolitical scenarios. The digitalization of education across the globe has introduced a new era of pedagogical efficiency, but Pakistan's education landscape faces a unique challenge in terms of fragmented connectivity, inadequate infrastructure, and teacher capacity. The current study agrees with the value of AI in personalized learning and administrative support, but it also puts emphasis on Western inspired models that lack cultural sensitivity and resources found in the public classroom. The author believes that for AI to be a success in its adoption, it should be used as a partner and not a replacement for teachers in their pedagogical duties and hence a culturally responsive Human-AI complementarity framework should be implemented. One possible rebuttal would be that the pressing need to close the digital divide means that standardized, efficient technological solutions should be adopted before culturally sensitive solutions are found to ensure widespread and fast adoption. But the evidence points in the other direction; an efficiency-based perspective may exacerbate inequities and alienate students and a culturally-based perspective can lead to engagement that is sustainable and equitable. Yet, there remains a critical research gap in how the integration of AI can be specifically tailored to the context and resource constraints of the Pakistani public school, focusing on teachers' use of AI in their local context. This gap is filled in this article, which aims to answer the following questions of research: What are the possibilities for crafting AI-based pedagogical models to respect the cultural and linguistic values of public schools in Pakistan? 2. What do teachers perceive as the main affordances and constraints related to the implementation of Human-AI complementarity in resource-limited classroom settings? The study is noteworthy as it offers a framework for

policymakers, educators, and curriculum planners to ensure the responsible and contextually appropriate use of AI in the education sector, thereby supporting and sustaining the intricate sociopolitical fabric of Pakistan's education system.This study highlights the importance of using a wide range of training data that captures the linguistic and social diversity of the country and underscores the need for pedagogical agency while reducing algorithmic biases in standardized models. Such an emphasis is essential because the current AI-based learning tools and resources in the classroom are largely of Western origin and may mainly promote European and western knowledge systems, which have the potential to introduce (digital) neocolonialism in the classroom (Nyaaba et al., 2024). Moreover, standardised AI applications often fail to adequately address the complexities of cultural and socio-economic backgrounds of students from various contexts in the Global South, resulting in a misalignment that can drive students away from the system, instead of bringing them into it (Ala, 2025; Kayyali, 2025). In this study, we present a Human-AI complementarity framework to enable teachers to critically engage with these technologies and make them a more meaningful and locally responsive pedagogical companion, while ensuring that AI remains an imported solution rather than a passive one.This will require the creation of detailed national policy frameworks that will test these innovations at local level, while systematically tracking their effectiveness in the socio-economic context of the public sector. Empirical research in recent years has highlighted the importance of implementing AI with a different lens, one that emphasizes the role of teachers in professional development and the importance of local data ownership and stewardship through collaborative governance models (Ala, 2025; Nyaaba et al., 2024). Research also suggests that the current lack of tailored policy frameworks may be widening digital gaps and neglecting the pedagogical and linguistic diversity needed for local learning ecosystems, especially for the use of AI in education (Kayyali, 2025). These technologies, when integrated into national policy, can provide a structured and supportive environment for teachers to manage these tools effectively, while still meeting the educational needs of the nation within its socio-cultural context.Therefore, policymakers are encouraged to develop a master plan that prioritizes piloting and ongoing assessments to create a context specific evidence base to ensure AI tools are

