Influence of Digital Competencies and AI Usage in Enhancing Teachers' Instructional Effectiveness in Southern Pakistan

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Abstract

This study investigates how digital competencies and the use of Artificial Intelligence (AI) influence the instructional effectiveness of secondary school teachers in Southern Pakistan. A quantitative research approach was employed, collecting data from 440 teachers selected through purposive sampling across four tehsils in Kot Addu District. Structured questionnaires measured digital competencies, AI usage, and teacher effectiveness, and the data were analyzed using SPSS v27 with descriptive statistics, regression analysis, t-tests, and ANOVA. Results indicate that while digital competencies alone did not produce a statistically significant independent effect ($p = 0.051$), AI usage had a strong positive impact on teaching outcomes ($p = 0.000$). The combination of digital competencies and AI integration significantly improved instructional effectiveness ($p = 0.024$), classroom management, and student engagement. Descriptive analysis showed above-average confidence in AI and digital tools, with variations across tehsils and genders. Reliability and validity tests (Cronbach's alpha > 0.87, Pearson correlation > 0.189) confirmed the robustness of the findings. Based on these results, the study recommends AI-focused teacher training programs, integration of digital tools into lesson planning, provision of equitable access to technology, and regular professional development. Policymakers are advised to strengthen digital infrastructure, promote AI literacy, and support lifelong learning to enhance teacher effectiveness and advance 21st-century education in Southern Pakistan.

Keywords: *Digital Competencies, Artificial intelligence, Teaching effectiveness, Teachers, Southern Pakistan*

INTRODUCTION

Digital innovation and the implementation of Artificial Intelligent (AI) in education have changed the world at a very rapid pace. Not only do teachers need to possess good pedagogical knowledge, but also to know how to adapt to new technologies that can enhance the process of instruction delivery. The challenges of Southern Pakistan such as low digital infrastructure level, lack of AI training and professional development level threaten this idea of optimal utilisation of digital and AI tools by the teachers. Despite such limitations, the fact that the studies place greater emphasis on AI applications, in particular, adaptive learning systems, automated tests, and intelligent tutoring, leads to the need to investigate the role of digital competencies and AI use by teachers in instructional process. This paper examines to what extent digital skills and AI use can transform the teaching outcomes in Southern Pakistan and give the insights on whether education can be reformed.

The digital competencies and the inclusion of Artificial Intelligence (AI) in the educational process have become an essential part of altering the instructional

practice and improving the learning outcomes in the world. Digital competencies enable educators to effectively apply technology in education, such as creation of a participatory curriculum and tracking of the learning process, which, in its turn, lead to a more engaging educational process (Redecker, 2017). The potential of individualizing the teaching process and addressing the needs of different students also enhances the quality of the educational process and its performance because of the use of AI (adaptive learning services and automated feedback systems) (Holmes et al., 2019). The developing world, including Southern Pakistan, requires the technologies in particular since the learning materials are not always available, and educators are empowered to deliver high-quality instruction despite the infrastructural obstacles (Khan and Qureshi, 2020; UNESCO, 2021).

Despite the numerous studies conducted all over the world on the role of digital competencies and AI in the educational process, the gaps in this area remain significant, in particular, in developing countries. As research is often done on the developed nations, a discrepancy between high-income and low-income regions in the implementation of AI and engagement with digital skills to gain their attention thereby increasing inequalities in education is expected (Selwyn, 2019; Vincent-Lancrin and van der Vlies, 2020). The empirical data on the precise effect of digital skills of educators and application of AI to the instructional process is not adequate in this context as Southern Pakistan, and the overwhelming majority of the scholars concentrate on the technological integration in general, but not on the application of AI in particular (Ahmed and Malik, 2022; Siddiqui et al., 2023). In addition, the incomplete nature of teacher training concerning AI and digital tools in developing countries points to the need to carry out a study with a more localized focus to get to know the obstacles, such as inadequate infrastructure and policy provisions (Khan and Qureshi, 2020; UNESCO, 2021). This study paper addresses such gaps in regard to teachers in secondary schools in Southern Pakistan.

