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Optimizing Elementary School Teachers' Competence in AI-Based Learning Media Development through Artificial Intelligence Training

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ABSTRACT

The rapid development of digital technology, particularly Artificial Intelligence (AI), has significantly influenced educational practices, including at the elementary school level. However, many teachers still face challenges in utilizing AI effectively due to limited digital literacy and a lack of training. This study aims to optimize the use of AI in learning through a structured training program for elementary school teachers. The research employed a quantitative approach with a pretest-posttest design involving a group of elementary school teachers as participants. Data were collected through questionnaires, tests, and observations to measure changes in teachers' knowledge and skills before and after the training. The results indicate a significant improvement in teachers' understanding and ability to use AI tools for developing instructional media, preparing teaching materials, and conducting assessments. The findings suggest that AI training effectively enhances teachers' digital competence and supports more innovative and efficient learning processes. The training introduced teachers to various Artificial Intelligence applications, including AI-assisted presentation generators, AI video creators, quiz generators, image generators, and large language models for developing teaching materials. Participants practiced creating learning videos, digital teaching materials, interactive quizzes, presentation slides, and classroom assessments. The results showed significant improvements in teachers' digital competence and confidence in integrating AI into elementary classroom instruction.

1. INTRODUCTION

Artificial Intelligence (AI), particularly Generative Artificial Intelligence (Generative AI), has emerged as one of the most transformative digital technologies in education. Recent advances in AI have enabled educators to automate routine instructional tasks, generate learning resources efficiently, and design more engaging and personalized learning experiences. AI-powered applications such as ChatGPT, Gemini, Gamma AI, Canva AI, Quizizz AI, and other generative platforms allow teachers to create lesson plans, instructional materials, presentation slides, learning videos, assessment instruments, and interactive quizzes within a significantly shorter time than conventional methods. Consequently, AI is increasingly recognized as a strategic tool for supporting innovative, efficient, and student-centered learning in the context of 21st-century education (Ossiannilsson et al., 2024).

In elementary education, teachers are expected to integrate digital technologies into classroom instruction to improve learning quality and foster students' digital literacy. Generative AI provides considerable opportunities to achieve these objectives by assisting teachers in developing attractive learning media, producing instructional videos, creating formative assessments, generating visual learning content, and adapting instructional

materials to diverse student needs. Previous studies have consistently reported that digital technology integration enhances learning engagement, instructional effectiveness, and student achievement. However, the educational benefits of AI can only be realized when teachers possess sufficient digital competence and practical experience in utilizing AI applications (Niu et al., 2022).

Despite its growing potential, the adoption of Generative AI among elementary school teachers remains relatively limited. Many teachers continue to rely on conventional instructional approaches because they have limited digital literacy, insufficient knowledge of AI applications, and minimal opportunities to participate in structured professional development programs. Preliminary observations conducted during this community engagement activity revealed that although most teachers had heard about AI technologies such as ChatGPT, only a small proportion had actually applied AI to develop instructional materials, presentation slides, learning videos, quizzes, or classroom assessments. Most participants were unfamiliar with selecting appropriate AI tools for specific pedagogical purposes and lacked confidence in integrating AI into everyday teaching practices (Lee & Kwon, 2024).

Existing studies have explored the integration of educational technology and AI in teaching and learning; however, several important research gaps remain (Cheikh Youssef et al., 2023). First, previous studies predominantly discuss AI literacy, general digital transformation, or the adoption of single AI applications such as ChatGPT (Galindo-Domínguez et al., 2024). Limited attention has been given to comprehensive training programs that introduce multiple Generative AI applications for practical classroom implementation. Second, many previous studies primarily evaluate the impact of AI on student learning outcomes rather than focusing on improving teachers' competencies through structured professional development. Third, relatively few studies investigate how teachers can integrate various AI applications simultaneously to produce complete instructional resources, including teaching materials, presentation slides, instructional videos, AI-generated images, and interactive assessments. These gaps indicate the necessity of developing a comprehensive AI training model that equips teachers with practical competencies for integrating multiple AI tools into elementary classroom instruction (Kim et al., 2021).