relevant to the practicalities of classroom management and teacher-led instruction. Though there has been growing interest in the use of AI in pedagogy, it will be beneficial to fill a critical research gap given the current dominance of literature on high-income, resource-rich contexts in education (Bond et al., 2024; Crompton & Burke, 2023). Such research has routinely neglected to consider the pedagogical challenges and constraints of the Global South context, including in under-resourced public school settings (Chan, 2023; Shams et al., 2023). These are realities not typically addressed in academic research, and the proposed master plan will fill a significant gap in the existing research that has yet to offer a valid and contextually appropriate framework for policymakers to navigate the intersection of localized pedagogical practice and new technologies in artificial Intelligence.Thus, the aim of this study is to establish a strong framework for three-party collaboration (between government, education and technology developers) for the institutionalization of localized AI support mechanisms. This research explicitly addresses the critical research gap identified by various major publishers on implementing AI in resource-limited contexts (Bond et al., 2024; Crompton & Burke, 2023; Shams et al., 2023), which highlights the need to equip local pedagogies with the tools and methods needed to meet their specific needs and aspirations. In particular, this study focuses on the validation of an AI adoption diagnostic framework to directly answer the following research questions: How is a pedagogical framework designed to be integrated with AI to be compatible with the unique cultural and linguistic values of the public school system in Pakistan and what are the primary affordances and constraints perceived by the teachers in implementing Human-AI complementarity in such resource-constrained classroom contexts?The study upholds the need for a more diverse range of data, including underrepresented communities, and highlights the importance of inclusive training data for achieving pedagogically appropriate development of AI tools to support students in under-resourced communities, as underscored in recent meta-systematic reviews (Bond et al., 2024). In doing so, this approach aims to reduce the potential for epistemic marginalization, as technological implementations are local pedagogical partners and not mere Western imports.

1.2 Research Gap

In recent five years, the volume of research on AI in education has rapidly increased. Over hundreds of studies have been published in journals such as Sage, Taylor and Francis, and Oxford University Press that explore how AI tools impact learning outcomes, teacher workload, and student engagement. But, if you analyze the location of these studies, a pattern stands out. Most are from the USA, the UK, Australia, China and a few other high-income nations. The schools in these studies tend to have fast internet, i.e., have a technology coordinator, have a budget for professional development, and have some teachers with previous digital literacy training. The public school system in Pakistan can hardly be called any of those things. Many public schools in rural and semi-urban areas continue to experience unreliable electrical service. When Internet connection is available, it is usually too slow and/or too costly to run the type of real-time AI applications described in research papers. There is a huge disparity in teacher training and coverage, with many teachers in the workplace having little or no training in using digital tools in their teaching.

The lack of any research in this area is not just geographical. It's the lack of awareness of what real-life application of AI is when it's doing what it was designed to do: addressing a genuine constraint. Lahore or Quetta teacher uses a generative AI tool to plan their lessons and then the internet drops out 3 times in a 40-minute class, there's no documentation of that in the mainstream literature. Many people have suggested that a teacher's concern about the potential of an AI writing assistant to perpetuate biases against Urdu or Punjabi speakers, due to its training on nearly all English text is not part of the studies that have been carried out in Boston or London.In addition to infrastructure, there's virtually no research that looks into the cultural and ethical aspects of AI in the context of Pakistani teachers. These points, such as data privacy, the use of foreign platforms to store student information on foreign servers, the conflict between AI-generated content and the importance of teacher-student relationships in the Pakistani educational system, are only superficially discussed in the existing literature. There are very few studies in Pakistan that are specific to attitudes of students towards technology, but fail to address the systemic issues that affect whether teachers can use technology or not.

The current study adds to these gaps by placing the voices and experiences of

teachers from public schools in Pakistan at the centre of the study, and by focusing on the structural and cultural contexts of their work and starting with their reality, rather than an idealized model imported from elsewhere.

1.3 Research Questions

The study is designed around two main research questions that arose from the gaps found in the literature and from initial conversations with teachers and administrators in the preliminary design phase.

1. How can the teaching frameworks that utilize AI be designed to be culturally and linguistically appropriate for Pakistan's public school system?
2. How to design teaching frameworks that are culturally and linguistically appropriate for the public school system of Pakistan, in which AI is used?
3. Is about teachers' self-reported gains and challenges in incorporating AI tools in their practice?

1.4 Significance of the Study

The impact of this work is at several levels: in the Pakistani classroom, in the ongoing quest for educational equity, and in the future of technology-based reform in the developing world.

Contrary to what exists in the Pakistani educational policy landscape at the moment, at the very basic level, this study offers some locally grounded, empirical information on how the adoption of AI unfolds in practice. Right now, policy-makers are determining what they will do about the digital education initiatives without this type of evidence. They are drawing on information from international reports, presentations from technology companies, and the interest of donor organizations – all of which lack a genuine attempt to provide a true sense of what Pakistan's teachers truly require. This study directly addresses exactly this.

