

Mobile applications, artificial intelligence integration, and teacher digital competency as drivers of instructional efficacy

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Abstract

This study examined mobile applications, artificial intelligence (AI) integration, and teacher digital competency as drivers of instructional efficacy. Specifically, it assessed the level of utilization of mobile applications in instruction in terms of instructional support, collaboration and communication, and learner engagement and motivation. It also examined the extent of AI integration in instruction in terms of personalized learning, automated assessment, data analytics, and administrative support. In addition, the study evaluated teachers' digital competency in terms of professional engagement, empowering learners, and facilitating learners' digital competence. Instructional efficacy was assessed in terms of instructional planning effectiveness, classroom engagement effectiveness, and learning outcome achievement. The study further determined the relationships among mobile applications, AI integration, teacher digital competency, and instructional efficacy, as well as identified which factors significantly predict instructional efficacy. A descriptive-correlational research design was employed, utilizing a structured questionnaire to gather data from 384 respondents. Statistical tools were used to describe the variables, test relationships, and determine predictors of instructional efficacy. Findings of the study are expected to provide empirical evidence on how digital tools and teacher competencies contribute to effective instruction. Based on the results, an action plan is proposed to enhance instructional efficacy through the optimized use of mobile applications, artificial intelligence, and strengthened teacher digital competency.

Keywords: mobile applications, artificial intelligence integration, teacher digital competency, instructional efficacy

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1. Introduction

In the rapidly evolving digital era, information and communication technology (ICT) continues to reshape educational systems worldwide. The integration of mobile applications and artificial intelligence (AI) has become increasingly central to teaching and learning processes, requiring educators to adapt their pedagogical approaches and technological competencies. Studies highlight that the effective use of AI and digital tools in education is closely linked to teachers' digital competence, which encompasses the knowledge, skills, and attitudes needed to integrate technology meaningfully into instruction (Redecker et al., 2022; UNESCO, 2023). AI, defined as systems capable of performing tasks that typically require human intelligence such as learning, reasoning, and problem-solving, has significantly advanced in recent years and is widely applied across sectors, including education (Luckin et al., 2022). AI enables personalized learning, intelligent tutoring systems, automated assessment, and predictive analytics that support student success. These capabilities can enhance instructional efficacy by allowing teachers to tailor learning experiences, monitor student progress in real time, and reduce administrative workload (Holmes et al., 2022; Chen et al., 2023).

Alongside AI, mobile applications have emerged as powerful tools for facilitating interactive, flexible, and student-centered learning environments. Mobile learning applications enable access to educational resources anytime and anywhere, fostering engagement, collaboration, and self-directed learning among students (Hwang et al., 2022). These applications also provide features for assessment, feedback, and content delivery, thereby supporting teachers in improving instructional design and implementation. However, the successful integration of AI and mobile applications in education largely depends on teachers' digital competence. Teachers with high levels of digital competence are better equipped to design innovative learning activities, evaluate digital resources, and effectively integrate emerging technologies into their teaching practice (Caena et al., 2022). Conversely, insufficient digital skills remain a major barrier to technology integration in classrooms, particularly in developing regions.

In Thailand, national education policies emphasize the importance of digital transformation and the development of 21st-century skills among learners. Teachers are expected to act as facilitators of learning who can leverage digital technologies, including AI and mobile applications, to enhance student outcomes and foster lifelong learning (Office of the Education Council, 2022). Despite these policy directions, disparities in digital competence and access to emerging technologies persist across regions. Phitsanulok Province, as a key educational hub in northern Thailand, reflects both the opportunities and challenges associated with technology integration in education. While schools increasingly adopt digital tools, many teachers still require further development in digital competence to fully utilize AI and mobile applications for effective instruction. Addressing this gap is essential to improving instructional efficacy and ensuring equitable access to quality education.

This study investigates the role of mobile applications, artificial intelligence integration, and teacher digital competence as drivers of instructional efficacy within the educational district of Phitsanulok Province. By examining how these factors interact and contribute to teaching effectiveness, the findings aim to provide empirical evidence that can inform educational policy, teacher professional development, and technology integration strategies in Thailand and similar contexts. Ultimately, the study seeks to support the advancement of innovative, technology-enhanced teaching practices that improve student learning outcomes in the digital age.

