Examining the Role of Digital Pedagogy in Supporting Inclusive and Interdisciplinary Learning in Primary Education: Evidence from Teachers' Perspectives.

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ABSTRACT:

The integration of digital technologies into education has transformed teaching and learning practices worldwide, creating opportunities to promote inclusive and interdisciplinary learning in primary education. This study aimed to examine the role of digital pedagogy in supporting inclusive and interdisciplinary learning in primary education from teachers' perspectives. A quantitative and descriptive research design was employed from this study. Data were collected from primary school teachers in public sector schools in Pakistan using a self-developed questionnaire. The questionnaire consisted of items related to digital pedagogy practices, inclusive learning, interdisciplinary learning, and the perceived impact of digital pedagogy. The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 24. Descriptive statistics, including means and standard deviations, were used to interpret the findings. The findings revealed that teachers use digital platforms to enhance student engagement and reported confidence while using digital technologies in the classroom. However, lower levels of agreement were observed regarding the integration of digital resources into daily lesson planning and the use of technology to differentiate instruction according to students' needs. Despite these challenges, teachers perceived digital pedagogy as a valuable tool for promoting inclusive learning by supporting learners with diverse abilities and encouraging equal participation. The results also indicated that digital pedagogy facilitates interdisciplinary learning by helping students connect knowledge across subjects and supporting integrated learning experiences. Furthermore, teachers reported positive effects of digital pedagogy on student motivation, classroom participation, problem-solving skills, and overall learning outcomes. The study concludes that digital pedagogy

plays an important role in supporting inclusive and interdisciplinary learning in primary education. It is recommended that schools strengthen teacher training and provide greater support for integrating digital technologies into instructional planning and differentiated teaching practices.

Keywords: Digital pedagogy, inclusive learning, interdisciplinary learning, primary education, teachers' perceptions, educational technology, quantitative research.

1. Introduction

In recent years, education systems worldwide have increasingly integrated digital technologies into teaching and learning processes. This shift, often referred to as digital pedagogy, involves the purposeful use of digital tools, platforms, and resources to enhance instructional practices and student learning experiences (Selwyn, 2016). In primary education, digital pedagogy has become particularly significant as it supports early skill development, engagement, and differentiated instruction (Voogt & McKenney, 2017).

At the same time, modern education emphasizes two key priorities: inclusive education and interdisciplinary learning. Inclusive education ensures that all learners, regardless of ability, background, or learning needs, have equitable access to quality learning opportunities (UNESCO, 2020). Interdisciplinary learning, on the other hand, encourages the integration of knowledge across subject areas to promote deeper understanding and real-world application of concepts (Drake & Burns, 2004).

Digital pedagogy has the potential to support both goals by offering flexible learning environments, adaptive resources, and interactive tools that accommodate diverse learners while also enabling cross-curricular teaching approaches (Hattie, 2015). However, the effectiveness of these practices largely depends on teachers' competencies, attitudes, and classroom implementation strategies (Ertmer & Ottenbreit-Leftwich, 2010).

Despite increasing access to digital technologies in schools, their pedagogical use remains inconsistent, particularly in primary education settings. Many teachers still struggle to integrate digital tools effectively in ways that promote both inclusive and interdisciplinary learning (Tondeur et al., 2017). Furthermore, there is limited empirical evidence from teachers' perspectives on how digital pedagogy influences these two important educational outcomes simultaneously. This study seeks to address this gap.

The aim of this study is to examine the role of digital pedagogy in supporting inclusive and interdisciplinary learning in primary education from teachers' perspectives. The present study aims to answer the following research questions.

RQ1. How do primary school teachers perceive the role of digital pedagogy in supporting inclusive learning in primary education?

RQ2. How do primary school teachers perceive the role of digital pedagogy in supporting interdisciplinary learning in primary education?

2. Literature Review

Digital pedagogy refers to the integration of digital technologies into teaching strategies to enhance learning outcomes (Helen & Sharpe, 2013). It goes beyond the use of technology as a tool and focuses on how digital resources transform teaching learning process. Research suggests that digital pedagogy can improve student engagement, motivation, and collaboration when effectively implemented (Mishra & Koehler, 2006). However, its success depends on teacher competence, access to resources, and institutional support (Ertmer et al., 2012).

