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Research Article

Examining Pre-service Mathematics Teachers' Purposes of Using ChatGPT in Lesson Plan Development

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Abstract: This study aimed to examine pre-service middle school mathematics teachers' purposes of using ChatGPT in lesson plan development. Phenomenology, one of the qualitative research designs, was applied in this study. A total of 56 third-grade pre-service middle school mathematics teachers, 43 females and 13 males were selected for the study. A questionnaire with open-ended questions was employed to gather data. First, pre-service teachers were asked to select one or more learning outcomes in the mathematics curriculum and prepare a lesson plan to address these outcomes using the ChatGPT program. Then, they completed the questionnaire. Content analysis was utilized in the current study to analyze the data. According to the results of the study, ChatGPT served as a valuable tool for pre-service mathematics teachers during lesson plan development. While not all participants utilized it for every subcategory, ChatGPT played a significant role in various aspects, including determining the subject scope, getting creative and interesting ideas, explaining math concepts, establishing relationships and the course flow, developing learning activities, problems, and evaluation tools, and even reviewing and improving the lesson plan. Moreover, pre-service teachers used ChatGPT to deepen their knowledge of mathematical concepts, learning strategies, and teaching models. However, it is important to remember that ChatGPT should be viewed as a support system, not a replacement for a teacher's knowledge and expertise.

Keywords: Artificial Intelligence, ChatGPT, Pre-Service Teacher, Lesson Plan, Education

1. Introduction

Recent technological advancements and expansions have led to more sophisticated and innovative digital content production techniques, such as generative artificial intelligence. Artificial intelligence (AI) has achieved extraordinary success in processing text, and the results are often indistinguishable from what humans can produce (Bishop, 2021). Advanced AI systems called large language models are made to comprehend and produce text that resembles that of a person. Large volumes of text data are used to train these models, like the GPT (Generative Pre-Trained Transformer) series, to identify patterns and linguistic structures in human language. They can create text, translate it, summarize it, and do many other linguistic activities (OpenAI, 2024). Chatbots are computer programs that simulate human-to-human conversation using chat interfaces. The AI-based chatbot known as ChatGPT (Chat Generative Pre-trained Transformer) was introduced as a prototype by OpenAI on November 30, 2022, and it quickly gained publicity for its extensive and well-spoken answers to queries covering a wide range of technical and professional knowledge disciplines (Wikipedia, 2024). Due to its substantial text data training, ChatGPT can interpret the context, intent, and tone of user input, allowing it to provide insightful and accurate answers (Haleem et al., 2022).

A supercomputer, a device with massive processing capacity and adaptive behaviors like adding sensors and other characteristics that allow it to work and think like a person, comes to mind when one thinks about AI. The use of AI in education has expanded, going beyond the traditional idea of AI as a supercomputer to include embedded computer systems (Chen et al., 2020). Education is one of the industries that will benefit greatly from artificial intelligence technology. AI has revolutionized education by making learning easier and fostering greater independence in students (Osman & Ahmed, 2024). Educational practices around the world have changed rapidly in recent decades, largely due to

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technological breakthroughs. Among these technological advancements, artificial intelligence models such as ChatGPT is one of the most important and influential forces (Grassini, 2023; Makridakis, 2017).

For teachers, preparing lesson plans that are effective, purposeful, and responsive to student needs and differences can be daunting tasks. One of these difficulties is that the fundamental components of a lesson plan—learning objectives, learning activities, and assessment—are not addressed or integrated (Sebullen, 2023). ChatGPT offers rapid access to a wide range of information and teaching methods, and it can generate summaries and educational resources to support lesson planning (Castro et al., 2024). Furthermore, ChatGPT allows teachers to brainstorm and develop creative ideas by generating ideas, suggesting relevant resources, and providing summaries of complex information. In this way, it can assist in the lesson planning process. Similarly, Kasneci et al. (2023) mentioned its ability to aid brainstorming, but they also stressed the need for review to guarantee accuracy and avoid plagiarism. ChatGPT can assist teachers in identifying instructional materials and creating plans; however, it is not an alternative for teachers. Rather, it should be employed to support teachers by offering ideas for better teaching methods and up-to-date instructional materials (Samala et al., 2024). It can also help teachers to create customized lesson plans for teaching with a set of parameters and constraints. Additionally, AI can serve as a starting point for novice teachers with less teaching experience and pedagogical knowledge (Farrokhnia et al., 2023). Moreover, "AI can be used to automatically grade assignments and assessments, which can save time and reduce the workload for teachers" (Zhai, 2022, p. 5). ChatGPT can also create exercises, tests, and even personalized assessment materials for specific learning objectives (Farrokhnia et al., 2023; Zhai, 2022). Overall, the use of AI for lesson planning has the potential to greatly increase the efficiency and effectiveness of education by enabling educators to plan lessons and other resources and providing students more easily and accurately with more personalized planning options (Fuchs, 2023; Zhai, 2022).

A study by Baidoo-Anu and Ansah (2023) summarizes earlier research to offer some potential benefits of ChatGPT in advancing education. Among the many advantages of ChatGPT are its ability to facilitate personalized and interactive learning and generate ideas for formative assessment tasks that provide continuous feedback. The study offers suggestions for enhancing classroom instruction through the use of ChatGPT. Consequently, the researchers argued that educators might use ChatGPT and further generative AI-based technologies to support their students' learning. According to a study by Alshahrani (2023), ChatGPT could be used to customize learning and increase engagement. The study provided a model for sustainable learning that incorporates AI and assessed the application of AI approaches in enhancing the sustainability of educational settings. The results of the study demonstrated the possible advantages of incorporating ChatGPT and other AI chatbots into the classroom. These advantages included encouraging student motivation, engagement, and self-directed learning through rapid feedback and support. ChatGPT and similar AI technologies offer numerous promising opportunities for education, but it is important to be aware of their limitations and potential drawbacks. Undoubtedly, the primary drawback of implementing ChatGPT in education is the possibility of false information. Despite ChatGPT's extensive training on vast amounts of data, there remains a possibility that it may provide erroneous or incomplete information. For educators lacking the necessary expertise or time, monitoring ChatGPT responses poses a considerable challenge (Samala et al., 2024).