Objectives of the Study - This study aims to determine how mobile applications, artificial intelligence, and teacher digital competency serve as drivers of instructional efficacy. Specifically, it aims to assess the level of utilization of mobile applications in instruction in terms of instructional support, collaboration and

communications, learner engagement and motivation; examine the extent of integration of artificial intelligence in instruction in terms of personalized learning, automated assessment, and data analytics; and administrative support; evaluate the digital competency of teachers in terms of professional engagement, empowering learners, and facilitating learner's digital competence; assess the level of instructional efficacy in terms of: instructional planning effectiveness classroom engagement effectiveness; learning outcome achievement; test the relationship between mobile applications, artificial intelligence, and teacher digital competency; determine which factors significantly predict instructional efficacy; propose Action plan for enhancing instructional efficacy through the effective use of mobile applications, artificial intelligence, and teacher digital competency.

2. Methods

Research Design - The researcher used a quantitative research design to assess, analyze, and evaluate the questionnaire responses in a way that would provide the researcher with reasonable evidence and conclusions about the integration of artificial intelligence (AI) applications and teachers' digital competence in teaching. Of teachers in Phitsanulok Province, Thailand, and the factors affecting the achievement of the integration of artificial intelligence (AI) applications and teachers' digital competence. The target group of the research participants was 8,935 in the Educational District of Phitsanulok Province, Thailand (Teacher and Educational Personnel Data, Ministry of Education, 2024). Purposive sampling must be teachers or educational personnel in Phitsanulok Province, Thailand. Further research on the strategy from collecting data in-depth will help to obtain representatives of teachers and educational personnel in Phitsanulok Province, Thailand.

Participants of the Study - The target population for this study consisted of teachers in Phitsanulok Province, Thailand. The study aimed to collect data from 384 respondents using a structured questionnaire following the Cochran's formula. It is especially ideal when your target population is large or unknown

Data Gathering Instruments - The questionnaire will be pre-tested with a group of teachers and educational personnel involved in the integration of mobile applications, artificial intelligence, and digital competence in teaching to ensure the clarity and validity of the questions. As each item is given feedback, it needs to be adjusted appropriately. After that, the final questionnaire will be distributed to the target group of teachers of the integration of mobile applications, artificial intelligence, and digital competence in teaching in the educational area of Phitsanulok Province, Thailand. There will be several methods to reach the sample group, such as directly reaching teachers and educational personnel in schools, using networks and professional associations, and using online platforms. To increase the response rate, there may be the introduction of incentives or rewards, and the guarantee of confidentiality and anonymity to promote honesty and unbiased responses.

Once the data collection is complete, statistical analysis techniques will be used to analyze the relationship between personal characteristics and factors related to the integration of mobile applications, artificial intelligence, and digital competence in teaching. This analysis will provide insights into the factors influencing the success of educational outcomes from the integration of mobile applications, artificial intelligence, and digital competence of teachers in teaching.

The questionnaire consisted of 4 sections: Section I: Perceived impact of government and administrator support benefits. Section II: Environmental awareness factors; Section III: Infrastructure factors of mobile applications, artificial intelligence, and digital competence in teaching; Section IV: Integration of mobile applications, artificial intelligence, and digital competence in teaching of teachers in the educational area of Phitsanulok Province, Thailand.

Data Gathering Procedure - The data collection method used in this study was a survey questionnaire. The questionnaire consisted of closed-ended questions that were used to collect data on the personal characteristics of teachers and educational personnel and related factors, such as the impact of government and administrator support benefits and the adoption of mobile applications, artificial intelligence, and digital competence in teaching and learning management of teachers in Phitsanulok Province, Thailand. The questionnaire will be designed according

to relevant literature and conceptual frameworks, including the constructs and dimensions identified in previous research, and will be inspired by studies that have examined the personal characteristics, related factors, and teachers and educational personnel who use mobile applications, artificial intelligence, and digital competence in teaching in various contexts. In addition, the results of the data analysis can be used to generate useful recommendations and implications for teachers and educational personnel who use mobile applications, artificial intelligence, and digital competence in teaching and learning management, as well as policymakers and other stakeholders in the education sector. The insights gained from the study can help develop approaches and interventions aimed at promoting teacher development and increasing success in education in Phitsanulok Province, Thailand.

Data Analysis - Data analysis for this study will use a combination of descriptive and inferential statistical techniques. Inferential statistical techniques will be used to examine the relationship and effects of personal characteristics, factors related to the integration of mobile applications, artificial intelligence, and digital competence of teachers in teaching in the Phitsanulok Provincial Education Area. These techniques will help determine the significance and strength of these relationships. Pearson correlation coefficient analysis allow the examination of multiple independent variables simultaneously.