Inclusive education aims to ensure that all learners, including those with diverse abilities and learning needs, can participate meaningfully in education (UNESCO, 2020). Therefore, digital

tools such as adaptive learning platforms, multimedia content, and assistive technologies play a crucial role in supporting inclusion (Al-Azawei et al., 2016). For example, text-to-speech tools, visual aids, and interactive applications can support learners with special educational needs, including those with conditions such as autism spectrum disorder.

Research indicates that digital pedagogy can reduce learning barriers by allowing teachers to differentiate instruction and provide personalized learning experiences (Florian & Black-Hawkins, 2011). However, challenges such as lack of training and unequal access to technology can limit its effectiveness (Lawrence & Tar, 2018; Khan et al., 2026).

Interdisciplinary learning involves integrating concepts from multiple subjects to create meaningful and connected learning experiences (Drake & Burns, 2004). In primary education, this approach helps students develop critical thinking, creativity, and problem-solving skills. So, digital tools can enhance interdisciplinary learning by enabling project-based learning, simulations, and collaborative activities (Bell, 2010).

For instance, students may use digital storytelling tools to combine language arts, social studies, and technology skills. Similarly, coding activities can integrate mathematics and logical reasoning (Resnick et al., 2009). Studies suggest that interdisciplinary digital learning increases student engagement and supports deeper conceptual understanding (Sawyer, 2005).

Teachers play a central role in the successful implementation of digital pedagogy. Their attitudes, digital competence, and pedagogical decisions directly influence how technology is used in the classroom (Khan et al., 2025). Teachers who are confident in using digital tools are more likely to implement innovative and inclusive teaching strategies (Tondeur et al., 2017). Conversely, limited training and lack of resources can hinder effective integration (Voogt et al., 2013).

Professional development programs focused on digital skills and pedagogical innovation are essential for improving teachers' ability to design inclusive and interdisciplinary learning experiences (Koehler & Mishra, 2009).

2.1 Theoretical Framework

This study is grounded in Universal Design for Learning (UDL) and constructivist learning theory. UDL emphasizes providing multiple means of representation, engagement, and expression to accommodate diverse learners (Phelan & Finnegan, 2025). This aligns closely with inclusive digital pedagogy. Constructivist theory supports interdisciplinary learning by emphasizing active, student-centered knowledge construction through experience and collaboration (Piaget, 1972; Vygotsky, 1978).

Although existing studies have explored digital pedagogy, inclusion, and interdisciplinary learning separately, limited research has examined the combined role of digital pedagogy in supporting both inclusive and interdisciplinary learning in primary education, particularly from teachers' perspectives. This study addresses this gap by providing quantitative evidence on these relationships.

3. Methodology

The aim of the study was to examine teachers' perceptions regarding the role of digital pedagogy in supporting inclusive and interdisciplinary learning in primary education. Specifically, the study investigates teachers' perceptions of digital pedagogy in public sector primary schools in Pakistan.

The study adopts a quantitative and descriptive research design, where the researcher examines teachers' perceptions of the role of digital pedagogy in supporting inclusive and interdisciplinary learning in primary education. Quantitative research is based on the collection of numerical data and an analytical framework used to test the acceptance or rejection of formulated hypotheses. Unlike qualitative research, the quantitative approach relies on structured data collection, typically through primary or secondary sources; in this study, primary data were collected from teachers' perceptions.

Furthermore, this research design enables the generalization of findings to a larger population, thereby extending the scope of the study and supporting evidence-based policy formulation. Descriptive research is a fundamental research approach that examines phenomena as they exist in their natural setting. It identifies characteristics and relationships between variables based on observation (Williams, 2017).

In descriptive research, data are collected in a systematic and quantifiable manner that allows statistical analysis. This method is considered appropriate because it provides a systematic, factual, and accurate description of the characteristics and relationships of the phenomenon under study (Siedlecki, 2020). The primary goal of descriptive research design is to clearly define the subject of the study. It is commonly used in case studies, surveys, and naturalistic observations. This approach involves data collection, analysis, and presentation, allowing the researcher to clearly communicate the research problem so that it can be easily understood by others (Thakur, 2021).