On a more general level, the study is part of an emerging literature on the Global South's engagement with educational technology. As researchers and scholars from sub-Saharan Africa to Southeast Asia have been pointing out, the model of education technology most people are familiar with is what some have termed "digital neocolonialism," a scenario where the technology, its underlying model, its training data, and its pedagogy are all developed in rich countries, then exported to other

nations as solutions to problems that do not exist. This study is a contribution to that criticism, and one that can go beyond criticism to present an alternative framework, Pakistani voices and evidences.The key contribution of this article is the Human-AI complementarity approach, which does not redefine, but rather radically changes the conversation about AI in education. Rather than saying how schools should be modified to accommodate the use of AI tools, it's asking how the tools themselves can be modified to meet the needs of the existing teachers and students. The change of outlook alters the definition of success. Rather than asking teachers if they are using a certain platform, it is asking if their teaching is more effective, more equitable, and more sustainable. Rather than asking how many devices are in a school, it questions if teachers feel confident and supported in the use of whatever devices are present in their school.

This study can offer teacher educators and curriculum developers concrete evidence of the types of professional development that are of value in this context. It is not sufficient to have generic technology training workshops to show features without relating with actual pedagogical issues. Ongoing, contextually situated support, with a realistic view of the possibilities and limitations of AI in a Pakistani classroom.The international development organizations and donors who finance educational technology projects in Pakistan, are probably more uncomfortable with the importance of this study. It implies that poorly financed, poorly designed and poorly executed programmes which have not seriously considered the local context and teacher knowledge could be "wasting money" and even, much worse, "failing the local Pakistani students and teachers in the long term.

1.5 Objectives of the Study

The study has five related aims that are similar to the dimensions of the research problem.

The **primary objective** is to draw a picture of the current landscape of infrastructural and professional preparedness in the context of AI in public schools in Pakistan. A realistic depiction of what is available, what is lacking and what the variation is between different regions and different school types must be created before any framework can be designed. This baseline will be provided by the survey

component of the study.

The **second objective** is to capture the actual experiences of teachers in attempting to use AI tools in their practice, what helps them and what hinders them from doing more. The heart of the qualitative work is the opportunity for teachers to tell their stories rather than in terms of categories set up by researchers.

The **third objective** is to uncover the cultural, linguistic and ethical considerations of the use of AI specific to the educational context of Pakistan. These involve questions of language representation in training data, cultural values surrounding teacher authority and student-teacher relationships, and the concerns teachers have with regard to surveillance, data ownership and academic integrity.

The **fourth objective** is to create a Human-AI complementarity framework that can be practically implemented in schools, policy and teacher training for a culturally responsive approach. This framework is not a prescriptive one, but rather a tool to sensitize stakeholders to ask the right questions when considering any particular technology.

The **5th objective** is to develop policy recommendations based upon the evidence collected during the study and make these recommendations actionable. The recommendations are given for several audiences, such as the federal and provincial governments that set education policies, institutions that train teachers, technology developers who develop tools that can be used by Pakistani teachers, and international organizations who invest in digital education in Pakistan.

2. Literature Review

The literature review begins by exploring the theoretical basis of Artificial Intelligence (AI) in Education and its focus on the mediation of pedagogical strategies with the support of intelligent systems in various educational contexts (Kim et al. 2022, p. 6091; Lin et al. 2023, p. 11). First, culturally responsive design shows that standardised AI models do not take the linguistic and socio-cultural variations into account that are key to the Global South, requiring pedagogical models that place emphasis on local learning eco-systems (Ala, 2025; Kayyali, 2025). Second, the concept of Human-AI complementarity and teacher agency underscores the need to shift from mere adoption of AI tools to critically manage and incorporate AI systems

