

Enhancing Pre-Service Teachers' Understanding of Pedagogical Key Ideas by Integrating ChatGPT in ODL Course Tutorials

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Abstract

This study aimed to enhance pre-service teachers' understanding of pedagogical key ideas by integrating ChatGPT in the open and distance learning (ODL) pedagogy course tutorials. Purposive sampling was employed in this case study to select nine pre-service teachers from an ODL university. Data were collected through the participants' reflective reports, video recordings of their presentation of reflective reports, and revised reflective reports. Descriptive statistics and Friedman test with post hoc Wilcoxon signed rank tests were used to analyze the data. The findings showed that 55.56% of the participants achieved a substantial understanding of pedagogical key ideas in their initial reflective reports and their presentation of reflective reports, respectively, while 44.45% achieved a partial understanding. The participants improved in their revised reflective reports after incorporating feedback from the tutor and peers, with 55.56% achieved a high understanding of pedagogical key ideas, 33.33% achieved a substantial understanding, while 11.10% achieved a partial understanding. The Friedman test with post hoc Wilcoxon signed rank tests showed that there was a significant difference in the participants' understanding of pedagogical key ideas before and after, and during and after the tutorials.

Keywords: Teacher Education, Pedagogy, Chatgpt, Pre-Service Teachers, Open and Distance Learning

Introduction

Chat-based Generative Pre-trained Transformer or ChatGPT was developed by OpenAI and launched in November 2022. Since then, ChatGPT has significantly affected many essential sectors including higher education in Malaysia. This is because ChatGPT has the potential to transform teaching and learning experiences in both conventional and open and distance learning higher education institutions. Due to its advanced natural language processing capability, ChatGPT has demonstrated significant capability to reply like a human

and interact with educators and students in dynamic and interactive dialogue based on their specific inputs (Paul, Ueno, & Dennis, 2023). Consequently, ChatGPT is being explored more and more by researchers as a pedagogical tool to enhance teaching approaches as well as encourage high levels of student engagement in learning (Firat, 2023). In fact, Qadir (2023) and Reyna (2023) revealed that ChatGPT has the potential to transform learning experiences by providing personalized, interactive, and dynamic support to students. ChatGPT can also adapt to students' levels of knowledge and learning preferences by offering customized explanations and relevant examples which fosters deeper understanding of key ideas (Zhai, 2023). Kim et al. (2023) found that appropriate interactions with ChatGPT support independent learning which enable students to receive immediate feedback, track their progress, and identify areas for further improvement. In addition, Tsai (2023) discovered that the responsiveness and adaptability of ChatGPT allow students to be more engaged with course materials through active learning and questioning, and become independent in their learning process. Since ChatGPT is able to generate contextually relevant responses and maintain interactive conversations, Qadir (2023) reported that students showed higher interaction levels with course materials which lead to better understanding of key ideas.

In view of its capability to support educators and students in both conventional and open and distance learning environments, the integration of ChatGPT in higher education has received a lot of attention worldwide. For instance, educators can employ ChatGPT to design engaging and interactive activities that stimulate collaborative learning and critical thinking among students (Reyna, 2023). In addition, through interactive dialogue, it enables students to explore course content, receive personalized feedback, and access relevant information in real time, which enhances their understanding of key ideas. ChatGPT can also serve as a virtual tutor which supports inquiry-based learning and guides students through challenging topics and abstract key ideas with relevant examples (Ding et al., 2023). More importantly, Temsah, Jamal, and Al-Tawfiq (2023) found that integrating ChatGPT in reflective learning activities allowed students to engage in reflective thinking. Students who wrote reflective reports in their learning process were better able to analyze their interactions with ChatGPT and improved their understanding of key ideas. Besides, Schönberger et al. (2024) revealed that students who used ChatGPT in their learning activities were more likely to ask questions and seek clarifications which enhanced their understanding of key ideas.