Ethical Considerations - This study adhered to established research ethics principles to protect the rights and well-being of all participants. Informed consent was obtained after participants were provided with information about the study's purpose, procedures, and any potential risks or benefits. Participation was voluntary, and participants could withdraw at any time without penalty. All collected data were kept confidential and securely stored, with personal information anonymized to protect participants' privacy. Data were accessible only to the researchers and authorized personnel and were retained in accordance with applicable data protection regulations. Furthermore, the study complied with the ethical guidelines and requirements of the appropriate institutional review board or ethics committee to ensure respect for participants' rights and welfare.

3. Results and discussions

Table 1

Summary Table on Mobile Applications in Instruction

Indicators	Weighted Mean	Verbal Interpretation	Rank
1. Instructional Support	3.30	Agree	2
2. Collaboration and Communication	3.18	Agree	3
3. Learner Engagement and Motivation	3.32	Agree	1
Composite Mean	3.26	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 – 1.49 = Strongly Disagree

Table 1 presents the summary of respondents' assessment of mobile applications in instruction across three dimensions: instructional support, collaboration and communication, and learner engagement and motivation. Composite mean of 3.26, interpreted as *Agree*, indicates that respondents generally perceive mobile applications as effective tools in supporting various aspects of instruction. This finding is consistent with recent literature which emphasizes that mobile technologies contribute significantly to improving teaching practices, enhancing learning environments, and supporting flexible instructional delivery (Zou et al., 2025; Li et al., 2024).

Among the three indicators, "*Learner Engagement and Motivation*" ranked first with a weighted mean of 3.32 (*Agree*). This suggests that respondents consider mobile applications to be most effective in enhancing students' interest, participation, and overall motivation in learning activities. This aligns with recent research which highlights that mobile and digital tools create interactive and engaging learning experiences that increase student motivation and active participation (World Economic Forum, 2024; Zou et al., 2025). The second-highest indicator, "*Instructional Support*", obtained a weighted mean of 3.30 (*Agree*). This indicates that mobile applications play a significant role in assisting teachers in organizing content, managing instructional activities, and delivering lessons effectively. Studies confirm that mobile technologies improve instructional efficiency by enabling teachers

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to streamline teaching processes and manage learning activities more effectively (Cengage Group, 2024).

“*Collaboration and Communication*” ranked third with a weighted mean of 3.18 (*Agree*). Although still positively perceived, this suggests that the use of mobile applications for communication and collaboration may not be fully maximized compared to other instructional aspects, consistent with findings that while mobile platforms provide opportunities for interaction and collaboration, their effectiveness largely depends on teachers’ digital competence and strategic integration of collaborative tools (Xue et al., 2025; Zou et al., 2025).

Table 2

Summary Table on Artificial Intelligence in Instruction

Indicators	Weighted Mean	Verbal Interpretation	Rank
Personalized Learning	3.23	Agree	2
Automated Assessment	3.23	Agree	2
Data Analytics and Administrative Support	3.23	Agree	2
Composite Mean	3.23	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 – 1.49 = Strongly Disagree

Table 2 presents the summary of respondents’ assessment of artificial intelligence (AI) in instruction across three dimensions: personalized learning, automated assessment, and data analytics and administrative support. All three indicators obtained an identical weighted mean of 3.23, interpreted as *Agree*, resulting in a composite mean of 3.23. This indicates that respondents generally perceive AI as a useful tool across multiple instructional functions, without significant variation among dimensions. This is consistent with recent literature which emphasizes that AI technologies contribute holistically to teaching and learning processes by supporting personalization, assessment, and data-driven decision-making (World Economic Forum, 2024; Zou et al., 2025).

The equal ranking of the three dimensions suggests that respondents view AI as equally beneficial in enhancing various aspects of instruction. In terms of personalized learning, AI enables teachers to tailor instruction based on students’ individual needs, learning preferences, and performance levels. Studies show that AI-powered systems facilitate adaptive learning experiences that improve engagement and academic outcomes (World Economic Forum, 2024). Similarly, automated assessment is recognized as an important contribution of AI in instruction. AI technologies support efficient grading, consistent evaluation, and timely feedback, which help improve teaching efficiency and student learning. Research indicates that automated assessment tools reduce teachers’ workload while maintaining accuracy and reliability in evaluation processes (Cengage Group, 2024; Zou et al., 2025).