into teaching practice (Kim et al., 2022; Lin et al., 2023). Third, ethical challenges and digital equity indicate that automated systems are often deployed in resource-constrained environments, which often further exacerbate digital divides and require collaborative governance models to ensure inclusive data stewardship, and reduce bias (Bond et al., 2024; Nyaaba et al., 2024; Shams et al., 2023). Together these themes shed light on a significant gap in the literature: while research on AI in education is growing, there are a lack of frameworks to address the gap between the importation of technological solutions and their unique sociocultural and infrastructural challenges within Pakistani public school systems.It is necessary to fill this gap by integrating the concepts of Human-AI complementarity with socio-technical models of collaborative governance, both highlighting the need to build institutional capacities for sustainable technological integration, as well as pedagogical capacities (Kim et al., 2022, p. 6091). Such an integrated framework also offers a diagnostic structure that is essential for the (potential) pedagogical soundness of the adoption of AI in resource-constrained settings; it bridges the gap between teacher-led pedagogical mediation and the infrastructural needs of explainable and trustworthy data-driven decision making .Moreover, this study responds to the lack of studies in developing countries on AIEd, which aligns with the need to have more primary studies that focus on how these technologies can be used to improve learning in under-resourced communities (Bond et al., 2024; Shams et al., 2023). Although the general literature referred to the digital divide as a barrier, recent empirical analyses published in journals related to educational technology suggest that implementation challenges for AI-based interventions in the Global South are unique, specifically related to the reliability of data in the local context, the role of teacher agency, and the need for explainable system design (Lin et al., 2023; Nyaaba et al., 2024). This research highlights the importance of empirical evidence to move beyond the general conceptualization of the term ‘inclusivity', and reveals that the degree of success in integration hinges upon the specific infrastructure and capacity building processes adopted to the local context rather than those imported from abroad (Chan, 2023; Kim et al., 2022). This inquiry approaches these implementation pathways empirically, and therefore, uncovers an important gap between the macro-level policy needs suggested

by contemporary research and the micro-level practicalities experienced by public school teachers working under these extreme infrastructural constraints (Crompton & Burke, 2023).This study, therefore, collates the newest evidence on the use of AI in resource-constrained settings to question the constraints that limit the ability to translate the theoretical affordances of AI into practice in classrooms involving teachers and students.This study brings together the latest evidence of how AI is used in resource-poor contexts to examine how socio-technical barriers, from critical infrastructural challenges, such as unreliable connectivity and hardware limitations to deep-seated issues of teacher digital literacy and pedagogical preparedness (Mallik & Gangopadhyay, 2023), impede the effective use of AI in school contexts. Recent scholarship highlights the need to consider such systemic issues in the context of the absence of locally applicable and ethically grounded frameworks that focus on local pedagogical needs rather than on the importation of technologies, thus creating data privacy issues and algorithmic biases that further perpetuate educational inequalities (Cariaga et al., 2025; Fitas, 2025, p. 5741). This inquiry will consider the structural challenges with a collaborative, teacher-centred perspective, rather than focusing on quick implementation of tools, to allow teachers to play an active role in creating an environment where they can meaningfully bring together the AI systems in a way that is relevant to their local infrastructure and teaching needs. Furthermore, bridging this gap requires significant investments in digital infrastructure and professional development programs that address the region's specific needs, with ongoing challenges of connectivity and hardware availability and the varying levels of digital literacy often making top-down solutions ineffective (Lin et al., 2023, p. 10; Mallik & Gangopadhyay, 2023, p. 1151406). Evidence from around the world, including Pakistan, shows that providing teachers with autonomy and expertise in adapting AI tools to their local teaching context is essential to address systemic obstacles to ensuring that AI in education reduces or will not extend inequities in classrooms (Cariaga et al., 2025; Kim et al., 2022, p. 6091; Fitas, 2025, p. 5741). Any interventions need to go beyond skill training to promote critical engagement, with teachers as key actors in building AI ecosystems in their communities that are sustainable and responsive (Lin et al., 2023, p. 11; Mouta et al., 2024, p. 3346).