Data were collected using a self-administered questionnaire distributed among participants. Prior to data collection, participants were informed about the purpose of the study and assured of the confidentiality and anonymity of their responses. The collected data were then analyzed using SPSS (V.24).

4. Results

In this study we investigated 350 primary school teachers in Khyber Pakhtunkhwa Pakistan. First look into the demographic information of the respondents in this study.

4.1 Demographic information of the respondents

Table 4.1.1 Designation of the respondents

Number of Respondents	Designation		
350	PST	SPST	PSHT
	189	95	66

Table 4.1.1. specifies the designation of the respondents. There were 350 respondents, among these there were 189Primary School Teacher (PST), 95 Senior Primary School Teacher (SPST) and 66 Primary School Head Teachers (PSHT).

Table 4.1.2. Academic qualification of the respondents

Number of Respondents	Academic Qualification				
350	HSSC	Graduation	Master	MPhil	PhD
	07	53	269	17	04

Table 4.1.2. indicates the academic qualification of the respondents. In a sum of 350 respondents, among these 07 was Higher Secondary School Certificate (HSSC), 53 were Graduate, 269 were Master degree holder, 17 were MPhil and 04 were PhD.

Table 4.1.3. Teaching experience of the respondents

Number of Respondents	Experiences				
350	1-5 years.	6-10 years	11-15 years	16-20 years.	21 and above
	119	123	41	19	48

Table 4.1.3. highlights the experiences of the respondents. In a number of 350 respondents among these 119 respondents shows their experiences in the range of 01 to 05 years, 123 respondent shows their experiences in the range of 06 to 10 years, 41 respondents answer that they have experience in the range of 11 to 15 years, 19 respondents experiences were in the range of 16 to 20 years and 48 respondents show that they have experiences in the range of 21 years and above.

4.2 **Digital Pedagogy Practices**

Table 4.2. Results of digital pedagogy practices

Statement	Mean	Std	Df	Chi- Value	Sig.
DPP1	3.8210	.73056	4	386.543	.000
DPP2	2.8913	.75001	4	334.086	.000
DPP3	4.2000	.84801	4	321.200	.000
DPP4	3.5310	.79532	4	304.943	.000
DPP5	2.7569	.73850	4	375.943	.000
DPP6	4.1537	.75769	4	252.537	.000

Table 4.2. indicates the results of digital pedagogy practices among teachers to supports inclusive and Interdisciplinary learning in primary education. The findings indicate that teachers demonstrate varying levels of engagement in digital pedagogy practices within their classrooms. Among the six statements, "I use digital platforms to support student engagement during lessons" received the highest mean score (M = 4.2000, SD = 0.84801), suggesting that teachers frequently utilize digital platforms to enhance student participation and engagement during instructional activities. Similarly, respondents reported a high level of confidence in using digital technologies in their classrooms (M = 4.1537, SD = 0.75769), indicating that most teachers feel competent using digital tools.

Teachers also agreed that they regularly use digital tools such as tablets, interactive boards, and educational applications in their teaching (M = 3.8210, SD = 0.73056), reflecting a moderate to high level of technology integration in classroom instruction. In addition, respondents reported moderate agreement with the statement that they design activities requiring students to use digital tools for learning (M = 3.5310, SD = 0.79532), suggesting that student-centered digital learning activities are implemented to some extent.

However, lower mean scores were observed for integrating digital resources into daily lesson planning (M = 2.8913, SD = 0.75001) and using technology to differentiate instruction based on students' needs (M = 2.7569, SD = 0.73850). These findings indicate that while teachers use digital technologies and feel confident in doing so, they may encounter challenges in systematically incorporating digital resources into lesson planning and employing technology to address diverse learning needs.