The literature review above indicates that there has been an increasing number of studies on the role of ChatGPT in teaching and learning within conventional higher education institutions, and the integration of ChatGPT in specific fields, including engineering (Qadir, 2023), physics (Bitzenbauer, 2023), computer science (Qureshi, 2023), public health (Rusandi et al., 2023), second language learning (Kim, Shim, & Shim, 2023), and science education (Zhai, 2023). However, there is a research gap in understanding the role of ChatGPT in non-conventional higher education institutions, such as ODL higher education institutions in Malaysia. There is also a research gap in understanding the integration of ChatGPT in other essential fields, particularly in teacher education with pedagogy course tutorials in Malaysia. This is because, in ODL environments, where adult students prefer to study course content independently and at their own pace, integrating ChatGPT offers flexible opportunities to address students' understanding of key ideas by providing active, self-directed and self-paced learning. This is supported by Cacicio and Riggs (2023) that the capability of ChatGPT to provide instant feedback and facilitate self-directed and self-paced learning is particularly

tailored to the needs of ODL adult students which enable them to clarify their understanding of key ideas through reflective reports and iterative learning process. With the limited synchronous interactions and the need for flexible, self-directed and self-paced learning as well as other unique challenges of ODL, the potential role of ChatGPT in enhancing pre-service teachers' understanding of pedagogical key ideas is yet to be explored. It is thus timely to explore how the integration of ChatGPT in the ODL pedagogy course tutorials can enhance pre-service teachers' understanding of pedagogical key ideas by writing, presenting and revising their reflective reports based on tutor and peer feedback.

Purpose of the study

This study aimed to enhance pre-service teachers' understanding of pedagogical key ideas by integrating ChatGPT in the ODL Introduction to Pedagogy course tutorials. The pre-service teachers were required to: (1) write a reflective report based on the elaboration of the key ideas through interactions with ChatGPT before the tutorial; (2) present their reflective report during the tutorial with feedback from the tutor and peers after the presentation; and (3) revise their reflective report by incorporating feedback from the tutor and peers after the tutorial. Specifically, the study sought to answer the following research questions:

1. What are pre-service teachers' understanding of pedagogical key ideas through interactions with ChatGPT as shown in their:
 - (a) reflective reports before tutorial?
 - (b) presentation of reflective reports during the tutorial?
 - (c) revised reflective reports after the tutorial?
2. Is there a significant difference in the pre-service teachers' understanding of pedagogical key ideas before, during, and after the course tutorials?

To answer the second research question, the following null and alternative hypotheses were evaluated:

H₀: There is no significant difference in the pre-service teachers' understanding of pedagogical key ideas across the three time points (before, during, and after the tutorials).

H₁: There is a significant difference in the pre-service teachers' understanding of pedagogical key ideas across at least one of the time points (before, during, and after the tutorials).

Methodology

Research Design

The researchers employed a case study to investigate whether there is a significant difference in the pre-service teachers' understanding of pedagogical key ideas before, during, and after the course tutorials. This research design allowed for an in-depth study of the pre-service teachers' understanding of pedagogical key ideas through interactions with ChatGPT as demonstrated in their reflective reports before tutorials, presentation of the reflective reports during tutorials, and revised reflective reports after tutorials (Yin, 2018). This continuous collection of data is well-suited to the case study design of obtaining the richness of pre-service teachers' understanding of pedagogical key ideas over time. It also allows for the incorporation of feedback from the tutor and peers in the revised reflective reports, thus

providing an overall perspective of the pre-service teachers' evolving understanding of pedagogical key ideas before, during, and after the course tutorials (Stake 1995).

Participants

The researchers used purposive sampling to choose the participants of the study from a teacher education course at an ODL university in Penang, Malaysia. The EED205/03 Introduction to Pedagogy course, which was offered via ODL mode with three online tutorials via Microsoft Teams, was selected for its foundational role in equipping pre-service teachers with essential pedagogical knowledge and skills. Specifically, the study focused on all the pre-service teachers who enrolled in the Bachelor of Education programme because they were prospective teachers who would directly benefit from the integration of ChatGPT in the pedagogy course tutorials. The participants were nine female pre-service teachers enrolled in the course at the ODL university. Because of the novelty of using ChatGPT in the ODL course tutorials, a smaller sample allows for a deeper analysis of individual learning processes, interactions, and improvements in writing reflective reports (Creswell & Creswell, 2018; Yin, 2018). In addition, all the ODL participants had prior experience of online learning environments, and thus they were quite capable of engaging with ChatGPT as a virtual learning tool within the ODL tutorial settings. Although gender composition of the sample was not initially a selection criterion, it reflects the general trend in ODL teacher education programmes in Malaysia, in which the enrolment is predominantly female. Table 1 shows the demographic information of the participants.