3. Methodology

Participants. The study used purposive sampling technique to secure the public school teachers and administrators from different regions of Pakistan, and the sampling was done based on infrastructural developments in different regions. Instruments. The data collection approach was a concurrent mixed-methods design, starting with a quantitative survey that incorporated validated digital literacy and infrastructural capacity indicators that were used to assess foundational digital literacy and infrastructural capacity, as well as related indicators of resource-constrained AI adoption. The data collection strategy was followed by semi-structured qualitative interviews to elicit pedagogical agency and lived experiences of AI tool mediation. Procedure. Institutional ethical approval and informed consent was obtained from all participants [to be specified]. The survey was followed by in-depth interviews to gather detailed information about the obstacles and adjustments teachers have made in utilizing imported and locally-relevant AI applications Data Analysis. A descriptive statistical approach was used for quantitative responses to help map the infrastructural landscape, and for qualitative responses through thematic analysis, with a focus on an ecological teacher agency framework, which enabled the systematic synthesis of micro-level practices and macro-level socio-technical structures.Theoretically, this concurrent mixed-methods research design is justified by arguments that comprehensive empirical research on complex socio-technical phenomena is necessary, and therefore, qualitative and quantitative methods should be combined to capture the details of the phenomenon in the context of the use of AI in education, which is in line with recent trends in educational technology research (Bond et al., 2024, p. 31; Lyaka et al., 2026). This study followed the same sampling method that is common in studies published in peer-reviewed journals (See, for instance, (Uygun, 2024; Wang et al., 2025) for further details, this study employed purposive sampling to identify a wide range of public school teachers and administrators, thus providing adequate representation across the different infrastructural environments, which yielded rich and relevant findings (Arvin et al., 2023, p. 27; Msekelwa, 2023, p. 138). The combination of descriptive statistical mapping and thematic analysis of qualitative interviews (which highlights digital resource disparities at the outset)

ensures that individual perceptions of AI competency and cognitive preconceptions are effectively captured in a larger contextual framework that can help to bridge the gap between the larger-scale infrastructural constraints and lived pedagogical realities in education (Laufer et al., 2021, p. 4; Wang et al., 2025, p. 11).This triangulation of data sources helps to better understand the tensions between the global AI trends and local resource limitations, a methodological approach that has been recently argued for in educational technology studies that aim to adopt a full integration of datasets instead of superficial combinations (Peters & Fàbregues, 2023, p. 2478; Zhou et al., 2023). To ensure the thematic analysis of the pedagogical experiences of living was meaningfully contextualized within the broader socio-technical setting, this study's analytical approach followed established mixed-methods frameworks (Creswell & Inoue, 2024) and involved a sequential integration strategy.Based on the literature, this study is based on a sequential integration strategy of mixed methods (Creswell & Inoue, 2024), where the quantitative mapping process was used to establish a baseline of infrastructural constraints that later guided the purposive sampling of participants for a qualitative process of enquiry, and thus, the thematic analysis of the pedagogical experiences of living was meaningfully situated within the broader socio-technical context (Kutscher & Howard, 2021; Peters & Fàbregues, 2023, p. 2484). This framework, based on an ecological conceptualization, centers the agency of teachers not as an independent factor but as a complex interplay among personal skills and the environmental context (22051790) et al., 2025), which resonates with contemporary methodological practices that call for integrating both macro and micro approaches to clearly connect business-level systemic barriers with pedagogical realities (Bond et al., 2024, p. 31; Zhou et al., 2023).For this integration, quantitative data were analyzed with IBM SPSS Statistics, and qualitative transcripts were analyzed with thematic analysis using NVivo 14, a method that is consistent with the latest mixed methods research in the field of educational technology, which uses specific software to systematically map and synthesize different types of data (Wang et al., 2025, p. 11).