Overall, the results suggest that teachers hold positive attitudes toward the use of digital technologies and actively employ them to support student engagement. However, the relatively lower scores for lesson planning and differentiated instruction indicate areas where additional professional development and support may be needed. Enhancing teachers' skills in integrating digital resources into instructional planning and adapting technology for diverse learners could further strengthen the implementation of digital pedagogy in primary education

4.3 Inclusive Learning (Perceptions & Practice)

Table 4.3 results of Inclusive Learning (Perceptions & Practice)

Statement	Mean	SD	df	Chi Square	Sig
IL (P&P)1	4.4200	.73640	4	416.629	.000
IL (P&P)2	4.3457	.70032	4	247.737	.000
IL (P&P)3	4.3686	.65440	4	255.783	.000
IL(P&P)4	4.3571	.70682	4	233.474	.000
IL (P&P)5	4.3457	.77786	4	372.486	.000
IL (P&P)6	4.4392	.74649	4	416.530	.000

Table 4.3 supports the statistical analysis of Inclusive Learning (Perceptions & Practice) among primary school teachers. The findings indicate that teachers hold highly positive perceptions regarding the role of digital pedagogy in promoting inclusive learning in primary education. Among the six statements, "Digital learning environments promote equal participation among students" recorded the highest mean score (M = 4.4392, SD = 0.74649), suggesting that respondents strongly believe digital environments foster equitable participation in the classroom. Similarly, teachers agreed that digital tools help support learners with different abilities (M = 4.4200, SD = 0.73640) and that digital resources can be used to adapt lessons for diverse learners (M = 4.3686, SD = 0.65440).

Teachers also expressed strong agreement that digital pedagogy improves the engagement of low-performing students (M = 4.3571, SD = 0.70682). In addition, they agreed that technology enables the participation of students with learning difficulties (M = 4.3457, SD = 0.70032) and that assistive or supportive technologies, such as text-to-speech tools and visual aids, enhance inclusion (M = 4.3457, SD = 0.77786).

Broadly, all mean scores exceeded 4.30 on a five-point Likert scale, indicating a high level of agreement among teachers that digital pedagogy contributes positively to inclusive learning practices in primary education. The relatively low standard deviations further suggest consistency in participants' responses, reflecting a shared perception that digital technologies play an important role in supporting learners with diverse abilities and promoting equitable educational opportunities.

4.4 Interdisciplinary Learning

Table 4.4, Statistical analysis of Interdisciplinary Learning

Statement	Mean	SD	Df	Chi Square	Sig
IL1	4.3143	.78567	4	378.857	.000
IL2	4.2257	.78154	4	343.400	.000
IL3	4.3229	.79128	4	353.600	.000
IL4	4.1200	.86802	4	286.257	.000
IL5	4.3029	.89554	4	343.857	.000
IL6	4.2776	.78754	4	343.460	.000

Table 4.4 describe teachers' perceptions of Interdisciplinary Learning in primary education. The findings indicate that teachers generally perceive digital pedagogy as an effective means of supporting interdisciplinary learning in primary education. Among the six statements, "Technology helps students connect knowledge across disciplines" received the highest mean score (M = 4.3229, SD = 0.79128), suggesting that teachers strongly believe digital technologies facilitate the integration of concepts from different subject areas.

Teachers also agreed that they use digital tools to integrate multiple subjects within a single lesson (M = 4.3143, SD = 0.78567) and that digital resources make it easier to teach real-world, interdisciplinary topics (M = 4.3029, SD = 0.89554). Furthermore, respondents indicated that students demonstrate better understanding when subjects are taught using an integrated digital approach (M = 4.2776, SD = 0.78754), highlighting the perceived educational value of digitally supported cross-curricular instruction.

In addition, teachers reported that they design project-based activities combining different subject areas (M = 4.2257, SD = 0.78154), reflecting a positive orientation toward interdisciplinary teaching practices. The statement "I use digital platforms to support collaborative cross-curricular projects" recorded the lowest mean score among the items (M = 4.1200, SD = 0.86802), although it still indicates agreement that such practices are being implemented.