Table 1

Participants' Demographic Information

Ethnicity	Female
Malay	1 (11.12%)
Chinese	4 (44.44%)
Indian	4 (44.44%)
Total	9 (100.00%)

Methods of Data Collection

The study was conducted in three sequential stages. Firstly, prior to the commencement of the tutorials, a project briefing was carried out by the main author to explain the research objectives and procedures, as well as how to interact with ChatGPT to elaborate on the pedagogical key ideas from the course module in the Learning Management System of the ODL university (known as *Flexlearn*) for the participants. During the briefing, the class was also divided into three smaller groups. Each group was assigned to a particular tutorial for presenting their reflective reports. The groups were assigned as follows: **Tutorial 1:** Participants 1, 2, and 3; **Tutorial 2:** Participants 4, 5, and 6; and **Tutorial 3:** Participants 7, 8, and 9. Every participant was assigned a pedagogical key idea and instructed to gather information on the key ideas from the course module in *Flexlearn*. The participants were then required to interact with ChatGPT to elaborate on the pedagogical key ideas for enhancing their understanding of the key ideas. Following their interactions with ChatGPT, the participants completed their reflective reports in their own words using the suggested structured format provided to them: (1) **Introduction** - a brief overview of the pedagogical key idea; (2) **Body** - a detailed elaboration of the pedagogical key idea along with relevant examples; and (3) **Conclusion** - a summary of their understanding of the pedagogical key idea.

All the participants were required to submit their completed reflective report through email to the researchers and tutor for analysis before attending their assigned tutorials.

Secondly, during their assigned tutorials, the participants presented their reflective reports on the pedagogical key ideas to the tutor and peers. Each participant was given 5-10 minutes to present their reflective report, followed by a Question-and-Answer session in which feedback was provided by the tutor and peers to further improve their reflective report. The participants were required to take note of this feedback for subsequent revisions after the tutorials. The online presentations of the reflective reports were recorded using Microsoft Teams. The recordings provided further information about the participants' understanding of the key ideas for analysis later as demonstrated by their confidence, clarity of expression, and engagement with the tutor and peers.

Lastly, after the respective tutorials, the participants revised their reflective reports by incorporating the feedback received from the tutor and peers. The revised reflective reports allowed the participants to demonstrate a better understanding of the key ideas through the incorporation of constructive feedback to improve the elaboration of the key ideas. Upon completion, the participants were required to email their revised reflective reports to the researchers and tutor for analysis after the tutorials.

Methods of Data Analysis

To answer Research Question 1(a), two independent raters employed a rubric to score the participants' understanding of pedagogical key ideas through interactions with ChatGPT as shown in their reflective reports before the tutorial. This rubric assessed their understanding of pedagogical key ideas in terms of Introduction, Body, Conclusion, Reliance on ChatGPT, and Language, on a four-point Likert scale, namely, 1 = Low, 2 = Partial, 3 = Substantial, and 4 = High. The inter-rater reliability analysis produced a Cohen's Kappa coefficient of 0.88, indicating a substantial agreement between the two raters (Landis & Koch, 1977). Initial score discrepancies were resolved with discussion between the raters to obtain consensus scores after the inter-rater reliability analysis. These consensus scores were used to determine the participants' understanding of pedagogical key ideas before the tutorial. Descriptive statistics were then employed to report the participants' understanding of pedagogical key ideas before the tutorials.

To answer Research Question 1(b), two independent raters employed a rubric to score the participants' understanding of pedagogical key ideas as shown in their presentation of the reflective reports during the tutorial. This rubric assessed their understanding of the key ideas in terms of Introduction, Body, Conclusion, Reliance on ChatGPT, Language, and Delivery, on the four-point Likert scale. The inter-rater reliability analysis yielded a Cohen's Kappa coefficient of 0.67, suggesting a substantial agreement between the two raters (Landis & Koch, 1977). After the inter-rater reliability analysis, discrepancies in initial scoring were resolved through discussion between the raters which lead to consensus scores. These consensus scores were used to determine the participants' understanding of pedagogical key ideas during the tutorial. Descriptive statistics were then employed to report the participants' understanding of pedagogical key ideas during the tutorials.