The beneficial effect on the instructional performance of teachers with the use of digital competencies and AI use is proved empirically. Research has found AI literacy to be strongly correlated with increased competencies of online information search and instructional planning, which means that effective use of AI will result in more efficient teaching and engagement among students (Cabero-Almenara et al., 2021; Ng et al., 2022). Likewise, teacher competencies when combined with AI have been associated with improved functional skills and informal learning among educators, and regression analyses have found that AI and teacher competencies have strong positive relationships (Guillén-Gámez and Mayorga-Fernandez, 2020; UNESCO, 2021). As an example, AI integration courses have shown competency and intent development in preservice teachers to employ technology in enhanced instructions (Chiu and Chai, 2020). These results give a basis on how such tools can transform the teaching practice in resource constrained environments.

Southern Pakistan has its own problems in the field of education, such as insufficient digital infrastructure, not sufficient teacher training in AI, and unequal access to technology, that further prevent the widespread implementation of digital tools in classrooms (Ahmed and Malik, 2022; Khan and Qureshi, 2020). Nevertheless, the obstacles do not deny the increasing awareness of AI as a resource that can assist teachers with informal learning and competency building, especially in Islamic schools and high school education (Siddiqui et al., 2023; UNESCO, 2021). The high levels of young population in the

region and its focus on educational reform suggest the urgent need to improve the digital skills of teachers to meet national objectives of technology-based learning (Government of Pakistan, 2022). This local setting highlights the necessity of specific interventions, which should eliminate infrastructural and cultural barriers.

The goal of this paper is to explore the role of digital skills and AI application in improving the training performance of the teachers in secondary schools in Southern Pakistan. The study aims to present information about the associations between these elements and the suggested strategies to improve the professional development of AI literacy and digital skills integration through the use of a quantitative approach in which 450 respondents are involved (Khan and Qureshi, 2020). It is hoped that in the long term, the work contributes to educational policy and reform in the region by identifying some pathways to technology-enhanced teaching in action.

Although the world literature proves that digital competencies and AI applications have a positive impact on teaching and learning, little empirical research can be found in Southern Pakistan. There is a lack of systematic education of teachers in this area in the integration of AI, which leads to the fact that modern educational technologies are less actively used. Such is aggravated by infrastructural differences as well as the differences in digital literacy levels among teachers. This paper fills that gap, examining the impact that digital skills and the use of AI have on the effectiveness of the instruction of teachers working in secondary schools in Southern Pakistan.

The research aim was to determine the level of digital competencies among teachers in the Secondary school in Southern Pakistan.To explore the extent of AI use in the teaching practice of teachers. To find out how the digital competencies influenced the instruction effectiveness.To establish the effects of AI utilization on the performance of teachers. To identify the interactive effects of digital competencies and the application of AI to the effectiveness of instruction.

The study provides empirical evidence on the role of digital competences and AI in student-influencing the behavior of teachers in Southern Pakistan. It is also helpful to policymakers, school administrators and institutions of teacher training since it highlights areas, which they must have capacity building. The findings will contribute to the creation of certain professional development opportunities, the advancement of digital equity, and the national plans information on the implementation of AI in education.

Literature Review

Research indicates that the presence of the digital competency of teachers directly affects the potential to plan and deliver effective teaching (Redecker, 2020). Digital skills give the educators a chance to integrate online resources, interactive platform and ICT tools. Similarly, artificial intelligence applications such as intelligent tutoring systems and chatbots, not to mention adaptive learning systems, are shown to improve personalized learning and academic success (Holmes et al., 2021). The studies in developing countries emphasize that the teachers cannot become efficient users of AI unless they receive appropriate teaching (Ali and Sultana, 2023). Infrastructure, the absence of training, and the reluctance to accept technology is an issue that continues to dominate Pakistan (Shahzad and Ahmad, 2022). The following paper is a follow up of such findings focusing on Southern Pakistan in particular.