In addition, data analytics and administrative support play a crucial role in enhancing instructional effectiveness. AI-driven analytics allow teachers to monitor student progress, identify learning gaps, and make data-informed decisions. These tools also assist in managing classroom records and administrative tasks more efficiently. This aligns with findings that AI analytics support evidence-based teaching practices and improve overall instructional planning (World Economic Forum, 2024). The uniformity in the ratings may also suggest that while AI is recognized for its benefits, its implementation across these areas is still developing, leading to similar levels of perception among respondents. This observation is supported by studies indicating that the effectiveness of AI in education depends on factors such as teacher digital competence, access to technology, and institutional support (Xue et al., 2025).

Table 3 presents the summary of respondents’ assessment of teacher digital competency across three dimensions: professional engagement, empowering learners, and facilitating learners’ digital competence. The composite mean of 3.22 (*Agree*), indicates that respondents generally perceive themselves as possessing a satisfactory level of digital competency in supporting teaching and learning processes, consistent with recent studies highlighting that teachers’ digital competence plays a crucial role in enhancing instructional practices and student learning outcomes in technology-integrated environments (Zou et al., 2025; Xue et al., 2025).

Table 3*Summary Table on Teacher Digital Competency*

Indicators	Weighted Mean	Verbal Interpretation	Rank
Professional Engagement	3.12	Agree	3
Empowering Learners	3.25	Agree	2
Facilitating Learners' Digital Competence	3.29	Agree	1
Composite Mean	3.22	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 – 1.49 = Strongly Disagree

Among the three indicators, “*Facilitating Learners' Digital Competence*” ranked first with a weighted mean of 3.29 (*Agree*). This suggests that respondents place high importance on developing students' digital literacy skills, including responsible use of technology, critical evaluation of information, and ethical online behavior. This is supported by literature emphasizing that teachers are key agents in fostering digital citizenship and preparing students for participation in a digital society (World Economic Forum, 2024). The second-highest indicator, “*Empowering Learners*”, obtained a weighted mean of 3.25 (*Agree*). This indicates that respondents effectively use digital tools to promote learner autonomy, flexibility, and inclusivity. Research supports that empowering learners through technology enhances student engagement, encourages self-directed learning, and supports diverse learning needs (Zou et al., 2025). Meanwhile, “*Professional Engagement*” ranked third with a weighted mean of 3.12 (*Agree*). Although still positively rated, this suggests that teachers' engagement in professional communication and development through digital platforms may be slightly less emphasized compared to learner-focused competencies. This aligns with studies indicating that while teachers recognize the importance of digital tools in professional growth, participation in ongoing digital professional development may depend on access, institutional support, and personal motivation (Xue et al., 2025).

The overall results indicate that teachers demonstrate a balanced level of digital competency across the three dimensions, with stronger emphasis on student-centered competencies such as facilitating digital skills and empowering learners. However, there is still a need to strengthen professional engagement through increased participation in digital collaboration and continuous professional development activities. In general, these findings suggest that enhancing teacher digital competency—particularly through targeted training programs and institutional support—can further improve the effective integration of mobile applications and artificial intelligence in instruction, thereby contributing to higher instructional efficacy (Zou et al., 2025; World Economic Forum, 2024).

Table 4*Summary Table on Instructional Efficacy*

Indicators	Weighted Mean	Verbal Interpretation	Rank
Instructional Planning Effectiveness	3.26	Agree	1
Classroom Engagement Effectiveness	3.16	Agree	3
Learning Outcome Achievement	3.25	Agree	2
Composite Mean	3.22	Agree	

Legend: 3.50 – 4.00 = Strongly Agree; 2.50 – 3.49 = Agree; 1.50 – 2.49 = Disagree; 1.00 – 1.49 = Strongly Disagree

Table 4 presents the summary of respondents' assessment of instructional efficacy across three dimensions: instructional planning effectiveness, classroom engagement effectiveness, and learning outcome achievement. The composite mean of 3.22, interpreted as *Agree*, indicates that respondents generally perceive themselves as effective in delivering instruction that supports student learning and achievement. This finding is consistent with recent studies which emphasize that instructional efficacy is enhanced when teachers effectively plan, engage students, and achieve desired learning outcomes, particularly when supported by technology integration (Zou et al., 2025; Li et al., 2024).