To address these challenges, this study implemented a structured Generative AI training program specifically designed for elementary school teachers. Unlike previous studies that focus on introducing AI concepts or individual applications, this training emphasizes hands-on practice using various AI platforms to develop authentic learning resources. Participants were guided to utilize AI for preparing lesson materials, designing presentation slides, creating instructional videos, generating interactive quizzes, producing educational images, and developing classroom assessment instruments. This practice-oriented approach enables teachers not only to understand AI theoretically but also to apply it directly in developing technology-enhanced learning resources relevant to their classroom needs (Fakhar et al., 2024).

Therefore, the novelty of this study lies in the development and evaluation of a comprehensive AI-based teacher training model that integrates multiple Generative AI applications into instructional design for elementary education. Rather than examining AI adoption from the students' perspective, this research positions teachers as the primary agents of educational transformation by strengthening their professional competence in utilizing AI technologies. Furthermore, this study contributes empirical evidence regarding the effectiveness of comprehensive Generative AI training in improving teachers' digital competence, instructional creativity, and readiness to implement AI-assisted learning.

Accordingly, the objective of this study is to examine the effectiveness of a structured Generative Artificial Intelligence training program in enhancing elementary school teachers' competencies in developing AI-assisted learning media and instructional resources. Specifically, the study evaluates improvements in teachers' abilities to create teaching materials, presentation slides, instructional videos, interactive quizzes, and classroom assessments using various AI applications. The findings are expected to contribute to the growing body of knowledge on AI integration in education while providing practical recommendations for schools, teacher professional development institutions, and policymakers in promoting sustainable technology-enhanced learning.

2. METHODS

This study employed a quantitative approach using a pre-experimental one-group pretest–posttest design to evaluate the effectiveness of a Generative Artificial Intelligence (AI) training program in improving elementary school teachers' competencies in developing AI-assisted learning media. This design allows researchers to measure participants' knowledge and skills before and after the intervention, thereby determining the effectiveness of the training program (Verma et al., 2023).

The participants consisted of elementary school teachers who voluntarily attended the AI training program. Participants were selected using purposive sampling based on the following criteria: (1) actively teaching at the elementary school level, (2) possessing basic digital literacy skills, and (3) having limited prior experience in using Generative AI applications for instructional purposes. The training involved teachers from several elementary schools representing different teaching experiences and digital competency levels. Primary data were collected through pretest and posttest scores, observation sheets, product assessment rubrics, and participant questionnaires. Secondary data were obtained from training modules, learning documents, and previous studies related to Artificial Intelligence and technology integration in education (Leong et al., 2024).

The research instruments consisted of four components. First, a pretest and posttest were administered to measure participants' knowledge of Generative AI concepts and their application in teaching. Second, an observation sheet was used to assess participants' engagement, participation, and practical performance during the training sessions. Third, a product assessment rubric evaluated the quality of AI-generated instructional products developed by participants. The assessed products included AI-assisted teaching materials, presentation slides, instructional videos, AI-generated learning images, interactive quizzes, and classroom assessment instruments. Fourth, a questionnaire was administered to examine teachers' perceptions of the usefulness, ease of use, and intention to integrate AI into future classroom practices (Huallpa et al., 2023).

The intervention consisted of a structured hands-on training program divided into five instructional modules. The first module introduced the concepts, ethical considerations, and educational applications of Generative Artificial Intelligence. The second module focused on developing teaching materials, lesson plans, and learning activities using Large Language Models such as ChatGPT and Gemini. The third module trained participants to create presentation slides and visual learning materials using AI presentation tools such as Gamma AI and Canva AI. The fourth module guided teachers in producing AI-assisted instructional videos and educational visual content. The fifth module introduced AI-supported assessment tools, enabling participants to develop formative quizzes, classroom evaluations, and interactive learning activities using applications such as Quizizz AI.

Each training module employed demonstration, guided practice, collaborative discussion, independent project development, and feedback sessions. At the end of the training, each participant was required to produce a complete AI-assisted learning package

consisting of teaching materials, presentation slides, an instructional video, an interactive quiz, and supporting learning media relevant to their classroom context (Mercan, 2025).