This study aimed to examine the purposes of pre-service middle school mathematics teachers in preparing lesson plans using ChatGPT, an AI tool. Intelligent teaching systems that use AI to adapt content to each student are widely used in many classrooms (Molenar, 2021). Technology integration in teaching enriches the learning experience compared to traditional teaching methods. Artificial intelligence can assist teachers with tasks such as grading, lesson planning, and providing feedback (Singh & Singh, 2021). Similarly, AI tools such as ChatGPT are important tools for teachers to use technology effectively when creating course materials (Vincent-Lancrin & Van der Vlies, 2020). AI tools

like ChatGPT can save teachers time when creating and editing course materials. This way, teachers can focus more of their time on interacting with students and supporting learning. The other role of AI is to support human intelligence and help people with learning tasks (Osman & Ahmed, 2024). By offering individualized feedback, detecting trends in data, and facilitating group learning, AI has the potential to raise the standard of instruction. However, there are other challenges in incorporating AI into educational settings, such as dealing with ethical and privacy issues and ensuring that AI-based systems are compatible with human values (Renz & Vladova, 2021). In this context, pre-service mathematics teachers' purposes of using ChatGPT in the lesson plan development were examined. For this reason, the main research problem of the study is:

MP: What are the purposes of pre-service mathematics teachers in using ChatGPT in lesson plan development?

The research problem has two sub-problems:

SP1: To what extent do pre-service mathematics teachers use ChatGPT for creating lesson content?

SP2: How does ChatGPT support pre-service mathematics teachers in deepening individual knowledge and eliminating deficiencies while developing lesson plans?

2. Method

Determining and interpreting the shared meaning of people's experiences and perceptions of a phenomenon or idea is the aim of phenomenological research (Creswell, 2013; Yıldırım & Şimşek, 2018). In the same way, the current study aimed to examine the purposes of pre-service mathematics teachers in using ChatGPT when developing lesson plans. Therefore, phenomenology, one of the qualitative research designs, was applied in this study.

2.1 Participants

The study participants were chosen through the use of the method of convenience sampling voluntarily. The researcher benefits from speed and practicality while using the convenience sampling method (Yıldırım & Şimşek, 2018). In the spring semester of the 2023-2024 academic year, third-grade pre-service teachers enrolled in the middle school mathematics teaching program of a state university in Turkey were selected as participants of the research. A total of 56 pre-service middle school mathematics teachers, 43 females, and 13 males were selected for the study. All pre-service teachers took an "Information Technology" course that was about computer systems, software, and data and information processing. In addition, a conference on the use of AI in education was given to pre-service teachers at the end of the fall semester of the 2023-2024 academic year.

2.2 Data Collection

A questionnaire with open-ended questions was employed to gather data. The researcher prepared the questionnaire. In the questionnaire, there were an open-ended question and three follow-up questions. The purpose of the follow-up questions was to help participants understand the target response level and to enhance the depth of the data by prompting deeper responses from them. First of all, pre-service teachers were asked to select one or more learning outcomes in the mathematics curriculum and prepare a lesson plan to address these outcomes using the ChatGPT program. Lesson plans were not included in the data analysis. The purpose of asking pre-service teachers to prepare lesson plans was to ensure that all of them experienced preparing lesson plans with ChatGPT. Then, they completed the questionnaire. Two experts, one in mathematics education and the other in Turkish education, were shown the initial draft of the questionnaire. Three pre-service teachers who developed lesson plans

using the ChatGPT program but were not participating in the research were asked to respond to the questions to assess their clarity and understandability. The completed questionnaire was provided in its final version after the required adjustments were made. The questions in their final form are listed below:

Question: For what purpose did you use the ChatGPT program while preparing your lesson plan? Please explain in detail.

Follow-up questions: If you used the ChatGPT program during the lecture phase, for what purpose and how did you use it?

If you used the ChatGPT program during the evaluation phase, for what purpose and how did you use it?

If you used the ChatGPT program while preparing a lesson plan to deepen your own knowledge and eliminate your deficiencies, for what purpose and how did you use it?

2.3 Data Analysis

Content analysis was utilized in the current study to divide the data into manageable units (Patton, 2002). The content analysis method was used with the help of NVivo, a qualitative data analysis software. Content analysis is a method that requires in-depth analysis of the data and allows revealing previously undetermined themes and dimensions (Yıldırım & Şimşek, 2018). First, three main themes were created by considering three follow-up questions. Later, the first theme, the lecture phase, and the second theme, the evaluation phase, were combined and created lesson content due to overlaps and similarities. As a result, two main themes were created after data analysis: creating lesson content and deepening individual knowledge and eliminating deficiencies. Another field expert looked over the codes and themes that had been found. Ultimately, a concept map was used to define and explain the results. Information about the participants was given using abbreviations; for example, pre-service teacher 1 was coded as PT1.

2.4 Validity and Reliability

To strengthen the study's validity, quotes taken directly from participant responses were included while presenting the results. Additionally, preservice teachers were informed of the data analysis results, and their input was considered to depict the phenomenon accurately and impartially under study (Merriam, 2013). Moreover, some of the data obtained during the study were analyzed by a mathematics teacher as a second coder. Reliability of the data analysis was calculated using Miles and Huberman's (1994) formula, "Percent of agreement = [Agreements / (Agreements + Disagreements)]x 100." The percent of agreement between the two coders was found to be 98% and was considered reliable for this study (Miles & Huberman, 1994). The coders came together and agreed about the code under which the pre-service teachers should be coded by looking at the lesson plans of the pre-service teachers for the unanimous data. Ultimately, the latest version of the coding presented with frequencies under the findings was created (see Figure 1).