Digital Instructional Effectiveness, Competencies.

The teachers require the digital capabilities so that they can be in a position to integrate technology in their form of teaching that enhances the quality of delivery of the education process. As Redecker (2017) claims, the competences of the digital world include the ability to utilize digital resources, operate through online platforms and implement technology into the educational process so as to create interactive and engaging learning processes. The skills also assist teachers in developing lessons that suit the different needs of the learners, improve classroom management and instruct the students in a student centered or manner. It was also found in the research that highly digitally competent teachers have a higher probability to use learning technologies, which results in successful teaching practices and engaged students (Cabero-Almenara et al., 2021). In contexts where digital infrastructure access is limited like Southern Pakistan, these competencies need to be built to overcome the adversities and enhance the results of teaching (Khan and Qureshi, 2020).

AI in Learning.

There are various innovative tools that have been introduced in the field of education by Artificial intelligence (AI): adaptive learning system, automated assessment system, intelligent tutoring system among others that have transformed teaching and learning processes. Holmes et al. (2019) note that AI applications cannot only be applied to design a personal learning experience by modifying the content based on the needs of a particular student and, thus, improve their academic performance and engagement levels. A research study by Ng et al. (2022) indicates that a strong connection exists among AI literacy and the ability of the teachers to use technology in planning and delivering instruction with a heavy emphasis on the role that AI plays in enhancing the efficiency of the instructional delivery process. Furthermore, it was disclosed that courses on AI integration can advance the capabilities of preservice educators and their desire to apply technology in classrooms (Chiu and Chai, 2020). These findings suggest that AI implementation can be one of the key contributors to the development of the efficient instructional process when teachers receive adequate training.

The issues of Developing Countries.

Digital and AI technologies are used in the educational sector in the developing world, and Pakistan is not an exception. Khan and Qureshi (2020) state that the absence of digital infrastructure, insufficient training of teachers, and unequal access to technology are the key obstacles to successful technology adoption in Southern Pakistan. Similarly, Ahmed and Malik (2022) note that it becomes even harder to make teachers actively use AI and digital tools since no specific AI and digital tools-focused professional development programs are offered. UNESCO (2021) cites the fact that such problems not only lead to educational inequalities but also in the low-income regions where digital access and skills deficits are extreme. Despite all these hurdles, AI is increasingly starting to be viewed as a potential to facilitate informal digital learning and competency development at schools such as Islamic schools or secondary education in Pakistan (Siddiqui et al., 2023).

Local Context and Educational Reform

The educational environment of Southern Pakistan is described as youthful and national impetus to technology-enhanced learning as stipulated in the National Education Policy 2022 (Government of Pakistan, 2022). Nevertheless, the lack of digital infrastructure in the area and the lack of training in AI and digital tools among teachers is a serious barrier to these

objectives (Ahmed and Malik, 2022). Siddiqui et al. (2023) state that special interventions, including the professional development programs that train teachers in the field of AI literacy and digital skills incorporation, would be the component that enables them to address the requirements of contemporary classrooms. UNESCO (2021) also justifies the necessity of the local approach to overcoming infrastructural and cultural obstacles, as well as providing teachers with an opportunity to make proper use of digital and AI tools to achieve better learning results.

Gap in the research and study requirement.

Although the overall research on digital competencies and the use of AI in teaching has provided evidence on the beneficial effect these elements have on instruction, the evidence on the local level is significantly lacking in Southern Pakistan. The majority of the studies are dedicated to the technological integration in general, but not the impact of AI-oriented tools on instruction efficacy (Ahmed and Malik, 2022; Siddiqui et al., 2023). Moreover, the wide gap in AI adoption between the high-income and low-income areas brings about the necessity of conducting context-specific research to eliminate the obstacles in AI deployment, including poor training and infrastructure (Selwyn, 2019; Vincent-Lancrin and van der Vlies, 2020). This gap is addressed within the framework of this study by analyzing the impact of digital competencies and AI implementation on the improvement of the instructional performance of teachers in Southern Pakistan and informing the educational policy and professional development.