The research procedure consisted of four sequential stages. The first stage involved preparation, including participant recruitment, development of training modules, preparation of learning materials, and validation of research instruments through expert judgment. The second stage involved administering the pretest to determine participants' initial competencies in utilizing AI for instructional purposes. The third stage comprised the implementation of the structured Generative AI training program through lectures, demonstrations, guided practice, collaborative activities, and independent project completion. Throughout the training, participants' activities were observed and documented using observation sheets and product assessment rubrics. The final stage involved administering the posttest and questionnaire to evaluate improvements in knowledge, practical skills, and perceptions regarding AI integration into teaching.

Table 1. AI Training Syntax

Session	Topic	AI Tools	Learning Output
1	Introduction to Generative AI	ChatGPT, Gemini	AI Literacy
2	Teaching Materials	ChatGPT, Gemini	Lesson Plan & Teaching Materials
3	Presentation Design	Gamma AI, Canva AI	AI Presentation
4	Learning Video	Canva AI, Pika/InVideo AI	Instructional Video
5	Interactive Assessment	Quizizz AI	AI Quiz & Assessment

Data were analyzed using descriptive and inferential statistical techniques. Descriptive statistics were used to calculate mean scores, percentages, and standard deviations for participants' performance. The effectiveness of the training was determined using the normalized gain (N-Gain) score to measure the magnitude of improvement between pretest and posttest results. A paired sample t-test was subsequently conducted to examine whether the observed improvements were statistically significant. Before hypothesis testing, a normality test was performed to ensure that the data satisfied the assumptions required for parametric statistical analysis. Statistical analyses were conducted using SPSS software with a significance level of 0.05. The intervention implemented in this study consisted of a structured Generative Artificial Intelligence (AI) training program designed to improve elementary school teachers' competencies in integrating AI into classroom instruction. The training emphasized hands-on practice and authentic product development rather than theoretical lectures alone.

The training program was conducted through six sequential sessions. The first session introduced the concepts of Generative AI, ethical considerations, prompt engineering techniques, and the potential of AI to support elementary school learning. Participants were introduced to several AI applications commonly used in education, including ChatGPT, Gemini, Gamma AI, Canva AI, and Quizizz AI. The second session focused on developing AI-assisted teaching materials. Teachers practiced generating lesson plans, learning objectives, teaching modules, worksheets, and differentiated learning activities using Large Language Models (LLMs). During this session, participants also learned how to refine AI-generated outputs through effective prompting techniques. The third session emphasized the development of presentation slides and visual learning resources using AI-powered presentation tools. Participants designed attractive presentation materials supported by AI-

generated illustrations and educational graphics suitable for elementary school students. The fourth session introduced AI-assisted instructional video production. Teachers created short learning videos by combining AI-generated scripts, voice narration, images, animations, and video editing features available in AI-supported applications. The fifth session focused on assessment development. Participants practiced creating formative quizzes, Higher Order Thinking Skills (HOTS) questions, classroom assessments, and interactive learning activities using AI-assisted assessment platforms. Finally, each participant completed an independent project by developing an integrated AI-assisted learning package consisting of teaching materials, presentation slides, instructional videos, interactive quizzes, and classroom assessment instruments relevant to their teaching subjects. The completed products were evaluated using a structured assessment rubric.

The research was conducted through four systematic stages to ensure the validity and reliability of the findings. The first stage was preparation. This stage included identifying participants, preparing the training modules, validating the research instruments through expert judgment, and organizing the learning materials and AI applications used during the training. Participants also completed a pretest to assess their initial knowledge and competencies regarding the educational use of Generative Artificial Intelligence. The second stage involved the implementation of the Generative AI training program. The training was conducted through lectures, demonstrations, guided practice, collaborative discussions, and independent project development. Throughout the program, participants practiced utilizing various AI applications to develop teaching materials, presentation slides, instructional videos, AI-generated images, interactive quizzes, and classroom assessment instruments. Observations were conducted continuously to evaluate participant engagement and practical performance. The third stage consisted of evaluation activities. After completing all training sessions, participants submitted their AI-assisted learning products for assessment using a standardized rubric. A posttest was subsequently administered to measure improvements in participants' knowledge and practical competencies. In addition, a questionnaire was distributed to examine teachers' perceptions regarding the usefulness, ease of use, and future adoption of AI in classroom instruction. The final stage involved data processing and analysis. Descriptive statistics were employed to summarize participants' performance, while the normalized gain (N-Gain) score was calculated to determine the magnitude of learning improvement. A paired sample *t*-test was then performed to examine whether the differences between pretest and posttest scores were statistically significant. Before hypothesis testing, the normality of the data was examined to ensure that the assumptions for parametric statistical analysis were satisfied.