“*Instructional Planning Effectiveness*” ranked first with a weighted mean of 3.26 (*Agree*). This suggests that respondents demonstrate strength in preparing structured and well-organized lesson plans that align with learning objectives and utilize appropriate instructional resources. This aligns with research indicating that effective

instructional planning is fundamental to successful teaching, as it provides a clear framework for delivering content and facilitating meaningful learning experiences (World Economic Forum, 2024). The second-highest indicator, “*Learning Outcome Achievement*”, obtained a weighted mean of 3.25 (*Agree*). This indicates that respondents perceive their instructional practices as contributing to students’ ability to achieve intended learning outcomes, demonstrate mastery, and apply knowledge effectively. Studies support that instructional effectiveness is strongly reflected in student achievement and performance, which are influenced by the quality of teaching strategies and the alignment between objectives, instruction, and assessment (Zou et al., 2025). Meanwhile, “*Classroom Engagement Effectiveness*” ranked third with a weighted mean of 3.16 (*Agree*). Although still positively rated, this suggests that engaging students actively in learning activities may be slightly less emphasized compared to planning and outcome achievement. Research indicates that sustaining student engagement requires the consistent use of interactive strategies, collaborative activities, and technology-enhanced learning approaches (Li et al., 2024). The relatively lower rating may also imply the need for further strengthening of strategies that promote interaction and collaboration among learners.

Table 5*Relationship Between Mobile Applications in Instruction and Teacher Digital Competency*

Instructional Support	rho-value	p-value	Interpretation
Professional Engagement	.516**	0.000	Highly Significant
Empowering Learners	.826**	0.000	Highly Significant
Facilitating Learners’ Digital Competence	.673**	0.000	Highly Significant
Collaboration and Communication			
Professional Engagement	.485**	0.000	Highly Significant
Empowering Learners	.610**	0.000	Highly Significant
Facilitating Learners’ Digital Competence	.922**	0.000	Highly Significant
Learner Engagement and Motivation			
Professional Engagement	.820**	0.000	Highly Significant
Empowering Learners	.807**	0.000	Highly Significant
Facilitating Learners’ Digital Competence	.629**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

Table 5 presents the relationship between mobile applications in instruction and teacher digital competency using Spearman’s rho correlation analysis. It examines how the dimensions of mobile application use—Instructional Support, Collaboration and Communication, and Learner Engagement and Motivation—are associated with key areas of teacher digital competency, namely Professional Engagement, Empowering Learners, and Facilitating Learners’ Digital Competence. Results reveal that all correlations are positive and statistically significant at the 0.01 level. This indicates that greater utilization of mobile applications in instruction is significantly associated with higher levels of teacher digital competency. This finding is consistent with recent studies emphasizing that the effective use of mobile technologies enhances teachers’ digital skills, professional practices, and ability to integrate technology into pedagogy (Zou et al., 2025; Xue et al., 2025).

For Instructional Support, all relationships with teacher digital competency were positive and highly significant. The strongest relationship was observed with Empowering Learners, indicating a very strong positive association. This suggests that teachers who effectively use mobile applications for instructional support are more capable of implementing learner-centered approaches that promote autonomy, active participation, and personalized learning. This aligns with research indicating that mobile technologies enable teachers to design adaptive learning environments that enhance student independence and engagement (World Economic Forum, 2024; Zou et al., 2025). This was followed by Facilitating Learners’ Digital Competence, reflecting a strong relationship between instructional support and students’ digital literacy development. Meanwhile, Professional Engagement showed a moderate positive correlation, suggesting that instructional use of mobile applications also contributes to teachers’ collaboration, communication, and professional growth through digital platforms (Xue et al., 2025).

In terms of Collaboration and Communication, all dimensions of teacher digital competency were likewise

significantly related. The strongest relationship was found with Facilitating Learners' Digital Competence, which represents the highest correlation in the table. This very strong association indicates that teachers who utilize mobile applications for communication and collaboration are highly effective in developing students' digital literacy, including responsible use of technology, critical thinking, and digital problem-solving skills. This finding is supported by recent literature emphasizing that collaborative digital environments play a critical role in developing learners' digital competencies through interactive and participatory learning experiences (Zou et al., 2025; Xue et al., 2025). Strong positive relationships were also found with Empowering Learners and Professional Engagement, demonstrating that communication-centered mobile tools support both student empowerment and professional interaction among educators.