2.4 Ethical Principles

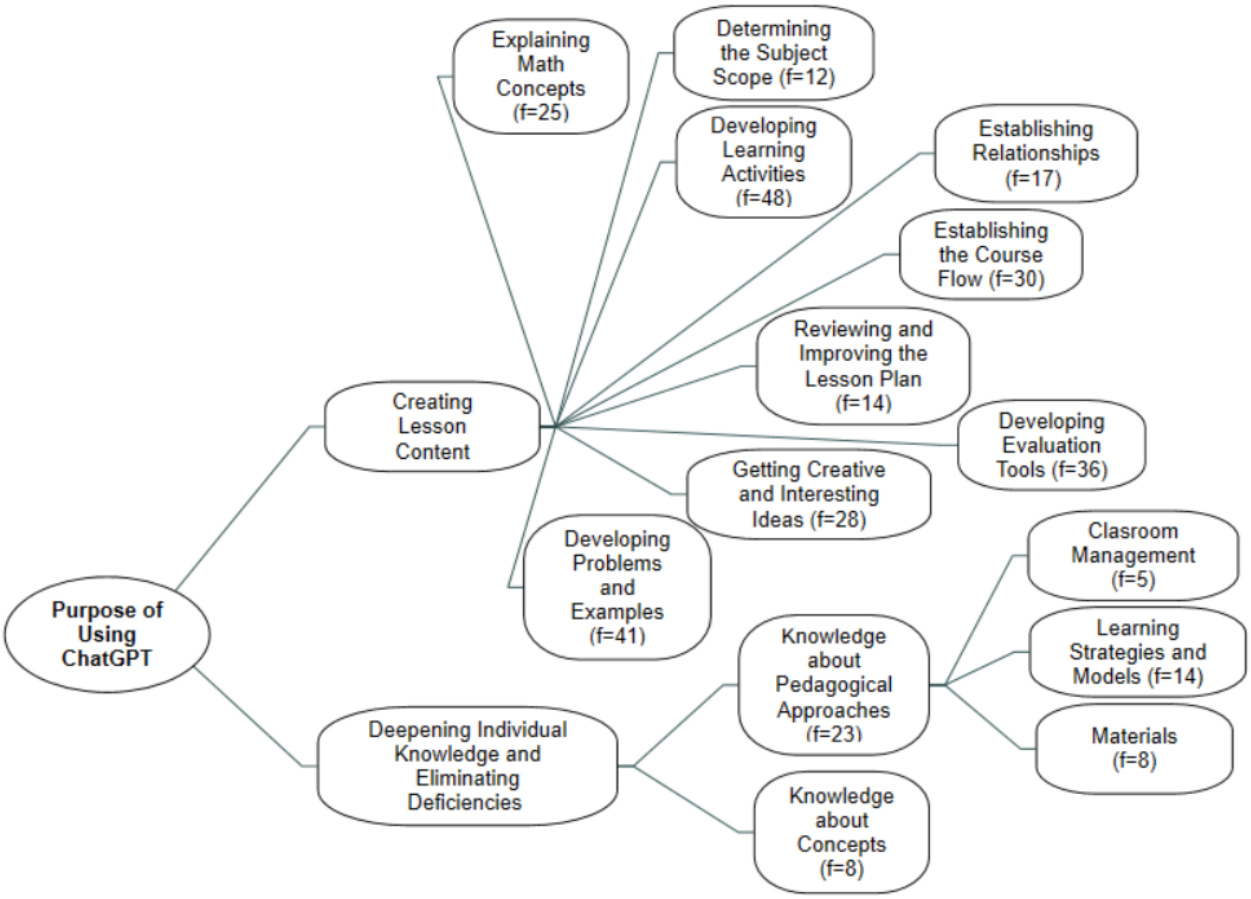
Ethics committee permission was received from Zonguldak Bülent Ecevit University Ethics Committee with the decision dated 04.04.2024 and numbered 588.

3. Findings

This section presents findings on pre-service teachers' purposes for using the ChatGPT program during lesson plan development. According to the analysis of data, pre-service teachers' purposes for using the ChatGPT program were classified under two main categories: creating lesson content and deepening individual knowledge and eliminating deficiencies. In Figure 1, the categories and subcategories are displayed in parentheses, along with the frequencies of participants in each category.

Figure 1

Categories and Subcategories about the Purpose of Using ChatGPT While Preparing Lesson Plan



3.1 Findings regarding creating lesson content

Under the first main category, creating lesson content, nine subcategories emerged: determining the subject scope, getting creative and interesting ideas, explaining math concepts, establishing relationships, establishing the course flow, developing learning activities, developing problems and exercises, developing evaluation tools, and reviewing and improving the lesson plan.

3.1.1 Developing learning activities

The majority of the pre-service teachers argued that they used ChatGPT to develop learning activities for their lesson plan. Some pre-service teachers directly gave the concept or learning outcomes in the curriculum for which they wanted to prepare a lesson plan and asked the program to prepare an activity. For example, two pre-service teachers said:

"When I asked the program to find an activity related to the subject, it suggested the bingo game." (PT3), *"It suggested activities that I had not thought of. So, I used it to develop learning activities for the lecture."* (PT44).