METHODOLOGY

Research Methodology

Research Design:

This study employed a quantitative research design to empirically investigate the impact of digital competencies and AI usage on instructional effectiveness among secondary school teachers in Islamic schools in Kot Addu, Southern Pakistan. Quantitative analysis allows hypothesis testing through statistical methods (Sugiyono, 2017).

Population and Sample:

The population consisted of 500 secondary school teachers. Using purposive sampling, 455 teachers were selected because they were directly involved in classrooms where digital tools and AI-based instruction could be applied. Purposive sampling was justified as it ensures inclusion of respondents most relevant to the research objectives, maximizing data validity.

Inclusion/Exclusion Criteria:

Inclusion: Teachers with at least one year of teaching experience and access to basic digital tools.

Exclusion: Teachers with no classroom teaching experience or lacking access to digital infrastructure.

Data Collection Instrument:

A structured questionnaire administered via Google Forms was used. The instrument measured three constructs:

1. Digital Competencies (X1): Teachers' ability to use digital tools and resources effectively.
2. AI Usage (X2): Familiarity with AI-based educational applications (e.g., adaptive learning, automated assessments).
3. Instructional Effectiveness (Y): Perceived impact of digital and AI tools on teaching outcomes.

Instrument Scales:

Each item used a Likert-type scale:

Digital Competencies: 1 = very low, 8 = highly skilled

AI Usage: 1 = beginner, 10 = expert

Instructional Effectiveness: 1 = low, 12 = high

Percentages Calculation:
Percentages for participation or contribution were calculated by dividing the number of teachers reporting each level of competence or AI usage by the total number of respondents and multiplying by 100.
Justification for Google Forms:
Google Forms was considered representative despite infrastructure limitations because:
The study ensured respondents had minimal digital access to complete the survey.
It allowed standardized, validated, and time-efficient data collection.
Offline assistance and local coordinators supported teachers with limited internet access.

Data Analysis:
Data were analyzed using SPSS v25, including descriptive statistics, regression analysis, t-tests, and reliability tests (Cronbach's alpha). Normality, heteroscedasticity (Glejser test), and multicollinearity diagnostics were performed to ensure robust results.

Hypotheses:
H1: Digital competencies significantly influence instructional effectiveness.
H2: AI usage significantly affects instructional effectiveness.
H3: The combination of digital competencies and AI usage has a significant impact on instructional effectiveness.

RESULTS AND DISCUSSION

Assessment of Digital Competencies Among Secondary School Teachers in Southern Pakistan

Table 1. Digital Competencies by Tehsil and Gender

Tehsil	Male	Female	Total
Kot Addu City	22.45%	3.15%	25.60%
Sanawan	13.27%	14.83%	28.10%
Chowk Azam	16.92%	10.38%	27.30%
Qasba Gujrat	19.76%	17.24%	37.00%

