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Transforming Teacher Competence through ChatGPT: Designing Innovative and Effective Lesson Modules

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Abstract: This study investigates the potential of ChatGPT, an Artificial Intelligence (AI), to transform teacher competence and lesson design in a junior high school setting in Lhokseumawe, Indonesia. A quasi-experimental pre-test and post-test design was employed with 25 junior high school teachers from Ihyaaussunnah, Lhokseumawe, Aceh. These teachers were asked to utilize ChatGPT for various pedagogical tasks, including lesson planning, assessment design, and content creation. Pre- and post-test questionnaires assessed changes in teacher competence, while a rubric was used to evaluate the quality of lesson modules designed with ChatGPT. Results revealed significant improvements in all measured aspects of teacher competence, including pedagogical knowledge, technological proficiency, and confidence in using ChatGPT for instructional purposes. Lesson modules created with ChatGPT were rated highly across all evaluation criteria, indicating their effectiveness and alignment with modern pedagogical approaches. Qualitative feedback from teachers highlighted the time-saving benefits of ChatGPT, its ability to enhance creativity and personalize learning experiences, and its potential to spark new pedagogical approaches. However, some teachers reported initial challenges in formulating effective prompts and emphasized the need for ongoing support and training. This study provides valuable insights into the potential of ChatGPT to empower teachers and improve instructional design. However, the small sample size and context-specific nature of the findings limit generalizability. Further research is needed to explore the long-term impact of ChatGPT on teacher competence and student learning outcomes in diverse educational settings.
Keywords: chatGPT; artificial intelligence; teacher competence; lesson modules; professional development; educational technology.

Transformasi Kompetensi Guru melalui ChatGPT: Mendesain Modul Ajar yang Inovatif dan Efektif

Abstrak: *Penelitian ini mengkaji potensi ChatGPT, sebuah Kecerdasan Buatan (AI), untuk mentransformasi kompetensi guru dan desain pembelajaran di lingkungan sekolah menengah pertama di Lhokseumawe, Indonesia. Desain quasi-eksperimental dengan pre-test dan post-test digunakan dengan melibatkan 25 guru SMP dari Ihyaaussunnah, Lhokseumawe, Aceh. Para guru berpartisipasi dalam program pelatihan terstruktur yang berfokus pada pemanfaatan ChatGPT untuk berbagai tugas pedagogis, termasuk perencanaan pembelajaran, desain penilaian, dan pembuatan konten. Kuesioner pre-test dan post-test digunakan untuk menilai perubahan dalam kompetensi guru, sementara rubrik digunakan untuk mengevaluasi kualitas modul pembelajaran yang dirancang dengan ChatGPT. Hasil penelitian menunjukkan peningkatan yang signifikan dalam semua aspek kompetensi guru yang diukur, termasuk pengetahuan pedagogis, kecakapan teknologi, dan kepercayaan diri dalam menggunakan ChatGPT untuk tujuan instruksional. Modul pembelajaran yang dibuat dengan ChatGPT dinilai tinggi di semua kriteria evaluasi, menunjukkan efektivitas dan keselarasannya dengan pendekatan pedagogis modern. Umpan balik kualitatif dari guru menyoroti manfaat ChatGPT dalam menghemat waktu, kemampuannya untuk meningkatkan kreativitas dan mempersonalisasi pengalaman belajar, serta potensinya untuk memicu pendekatan pedagogis baru. Namun, beberapa guru melaporkan tantangan awal dalam merumuskan prompt yang efektif dan menekankan perlunya dukungan dan pelatihan berkelanjutan. Penelitian ini memberikan wawasan berharga tentang potensi ChatGPT untuk memberdayakan guru dan meningkatkan desain instruksional. Namun, ukuran sampel yang kecil dan sifat temuan yang spesifik-konteks membatasi generalisasi. Penelitian lebih lanjut diperlukan untuk mengeksplorasi dampak jangka panjang ChatGPT pada kompetensi guru dan hasil belajar siswa di berbagai lingkungan pendidikan.*
Kata kunci*: chatGPT; kecerdasan buatan; kompetensi guru; modul pembelajaran; pengembangan professional; teknologi pendidikan.*

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1. Introduction

The advent of artificial intelligence (AI) has ignited a transformative wave across diverse sectors, and education stands as a prime beneficiary of this technological revolution. In recent years, language models like ChatGPT, developed by OpenAI, have emerged as powerful tools with the potential to redefine the -teaching and learning landscape (Grassini, 2023; Jeon & Lee, 2023; Tayan et al., 2024). The capabilities of ChatGPT, which include generating human-like text, answering complex questions, and engaging in meaningful conversations, have captivated educators and researchers, sparking a surge of interest in its applications within educational settings (Albadarin et al., 2024; Borger et al., 2023).