Altogether, the consistently high mean scores on Likert scale, suggest that teachers view digital pedagogy as a valuable tool for fostering interdisciplinary learning in primary education. The relatively low standard deviations indicate a reasonable level of consistency in participants' responses, demonstrating broad agreement regarding the benefits of digital technologies in supporting cross-curricular teaching and learning.

4.5 Perceived Impact of Digital Pedagogy

Table 4.5 Statistical analysis of Perceived Impact of Digital Pedagogy

Statement	Mean	SD	df	Chi Square	Sig
PIDP1	4.2886	.82207	4	384.514	000
PIDP2	4.3714	.81130	4	385.229	.000
PIDP3	4.4057	.69048	4	424.286	.000
PIDP4	4.4171	.75908	4	420.686	.000
PIDP5	4.3114	.76277	4	371.686	.000

Table 4.5 indicates the perceived impact of digital pedagogy. The findings reveal that teachers perceive digital pedagogy as having a highly positive impact on teaching and learning in primary education. Among the five statements, "Digital teaching practices improve classroom participation" received the highest mean score (M = 4.4171, SD = 0.75908), indicating that teachers strongly believe the integration of digital technologies encourages greater student involvement and engagement during classroom activities.

Similarly, respondents agreed that digital pedagogy enhances students' problem-solving skills (M = 4.4057, SD = 0.69048) and that students are more motivated when digital tools are used in instruction (M = 4.3714, SD = 0.81130). These findings suggest that teachers view digital technologies as effective in promoting active learning and developing higher-order thinking skills.

Teachers also expressed positive perceptions regarding the broader educational benefits of digital pedagogy. They agreed that overall, digital

pedagogy supports better learning outcomes in primary education (M = 4.3114, SD = 0.76277) and that digital pedagogy improves overall teaching effectiveness (M = 4.2886, SD = 0.82207). Although the latter statement recorded the lowest mean score within this construct, it still reflects a high level of agreement among respondents.

As a whole, the mean scores for all items, demonstrating that teachers perceive digital pedagogy as making a substantial contribution to effective teaching, student motivation, classroom participation, problem-solving abilities, and learning outcomes.

Discussion

The findings of this study indicate that primary school teachers hold highly positive perceptions regarding the role of digital pedagogy in supporting inclusive and interdisciplinary learning. Across all dimensions examined by digital pedagogy practices, inclusive learning, interdisciplinary learning, and the perceived impact of digital pedagogy, the mean scores on a five-point Likert scale, suggesting strong agreement among respondents that digital technologies contribute meaningfully to teaching and learning in primary education.

Regarding digital pedagogy practices, teachers reported frequent use of digital tools, integration of digital resources into lesson planning, and confidence in using educational technologies. The highest-rated item, which reflected teachers' confidence in using digital technologies in the classroom, suggests that participants feel prepared to incorporate digital resources into their instructional practices. These findings support the work of Mishra and Koehler (2006), who argued that effective technology integration depends on teachers' technological and pedagogical knowledge. Likewise, the results are consistent with Ertmer and Ottenbreit-Leftwich (2010), who emphasized that teachers' confidence and beliefs play a central role in the successful implementation of technology-enhanced instruction. The findings also align with Selwyn's (2016) view that digital pedagogy extends beyond the use of technology itself and encompasses purposeful instructional strategies that enrich teaching and learning.

The results relating to inclusive learning demonstrate that teachers perceive digital pedagogy as an important mechanism for supporting learners with diverse needs. Respondents strongly agreed that digital learning environments promote equal participation, facilitate lesson adaptation for diverse learners, and improve engagement among low-performing students. These findings are consistent with UNESCO's (2020) emphasis on inclusive education as a means of ensuring equitable access and participation for all learners. They also support the arguments of Al-Azawei et al. (2016), who highlighted the potential of digital technologies and Universal Design for Learning principles to accommodate learner diversity, and Florian and Black-Hawkins (2011), who noted that inclusive pedagogical approaches should create learning opportunities accessible to all students rather than targeting only specific groups. The positive perceptions expressed by teachers in this study suggest that digital pedagogy can be an effective tool for fostering educational equity in primary classrooms.