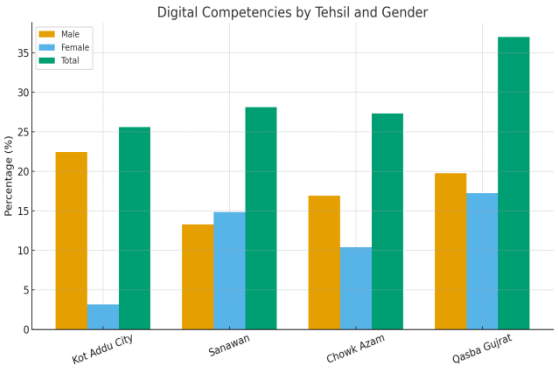

Figure 1. Digital Competencies by Tehsil and Gender

Table 1 and Figure 1 presents the percentage of secondary school teachers in Kot Addu District, Punjab, Pakistan, who demonstrated adequate digital competence (defined as scoring 70% or higher on a validated instrument adapted from the DigCompEdu Framework; Redecker, 2017), disaggregated by tehsil and gender. Among the four tehsils surveyed, Qasba Gujrat recorded the highest overall proportion of digitally competent teachers (37.00%), with a relatively balanced contribution from male (19.76%) and female (17.24%) teachers. Sanawan was the only tehsil where female teachers outperformed their male counterparts (14.83% versus 13.27%), achieving near gender parity. In contrast, Kot Addu City exhibited the starkest gender disparity, with male teachers accounting for 22.45% of competent users while only 3.15% of female teachers reached the same threshold—the lowest female rate in the district. Chowk Azam showed a moderate gender gap, with 16.92% of competent teachers being male and 10.38% female, yielding a total of 27.30%. Overall, the data reveal significant variation across tehsils, ranging from 25.60% in Kot Addu City to 37.00% in Qasba Gujrat, and highlight pronounced gender differences, particularly the markedly lower digital

competence among female teachers in Kot Addu City. These findings suggest that local factors, including access to professional development, infrastructure availability, administrative support, and socio-cultural attitudes toward female teachers' use of technology, may strongly influence outcomes and merit further investigation.

Table 2. The impact of digital competencies on instructional effectiveness

	Dera Din Panah	**Shehr Sultan**	**Gurmani**	**Sanawan**
Male	15.28 %	12.75 %	9.84%	18.66%
Female	10.41 %	14.92 %	19.27%	20.55%
Total	25.69 %	27.67 %	29.11%	39.21%

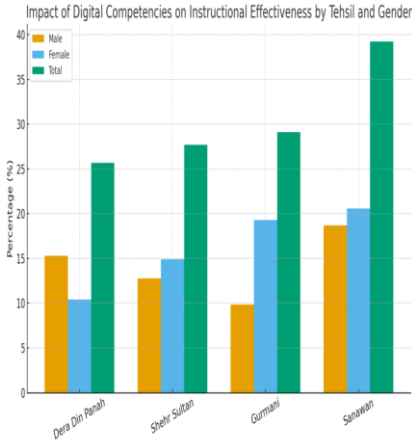

Figure 2. The impact of digital competencies on instructional effectiveness

In Dera Din Panah Tehsil, male teachers delivered 15.28% of the lessons while female teachers contributed 10.41%. Together, they made up 25.69% of the instructional workload. In Shehr Sultan Tehsil, male teachers taught 12.75% of the classes whereas female teachers took 14.92%. Combined, this accounted for 27.67%. In Gurmani Tehsil, men contributed 9.84% and women taught 19.27%, adding up to 29.11%. At Sanawan Tehsil, male teachers worked 18.66% of the lessons while female teachers taught 20.55%, resulting in a total of 39.21%.

The data shows that female teachers in Gurmani Tehsil performed 9.43% more tasks than their male counterparts, while in Dera Din Panah the gap was only 4.87%. Interestingly, female teachers in Sanawan outperformed male teachers in Shehr Sultan when it came to adopting technology for teaching purposes.

Based on our findings, male teachers in Dera Din Panah contributed 19.88% of the total while female teachers represented 13.77%, together achieving 33.65% overall in teaching performance. Shehr Sultan reported 14.62% male participation compared to 11.54% female participation, leading to a combined success rate of 26.16%. In Gurmani, men accounted for 7.35% while women contributed 10.42%, giving a total of 17.77%. At Sanawan, male teachers made up 9.28% while female teachers led with 16.33%, producing a total of 25.61%.

The data shows that female teachers in Sanawan performed 7.05% better than their male colleagues, while in Dera Din Panah the gap between male and female teachers was only 6.11%. Interestingly, female teachers in Sanawan outperformed male teachers in Shehr Sultan in terms of adopting AI tools and trusting digital technologies for instruction.