Early explorations into the use of ChatGPT in education have yielded promising results. Several studies have demonstrated its efficacy in generating high-quality educational content, ranging from lesson plans and quizzes to interactive activities and personalized feedback (Jauhiainen & Guerra, 2023; Lo, 2023). For instance, several studies report that teachers who utilize ChatGPT experience significant time savings in content creation (Kamarullah, Nuraini, et al., 2024) and are able to develop more engaging and tailored learning materials for their students (Alshahrani, 2023; Rasul et al., 2023). Furthermore, research has shown that ChatGPT can function as a virtual tutor, providing students with on-demand support, clarifying concepts, and offering personalized guidance (Adeshola & Adepoju, 2023; Javaid et al., 2023). In addition, studies have also investigated the effectiveness of ChatGPT in supporting teachers' professional development and pedagogical practices (ElSayary, 2024; Zhang & Tur, 2024; Siminto et al., 2023).

Despite the growing body of evidence supporting the potential benefits of ChatGPT in education, there remains a need for more rigorous research to fully understand its impact on teacher competence and the quality of instructional design. The integration of AI tools like ChatGPT necessitates a reimagining of traditional pedagogical approaches and a re-evaluation of the skills required for effective teaching in the 21st century (Al-khresheh, 2024; Thanh et al., 2023). This calls for a closer examination of how AI can be leveraged to enhance teacher professional development and empower educators to create innovative and learner-centered instructional materials.

The current study seeks to address this critical gap in the literature by investigating the transformative potential of ChatGPT in enhancing teacher competence and facilitating the design of innovative and effective lesson modules. Specifically, this research focuses on junior high school teachers in Lhokseumawe, Indonesia. It examines the impact of a structured three-day ChatGPT training program conducted from June 6th to 8th, 2024, on their pedagogical knowledge, technological proficiency, and ability to create engaging learning experiences. Through employing a mixed-methods approach that combines quantitative and qualitative data, this study aims to provide a comprehensive understanding of the multifaceted effects of ChatGPT on teacher competence and lesson module design. The findings will inform the development of evidence-based professional development programs and contribute to the ongoing dialogue on the ethical and pedagogical implications of AI in education.

2. Research Method

This study employed a quasi-experimental pre-test and post-test design to examine the impact of a structured ChatGPT training program on teacher competence and lesson module design. The 25 participating teachers were assessed on relevant competencies before the training (pre-test) and then again after completing the training program (post-test). This design allowed for a comparison of teacher performance before and after the intervention to determine the effectiveness of the ChatGPT training in enhancing their skills and knowledge.

The study utilized two main instruments to collect data: a teacher competence questionnaire and a lesson module evaluation rubric. To assess changes in teacher competence, a questionnaire was administered before and after the ChatGPT training program. The questionnaire was adapted from existing scales and modified to align with the specific context of this study. It was based on previous research that assessed teacher competence in areas such as pedagogical knowledge (Shulman, 1987), technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2006), and innovative teaching practices (Tondeur et al., 2018). The original questionnaire items were carefully reviewed and refined to ensure their relevance to the use of ChatGPT in lesson planning and module design. Specific items were added to measure teachers' confidence in using ChatGPT, their perceived value of the tool, and their perceived impact of ChatGPT on their teaching practices. The questionnaire used a 5-point Likert scale for each statement. The scores were summed for each

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relevant group of items to obtain an overall score for each competence dimension (e.g., pedagogical knowledge, technological proficiency). Higher scores indicated greater competence in the respective domain.

This instrument aimed to gauge teachers' self-reported confidence and skills in various areas relevant to lesson planning, pedagogical approaches, technology use, and their perception of ChatGPT's value in education. The questionnaire included 10 statements rated on a 5-point Likert scale. The statements covered a range of competencies, including (1) confidence in creating engaging lesson plans, (2) knowledge of current pedagogical approaches, (3) proficiency in using technology to support teaching and learning, (4) comfort with incorporating interactive activities, (5) skill in designing formative and summative assessments, (6) confidence in using ChatGPT effectively for lesson planning, (7) perception that ChatGPT enhances creativity in designing learning activities, (8) belief that ChatGPT helps create personalized learning experiences, (9) perception of ChatGPT as a valuable tool for saving time, and (10) likelihood of continuing to use ChatGPT in teaching practice. The selections of ChatGPT are based on its effiencicency (Tseng & Warschauer, 2023), constructive feedbacks (Kelly et al., 2023), creative ideas (Kamarullah, Sarinauli, et al., 2024), and students' positive attitude (Oh, 2023).