With respect to interdisciplinary learning, teachers agreed that technology helps students connect knowledge across disciplines and supports the integration of multiple subjects within classroom instruction. Respondents also perceived digital resources as valuable for teaching real-world interdisciplinary topics and improving students' understanding through integrated learning experiences. These findings reinforce the work of Drake and Burns (2004), who argued that interdisciplinary teaching promotes meaningful connections between subject areas and enhances student learning. Similarly, Bell (2010) emphasized that technology-supported project-based learning enables students to apply knowledge across disciplines while developing critical thinking and collaboration skills. The findings also resonate with Sawyer (2005), who suggested that authentic, technology-enhanced learning experiences contribute to deeper conceptual

understanding by encouraging learners to integrate ideas from multiple domains.

The study further revealed that teachers perceive digital pedagogy as having a substantial positive impact on educational outcomes. In particular, respondents agreed that digital teaching practices improve classroom participation, enhance students' problem-solving skills, increase motivation, and contribute to better learning outcomes overall. These findings are in line with Hattie (2015), who identified technology as having the potential to positively influence student achievement when used effectively within sound pedagogical frameworks. They also support Helen and Sharpe's (2013) argument that digital pedagogy can transform teaching practices by promoting interactive, collaborative, and learner-centered environments. The high ratings for classroom participation and motivation additionally suggest that digital technologies encourage active engagement, a principle closely associated with constructivist approaches to learning as described by Vygotsky (1978) and Piaget (1972).

Taken together, the findings provide empirical support for the theoretical perspectives underpinning this study. The positive perceptions of teachers regarding inclusion are consistent with the principles of Universal Design for Learning, which advocate providing multiple means of engagement, representation, and expression to address learner variability (Phelan, 2025). Likewise, teachers' views on interdisciplinary learning reflect constructivist principles that emphasize active knowledge construction through authentic and collaborative experiences (Piaget, 1972; Vygotsky, 1978).

Overall, the study demonstrates that teachers perceive digital pedagogy as a valuable approach for creating inclusive, engaging, and interdisciplinary learning environments in primary education. These findings contribute to the growing body of literature suggesting that digital technologies can enhance educational quality when integrated thoughtfully and supported by teacher competence and effective pedagogical practices (Khan et al., 2026; Tondeur et al., 2017). They also highlight the importance of continued investment in teacher professional development and digital infrastructure to maximize the benefits of digital pedagogy for diverse groups of learners.

5. Conclusion

This study examined teachers' perceptions of the role of digital pedagogy in supporting inclusive and interdisciplinary learning in primary education. The findings revealed a consistently high level of agreement among respondents across all dimensions of the study, indicating that teachers view digital pedagogy as a valuable and effective approach to enhancing teaching and learning processes.

The results showed that teachers actively engage in digital pedagogy practices, demonstrating strong confidence in using digital tools, integrating digital resources into lesson planning, and designing technology-supported learning activities. In terms of inclusive learning, teachers reported that digital pedagogy significantly contributes to promoting equity, supporting learners with diverse needs, and enhancing the participation of students with learning difficulties. Similarly, the findings indicated that digital pedagogy facilitates interdisciplinary learning by enabling the integration of multiple subjects, supporting project-based learning, and helping students connect knowledge across different disciplines.

Furthermore, teachers perceived digital pedagogy as having a positive overall impact on teaching effectiveness, student motivation, classroom participation, problem-solving skills, and learning outcomes. These findings suggest that digital technologies, when used purposefully, can create more engaging, inclusive, and meaningful learning environments in primary education.

In conclusion, the study provides strong evidence that digital pedagogy plays a significant role in enhancing inclusive and interdisciplinary learning in primary schools. The positive perceptions of teachers highlight the importance of integrating digital tools into everyday teaching practices. However, the effectiveness of digital pedagogy depends on teachers' digital competence, access

to resources, and continuous professional development.

Based on these findings, it is recommended that educational stakeholders focus on strengthening teacher training programs, improving access to digital infrastructure, and supporting innovative pedagogical practices. Such efforts will ensure that digital pedagogy is effectively utilized to promote equity, collaboration, and holistic learning in primary education.

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