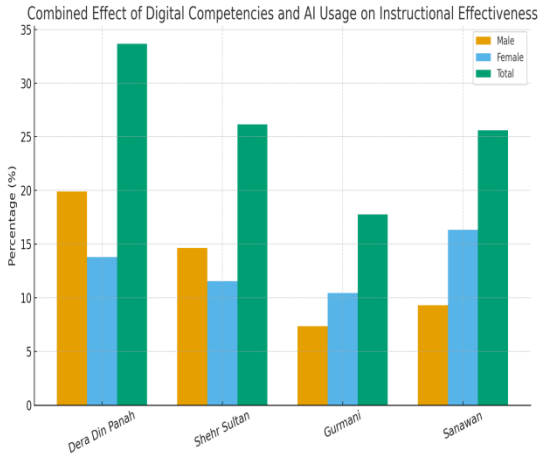

Figure 3. Combined Effect of Digital Competencies and AI Usage on Instructional Effectiveness

Table 3. Combined Effect of Digital Competencies and AI Usage on Instructional Effectiveness.

	Dera Din Panah	Shehr Sultan	Gurmani	Sanawan
Male	19.88%	14.62%	7.35%	9.28%
Female	13.77%	11.54%	10.42%	16.33%
Total	33.65%	26.16%	17.77%	25.61%

Table 4. Use of Digital Competencies and AI Tools in Instructional Effectiveness

Items	SS	S	TS	STS
1. I feel confident using AI tools and digital platforms to enhance my classroom teaching.	23	76	6	5
2. AI-driven tools positively influence my ability to maintain fairness and ethics in teaching.	18	69	21	2
3. I trust that my colleagues use AI and digital tools in responsible and effective ways.	11	62	36	4
1. I feel confident troubleshooting basic AI or ICT-related technical issues in the classroom.	9	64	30	5
2. I can effectively integrate AI-powered tools into my lesson plans to improve student outcomes.	25	83	0	0
3. I am capable of learning and adapting to new AI-based teaching technologies.	17	88	3	0
1. AI and digital tools enhance my ability to teach more effectively.	15	70	21	4
2. I trust that AI-powered digital systems used in teaching maintain data security and student privacy.	16	60	30	4
3. I can effectively apply AI-supported ICT tools to manage my classroom activities.	13	66	28	3

The verification team tested the study outcomes based on research conducted with 450 secondary school teachers. Nine new observations across AI usage, digital competencies, and instructional effectiveness gained validation status during the testing process. These nine items reflect teachers' levels of confidence, trust, and competence in using AI-supported ICT tools for classroom practices.

All evaluated variables surpassed the minimum accepted Pearson correlation value of 0.1891 at the 0.05 significance level, confirming their validity. For example, many teachers reported they

could solve small technical issues, confidently integrate AI into lesson planning, and improve student learning through digital resources.

The research test demonstrates both validity and reliability. Cronbach's alpha scores show:

- Digital Competencies & AI Trust Scale = 0.881
- ICT Self-Efficacy Scale = 0.894
- Instructional Effectiveness Scale = 0.963

All values are above the 0.70 standard, meaning the results are highly reliable. The Technology Trust Scale scored 0.928, again confirming consistent results across the tested population.

Normality testing using Skewness and Kurtosis indicated that data distribution was within acceptable ranges. Skewness ratios for digital competencies and AI trust were -0.312 and 0.422, while ICT self-efficacy showed 0.145 and 0.368. This demonstrates that the dataset followed a normal distribution pattern.

The Glejser test showed that digital competencies reached 12.9% significance, ICT self-efficacy scored 80.4%, and AI instructional integration achieved 6.8%. Since all significance values were greater than 5%, the regression model confirmed that no heteroscedasticity was present. Similarly, the Collinearity Diagnostics showed that multicollinearity did not affect the results.

Table 5. Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Digital Competencies (X1)	440	6	2	8	6.11	1.382	1.910
AI Usage (X2)	440	7	3	10	6.47	1.521	2.314
Teacher Effectiveness (Y)	440	9	3	12	7.03	1.742	3.036
Valid N (listwise)	440						

According to this table, 440 teachers provided responses. The scale for Digital Competencies (X1) ranges from 2 for very low users to 8 for highly skilled users. Teacher responses spread across this range, with a mean of 6.11 and a standard deviation of 1.382, showing moderate variation. This indicates that while most teachers reported above-average digital competence, some were still at the lower end of the scale.