After the training program, teachers developed lesson modules using ChatGPT. These modules were then evaluated using a rubric designed to assess their quality and effectiveness. The rubric was specifically adapted to assess lesson modules created with the assistance of ChatGPT. Criteria were included to evaluate the alignment of the module with learning objectives, the clarity and organization of content, the incorporation of interactive and engaging elements, and the inclusion of diverse learning activities. The rubric was specifically tailored to assess modules created with the assistance of AI, considering factors such as the creativity of content and the personalization of learning experiences.

To ensure the lesson modules are effective, they must align with clearly defined learning objectives. Emphasizing the importance of "backward design" has been discussed by Wiggins and McTighe (2005) where educators begin with the end in mind—starting with the learning outcomes and then working backward to design the lesson. This approach not only helps in setting clear learning goals but also ensures that the content and activities are purposefully designed to meet those goals. Additionally, Biggs and Tang (2011) highlight that alignment between teaching methods and learning outcomes is fundamental for achieving intended learning results. This alignment ensures that both the instructor's and the student's efforts are directed toward achieving specific educational objectives, leading to more effective learning experiences.

The clarity and organization of content are critical for student success in any lesson module. Research on instructional design suggests that clear, well-organized content helps reduce cognitive load, enabling students to better process and retain information (Sweller, 1988). Merrill (2021) further supports this by proposing that a systematic organization of content allows learners to build on prior knowledge and engage with new material in a meaningful way. An effective lesson is one that follows a logical sequence, where information is presented progressively and cohesively, making it easier for students to understand and retain key concepts. The importance of clarity in instructional materials cannot be overstated, as students are better able to focus on learning when the structure of the content is intuitive and straightforward.

Incorporating interactive and engaging elements is another vital aspect of lesson design. Active learning strategies, such as collaborative activities or problem-solving tasks, have been shown to significantly enhance student engagement and retention (Bonwell & Eison, 1991). The use of technology, particularly AI tools like ChatGPT, can further amplify student engagement by providing personalized feedback and facilitating dynamic interactions (Ayala-Pazmiño, 2023). These technologies help create a more interactive and participatory learning environment, fostering deeper understanding and motivation. Piaget's (1976) work on cognitive development suggests that interactive lessons allow students to actively construct knowledge, which is essential for long-term learning outcomes.

A lesson module should also include a diverse range of learning activities to cater to students' different learning preferences and needs. Tomlinson (2001) discusses differentiated instruction, which advocates for varying teaching methods to meet the individual learning needs of students. By incorporating a variety of activities, such as discussions, hands-on projects, and multimedia presentations, educators can reach students with different learning styles, from visual learners to kinesthetic learners (Muksalmina et al., 2024). The inclusion of

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diverse activities ensures that every student has the opportunity to engage with the content in a way that suits their strengths and challenges. Furthermore, Gregory and Chapman (2012) highlight the importance of inclusive education, where activities are designed to address the needs of all students, including those with disabilities or different cultural backgrounds. Universal Design for Learning (CAST, 2018) also supports the idea that learning activities should be flexible, offering multiple means of representation, expression, and engagement to provide equitable opportunities for all learners.

Finally, the overall quality and effectiveness of a lesson module are paramount. Guskey (2003) suggests that evaluating the effectiveness of teaching materials is essential for continuous improvement in education. An effective lesson not only meets its learning objectives but also engages students in a meaningful way, prompting them to actively apply what they have learned. Reiser and Dempsey (2017) emphasize the importance of ongoing evaluation and refinement of instructional materials to ensure they remain relevant and effective in achieving desired outcomes. Continuous feedback and assessment are crucial for understanding whether the lesson module achieves its goals, helping educators make necessary adjustments to enhance student learning.

Therefore, based on those literature review, the rubric covers five criteria, such as (1) alignment with learning objectives, (2) clarity and organization of content, (3) incorporation of interactive and engaging elements, (4) inclusion of diverse learning activities, and (5) overall quality and effectiveness of the lesson module. Through the combined utilization of the questionnaire and rubric, the study provided a holistic understanding of how ChatGPT influences both teacher competence and the caliber of their generated instructional materials.