However, some participants guided the program and helped with activity preparation. For instance, a participant stated:

"I asked ChatGPT to generate activities for students in the exploration and elaboration phases. Since the exploration phase preceded the elaboration phase, I requested separate utilization of learning outcomes and preparation of two short and simple activities. In the elaboration phase, considering the topic's prior explanation, I wanted it to integrate the two learning outcomes I wished to teach into a single activity." (PT4)

Similar to the quote above, pre-service teachers directed the ChatGPT by telling the specific features of the activity, such as the phase of the lesson plan they wanted the activity for, the difficulty level of the activity, its duration, and its purposes. In addition, some participants used the program to improve and enrich the learning activities they designed. For instance, a participant said*:*

"I asked ChatGPT to create a bingo game with numbers and operations so that I could play it as an activity. It assisted me in organizing a lovely occasion in which the winner of the selected number would complete the transaction and shout BINGO. Thus, I developed it and wrote it." (PT49)

3.1.2 Developing problems and examples

The majority of pre-service teachers stated that they used ChatGPT to develop problems and examples for their lesson plans. Some pre-service teachers even highlighted its specific utility in generating diverse problems and examples. For example, two pre-service teachers stated:

"I can say that I primarily used artificial intelligence to generate problems. I believe that an effective lesson plan should captivate students and offer genuine insights. To maximize student achievement, I aimed to provide problems aligned with their abilities and interests. (PT36), "*I consider ChatGPT a valuable tool for generating problem and example ideas. It proved particularly helpful in crafting introductory problems and illustrative examples during concept explanations."* (PT14)

Pre-service teachers highlighted the value of generating diverse problems and examples related to the target subject matter using the program. In addition, they provided guidance to the AI concerning the desired difficulty level, complexity, and purpose of the problems and examples.

3.1.3 Developing evaluation tools

Many pre-service mathematics teachers used ChatGPT while developing evaluation tools for their lesson plans for various purposes. Some participants use AI to select suitable evaluation methods tailored to specific learning outcomes. To illustrate, two participants mentioned:

"I asked what kind of evaluation tool would be suitable for this learning outcome. Then, out of all the ideas, I requested the program prepare the one I thought was most appropriate." (PT1), "*First, I inquired about how to assess the learning outcome. Using the provided response as a foundation, I constructed the evaluation phase by requesting examples encompassing formative, summative, and self-evaluation components."* (PT34).

As seen in the above quotes, pre-service teachers used ChatGPT to determine which evaluation method would be appropriate for a particular learning outcome. Moreover, like the pre-service teacher in the last quote, some participants utilized the program in developing summative and formative evaluation

methods such as classroom observation, exams, quizzes, and projects. For example, two participants said:

> *"I requested that it design a game for the evaluation phase."* (PT7), *"ChatGPT suggested administering a mini-exam for the evaluation part.* (PT33)

Similar to quotes above, some participants received suggestions from the program for summative assessment, which evaluates students' learning outcomes at the end of a unit, course, or instructional period. Its main purpose is to determine to what extent students achieve their learning goals. However, some pre-service teachers used ChatGPT to develop self-evaluation tools. For instance, two of them stated:

> *"It recommended the self-assessment chart. I would never have considered evaluating students in this way; we always administer exams or similar assessments."* (PT30), "*It prepared self-assessment questions."* (PT19)

Although pre-service teachers did not think of preparing self-assessment tools, which would allow individuals to critically analyze their own progress, strengths, weaknesses, and areas for improvement, ChatGPT offered this option. Additionally, pre-service teachers utilized ChatGPT while preparing assignments for the lesson plan. Alternatively, as illustrated by the quote below, some pre-service teachers requested that the AI to customize evaluation activities to meet their specific needs. To illustrate, a participant mentioned:

> *" The plan lacked a homework component in the evaluation phase, so I asked the program to modify the evaluation phase to include homework."* (PT36).

3.1.4 Establishing the course flow

Most of the pre-service teachers stated that they used ChatGPT to establish the course flow. In other words, participants noted that ChatGPT helped them create the course flow by providing a step-by-step plan and general instructions for each step. For example, a participant expressed:

> *"At first, I directly asked it to prepare a lesson plan for me; it wrote the flow of the lesson minute by minute, so a lesson flow was created in my mind."* (PT54)

Pre-service teachers could gain a precise understanding of the tasks required at each stage of the lesson plan, enabling them to effectively organize their time. ChatGPT also assisted pre-service teachers in sequencing activities and allocating time for each. Moreover, according to pre-service teachers, AI facilitated the initial planning process by providing blank lesson plan templates or giving them sample lesson plans. To illustrate, two pre-service teachers said:

> *"I had ChatGPT create a general plan, and then I detailed it.* (PT18), *"I had ChatGPT prepare a lesson plan, and by examining it, I guided my own plan."* (PT19)

In this way, pre-service teachers stated that they could organize the content and scope of the course more easily. Furthermore, AI assisted pre-service teachers in maintaining the subject's logical flow by suggesting the optimal order of information presentation.

3.1.5 Getting creative and interesting ideas

According to the data analysis, half of the pre-service teachers argued that they used ChatGPT to generate creative and interesting ideas for their lesson plans. Participants claimed that AI helped them design innovative and creative activities and games. They mentioned that in this way, the lessons could be more entertaining, and they could create lectures that would attract the attention of the students. Some pre-service teachers stated that AI stimulated and activated their thoughts and ideas. In other

words, pre-service teachers thought that AI could stimulate creativity, encourage new thinking, and challenge existing assumptions. To illustrate, two participants mentioned:

> "*ChatGPT triggers my brain and encourages me to think differently."* (PT37), *"When I asked ChatGPT for examples from daily life, even if they were not always beautiful, it sparked creative thought processes. These initial ideas were forming the seed of a thought in my mind. So, when I did not have an idea about what to say or what to do, I used it because it provided problem and activity ideas."* (PT13).

As illustrated in the above quotes, some participants said that while not all of ChatGPT's suggestions were ideal, they found the tool helpful for generating and developing ideas. Additionally, they argued that ChatGPT stimulated their thinking by offering novel ideas and perspectives. As a result, participants emphasized the role of AI in stimulating intellectual growth and encouraging creative thinking.