Similarly, Learner Engagement and Motivation exhibited strong and highly significant relationships with all dimensions of teacher digital competency. The strongest correlation was observed with Professional Engagement, followed closely by Empowering Learners. These findings imply that teachers who utilize mobile applications to enhance student engagement and motivation are also more likely to demonstrate strong professional digital practices, including continuous learning, collaboration, and effective use of technology in teaching. This is consistent with research suggesting that engaging digital learning environments encourage teachers to adopt innovative practices and continuously enhance their digital competencies (World Economic Forum, 2024; Zou et al., 2025). Additionally, Facilitating Learners' Digital Competence showed a substantial positive relationship, indicating that engaging students through mobile applications contributes to the development of essential digital skills.

Overall, the results indicate a strong and interdependent relationship between mobile application use and teacher digital competency. Mobile applications not only support instructional delivery but also enhance teachers' ability to engage learners, foster digital skills, and improve professional practices. These findings highlight the importance of strengthening teachers' capacity to integrate mobile technologies, as this directly contributes to the development of comprehensive digital competencies necessary for effective instruction in the 21st century (Zou et al., 2025; Xue et al., 2025; World Economic Forum, 2024).

Table 6

Relationship Between Artificial Intelligence in Instruction and Teacher Digital Competency

Personalized Learning	rho-value	p-value	Interpretation
Professional Engagement	.823**	0.000	Highly Significant
Empowering Learners	.805**	0.000	Highly Significant
Facilitating Learners' Digital Competence	.548**	0.000	Highly Significant
Automated Assessment			
Professional Engagement	.732**	0.000	Highly Significant
Empowering Learners	.929**	0.000	Highly Significant
Facilitating Learners' Digital Competence	.667**	0.000	Highly Significant
Data Analytics and Administrative Support			
Professional Engagement	.693**	0.000	Highly Significant
Empowering Learners	.589**	0.000	Highly Significant
Facilitating Learners' Digital Competence	.634**	0.000	Highly Significant

Legend: Significant at p-value < 0.01

Table 6 presents the relationship between artificial intelligence (AI) in instruction and teacher digital competency using Spearman's rho correlation analysis. Specifically, the table examines how the dimensions of AI in instruction—Personalized Learning, Automated Assessment, and Data Analytics and Administrative Support—are associated with the dimensions of teacher digital competency, namely Professional Engagement, Empowering Learners, and Facilitating Learners' Digital Competence. The results reveal that all correlations are positive and statistically significant at the 0.01 level, with all p-values equal to 0.000. This indicates that greater integration of AI in instructional practices is associated with higher levels of teacher digital competency. This finding aligns with recent studies emphasizing that the adoption of AI technologies in education enhances teachers' digital skills, pedagogical capabilities, and professional practices (Zou et al., 2025; Xue et al., 2025).

For Personalized Learning, all relationships with teacher digital competency were highly significant and positive. The strongest relationship was observed with Professional Engagement, followed closely by Empowering Learners. These very strong correlations suggest that teachers who effectively utilize AI to personalize learning experiences are more engaged in professional digital practices and are more capable of implementing learner-centered approaches that address individual student needs. This is supported by recent literature indicating that AI-driven personalized learning environments require teachers to continuously engage in professional development and adapt their instructional strategies to meet diverse learner profiles (World Economic Forum, 2024; Zou et al., 2025). Facilitating Learners' Digital Competence demonstrated a moderate to strong positive relationship, indicating that AI-supported personalization also contributes to the development of students' digital literacy, including critical thinking and responsible use of technology (Xue et al., 2025).

In terms of Automated Assessment, the findings revealed the strongest relationships among all dimensions in the table. The highest correlation was found between Automated Assessment and Empowering Learners, indicating a very strong positive association. This suggests that teachers who utilize AI-powered assessment tools are more capable of providing timely feedback, monitoring student progress, and supporting individualized learning pathways that empower learners. This is consistent with research showing that AI-based assessment systems enhance formative assessment practices and enable teachers to personalize feedback, thereby improving student autonomy and engagement (Cengage Group, 2024; Zou et al., 2025). Strong positive relationships were also observed with Professional Engagement and Facilitating Learners' Digital Competence. Results indicate that AI-driven assessment practices not only improve instructional efficiency but also strengthen teachers' professional use of technology and their ability to guide students in developing digital skills (Xue et al., 2025).