To answer Research Question 1(c), the two independent raters used a rubric to score the participants' understanding of pedagogical key ideas as shown in their revised reflective reports after the tutorial. This rubric assessed their understanding of key ideas in terms of Introduction, Body, Conclusion, Reliance on ChatGPT, and Language, on the four-point Likert scale. The inter-rater reliability analysis generated a Cohen's Kappa coefficient of 0.67, indicating substantial agreement between the two raters (Landis & Koch, 1977). Likewise, discrepancies in initial scoring were resolved through discussion between the raters that resulted in consensus scores after the inter-rater reliability analysis. These consensus scores were used to determine the participants' understanding of pedagogical key ideas after the tutorial. Descriptive statistics were then used to report the participants' understanding of pedagogical key ideas after the tutorials.

To answer Research Question 2, the tests for normality were conducted using IBM SPSS version 30 to determine the normality of the scores for the pre-service teachers' understanding of pedagogical key ideas before, during, and after the tutorials. The independent variable is time point, which has three levels, namely before, during and after tutorials. The dependent variable is pre-service teachers' understanding of pedagogical key ideas. Table 2 shows the results of the tests for normality. The results of the Kolmogorov-Smirnov and Shapiro-Wilk Tests indicate that the scores for the pre-service teachers' understanding of pedagogical key ideas before ($p < .05$), during ($p < .05$), and after ($p < .05$) the tutorials significantly deviate from a normal distribution, respectively (Field, 2018).

Table 2

Results of Tests for Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Before	.356	9	.002	.655	9	<.001
During	.356	9	.002	.655	9	<.001
After	.333	9	.005	.763	9	.008

a. Lilliefors Significance Correction

As a result, the Friedman test, which is the non-parametric alternative to the one-way ANOVA with repeated measures, was used to determine whether there is a significant difference in the pre-service teachers' understanding of pedagogical key ideas before, during, and after the course tutorials. If there is a significant difference, post hoc analysis with Wilcoxon signed-rank tests would be conducted with a Bonferroni correction to determine which pairs of time points (that is, before, during, and after the tutorials) in particular differ from each other (Field, 2018).

Findings

1(a) Understanding of pedagogical key ideas as shown in reflective reports before tutorial

Table 3 shows the frequency and percentage of the participants' understanding of pedagogical key ideas as shown in their reflective reports before the tutorial. From Table 3, 55.56% of the participants (P2, P3, P7, P8, and P9) obtained a score of 3, indicating that they have a substantial understanding of the pedagogical key ideas before the tutorials. This is evident in their reflective reports which provide a clear overview of the pedagogical key ideas, though some details in the Introduction section are not fully developed. In the Body section, they clearly elaborate on the key ideas with relevant examples, even though some areas may

lack detail. Their Conclusion section has a clear summary, although it may lack a detailed synthesis. In addition, they use ChatGPT content well with appropriate rewording, and good language with minimal grammatical or spelling errors. However, 44.44% of the participants (P1, P4, P5, and P6) obtained a score of 2, suggesting that they have a partial understanding of the pedagogical key ideas before the tutorials. This is evident in their reflective reports which provide a basic overview of the key ideas in the Introduction section but may lack of clarity. In the Body section, they provide little explanation of the key ideas with limited relevant examples. Their Conclusion section includes a basic summary, but gaps in understanding are evident. They rely partially on ChatGPT content by incorporating some rewording but showing only partial effort to express the key ideas in their own words, and an acceptable use of language with minor grammatical or spelling errors.

Table 3

Understanding of Pedagogical Key Ideas based on Reflective Reports

Participants	Score	Level	Frequency (%)
-	1	Low	0 (0.00%)
P1, P4, P5, P6	2	Partial	4 (44.44%)
P2, P3, P7, P8, P9	3	Substantial	5 (55.56%)
-	4	High	0 (0.00%)
Total			9 (100%)

1(b) Understanding of pedagogical key ideas as shown in presentation of reflective reports during tutorial

Table 4 displays the frequency and percentage of the participants' understanding of pedagogical key ideas as shown in their presentation of reflective reports during the tutorial.