3.1.6 Explaining math concepts

One of the purposes for which pre-service mathematics teachers used AI when preparing lesson plans was to explain math concepts. It was understood that pre-service teachers used ChatGPT for diverse purposes in explaining mathematics concepts. First, the participants stated that they use ChatGPT to explain complex mathematical concepts in a simpler and more understandable way. For example, a pre-service teacher said:

> *"Sometimes, when I asked it if it could explain a mathematical concept I wanted to explain in a simpler way or in a way that a child could understand, I often saw that the application explained mathematical concepts in a simpler and more understandable way.*

Some participants stated using ChatGPT to request simplified explanations or examples of math concepts often resulted in more understandable explanations. Moreover, AI helped pre-service teachers explain mathematical concepts in a way appropriate to the student's level. In this way, pre-service teachers were able to plan their lessons considering each student's comprehension level. Additionally, some participants requested detailed explanations of the properties of mathematical concepts from ChatGPT. To illustrate, two pre-service teachers stated:

> *"I requested a detailed explanation of exponent properties." (PT3), "I employed ChatGPT to define key concepts such as prime factors, prime numbers, and perfect numbers."* (PT55).

As seen in the quotes above, pre-service teachers used ChatGPT to obtain definitions and explanations of mathematical concepts. This approach enabled participants to develop course content with enhanced rigor and reliability.

3.1.7 Establishing relationships

Pre-service teachers used ChatGPT in various ways to establish mathematical relationships when preparing lesson plans. Some pre-service teachers argued that they used AI in their lesson plans to make relationships with daily life and other lessons. For instance, a participant mentioned:

> *"For the exploration phase of the plan, I used ChatGPT to prepare a temperature chart based on real-world examples. As temperature is also a science concept, this interdisciplinary approach was beneficial. Apart from this, in the elaborate stage, I prepared real-world problems, such as those involving pools and banks, with the assistance of ChatGPT."* (PT11).

In the quote above, the participant used AI to create the temperature chart and prepare problems that included examples from everyday life, such as pools and banks. Similarly, some participants integrated real-world applications of mathematics and interdisciplinary connections into their lesson plans with

the aid of ChatGPT. Moreover, the pre-service teachers said that they used AI to create relationships between mathematical concepts. To illustrate, a pre-service teacher said:

> *"Due to factors such as limited knowledge and imagination, identifying connections between concepts can be challenging. In such cases, ChatGPT effectively bridges these knowledge gaps."* (PT13).

AI helped the pre-service teacher make connections that he could not have thought of or imagined on his own. In addition, some pre-service teachers used AI to determine the prior knowledge that students should acquire and establish a relationship between the concept they wanted to teach in the plan and their prior knowledge.

Moreover, some participants utilized AI to establish relationships between different representations of concepts in lesson plans. For instance, a participant said:

> *"I got help with different representations of fractions. It gave me the idea that I could display it in decimal and percent format."* (PT20)

ChatGPT offered participants different perspectives and helped them better explain their connections with different representations of mathematical concepts.

3.1.8 Reviewing and improving the lesson plan

A few pre-service mathematics teachers used ChatGPT to revise and improve their lesson plans. Some participants asked the AI to correct their plans' semantic and grammatical errors. According to the statements of the pre-service teachers, AI helped make the lesson plans more understandable and fluent. To illustrate, a pre-service teacher stated:

> *"After writing the introduction part of the lesson plan, I asked ChatGPT to correct the punctuation and semantic errors in my text. It was successful."* (PT17)

Participants requested that ChatGPT enhance their lesson plans by providing additional details and resources. Through the generation of supplementary materials, diverse presenting techniques, and engaging activities, ChatGPT facilitated improvements in lesson plan quality. For example, a participant mentioned:

> *"When the initial lesson plan proved inadequate, I asked ChatGPT to create a more comprehensive and robust plan."* (PT21), "*I identified areas for improvement in the lesson plan and asked it to prepare it in a different way."* (PT23).

Some pre-service teachers asked AI to find the deficiencies in their lesson plans and correct them. AI pointed out the errors and flaws that pre-service teachers missed, enabling them to build their lesson plans on a stronger foundation.

3.1.9 Determining the subject scope

Too few pre-service teachers utilized ChatGPT to determine the subject scope. Some pre-service teachers used AI to investigate subject content, determine its scope, and check its suitability for grade level. For instance, two participants mentioned:

> "*For a sixth-grade learning outcome, ChatGPT helped define the subject's boundaries."* (PT35), *"When focusing on fifth-grade fractions, ChatGPT provided guidance on appropriate explanations and activities."* (PT20).

AI helped pre-service teachers make their lesson plans more comprehensive by giving them a broader perspective on the subject scope. However, some pre-service teachers stated that AI does not always

provide accurate information about the subject scope. Therefore, pre-service teachers should always check the information they receive from AI in the curriculum and evaluate it using their own knowledge. For example, a pre-service teacher said:

> *"I used it to determine the scope of the subject, but within the scope of the subject, it included not only the exponent number concepts taught in the sixth-grade, for which I prepared the lesson plan, but also the exponent number concepts taught in the eighth-grade."* (PT34).

3.2 Findings regarding deepening individual knowledge and eliminating deficiencies

Under the second main category, deepening individual knowledge and eliminating deficiencies, two subcategories emerged: knowledge about pedagogical approaches and knowledge about concepts.

3.2.1 Knowledge about pedagogical approaches

Some pre-service teachers used ChatGPT to get ideas about pedagogical approaches. They utilized the program to deepen their knowledge about learning strategies and models, materials, and classroom management.