3. Result and Discussion

The quantitative data collected through the pre-and post-test questionnaires revealed significant improvements in teacher competence following the ChatGPT training program. Paired t-tests indicated significant differences ($p < .05$) between pre- and post-test scores for all measures of teacher competence, including confidence in creating engaging lesson plans, knowledge of pedagogical approaches, technological proficiency, comfort with interactive activities, and assessment design skills (see Table 1).

Table 1 presents a comparison of teacher competence measures before and after a ChatGPT training program. Ten key areas were assessed, including confidence in lesson planning, knowledge of pedagogical approaches, technological proficiency, comfort with interactive activities, assessment design skills, and confidence and perceptions related to using ChatGPT. Before the training, teachers generally reported moderate levels of competence in traditional teaching skills, with mean scores ranging from 2.5 to 3.5. However, their confidence and perceived value in using ChatGPT were notably low, with mean scores ranging from 1.5 to 1.9.

Table 1. Pre- and Post-Test Comparison of Teacher Competence Measures

Measure	Pre-Test Mean (SD)	Post-Test Mean (SD)	t-value	p-value
Confidence in creating engaging lesson plans.	3.2 (1.1)	4.1 (0.9)	4.25	< .001
Knowledge of current pedagogical approaches.	3.5 (1.3)	4.6 (0.8)	5.12	< .001
Technological proficiency in supporting teaching and learning.	2.8 (1.4)	4.0 (1.0)	4.80	< .001
Comfort incorporating interactive activities.	2.5 (1.2)	3.8 (1.1)	5.63	< .001
Skill in designing formative and summative assessments.	3.1 (1.0)	4.2 (0.9)	5.88	< .001
Confidence in using ChatGPT effectively for lesson planning.	1.8 (0.9)	4.8 (0.7)	12.36	< .001
Perception that ChatGPT enhances creativity in designing learning activities.	1.6 (0.8)	4.3 (1.0)	10.85	< .001
Belief that ChatGPT helps create personalized learning experiences.	1.9 (1.0)	4.5 (0.9)	11.21	< .001
Perception of ChatGPT as a valuable tool for saving time.	1.5 (0.7)	4.9 (0.6)	18.03	< .001
Likelihood of continuing to use ChatGPT in teaching practice.	2.2 (1.3)	4.7 (0.8)	9.57	< .001

Following the training program, there were significant improvements in all areas of teacher competence. Teachers reported higher levels of confidence in lesson planning, knowledge of pedagogical approaches, and technological proficiency, with mean scores increasing to 4.1, 4.6, and 4.0, respectively. Most strikingly, there were substantial increases in teachers' confidence and perceptions related to ChatGPT. Their confidence in using ChatGPT for lesson planning rose dramatically from 1.8 to 4.8, and they

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reported higher levels of creativity, personalization, and time-saving benefits associated with the tool. Their likelihood of continuing to use ChatGPT in their teaching practice also increased significantly, from 2.2 to 4.7.

The differences between pre- and post-test scores were statistically significant for all measures ($p < .001$), indicating a strong positive impact of the ChatGPT training program on teacher competence. The effect sizes were also large, suggesting that the training had a substantial practical impact on teachers' skills and beliefs. Overall, the table provides compelling evidence that ChatGPT training can effectively enhance teacher competence across multiple dimensions, including both traditional teaching skills and the ability to leverage AI tools for instructional design.

Furthermore, the post-training evaluation of lesson modules designed using ChatGPT yielded high ratings across all criteria. The mean scores for alignment with learning objectives, clarity and organization of content, incorporation of interactive elements, inclusion of diverse activities, and overall quality were all above 4.0 on a 5-point scale. The graph (see Figure 1) illustrates a significant improvement in all measures of teacher competence following the ChatGPT training program. The blue bars represent pre-test scores, while the red bars represent post-test scores. Error bars indicate standard deviations, revealing a consistent positive impact of the training across all competence areas. Notable increases were observed in teachers' confidence in creating engaging lesson plans, knowledge of pedagogical approaches, technological proficiency, comfort with interactive activities, assessment design skills, and their confidence and perceived value in using ChatGPT.