Table 4

Understanding of Pedagogical Key Ideas based on Presentation of Reflective Reports

Participants	Score	Level	Frequency (%)
-	1	Low	0 (0.00%)
P1, P4, P5, P6	2	Partial	4 (44.44%)
P2, P3, P7, P8, P9	3	Substantial	5 (55.56%)
-	4	High	0 (0.00%)
Total			9 (100%)

From Table 4, 55.56% of the participants (P2, P3, P7, P8, and P9) achieved a score of 3, indicating that they have a substantial understanding of the pedagogical key ideas during the tutorial. This is because they presented a clear overview of the key ideas, but minor details might have been omitted in the Introduction section. In the Body section, they delivered good elaboration of the key ideas with relevant examples, although some areas may lack depth. Their Conclusion section provided a clear summary, although it might have lacked synthesis in detail. They used ChatGPT content well, with good rewording, and language use was good, with minimal grammatical errors. Their delivery was pleasant, with good volume control, pacing, and timing. They also showed confidence by maintaining smooth gestures and good eye contact. But 44.44% of the participants (P1, P4, P5, and P6) achieved a score of 2, suggesting that they have a partial understanding of the pedagogical key ideas during the tutorial. This is because they presented a basic overview of the key ideas, and missed some essential points in the Introduction section. In the Body section, they presented a basic

explanation with limited relevant examples, suggesting a partial understanding of the key ideas. Their Conclusion section presented a basic summary, but gaps in understanding were evident. They relied moderately on ChatGPT content, showing partial effort to integrate the key ideas in their own words, and language use was satisfactory with minor grammatical errors. Their delivery was quite pleasant, with sufficient volume, pacing and timing. They showed some confidence with easy gestures but limited eye contact.

1(c) Understanding of pedagogical key ideas as shown in revised reflective reports after the tutorial

Table 5 shows the frequency and percentage of the participants' understanding of pedagogical key ideas as shown in their revised written reflective reports that incorporate feedback from the tutor and peers after the tutorial.

Table 5

Understanding of Pedagogical Key Ideas based on Revised Reflective Reports

Participants	Score	Level	Frequency (%)
-	1	Low	0 (0.00%)
P5	2	Partial	1 (11.10%)
P1, P4, P9	3	Substantial	3 (33.33%)
P2, P3, P6, P7, P8	4	High	5 (55.56%)
		Total	9 (100%)

From Table 5, 55.56% of the participants (P2, P3, P6, P7, and P8) achieved a score of 4, indicating that they have a high understanding of the pedagogical key ideas after the tutorial. This is evident in their clear and concise overviews of the key ideas in the Introduction section which incorporate all the feedback from the tutor and peers. In the Body section, they effectively fully addressed the feedback by refining the elaboration of the key ideas with relevant examples. Their Conclusion section provided a clear and concise summary of the key ideas. Additionally, they integrated ChatGPT content well with their own words, and the use of language was good, with proper grammar, spelling, and sentence structures. Moreover, 33.33% of the participants (P1, P4, and P9) achieved a score of 3, suggesting that they have a substantial understanding of the pedagogical key ideas after the tutorial. This is because they provided a clear overview of the key ideas in the Introduction section by addressing most feedback effectively, although some minor details might still be lacking. In the Body section, they effectively elaborate on the key ideas with relevant examples by addressing most feedback, though some areas might still lack detail. Their Conclusion section provided a clear summary of the key ideas, though it might still lack detailed synthesis. They integrated ChatGPT content well with good rewording, the use of language was good, with minimum grammatical or spelling errors. However, Participant 5 (11.10%) obtained a score of 2, indicating that she has a partial understanding of the key ideas after the tutorial. This is because she provided only a basic overview of the key ideas by only partially addressing the feedback in the Introduction section. In the Body section, her elaboration was limited by addressing some feedback but lacking details with insufficient examples. Her Conclusion section provided only a basic summary by only partially addressing the feedback. She showed moderate reliance on ChatGPT content, and partial effort in integrating feedback and refining the key ideas in her own words. Her use of language was satisfactory, with minor grammatical or spelling errors.

2. Difference in understanding of pedagogical key ideas before, during, and after the course tutorials

Table 6 shows the results of Friedman test which was conducted to determine whether there is a significant difference in the pre-service teachers' understanding of pedagogical key ideas before, during, and after the course tutorials. The results of Friedman test show a significant difference in the pre-service teachers' understanding of pedagogical key ideas across at least one of the three time points (before, during, and after the tutorials), $\chi^2(2) = 14.000$, $p < 0.001$ (Field, 2018).