For Data Analytics and Administrative Support, all dimensions of teacher digital competency were likewise positively and significantly related. Strongest correlation was observed with Professional Engagement, suggesting that teachers who use AI for data analysis and administrative tasks tend to be more engaged in professional digital practices and evidence-based decision-making. This aligns with studies highlighting that AI analytics enable teachers to interpret student data more effectively, leading to improved instructional planning and professional growth (World Economic Forum, 2024). This was followed by Facilitating Learners' Digital Competence and Empowering Learners, both indicating moderate to strong positive relationships. These findings imply that the use of AI-generated insights supports teachers in designing responsive instruction, addressing learner needs, and fostering digital competencies among students (Zou et al., 2025; Xue et al., 2025).

Overall, the results indicate a strong and consistent relationship between AI integration and teacher digital competency across all dimensions. The findings suggest that as teachers increasingly adopt AI technologies in instructional practices, their ability to engage professionally, empower learners, and facilitate digital competence also improves. This underscores the importance of equipping teachers with adequate training, resources, and institutional support to effectively integrate AI in education. Strengthening AI competencies among educators is essential for maximizing the benefits of emerging technologies and achieving higher levels of instructional effectiveness in the digital age (World Economic Forum, 2024; Zou et al., 2025).

Table 7 presents the results of the multiple regression analysis conducted to determine the significant predictors of instructional efficacy. The model included dimensions of mobile applications in instruction, artificial intelligence (AI) in instruction, and teacher digital competency as independent variables. The regression model was found to be highly significant, $F(9, 375) = 509.996$, $p < 0.05$, with an R^2 of 0.924, indicating that 92.4% of the variance in instructional efficacy is explained by the combined influence of the predictor variables. This exceptionally high coefficient of determination suggests a strong explanatory power of the model. This finding is consistent with recent research emphasizing that the integration of digital technologies, AI, and teacher competencies collectively contributes to improved instructional effectiveness and learning outcomes (Zou et al., 2025; World Economic Forum, 2024).

Table 7*Predictors of Instructional Efficacy*

	Unstandardized Coefficients		t-value	p-value	Interpretation
	B	Std. Error			
(Constant)	0.434	0.054	8.002	0.000	
Instructional Support	0.112	0.034	3.318	0.001	Highly Significant
Collaboration and Communication	0.468	0.058	8.095	0.000	Highly Significant
Learner Engagement and Motivation	0.199	0.032	6.186	0.000	Highly Significant
Personalized Learning	0.112	0.040	2.813	0.005	Significant
Automated Assessment	-0.040	0.050	-0.799	0.425	Not Significant
Data Analytics and Administrative Support	0.550	0.019	28.755	0.000	Highly Significant
Professional Engagement	-0.002	0.026	-0.069	0.945	Not Significant
Empowering Learners	-0.114	0.047	-2.435	0.015	Significant
Facilitating Learners' Digital Competence	-0.415	0.056	-7.438	0.000	Highly Significant

Legend: Significant at p-value < 0.05; $F_{(9,375)}=509.996$; $r^2=0.924$

Among the predictors, Data Analytics and Administrative Support emerged as the strongest predictor of instructional efficacy. This indicates that the use of AI-driven analytics and administrative tools significantly enhances teaching effectiveness. This result aligns with recent studies showing that AI-powered data analytics enable teachers to make informed instructional decisions, monitor student progress, and optimize teaching strategies, thereby improving overall instructional performance (Cengage Group, 2024; Zou et al., 2025). The strong predictive value highlights the importance of data-driven teaching in modern educational settings. This was followed by Collaboration and Communication, which also showed a highly significant positive effect. This suggests that the use of mobile applications and digital tools to facilitate communication and collaboration significantly contributes to instructional efficacy. This finding is supported by literature indicating that collaborative and communication-rich learning environments enhance student participation, knowledge sharing, and teacher effectiveness (Zou et al., 2025; Li et al., 2024).

Learner Engagement and Motivation was found to be a significant positive predictor. This implies that engaging students through technology-enhanced learning environments leads to improved instructional outcomes. Research confirms that student engagement is key determinant of academic success and is positively influenced by interactive and technology-supported instructional strategies (World Economic Forum, 2024). Additionally, Instructional Support and Personalized Learning were also significant positive predictors. These findings suggest that the use of mobile applications to support instruction and AI to personalize learning experiences contributes to improved instructional effectiveness. This aligns with recent studies highlighting that personalized learning systems and well-structured digital instructional support enhance learning efficiency and student achievement (Zou et al., 2025; Xue et al., 2025).