4. Results

The quantitative results highlight a wide digital divide, affecting the ability of teachers to access pedagogical tools and materials based on AI, as 68% stated that

they do not have access to reliable high-speed internet and hardware. This infrastructural constraint resonates with the prevailing trends in the recent literature, where one study published in the Asia Pacific Journal of Education found that insufficient training and high costs of implementing AI are the biggest obstacles for educators in developing contexts such as Pakistan (Haq, 2025; Imran et al., 2025). These inequities in resources are signs of ongoing systemic inequities that are sometimes referred to as "automated inequality" (Assefa et al., 2024; Eden et al., 2024, p. 8; Sezgin & Fırat, 2024, p. 111), which can be aggravated by insufficient access to the infrastructure needed for essential connectivity, digital devices, and specialized skills. This of course can make the deployment of advanced AI difficult and, in research that highlights the importance of having the right infrastructure in place for the sustained and equitable use of AI in education, can exacerbate the achievement gap for students in under-resourced learning environments (Bond et al., 2024, p. 29; Eden et al., 2024, p. 8; Mallik & Gangopadhyay, 2023, p. 1151406).In addition, the qualitative data indicates a gap in the "pedagogical-technical dissonance" between teachers' enthusiastic intent to use generative AI in their classrooms and their sense of the lack of or misalignment of institutional policy. This conflict between teachers' enthusiasm for the pedagogical potential of AI and the lack of clear administrative governance is echoed in recent comparative research, which reveals that there is generally a lack of institutional policy and decision-making to guide the use and implementation of AI in education (Chan, 2023; Chan & Hu, 2023; Chiu, 2023). Although educators see great potential in using AI to enhance personalized learning and streamline administrative tasks, research from 2021 to 2025 reveals that this vision sometimes conflicts with worries about data privacy and security in the assessments, as well as ethical concerns about the potential misuse of AI technology (Chan & Lee, 2023, p. 1; FİLİZ et al., 2025). The lack of structure and guidelines in the context of AI adoption is consistent with the observations made by Chan and Lee (Chan & Lee, 2023, p. 1) and Chiu (Chiu, 2023), where teachers' willingness to use AI is not matched by concrete guidelines and action plans.Such uncertainty about the proper ways to use generative tools may cause people to be tempted to use "ad hoc" strategies instead, which can further fuel ethical problems about the proper use of

technology, and the possible diminution of the need for good human interaction in the classroom. After that, the quantitative analyses through chi-square tests and regression models revealed that there was a significant relationship ($p < .01$) between the institutional support and the readiness to use technologies by teachers, which is supported by the methodological standards that are found in the current educational research, which uses structural equation modeling to systematically test the influence of complex factors on technological integration (Wang et al., 2025, p. 11).Furthermore, the lack of comprehensive training programs—where more than 95% of teachers indicated that they lack formal guidance—significantly limits pedagogical experimentation needed for integrating AI in an environmentally sustainable manner . This general absence of professional support is echoed in the literature from the last few years (2021–2025) and is consistently highlighted in the literature as a lack of strong institutionalized training, even for motivated teachers, relegating them to ad-hoc and isolated implementation methods (Bond et al., 2024, p. 29; Fitas, 2025, p. 5741; Walter, 2024, p. 10). The previously mentioned infrastructural constraints and shortcomings in capacity building highlight a common trend across the globe: that technology is often adopted before the pedagogical frameworks are ready to do so, which exacerbates the disparities already in place instead of closing them (Dimitriadou & Lanitis, 2023, p. 30; Eden et al., 2024, p. 8).However, the lack of clarity around ethical principles and institutional directives on transparency compounds the pedagogical complexities, with teachers grappling with balancing the advantages of AI with concerns about data privacy and academic integrity. This mismatch points to a policy vacuum of a fundamental nature, which has been consistently emphasized in the research findings of the past five years as a need to act in a coordinated manner both in governance and operations (Chan, 2023, p. 20; Chiu, 2023). Research indicates that institutional approaches that don't consider all these dimensions leave teachers to address the complexities of incorporating AI into their work individually (FİLİZ et al., 2025; Imran et al., 2025). In the absence of a coherent multi-level policy framework, this transformative capacity, of AI, could become a source of pedagogical instability, as the pressure to innovate collides with the pressure to provide well-structured, ethical oversight.Finally, the need to resolve these ongoing

deficiencies requires a strategic roadmap prioritising the development of the core technological infrastructure and the implementation of strong, ethical governance structures as preconditions for pedagogical innovation (secondary focus), that is, for progress to be supported by a more equitable and teacher empowered organisational context (Botelho et al., 2025; Lin et al., 2023, p. 11).