3.2.1.1 Learning strategies and models

Pre-service teachers used AI to deepen their individual knowledge of learning strategies and models and to eliminate their deficiencies. In other words, pre-service teachers used ChatGPT to learn about different teaching models and techniques and choose methods that fit their lesson plans. To illustrate, two pre-service teachers stated:

> *"ChatGPT told me that I could create a discussion environment with the question-answer method in the introduction part."* (PT11), *"I learned about which methods are suitable for more permanent learning. I wanted to get information about the important approaches in education and create a plan accordingly."* (PT47).

As seen in the above quotes, ChatGPT helped pre-service teachers select appropriate teaching methods for their lesson plans. Moreover, AI helped pre-service teachers prepare more effective and student-focused lesson plans.

3.2.1.2 Materials

Few pre-service teachers utilized ChatGPT to design and select materials to use in their lesson plans. AI helped pre-service teachers find materials that would engage students and help them understand the subject better. For example, two participants said:

> *"I used the materials and ideas that were required for the learning outcome I selected."* (PT16), *"I asked ChatGPT what materials I could bring to the classroom to teach the subject well to students."* (PT50).

Pre-service teachers used AI to learn how to use instructional technologies in their lesson plans. AI assisted pre-service teachers in discovering technological tools and resources to enhance lesson interactivity and engagement. For instance, a participant mentioned:

> *"Following a dice activity, I sought ChatGPT's recommendations for software capable of graphically displaying results."* (PT40).

3.2.1.3 Classroom management

Too few pre-service teachers used ChatGPT to deepen their individual knowledge of classroom management. Pre-service teachers used AI to learn about classroom management techniques and how

to solve classroom problems such as peer bullying. AI has helped pre-service teachers create a more disciplined and safe learning environment. To illustrate, three participants stated:

> "*I asked about peer bullying in the evaluation part of the activity, and ChatGPT explained logically that the teacher should keep the environment under control in groups."* (PT18), *"ChatGPT provides information about different teaching methods, approaches, and classroom management, and that's why I used it when choosing the methods and techniques suitable for my plan."* (PT35), *"I specifically asked what the teacher's role should be in classroom management."* (PT41).

3.2.2 Knowledge about concepts

Only a few pre-service teachers utilized ChatGPT to bridge any conceptual gaps in their own understanding. Pre-service teachers used AI to find definitions of concepts they had not thought of, to better understand and give examples of concepts they did not know. To illustrate, three participants stated:

> *"I utilized it to look up definitions of ideas I was having trouble thinking of then."* (PT10), *"I thought it corrected my shortcomings by simplifying a subject I did not know and giving examples."* (PT13), "*I used ChatGPT to obtain an overview of exponents, clarifying the underlying concepts and addressing knowledge gaps.."* (PT34).

Pre-service teachers used AI to learn different definitions and perspectives of mathematical concepts. AI helped pre-service teachers look at concepts from a broader perspective and gain more comprehensive knowledge. For example, two pre-service teachers said:

> *"Since we prepared a lesson plan thinking that we would explain the learning outcome to the students in the lesson, I looked at the definitions of highest common factor and least common multiple and information on how to explain them to the students better to deepen my knowledge while preparing the plan."* (PT28), *"I wanted ChatGPT to come up with different definitions of the concepts related to my topic."* (PT41).

4. Results and Discussion

The current study aimed to examine the purposes for which pre-service middle school mathematics teachers utilized ChatGPT during lesson plan development. This study demonstrated different implications of ChatGPT on the development of lesson plans by pre-service mathematics teachers. The findings of the study showed that while some participants used AI only for certain tasks, a significant number benefited from its capabilities in various subcategories. The reason might be that ChatGPT offers rapid access to a wide range of information and teaching methods, and it can generate summaries and educational resources to support lesson planning (Castro et al., 2024). Educational practices around the world have changed rapidly in recent years, largely due to technological advances. Among these technological developments, AI models such as ChatGPT are one of the most important and effective forces (Grassini, 2023; Makridakis, 2017). For this reason, it is not surprising that most of the pre-service teachers benefited from ChatGPT's capabilities in various ways while preparing lesson plans. The majority of pre-service teachers stated that they used ChatGPT to develop learning activities for lesson plans. Some pre-service teachers asked the program to prepare activities by directly entering the subject they wanted to teach or the learning outcomes in the curriculum into the program. However, some participants contributed to the preparation of the activity by guiding the program. Pre-service teachers directed ChatGPT by specifying specific features, such as for which stage of the lesson plan they wanted the activity, at what difficulty level, for how long, and for what purpose. In addition, some participants used the program to enhance and enrich the learning activities they designed. Most pre-service teachers stated that they used ChatGPT to develop problems and examples for lesson plans.

Some even emphasized that they used the program specifically to find different problems and examples. Pre-service teachers valued the program's ability to generate diverse problems and examples related to the subject planned to be taught. They also guided the AI on the difficulty level, complexity, and purpose of the problems and examples. In a similar way, Farrokhnia et al. (2023) argued that AI helped teachers to create customized lesson plans for teaching with a set of parameters and constraints.

According to the findings of the research, many pre-service teachers benefited from the AI-supported ChatGPT program while developing evaluation tools for their lesson plans. This program helped pre-service teachers choose assessment methods suitable for different purposes. Some participants used ChatGPT to determine the most appropriate assessment method or tool based on their learning outcomes. Some of the participants had an idea from ChatGPT for formative assessment techniques that were used during the instructional process to gather information about students' progress, understanding, and learning needs. Moreover, some participants used the program to develop summative assessment tools, which aim to measure what students have learned at the end of the semester, such as exams, quizzes, and projects. However, unexpectedly, some pre-service teachers have created self-assessment tools to evaluate individual learning progress, strengths, and weaknesses with ChatGPT. Finally, it was observed that the program also allowed pre-service teachers to adapt their homework and evaluation activities according to their needs. Similarly, research studies proposed that among the many advantages of ChatGPT are its ability to facilitate personalized and interactive learning and generate ideas for formative assessment tasks that provide continuous feedback (Baidoo-Anu & Ansah, 2023).