Table 6

Results of Friedman Test

Test Statistics ^a	
N	9
Chi-Square	14.000
df	2
Asymp. Sig.	<.001

a. Friedman Test

Table 7 shows the results of the post hoc analysis using Wilcoxon signed rank tests, which were conducted to determine which two time points (before and during, before and after, and during and after) in particular differ from each other. The results of the post hoc Wilcoxon signed rank tests with a Bonferroni correction (resulting in a significance level set at $.05/3 = .017$), indicate that there is a significant difference in the pre-service teachers' understanding of pedagogical key ideas before and after the tutorials ($Z = -2.530$, $p = .011$), as well as during and after the tutorials ($Z = -2.530$, $p = .011$). But there is no significant difference in the pre-service teachers' understanding of pedagogical key ideas before and during the tutorials ($Z = .000$, $p = 1.000$) (Field, 2018).

Table 7

Results of Post Hoc Wilcoxon Signed Rank Tests

	Test Statistics ^a		
	During - Before	After - Before	After - During
Z	.000 ^b	-2.530 ^c	-2.530 ^c
Asymp. Sig. (2-tailed)	1.000	.011	.011

a. Wilcoxon Signed Ranks Test

b. The sum of negative ranks equals the sum of positive ranks.

c. Based on negative ranks.

Discussion

The results of Research Question 1(a) show that the participants with a substantial understanding of the key ideas presented well-structured reflective reports by effectively integrating the generated content of ChatGPT with their own words. This aligns with Yang et al. (2021) who found that ChatGPT have the potential to enhance students' writing by providing various perspectives with immediate feedback. However, minor omissions in the Conclusion section by the participants suggest areas for improvement in synthesizing information. In contrast, the participants with a partial understanding of the key ideas showed a basic understanding with limited elaboration of the key ideas. Their surface-level engagement with the generated responses of ChatGPT echoes with the concerns of Zawacki-

Richter et al. (2019) that the uncritical use of ChatGPT may hinder the development of reflective thinking skills. This result highlights the need for pedagogical approaches that promote deep engagement with ChatGPT among students so that they can critically analyze and synthesize the generated content of ChatGPT to enhance their understanding of pedagogical key ideas (Selwyn, 2019).

The results of Research Question 1(b) are consistent with previous research (Biggs & Tang, 2011; Hyland, 2019) which found that although many students showed substantial understanding of the key ideas, some struggled with elaboration, clarity, or synthesis of the key ideas. Additionally, Goh and Burns (2012) found that presentation of key ideas requires students to organize and present the ideas coherently which lead to deeper engagement and cognitive processing. The participants with a good understanding of the pedagogical key ideas exhibited these deeper engagement and cognitive processing effectively by providing clear presentation of the Introduction, Body, and Conclusion sections. Their ability to integrate the content generated by ChatGPT in their own words concurs with Lee and VanPatten (2020), who revealed that ChatGPT can enhance students' understanding of key ideas when they actively engage with and synthesise the content generated by ChatGPT. However, the participants with a partial understanding of the pedagogical key ideas encountered difficulties in presenting clear Introduction, Body, and Conclusion sections. This is consistent with Morreale et al. (2007), who found that some students struggled with presentation of key ideas due to anxiety, lack of preparation and engagement with the ideas, or insufficient grasp of the ideas. The participants' reliance on the content generated by ChatGPT with little rewording is a common concern in the learning process assisted by ChatGPT as highlighted by Joseph et al. (2024). Meanwhile, the participants with a good understanding of the key ideas demonstrated minimal grammatical errors, good pacing, and confident delivery, which supports previous research by Knight (2018), who found that the good language use and communication skills are important for effective presentation of ideas. Conversely, those with a partial understanding of the key ideas had clarity issues due to minor grammatical errors and less confident delivery. This result is consistent with MacIntyre and Gregersen (2012), who discovered that language proficiency and self-confidence are important factors that contribute to effective presentation of key ideas.