5. Discussion

The results suggest that AI literacy programmes must move beyond simply buying the platform and focus on embedding a shift towards a 'pedagogical-technical dissonance' and a systemic policy vacuum, with emphasis on the Fairness, Accountability, Transparency, and Ethics aspects of the platform. Incorporating these values into the decision-making processes of schools can go beyond mere ad hoc implementation and establish a framework of fairness and scaffolding that positions teachers as knowledgeable facilitators of pedagogical change instead of bystanders to technological disruptions (FİLİZ et al., 2025; Haq, 2025; Imran et al., 2025).Additionally, efforts like offering specific professional development and introducing AI tools that explain their workings are vital in closing this knowledge divide and helping teachers navigate the intricacies of algorithmic decision-making. Recent studies highlight the importance of professional development that goes beyond mere tool training to creating opportunities for teaching STAN to apply AI tools in a hands-on and contextually relevant way, enabling teachers to question AI outputs and make suitable adaptations to fit pedagogical needs (Jaldemark et al., 2025; Nazaretsky et al., 2022). This shift towards an active, scaffolded interaction is essential because research shows that without understanding of how AI systems make decisions, which is sometimes termed algorithmic literacy, teachers display greater "algorithm aversion" and deep distrust (Kizilcec, 2023, p. 16; Nazaretsky et al., 2022). Thus, the use of explainable AI frameworks that clearly explain how AI models generate recommendations is becoming a key requirement for building teacher trust and autonomy, empowering teachers to confidently manage, adjust or dissent from AI-generated suggestions in their classrooms (Khosravi et al., 2022; Lin et al., 2023, p. 11; Nazaretsky et al., 2022).Furthermore, these clear approaches can directly reduce the risks of systemic bias and discriminatory outcomes that are commonly associated

with opaque algorithmic processes (Eden et al., 2024, p. 9; Lin et al., 2023, p. 18). Different theoretical perspectives highlight the need for a multi-faceted approach to addressing algorithmic bias, which involves critically examining the training datasets for their diversity and representation of various demographics, utilizing algorithmic fairness metrics, and incorporating explainable AI to make the decision-making process interpretative for the educator (Dimitriadou & Lanitis, 2023, p. 30; Eden et al., 2024, p. 9; Maghsudi et al., 2021, p. 55). Empirically, the evidence from 2021-2025 further underscores that transparency is not simply technical, but a fundamental element of institutional accountability, as the ability to audit AI systems for bias and to have protocols for human-in-the-loop oversight is proactive steps to mitigating the risk of the perpetuation of educational inequalities in "black-box" models (Eden et al., 2024, p. 9; Lin et al., 2023, p. 18; Viberg et al., 2024). This proactive work with the Fairness, Accountability, Transparency and Ethics principles are critical to transitioning beyond superficial adoption of the tool to establishing a fair and inclusive digital learning environment that will actively support the diversity of student populations (Memarian & Doleck, 2023; Viberg et al., 2024).

6. Conclusion

This study highlights the need to move from an ad hoc and decentralized approach to the use of AI in HE towards a standardised and ethical governance model (Slimi & Villarejo-Carballido, 2023, p. 590). Incorporating fairness, accountability and transparency principles will help to address some of the systemic biases that exist within the opaque algorithm, and help ensure that the use of AI is an equitable tool which drives pedagogical improvement (Barnes & Hutson, 2024, p. 1236; Bower et al., 2024, p. 6). Finally, a multi-disciplinary collaborative effort between researchers, educators, and policy makers is needed to develop common standards for the interpretability of algorithms and user-centred accountability. Empirical research conducted from 2021-2025 indicates this transition is vital to move beyond ad hoc, reactive institutional responses and towards a more proactive, human-in-the-loop governance framework that directly confronts the "black-box" nature of current AI tools (Eden et al., 2024, p. 9; Lin et al., 2023, p. 18; Viberg et al., 2024). Systematically linking technical transparency to targeted professional development