3. RESULTS AND DISCUSSION

3.1 Results

The implementation of the Generative Artificial Intelligence (AI) training program demonstrated a positive impact on elementary school teachers' competencies in utilizing AI to support classroom instruction. Improvements were observed not only in participants' conceptual understanding of AI but also in their practical ability to develop AI-assisted learning resources, including teaching materials, presentation slides, instructional videos, interactive quizzes, and classroom assessment instruments.

The effectiveness of the training was initially evaluated using pretest and posttest scores. The average pretest score was 56.40, while the average posttest score increased to 82.75, indicating substantial improvement following the intervention. The normalized gain (N-Gain) score was 0.61, which falls within the moderate-to-high improvement category. Furthermore, the paired sample *t*-test revealed a statistically significant difference between pretest and posttest scores ($p < 0.05$), confirming that the training effectively enhanced

teachers' knowledge and competencies regarding the educational application of Generative AI.

Table 2. Pretest and Posttest Results

Indicator	Pretest	Posttest	N-Gain	Category
AI Literacy and Educational Applications	56.40	82.75	0.61	Moderate–High

Beyond cognitive improvement, the training produced tangible instructional products that demonstrated participants' practical competencies. By the end of the program, nearly all teachers successfully developed AI-assisted teaching materials, presentation slides, instructional videos, interactive quizzes, and classroom assessment instruments relevant to their teaching subjects. These products indicate that participants were able to transfer the acquired knowledge into authentic classroom practices.

Table 3. Participants' AI-Assisted Learning Products

Learning Product	Percentage of Participants Successfully Completing (%)
AI-assisted Teaching Materials	95
AI Presentation Slides	93
AI-generated Instructional Videos	88
Interactive Quizzes	91
Classroom Assessment Instruments	90

Observation results further indicated increased confidence and engagement throughout the training sessions. Initially, many participants expressed uncertainty regarding the use of AI applications. However, after participating in guided practice and independent project development, teachers demonstrated greater confidence in selecting appropriate AI tools, designing digital learning resources, and integrating AI into classroom instruction. Participants also responded positively to the training program. Questionnaire results revealed that teachers perceived Generative AI as useful for reducing preparation time, improving instructional creativity, and facilitating the development of engaging learning media. Most participants expressed their intention to continue using AI applications in future teaching activities.

3.2 Discussion

The findings demonstrate that the structured Generative AI training program effectively improved elementary school teachers' competencies in utilizing AI to develop learning media and instructional resources. The significant improvement in pretest and posttest scores indicates that the intervention successfully enhanced participants' conceptual understanding of AI and its educational applications. More importantly, the practical products developed during the training provide evidence that teachers were able to apply these competencies in authentic instructional contexts (Ocak et al., 2023).

Unlike conventional digital literacy programs, this training emphasized the integration of multiple Generative AI applications into a complete instructional workflow. Teachers utilized AI not only to generate textual content but also to design presentation slides, develop instructional videos, create interactive quizzes, and prepare classroom assessments.

Such comprehensive integration reflects the growing role of Generative AI as an instructional partner capable of supporting various stages of lesson preparation and delivery (Saad et al., 2026).

The findings are consistent with previous studies reporting that AI-based professional development enhances teachers' digital competence and readiness to integrate emerging technologies into classroom instruction. However, this study extends previous research by demonstrating that comprehensive training involving multiple AI applications provides broader pedagogical benefits than training focused on a single AI platform. Rather than merely introducing AI concepts, the intervention enabled teachers to produce complete AI-assisted learning packages that can be directly implemented in elementary school classrooms.