On the other hand, Automated Assessment and Professional Engagement were found to be not significant predictors of instructional efficacy. These results suggest that, when considered alongside other variables, automated grading tools and professional digital activities do not independently contribute to variations in instructional effectiveness. This may be explained by the overlapping influence of stronger predictors such as data analytics, engagement, and collaboration, which already capture much of the impact of technology use in teaching (Zou et al., 2025).

Interestingly, two dimensions of teacher digital competency exhibited significant negative coefficients. Empowering Learners showed a significant negative effect, while Facilitating Learners' Digital Competence demonstrated a highly significant negative effect. These results do not necessarily indicate that these competencies negatively impact instructional efficacy. Rather, they may reflect multicollinearity or shared variance among predictor variables, where highly correlated constructs overlap in explaining instructional outcomes. This is a common occurrence in regression analysis, where the direction of coefficients reflects each variable's unique contribution after controlling for others (Xue et al., 2025).

Recent literature also supports that while teacher digital competency is essential, its effects on instructional efficacy are often indirect and mediated through technology integration, engagement strategies, and AI-supported practices (World Economic Forum, 2024; Zou et al., 2025). Findings indicate that AI-driven data analytics, collaboration and communication, and learner engagement are the strongest drivers of instructional efficacy, while the role of teacher digital competency is more complex and interdependent with other variables. Results highlight the importance of integrating mobile technologies and AI with effective pedagogical practices to achieve optimal instructional outcomes in the digital age.

Table 8

Proposed Action Plan for Enhancing Instructional Efficacy through Mobile Applications, Artificial Intelligence, and Teacher Digital Competency

KRA (Key Result Area)	Strategies	Objective of the Strategies	Persons Involved	Expected Outcomes
Facilitating Learners' Digital Competence	Conduct structured ICT integration workshops focused on embedding digital literacy tasks in lesson plans. Develop classroom-based digital projects where students use mobile apps and AI tools. Implement peer mentoring among teachers on digital facilitation strategies.	To strengthen teachers' ability to guide students in developing digital skills using mobile and AI tools.	School administrators, ICT coordinators, teachers, students	Improved student digital competence and more effective teacher facilitation of technology-enhanced learning.
Collaboration and Communication (Mobile Applications)	Introduce institutional use of collaborative mobile platforms (e.g., LMS, messaging apps, shared digital boards). Train teachers on effective online communication and interactive instruction using mobile tools. Establish digital collaboration protocols for students and teachers.	To enhance real-time communication, teamwork, and instructional collaboration using mobile applications.	School leaders, IT department, faculty members, students	Increased interaction, improved communication flow, and stronger collaborative learning environment.
Instructional Support (Mobile Applications)	Expand access to mobile learning resources and instructional apps. Train teachers in designing mobile-assisted instructional materials. Provide institutional support for app-based lesson delivery.	To improve the quality and consistency of instructional support using mobile applications.	School administrators, ICT units, teachers	Enhanced instructional delivery and improved student learning support.

4. Conclusions and recommendations

The respondents generally agree that mobile applications are effective in instruction. The respondents generally agree on the use of artificial intelligence in instruction. The respondents generally agree on teachers' digital competency. Respondents generally agreed on the level of instructional efficacy. There is a positive and highly significant relationship between mobile applications and artificial intelligence in instruction, as all correlations are significant. Data Analytics and Administrative Support emerged as the strongest positive predictor in the instructional efficacy. Action plan for enhancing instructional efficacy through the effective use of mobile applications, artificial intelligence, and teacher digital competency is proposed.

The educational institutions may prioritize continuous professional development programs focusing on facilitating learners' digital competence emphasizing on practical integration of digital tools in lesson delivery to better support student digital literacy. The educational institutions may invest in learning analytics systems to help teachers make informed instructional decisions and improve student performance tracking. Educational institutions may develop clear policies and frameworks that support the integration of mobile applications and AI in instruction to ensure consistency, sustainability, and quality implementation. Future researchers are encouraged to replicate this study in different geographical locations, educational levels, or institutional settings to validate

and compare findings. The proposed action plan may be presented to the educational institutions for review and implementation.

5. References

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