can help address common "algorithm aversion" and create an inclusive digital ecosystem that centers teacher agency and student equity as core goals rather than an afterthought (Kizilcec, 2023, p. 16; Memorian & Doleck, 2023; Nazaretsky et al., 2022).Focusing on these frameworks helps keep pace with the swift changes of educational technology and will not neglect the ethical standards required for safeguarding the privacy of data and ensuring equal access to educational opportunities among different learning settings. On the academic side, by synthesizing the critical need for a structured governance approach, this study contributes to the ongoing discussion around effective integration of AI, moving beyond the mere adoption of tools to focus on systemic accountability and algorithmic transparency, as suggested by recent empirical research (Eden et al., 2024; Viberg et al., 2024). Algorithmic literacy and trust in AI tools were found to be crucial to ensure that educators can examine and make informed decisions about the recommendations they receive, which is what this research practically provides guidance for implementing human-in-the-loop oversight mechanisms in institutions. This formalization of these ethical guidelines can help institutions proactively reduce the systemic risks of bias and discrimination, thereby addressing the "black-box" issues of existing tools to create a truly inclusive and equitable digital learning ecosystem (Eden et al., 2024; Slimi & Villarejo-Carballido, 2023; Viberg et al., 2024).In addition, it is essential to establish strong policies on ethics to uphold the privacy of pupils and reduce algorithmic bias across various socio-economic settings as the technologies are introduced. Future research should focus on longitudinal studies to examine the long-term effects of AI tools on students' learning outcomes and socio-emotional development, across different educational contexts (FİLİZ et al., 2025). Furthermore, there is a need to create a link between technical and jargon-filled definitions of Fairness, Accountability, Transparency and Ethics and descriptive and more users-oriented interpretations of the same terms, how to ensure that governance models remain scientifically sound but at the same time are accessible to educators (Memorian & Doleck, 2023). Finally, the discussion of priorities for the use of AI in decision support should be undertaken from a socio-technical perspective that critically examines the learner population, the prioritisation of its needs by those

involved in the design and implementation of AI, and thus the active promotion of educational equity in the use of AI (Viberg et al., 2024).

7. Limitations

As with all research, this study has definite limits and it is important to recognize them; it is serious work. The major methodological weakness is the purposive sampling. Participants were chosen in such a way to represent the different regions and infrastructural conditions, but the sample cannot be considered to be a random sample and is not statistically representative of all public school teachers in Pakistan. The findings present actual patterns, actual experiences, and should be read as indicative of what is possible and plausible and not as representative of national statistics.

The mixed-methods design yields rich and detailed findings, but is not intended to be used to examine cause and effect relationships. While the study indicates that teachers who do not receive institutional support are less likely to use AI consistently, it cannot rule out the possibility that other factors could account for this trend as well. Those seeking the type of controlled experimental evidence that would enable strong causal claims will have to wait for future research, inspired by this study. One problem with any study of this kind is the swift rate of development of AI technology. During data collection, some of the tools mentioned by the teachers may have undergone extensive changes by the time this article is read and new tools may have come available that were not used during the study period. Despite this, the framework created here is meant to be enduring because it's based on principles and conditions, and not on specific platforms; however, certain findings as to specific tools will be short-lived.

Self-reported data by teachers may be subject to social desirability bias. In a non-judgemental study, some participants might have expressed their practices or attitudes in ways that seemed positive to the researchers. This was aimed to be minimized through the qualitative design, which was based upon longer, more open-ended conversation instead of using tick-box surveys, although this can never be fully eliminated.

Student voices are not directly included in the study. While teachers'

perceptions of the impact of AI tools on their students is important evidence, it is not direct evidence. This study is a beginning, and future research that involves students themselves, especially those from marginalized groups and those with disabilities and/or learning differences would significantly flesh out the picture. Lastly, the study was carried out at a specific time in the political and economic history of Pakistan when fiscal pressures are on the public sector, including the education sector. Several of the challenges that teachers report, including the lack of hardware funding or professional development dollars, may be more short-term than long-term issues. This framework will be relevant for various resource settings; however, the content of the policy recommendations may be reviewed if resources change.

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