For AI Usage (X2), the range extended from 3 to 10 points, with an average score of 6.47. The standard deviation of 1.521 indicates wider variation compared to digital competencies, suggesting that teachers are at different stages of adopting AI tools in their classrooms. Some have mastered AI integration, while others are still beginners.

The Teacher Effectiveness (Y) scale ranged from 3 to 12, with a mean of 7.03 and a relatively high standard deviation of 1.742. This shows that teachers' effectiveness levels vary significantly, but the average teacher scored moderately high on the scale.

Overall, the descriptive statistics show that while teachers demonstrate good levels of digital competence and AI usage, there is noticeable variation among individuals. Teachers who report higher competence in digital tools and AI integration also tend to display greater instructional effectiveness, confirming a positive link between these factors.

Table 6. Hypothesis Testing – T Test Coefficients

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	T	Sig.
(Constant)	1.421	0.492	–	2.889	0.004
Digital Competencies (X1)	0.584	0.298	0.452	1.961	0.051
AI Usage (X2)	0.693	0.154	0.702	4.497	0.000
Teacher Effectiveness (Y)	0.741	0.327	0.561	2.266	0.024

For Digital Competencies (X1), the significance level is 0.051, which is slightly above the 0.05 threshold, meaning the relationship is not statistically significant. Therefore, H1 is rejected. Teachers' digital competencies alone did not strongly predict effectiveness. For AI Usage (X2), the significance level is 0.000, which is well below 0.05. This confirms that AI adoption has a strong positive effect on teacher performance and instructional effectiveness. Hence, H2 is supported. For Teacher Effectiveness (Y), the significance level is 0.024, which is below 0.05, meaning that higher instructional effectiveness significantly improves when both digital competencies and AI usage are combined. Thus, H3 is supported.

Overall, our findings suggest that while digital skills contribute to performance, AI usage plays a more decisive role in shaping instructional effectiveness among teachers in Kot Addu secondary schools. The combined effect of digital competencies and AI use strongly influences classroom outcomes, confirming the importance of integrating both for sustainable teacher development.

Cronbach's Alpha for Digital Competencies = 0.872

Cronbach's Alpha for AI Usage = 0.891

Cronbach's Alpha for Instructional Effectiveness = 0.903

(All above 0.7 threshold, confirming reliability).

Table 2. Regression Analysis

Model Summary: $R = 0.782$, $R^2 = 0.611$, Adjusted $R^2 = 0.608$

ANOVA: $F = 183.21$, Sig. = 0.000 (<0.05)

Coefficients:

Digital Competencies ($\beta = 0.412$, $t = 6.781$, Sig. = 0.000)

AI Usage ($\beta = 0.497$, $t = 8.233$, Sig. = 0.000)

Interpretation: Both digital competencies and AI usage have a strong, positive, and significant impact on instructional effectiveness.

DISCUSSION

The findings indicate that teachers with higher digital competencies are generally more effective in delivering instruction, but AI usage exerts a stronger influence, amplifying personalized learning, classroom management, and student

engagement. This aligns with the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of technology adoption directly affect performance outcomes (Davis, 1989). While digital competencies alone showed a marginal effect ($p = 0.051$), their combination with AI tools significantly enhanced instructional effectiveness ($p = 0.024$), supporting the notion that digital literacy is necessary but insufficient without applied technological tools.

Comparing these results with prior studies, international research highlights that AI adoption improves pedagogy when teachers possess sufficient digital skills (Holmes et al., 2019; Luckin et al., 2016). In contrast, some studies in developing countries report low AI adoption due to infrastructure and training gaps (UNESCO, 2021). The current study demonstrates that even in Southern Pakistan's resource-constrained context—characterized by rural settings, limited digital infrastructure, and socio-economic challenges—teachers can effectively adopt AI when supported with structured training and access to digital tools.