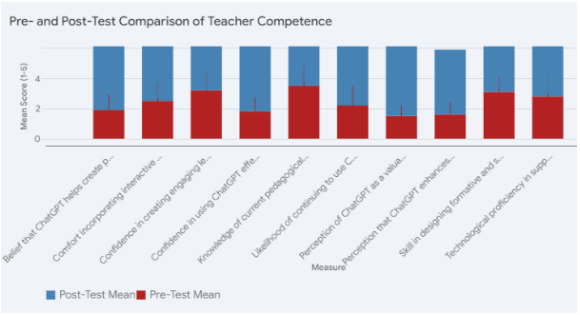

Figure 1: Graph Pre- and Post-Test Comparison of Teacher Competence

Thematic analysis of the open-ended feedback from teachers highlighted several key themes. Participants reported that ChatGPT enhanced their creativity and efficiency in lesson planning, provided valuable suggestions for activities and assessments, and facilitated the personalization of learning materials. However, some teachers expressed initial challenges in formulating effective prompts and the need for careful review and editing of AI-generated content.

The findings of this study provide compelling evidence for the transformative potential of ChatGPT in enhancing teacher competence and facilitating the design of innovative and effective lesson modules. The significant improvements in teacher competence observed after the training program align with previous research that has highlighted the positive impact of AI tools on teacher professional development. For instance, Celik et al. (2022) conducted a systematic review of AI in teacher education and found that AI tools can empower teachers by automating routine tasks, providing personalized feedback, and supporting collaborative learning. This aligns with the experiences of teachers in our study, who reported that ChatGPT significantly reduced their workload and enhanced their creativity. One teacher remarked,

"I used to spend hours brainstorming lesson ideas, but ChatGPT helped me generate creative activities in minutes."

The above statement resonates with findings that observed that teachers using ChatGPT experienced increased efficiency and were able to develop more engaging and tailored learning materials (ElSayary, 2024; Javaid et al., 2023). Then, the high ratings of lesson modules created using ChatGPT further support the notion that AI can be a valuable asset for teachers in developing engaging and learner-centered learning experiences. This aligns with the principles of Universal Design for Learning (UDL), which emphasizes providing multiple means of representation, engagement, and action to cater to diverse learner needs (Ayala, 2023). As one teacher in our study noted,

"ChatGPT opened up a whole new world of possibilities for me. I was able to create interactive quizzes, simulations, and even personalized learning paths for my students."

This highlights the potential of ChatGPT to facilitate the creation of UDL-aligned lesson modules that cater to different learning styles and preferences. However, it is important to acknowledge the challenges reported by some teachers in using ChatGPT, particularly in formulating effective prompts. This resonates with the findings of Kim (2024), those who emphasized the need for teachers to develop

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specific skills in interacting with AI tools to maximize their benefits. One teacher in our study shared,

"It took me some time to get the hang of using ChatGPT. I had to learn how to phrase my prompts carefully to get the results I wanted."

This underscores the importance of providing comprehensive training programs that not only teach teachers how to use AI tools but also how to leverage their capabilities effectively. Despite these challenges, the overall sentiment among teachers was overwhelmingly positive. They expressed enthusiasm for the potential of ChatGPT to revolutionize their teaching practice and improve student learning outcomes. This aligns with the broader literature on teacher adoption of educational technology, which emphasizes the importance of perceived usefulness and ease of use in influencing teachers' attitudes and behaviors toward new tools (Ifinedo, 2020; Granić & Marangunić, 2019; Li et al., 2019).

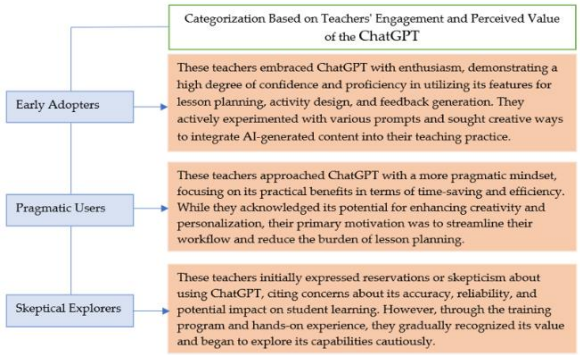

Figure 2. Categorization Based on Teachers' Engagement and Perceived Value of the ChatGPT

Figure 2 underscores the transformative potential of ChatGPT in enhancing teacher competence and facilitating the design of innovative and effective lesson modules. The significant improvements observed in teacher self-efficacy, pedagogical knowledge, and technological proficiency after the ChatGPT training program align with previous research that has highlighted the positive impact of AI tools on teacher professional development (ElSayary, 2024; Zhang & Tur, 2024; Siminto et al., 2023). Notably, teachers reported a heightened sense of confidence in their ability to create engaging lesson plans, incorporate diverse learning activities, and design effective assessments. This newfound confidence can be attributed to ChatGPT's ability to provide on-demand support, generate creative ideas, and streamline lesson planning processes, echoing the findings that noted a significant time-saving benefit for teachers using ChatGPT (Rasul et al., 2023; Thanh et al., 2023).