Findings showed that most pre-service teachers stated that they used ChatGPT to create the course flow. The program helped pre-service teachers structure their lesson plans by providing a step-by-step plan and general instructions for each step. In this way, pre-service teachers were able to manage their time more effectively by clearly understanding the tasks needed at each stage of the lesson plan. ChatGPT also provided support in determining the order of activities and how long each activity would take. Participants stated that AI helped them to start the process by presenting them with a lesson plan template or giving them sample lesson plans. In this way, pre-service teachers could more effectively organize course content and scope. Finally, AI assisted in maintaining the topic's logical flow by suggesting optimal information presentation sequences. It is important to note that AI tools like ChatGPT can save teachers time when creating and editing course materials. Teachers will be able to devote more of their time to engaging with students and promoting learning in this way.

According to the results of the data analysis, some pre-service teachers stated that they used ChatGPT to find creative and interesting ideas for lesson plans. Participants stated that AI helped them design innovative and creative activities and games. They believed AI could enhance lesson engagement and create more captivating course content. Some pre-service teachers emphasized that AI activated their thoughts and ideas. Consequently, by fostering creativity, AI could reveal new ways of thinking and question existing assumptions. While not always satisfied with ChatGPT's suggestions, participants found value in using the program as a catalyst for idea generation and development. They also stated that AI stimulated their thinking processes by offering them new ideas and perspectives. In conclusion, participants emphasized that AI played an important role in promoting cognitive development and supporting creative thinking. To sum up, ChatGPT allows teachers to brainstorm and develop creative ideas by generating ideas, suggesting relevant resources, and providing summaries of complex information. In this way, it can assist in the lesson planning process. Similarly, Kasneci et al. (2023) mentioned its ability to aid brainstorming.

Pre-service teachers stated that they used ChatGPT in various ways to explain mathematical concepts while preparing lesson plans. Artificial intelligence helped them explain complex mathematical topics

in a simpler and more understandable way. Participants created content appropriate to the students' comprehension level by requesting simplified explanations or examples to ChatGPT. The program also helped participants prepare more robust and reliable course materials by explaining the features of mathematical concepts in detail. Apart from this, ChatGPT supported pre-service teachers in strengthening the connections between mathematical concepts by establishing relationships with daily life and other courses. AI also helped pre-service teachers make connections between concepts that they would not have thought of. Finally, some participants used ChatGPT to determine the prior knowledge that students needed to learn and establish the relationship between this prior knowledge and the concept they wanted to teach. Additionally, the program provided participants with a variety of viewpoints to clarify the connections between various concept representations. Overall, the use of AI for lesson planning has the potential to greatly increase the efficiency and effectiveness of education by enabling educators to plan lessons and other resources and providing students more easily and accurately with more personalized planning options (Fuchs, 2023; Osman & Ahmed, 2024; Zhai, 2022).

A small number of pre-service teachers used ChatGPT to review and improve lesson plans. Some participants asked the AI to correct semantic and grammatical errors in their plans. In this way, lesson plans became more understandable and fluent. Participants also enabled the program to enrich lesson plans by suggesting more materials, various presentation techniques, and activities. AI helped some pre-service teachers to create lesson plans on stronger foundations by detecting deficiencies and errors that they did not notice. However, very few pre-service teachers used ChatGPT to determine course scope. Some participants used AI to research the content, scope, and suitability of the topic for the grade level. AI provided pre-service teachers with a wider understanding of the subject matter, which enabled them to create more thorough lesson plans. However, some pre-service teachers stated that AI did not always provide accurate information about subject coverage. Therefore, pre-service teachers must critically evaluate AI-generated information against the curriculum and their own expertise. ChatGPT and similar AI technologies offer numerous promising opportunities for education, but it is important to be aware of their limitations and potential drawbacks. Undoubtedly, the primary drawback of implementing ChatGPT in education is the possibility of false information. Despite ChatGPT's extensive training on vast amounts of data, there remains a possibility that it may provide erroneous or incomplete information. For educators lacking the necessary expertise or time, monitoring ChatGPT responses poses a considerable challenge (Samala et al., 2024).

Some pre-service teachers used ChatGPT to gain ideas about pedagogical approaches for lesson plans. AI helped pre-service teachers deepen their knowledge of learning strategies and models and address their deficiencies. In other words, pre-service teachers used ChatGPT to learn about different teaching models and techniques and choose methods that fit their lesson plans. In addition, AI supported participants in preparing more effective and student-focused lesson plans. A small number of pre-service teachers used ChatGPT to design and select materials to be used in lesson plans. AI helped them to find materials that would engage students and help them understand the subject better. Pre-service teachers used AI to learn how to use instructional technologies in their lesson plans. AI helped participants find technological tools and resources that would help them make their lessons more interactive and exciting. Very few pre-service teachers used ChatGPT to deepen their individual knowledge of classroom management. Pre-service teachers used AI to solve classroom problems such as peer bullying and learn about classroom management techniques. AI helped pre-service teachers create a more disciplined and safe learning environment. Only a few pre-service teachers used ChatGPT to bridge conceptual gaps in their understanding. Pre-service teachers used AI to find definitions of concepts they had not thought of, to better understand concepts they did not know, and to give examples. Pre-service teachers learned different definitions and perspectives of mathematical concepts thanks to AI. ChatGPT can assist teachers in identifying instructional materials and creating plans; however, it is not a substitute for teachers. Instead, it should be used as a tool to support teachers by

suggesting innovative teaching strategies and providing access to current instructional resources (Samala et al., 2024). Ultimately, ChatGPT should be viewed as a supplementary tool, rather than a replacement for a teacher's knowledge and expertise.