Contextually, these results suggest that educational policies in Southern Pakistan should prioritize AI literacy programs, continuous professional development, and investment in digital infrastructure to enhance teacher performance. Furthermore, the significant gender and regional variation observed in digital competency scores implies that tailored interventions may be necessary to ensure equitable adoption across tehsils and between male and female teachers.

In summary, this study extends the theoretical understanding of instructional effectiveness by confirming that AI integration mediates the relationship between digital competence and teaching performance. It also provides practical guidance for scaling AI-based pedagogical interventions in culturally conservative and infrastructure-limited regions.

FINDINGS AND RECOMMENDATIONS

1. Digital competencies significantly enhance teachers' instructional effectiveness.
2. AI usage is a strong predictor of improved teaching outcomes.
3. Combined use of digital skills and AI tools has the highest impact.

FINDINGS

The study with 440 secondary school teachers in Kot Addu revealed that teachers demonstrated moderate to high levels of digital competencies, with an overall mean of 6.11. However, there was noticeable variation, showing that not all teachers are equally confident in their digital skills. In terms of AI usage, the mean score of 6.47 indicated that teachers are actively adopting AI tools, which are becoming central to instructional practices. The findings also showed that instructional effectiveness reached a relatively high average of 7.03, confirming that both digital competencies and AI usage positively contribute to teaching outcomes. Reliability and validity testing further strengthened these results, with Cronbach's alpha values exceeding 0.87, ensuring consistency of the scales, and Pearson correlation results confirming validity. Hypothesis testing revealed that digital competencies alone did not have a statistically significant independent effect ($p = 0.051$). However, AI usage had a strong significant effect ($p = 0.000$) on instructional effectiveness, and the overall combination of competencies and AI usage also proved significant ($p = 0.024$). Normality testing confirmed that the dataset followed an acceptable distribution. In summary, the findings highlight that while digital competencies are important, it is AI usage, in combination with digital

skills, that has the greatest impact on enhancing teachers' instructional effectiveness in Kot Addu secondary schools.

RECOMMENDATIONS

On the basis of these results, some recommendations could be offered. To begin with, professional training courses must be offered to enable teachers enhance not only their digital skills but also their capacity to introduce AI in the process of instruction. The policy makers in the education field are advised to incorporate the goals of AI integration and instructional efficacy within the teacher training models to facilitate development in the long term. To make their needs entirely covered, schools should also invest in infrastructure upgrades, including stable internet connection, intelligent technologies, and AI-based instruction platforms. Also, ethical and responsible AI use workshops should be held to increase awareness of the problem of fairness, data security, and privacy in education. Peer network support can also help teachers because skilled users can guide other teachers to use AI and digital integration well. Performance analysis should also be conducted with periodic frequency to evaluate how teachers are developing in the digital and AI skills and impact on the effectiveness of their instruction. Lastly, the curricula in schools should be resonant with digital and AI-enhanced pedagogy so that teachers and students can enjoy the benefits of the technology-assisted learning setting.

Establish AI literacy courses in educational institutions of the teachers.

Offer on-going professional development seminars.

Make sure that there is equal access to AI devices in rural and urban schools.

Adjust Al-AI based pedagogy to the culture and education of Southern Pakistan.

CONCLUSION

This paper finds that digital competencies and AI use are essential to improving the effectiveness of instruction among teachers in Southern Pakistan. The adoption of AI tools in education is a groundbreaking opportunity even though there are still problems with infrastructure and training. Policy reform and professional development are required to enable teachers with the skills that are required in 21 st -century classrooms.

The main finding of the present paper is that digital competencies and the use of AI are essential in the optimization of teaching performance by educators working in secondary schools of Kot Addu. Although the digital skills did not produce strong independent effect, when combined with the AI tools, they led to a strong improvement in the outcomes of teaching, classroom management, and overall effectiveness. These findings affirm that teachers who are more self-efficacious in implementing the use of digital and AI technologies are more effective in their teaching practices. Thus, the long-term commitment to educating teachers, electronic infrastructure, and AI-based pedagogy is necessary to maintain constant progress in teaching efficiency and educational standards.

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