Furthermore, the high ratings of lesson modules created with ChatGPT suggest that AI can be a valuable asset for teachers in developing engaging and learner-centered learning experiences. This aligns with the principles of Universal Design for Learning (UDL), which emphasizes providing multiple means of representation, engagement, and action to cater to diverse learner needs (Baskara, 2024; Ayala, 2023). Teachers in this study reported that ChatGPT enabled them to create more interactive and personalized learning materials, incorporating elements such as quizzes, simulations, and tailored learning paths. This aligns with the findings of Rasul et al. (2023) and Javaid et al. (2023), who highlighted the potential of ChatGPT to enhance student engagement and learning outcomes.

Interestingly, the study revealed distinct patterns of ChatGPT adoption and utilization among the participating teachers. Some teachers (Early Adopters) embraced the tool with enthusiasm, actively experimenting and seeking innovative ways to integrate AI-generated content. Others (Pragmatic Users) focused on its practical benefits in terms of time-saving and efficiency, while a third group (Skeptical Explorers) initially approached ChatGPT with caution but gradually recognized its value. This categorization echoes (Rogers, 1962) the diffusion of innovations theory, which describes the varying rates at which individuals adopt new technologies. Recognizing these diverse adoption patterns is crucial for designing effective professional development programs that cater to the specific needs and preferences of different teacher groups. The study's findings have important implications for teacher professional development and educational technology design. To maximize the benefits of ChatGPT, professional development programs should offer differentiated support, providing basic training for Skeptical Explorers, practical guidance for Pragmatic Users, and advanced training for Early Adopters. Additionally, educational technology developers should consider the diverse needs of users when designing AI tools, incorporating features that appeal to both early adopters and late adopters.

While this study offers valuable insights, it is important to acknowledge its limitations, including the small sample size and the context-specific nature of the findings. Further research is needed to explore the long-term impact of ChatGPT on teacher competence and student

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learning outcomes in diverse educational settings. Longitudinal studies could examine how teachers' use of ChatGPT evolves over time and how it influences their pedagogical practices. Additionally, it would be beneficial to investigate the effectiveness of different professional development approaches in supporting teachers from diverse backgrounds and with varying levels of technological expertise. In conclusion, this study demonstrates the transformative potential of ChatGPT in enhancing teacher competence and facilitating the design of innovative and effective lesson modules. By acknowledging the diversity of teacher needs and providing tailored support, educators can harness the power of AI to revolutionize teaching and learning in the 21st century.

4. Conclusion and recommendation

The findings of this study provide compelling evidence of ChatGPT's transformative potential in enhancing teacher competence and facilitating the design of innovative and effective lesson modules. The significant improvements in teacher self-efficacy, pedagogical knowledge, and technological proficiency after the three-day ChatGPT training program, coupled with the high quality of the lesson modules they produced, underscore the value of integrating AI tools into teacher professional development. The diverse responses from teachers, categorized as Early Adopters, Pragmatic Users, and Skeptical Explorers, highlight the importance of tailoring professional development initiatives to individual needs and preferences. The study suggests that ChatGPT can empower teachers to create more engaging, personalized, and effective learning experiences for their students.

While the results of this study are promising, it is essential to acknowledge certain limitations. First, the small sample size (N=25) and convenience sampling method limit the generalizability of the findings to other contexts. Additionally, the short duration of the training program (three days) may not be sufficient for teachers to fully master the intricacies of using ChatGPT for lesson planning and module design. Further research with larger and more diverse samples, as well as longer-term interventions, is needed to validate and extend these findings. Moreover, this study focused primarily on teachers' self-reported perceptions and the quality of lesson modules as assessed by the researchers. Future studies could incorporate student perspectives and examine the actual impact of ChatGPT-designed lesson modules on student learning outcomes. It would also be valuable to explore the potential ethical implications of using AI in education, such as concerns about bias, equity, and the role of human teachers in the learning process. Despite these limitations, this study contributes valuable insights into the potential of ChatGPT to transform teacher competence and lesson design. The findings suggest that with proper training and support, teachers can leverage this powerful AI tool to create more effective and engaging learning experiences for their students.

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