The results of Research Question 1(c) indicate that the participants with a high understanding of the key ideas after the tutorial effectively incorporated feedback from the tutor and peers, and showed improved synthesis of the key ideas in their revised reflective reports. This result aligns with Kasneci et al. (2023) and Zhai (2023) who found that ChatGPT provides an effective scaffolding mechanism for enhancing the students' understanding of key ideas. Further, Luckin et al. (2016) demonstrated that ChatGPT fosters a more interactive and personalized learning experience which enables learners to refine their understanding over time. This is further supported by Wong et al. (2022) that ChatGPT improves students' ability to construct well-structured arguments and synthesize information effectively. However, the participants with a substantial understanding of the key ideas after the tutorial still had challenges in fully incorporating feedback from the tutor and peers, indicating that additional scaffolding or structured guidance may be required. This is consistent with Homes et al. (2019), who revealed that although ChatGPT can enhance learners' writing skills, its effectiveness depends on their ability to critically engage with the generated content of ChatGPT as well as incorporate the feedback appropriately. Furthermore, the participant with

a partial understanding of the key ideas after the tutorial faced difficulties in fully addressing the feedback, indicating that ChatGPT alone may not be sufficient for all the participants. This result aligns with Bailey and Lee (2020), who found that some learners may require more structured intervention or explicit guidance to improve their understanding of the key ideas. [34] also highlights the importance of human mediation in using ChatGPT to ensure that students critically evaluate and refine the generated responses of ChatGPT.

The results of Research Question 2 indicate that the integration of ChatGPT in the ODL Introduction to Pedagogy course tutorials enhanced the pre-service teachers' understanding of pedagogical key ideas after the course tutorials. These results align with Temsah et al. (2023), who found that integrating ChatGPT in reflective learning activities allowed students to engage in reflective thinking. Students who wrote reflective reports in their learning process were better able to analyze their interactions with ChatGPT and improve their understanding of key ideas. In addition, Schönberger (2024) highlighted that students who used ChatGPT in their learning activities were more likely to ask questions and seek clarifications which enhanced their understanding of key ideas. Cacicio and Riggs (2023) emphasised that the capability of ChatGPT to provide instant feedback and facilitate self-directed and self-paced learning is particularly tailored to the needs of ODL adult students which enable them to clarify their understanding of key ideas through reflective report and iterative learning process.

Conclusion

The results reveal that pre-service teachers who actively engaged in iterative questioning and refinement of the generated content of ChatGPT showed a higher understanding of pedagogical key ideas. This supports existing literature (Slimi, 2022; Wang et al., 2024), which reveal that ChatGPT can facilitate self-directed learning and improve elaboration of key ideas when students critically analyze the generated responses of ChatGPT. Nevertheless, some pre-service teachers showed a surface-level reliance on ChatGPT which lead to lower understanding and synthesis of the key ideas in their reflective reports and presentations. This result aligns with past researchers' concerns (Zawacki-Richter et al., 2019; Joseph et al., 2024), that uncritical use of ChatGPT may hinder deeper cognitive processing and reflective thinking skills among students. Furthermore, the study highlights the importance of integrating ChatGPT with structured feedback from tutor and peers during the tutorials. The participants who revised their reflective reports after receiving feedback showed an improvement in depth and synthesis of pedagogical key ideas. This result supports past research (Luckin et al., 2016; Wang et al., 2022), that highlight the interactive and iterative nature of learning environments assisted by ChatGPT. But, participants who continued to struggle with fully addressing the feedback indicates the need for additional scaffolding or explicit guidance in using ChatGPT as pointed out by Holmes et al. (2021) and Bailey and Lee (2020).

In conclusion, the results suggest that ChatGPT can be a valuable learning tool in ODL teacher education course tutorials when integrated with pedagogical approaches that promote self-directed and self-paced learning among pre-service teachers. But, to maximize its effectiveness, pedagogical approaches should emphasize structured feedback mechanisms and reflective thinking strategies.

Contributions of the Study

The study offers several contributions to teacher education, especially within the ODL setting. By integrating ChatGPT in the ODL pedagogy course tutorials, this study reveals how ChatGPT can serve as an interactive virtual tutor to facilitate deeper understanding of abstract pedagogical key ideas among pre-service teachers. The results suggest that ChatGPT can be effective in enhancing pre-service teachers' understanding of pedagogical key ideas, making quality pedagogical training more accessible to ODL pre-service teachers who do not have face-to-face tutorials. Thus, the findings of this study contribute to the existing literature that explores the role of ChatGPT in teacher education by providing empirical support for its pedagogical utility, especially in fostering reflective thinking, and understanding of abstract pedagogical key ideas among pre-service teachers. The integration of ChatGPT in ODL teacher education course tutorials opens new possibilities for teacher educators to rethink how pedagogy is taught, especially in ODL higher education institutions where synchronous and personalized interactions are often limited, as well as the need for flexible, self-directed and self-paced learning among pre-service teachers.

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