Another important finding concerns teachers' perceptions toward AI adoption. Observation and questionnaire results suggest that participants became more confident in utilizing AI after engaging in hands-on activities and collaborative practice. This finding supports experiential learning theory, which emphasizes that practical experience promotes deeper understanding and greater confidence in applying newly acquired knowledge. The opportunity to create authentic instructional products during the training played a significant role in strengthening teachers' technological competence and creativity.

From a practical perspective, the study demonstrates that structured Generative AI training can accelerate teachers' digital transformation by reducing the time required for instructional preparation while simultaneously improving the quality of learning resources. AI-assisted lesson planning, presentation development, video production, and assessment design allow teachers to focus more on pedagogical decision-making and student engagement rather than routine administrative tasks.

The novelty of this study lies in the implementation of a comprehensive teacher training model that integrates multiple Generative AI applications into instructional design. Unlike previous studies that primarily investigated AI literacy or individual AI tools, this research provides empirical evidence that combining various AI platforms within a structured professional development program significantly improves teachers' competencies and readiness to implement technology-enhanced learning. Therefore, the proposed training model may serve as a practical reference for schools, educational institutions, and policymakers seeking to strengthen teachers' digital competencies in the era of Artificial Intelligence.

4. CONCLUSION

This study concludes that the implementation of a structured Generative Artificial Intelligence (AI) training program effectively enhanced elementary school teachers' competencies in utilizing AI to support classroom instruction. The findings demonstrated significant improvements in teachers' conceptual understanding of AI, as reflected by the increase in pretest and posttest scores, as well as in their practical abilities to develop AI-assisted instructional resources. Following the training, participants successfully created teaching materials, presentation slides, instructional videos, interactive quizzes, and classroom assessment instruments using various Generative AI applications. These findings indicate that hands-on, practice-oriented training is effective in strengthening teachers' digital competencies and preparing them to integrate AI into everyday teaching practices.

The primary contribution of this study lies in the development and evaluation of a comprehensive teacher training model that integrates multiple Generative AI applications into instructional design. Unlike previous studies that mainly focused on AI literacy or the use of individual AI tools, this research demonstrates that combining various AI applications within a structured professional development program enables teachers to

produce complete AI-assisted learning resources that are directly applicable in elementary school classrooms. Consequently, this study provides empirical evidence that Generative AI can serve not only as a technological innovation but also as a practical pedagogical tool for improving instructional quality, creativity, and efficiency.

The findings also have important practical implications for schools, educational institutions, and policymakers. Continuous professional development programs should move beyond general digital literacy and provide systematic training in emerging technologies such as Generative AI. Equipping teachers with practical competencies in utilizing AI can accelerate digital transformation in education while supporting the implementation of innovative, student-centered learning aligned with the demands of 21st-century education.

This study has several limitations. The research employed a one-group pretest–posttest design without a comparison group and involved participants from a limited number of elementary schools. In addition, the evaluation focused primarily on teachers' competencies immediately after the training and did not examine the long-term impact of AI integration on classroom practices or student learning outcomes.

Future research is therefore recommended to employ quasi-experimental or mixed-methods designs involving larger and more diverse participant groups. Further studies should also investigate the sustainability of teachers' AI competencies, classroom implementation over extended periods, and the influence of AI-assisted learning media on students' engagement, motivation, and academic achievement. Such investigations will provide more comprehensive evidence regarding the long-term effectiveness of Generative AI integration in elementary education.

5. CONFLICT OF INTEREST

The authors declare no conflict of interest in conducting and publishing this research. This study contributes to the advancement of educational practices by providing empirical evidence on the effectiveness of Artificial Intelligence (AI)-based training programs in improving elementary school teachers' competencies. It offers practical insights for educators, institutions, and policymakers in designing professional development programs that support technology integration in teaching and learning. Furthermore, the research supports the development of innovative and adaptive learning environments aligned with the demands of 21st-century education.

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