In conclusion, the findings of the study showed that pre-service teachers used ChatGPT for two main purposes during lesson plan development: creating lesson content and deepening individual knowledge and eliminating deficiencies. According to the findings, most of the pre-service teachers stated that they benefited from ChatGPT in many ways to create lesson content. Furthermore, ChatGPT supported pre-service teachers in deepening individual knowledge and eliminating deficiencies while developing lesson plans in various ways. For these reasons, ChatGPT should be integrated into teacher education programs to prepare future teachers for AI-supported classrooms. Moreover, specific professional development opportunities should be provided to help in-service teachers use ChatGPT effectively. On the other hand, studies can be conducted to address the inappropriate implications of the use of AI in education, such as plagiarism and over-reliance on technology.

References

Alshahrani, A. (2023). The impact of ChatGPT on blended learning: Current trends and future research directions. *International Journal of Data and Network Science*, *7*(4), 2029-2040. http://dx.doi.org/10.5267/j.ijdns.2023.6.010

Baidoo-Anu, D., & Ansah, L. (2023). Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, *7*(1), 52-62. https://doi.org/10.61969/jai.1337500

Bishop, J. M. (2021). Artificial intelligence is stupid and causal reasoning will not fix it. *Frontiers in Psychology*, *11*, 513474. https://doi.org/10.3389/fpsyg.2020.513474

Castro, R. A. G., Cachicatari, N. A. M., Aste, W. M. B., & Medina, M. P. L. (2024). Exploration of ChatGPT in basic education: Advantages, disadvantages, and its impact on school tasks. *Contemporary Educational Technology*, *16*(3), ep511. https://doi.org/10.30935/cedtech/14615

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, *8*, 75264-75278. https://doi.org/10.1109/ACCESS.2020.2988510

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches (3rd ed.).* Thousand Oaks, CA: Sage.

Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2024). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*, *61*(3), 460-474. https://doi.org/10.1080/14703297.2023.2195846

Fuchs, K. (2023, May). Exploring the opportunities and challenges of NLP models in higher education: is Chat GPT a blessing or a curse?. In *Frontiers in Education* (Vol. 8, p. 1166682). Frontiers Media SA. https://doi.org/10.3389/feduc.2023.1166682

Grassini, S. (2023). Shaping the future of education: exploring the potential and consequences of AI and ChatGPT in educational settings. *Education Sciences*, *13*(7), 692. https://doi.org/10.3390/educsci13070692

Haleem, A., Javaid, M., & Singh, R. P. (2022). An era of ChatGPT as a significant futuristic support tool: A study on features, abilities, and challenges. *BenchCouncil transactions on benchmarks, standards and evaluations*, *2*(4), 100089. https://doi.org/10.1016/j.tbench.2023.100089

Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., … Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences, 103*, Article 102274. https://doi.org/10.1016/j.lindif.2023.102274

Makridakis, S. (2017). The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms. *Futures*, *90*, 46-60. https://doi.org/10.1016/j.futures.2017.03.006

Merriam, S. B. (2013). *Qualitative research: A guide to design and implementation.* John Wiley & Sons Inc., New York.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis*. Sage Publication.

Molenaar, I. (2021). Personalisation of learning: Towards hybrid human-AI learning technologies. *Blockchain, and Robots* (pp.57-77).

Montenegro-Rueda, M., Fernández-Cerero, J., Fernández-Batanero, J. M., & López-Meneses, E. (2023). Impact of the implementation of ChatGPT in education: A systematic review. *Computers*, *12*(8), 153. https://doi.org/10.3390/computers12080153

OpenAI. (2024). *ChatGPT* (3.5) [Large language model]. https://chat.openai.com

Osman, S. A., & Ahmed, Z. E. (2024). Navigating AI integration: Case studies and best practices in educational transformation. In Z. Ahmed, A. Hassan, & R. Saeed (Eds.), *AI-Enhanced teaching methods* (pp. 240–267). IGI Global. https://doi.org/10.4018/979-8-3693-2728-9.ch011

Patton, M. (2002). *Qualitative research and evaluation methods* (3rd ed.). Sage Publications.

Renz, A., & Vladova, G. (2021). Reinvigorating the discourse on human-centered artificial intelligence in educational technologies. *Technology Innovation Management Review, 11*(5), 5-16. Retrieved from https://www.timreview.ca/sites/default/files/article_PDF/TIMReview_2021_May - 1_1.pdf

Samala, A. D., Zhai, X., Aoki, K., Bojić, L., & Zikic, S. (2024). An in-depth review of ChatGPT's pros and cons for learning and teaching in education. *International Journal of Interactive Mobile Technologies*, *18*(2), 96-117. http://dx.doi.org/10.3991/ijim.v18i02.46509

Sebullen, M. T. (2023). Lesson planning challenges of pre-service teachers. Cognizance Journal of Multidisciplinary Studies, 3(5), 19–29. https://doi.org/10.47760/cognizance.2023.v03i05.003

Singh, V., & Singh, A. (2021). Role of artificial intelligence in educational management. *Journal of Education and Practice*, *12*(12), 78-85. Retrieved from https://iiste.org/Journals/index.php/JEP/issue/view/4890

Vincent-Lancrin, S., & Van der Vlies, R. (2020), Trustworthy artificial intelligence (AI) in education: Promises and challenges, *OECD Education Working Papers*, No. 218, OECD Publishing, Paris. https://doi.org/10.1787/a6c90fa9-en.

Wikipedia. (2024). *ChatGPT*. Retrieved from https://en.wikipedia.org/wiki/ChatGPT

Yıldırım, A., & Şimşek, H. (2018). *Qualitative research methods in the social sciences.* Seçkin Yayıncılık.

Zhai, X. (2022). ChatGPT user experience: Implications for education. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4312418

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