The Effect of the AI-Powered ChatGPT Application on Middle School Students' Mathematics Learning Experiences: A Qualitative Inquiry

Aysenur Guven
Necmettin Erbakan University

Esref Hatir
Necmettin Erbakan University

Abstract: This study investigates the impact of ChatGPT, an artificial intelligence-based platform, on the mathematics learning process of 7th-grade students using a qualitative research approach. Designed in accordance with the phenomenological design, the data were collected through semi-structured interviews conducted with two students and analyzed through thematic analysis. The findings reveal that students initially responded positively to the platform, expressing increased interest in learning through curiosity and interaction. However, some of ChatGPT's responses were found to be beyond the students' cognitive levels, leading to conceptual confusion and superficial learning. Moreover, inconsistencies between classroom instruction and AI-generated responses caused cognitive dissonance, and technological limitations were found to hinder equal access. While highlighting the transformative role of AI in education, the study underlines the necessity of using such tools within a pedagogical framework, under teacher guidance, and with the support of digital literacy skills. Accordingly, the ethical, cognitive, and affective dimensions of digitalization in educational settings should be addressed through a holistic approach.

Keywords: Artificial intelligence, ChatGPT, Mathematics education, Qualitative research, Thematic analysis, Middle school students

Introduction

Intelligence refers to an individual's fundamental cognitive capacity to perceive their environment, understand the relationships between concepts, learn through experience, reason logically, and solve problems effectively. Artificial intelligence (AI), which now guides technological transformation, is a multidisciplinary research and application field that aims to model and mimic these cognitive functions through machines. AI systems encompass a wide range of technical disciplines including statistical modeling, machine learning, natural language processing, and algorithmic logic. This technological infrastructure has the potential not only to influence engineering applications but also to deeply affect knowledge production, learning processes, and societal structures. In this context, AI is regarded as a transformative force reshaping the scientific, pedagogical, and cultural dynamics of the modern world (Russell & Norvig, 2021; Kaplan & Haenlein, 2019).

In the second quarter of the 21st century, the impact of digitalization on education is not limited to technological tools alone; it also affects the very nature of teaching and learning processes. One of the most evident examples of this impact is the integration of AI technologies into learning environments. AI offers innovative solutions in education, particularly through features such as personalized learning, real-time feedback, data-driven guidance, and cognitive support (Luckin et al., 2016). Among AI-supported tools, chatbots based on natural language processing (NLP) have started playing a significant role in students' individual learning processes. These tools provide active learning environments especially in the context of open-ended problem solving and constructing

their own methods. ChatGPT, developed by OpenAI, is one of the most widely used tools in this category. It enables students to access information quickly and construct their own learning paths (Stahl, 2023). In addition to delivering information, models like ChatGPT support cognitive development by guiding students' thinking processes (Zawacki-Richter et al., 2019). However, the educational value of such technologies depends greatly on how students' experiences are shaped. It also raises important questions regarding the pedagogical use, short- and long-term effects on students, and its role in mathematical meaning-making processes.

Mathematics education is one of the key fields where the impact of AI innovations is most strongly felt. The significance of AI in mathematics education stems from its ability to offer personalized learning experiences through intelligent tutoring systems, adaptive platforms, and automatic assessment tools. These technologies can provide customized content based on students' individual pace and learning styles, thereby fostering a more effective learning process. While reducing the workload of teachers, AI also has the potential to enhance student performance. Mathematics education, with its emphasis on problem-solving, analytical thinking, and the understanding of abstract concepts, is particularly affected by this technological transformation. Therefore, understanding how AI-supported tools influence students' experiences in this context is of great pedagogical importance. This study focuses on the experiences of two 7th-grade students interacting with ChatGPT to examine the contributions of this interaction to their mathematics learning through a qualitative lens.

Significance of the Study

AI-supported digital tools offer many educational potentials such as personalized learning, instant feedback, and data generation for learning analytics. However, how these technologies concretely reflect on students' learning experiences—particularly among younger age groups—and the pedagogical implications of these interactions have not been adequately studied. This research provides qualitative, in-depth, and realistic data that can inform teachers, educational technology developers, and policymakers regarding the role of AI applications in education.

Purpose of the Study

The main purpose of this study is to examine the personal experiences of 7th-grade middle school students regarding the use of ChatGPT as an AI-supported tool in mathematics classes. Specifically, the study focuses on how students position this tool, how they evaluate its contribution to their learning, and how they perceive its limitations.

Research Question

What is the effect of the AI-supported ChatGPT application on middle school students' mathematics learning experiences?

Method

Research Design

This study was conducted using a phenomenological design, which is one of the qualitative research approaches. This design aims to reveal individuals lived experiences and the meanings they assign to them (Creswell, 2012). Phenomenology seeks to explore the nature of subjective experiences and understand participants' cognitive, emotional, and behavioral responses to a given phenomenon. It questions how knowledge is structured in individual experiences rather than in objective external reality (Moustakas, 1994; van Manen, 1990).

Phenomenological studies typically revolve around the concept of "lived experience." Researchers attempt to understand participants' thoughts, perceptions, and feelings toward a specific phenomenon through open-ended, in-depth data collection techniques. Thematic analysis is then used to derive themes from participants' narratives (Creswell, 2013). In educational research, phenomenology is often preferred to understand how students, teachers, or parents experience specific educational phenomena. It offers meaningful and in-depth insights, especially when complex concepts such as technology, teaching strategies, or learning processes are investigated.

Participants

Two 7th-grade male students attending a public school in Istanbul participated in the study. Both students had previous experience with ChatGPT and were familiar with how it works. Participation in the study was voluntary.

Table 1. Characteristics of the students

Participant Code	Gender	Grade	Age
S1	Male	7	12
S2	Male	7	12

The reason for selecting these students for the study stems from the noticeable differences in their academic performance, particularly in mathematics, before and after the introduction of artificial intelligence platforms. It was also observed that they frequently use ChatGPT in their daily lives. Within the study, the students are coded as "Student A" and "Student B." The reporting has been carried out accordingly.

Data Collection Tool and Process

In this study, data were collected through a semi-structured interview form. Aligned with the phenomenological design, the form aimed to explore participants' mathematics learning experiences with ChatGPT. The questions were open-ended to allow participants to express their experiences in their own words. The development of the interview form was informed by a literature review of previous qualitative studies on AI-based learning tools. The questions were adapted to match the cognitive and affective characteristics of middle school students, maintaining clarity and openness. The interview form addressed three dimensions:

1. Cognitive experiences (learning, understanding, comprehension)
2. Affective responses (attitudes, motivation, trust)
3. Comparative evaluation (comparison with traditional methods, willingness to reuse)

The interviews were conducted face-to-face by the researcher, recorded with audio devices, and lasted approximately 25–30 minutes. Permissions were obtained from both the participants and their guardians. The recorded data were later transcribed and used in thematic analysis.

Data Analysis

In this study, the thematic analysis method proposed by Braun and Clarke (2006) was employed for the analysis of qualitative data. Thematic analysis is a flexible method that allows for the systematic identification, analysis, and reporting of recurring patterns of meaning (themes) within data. In this study, the data obtained from student interviews were thematically organized and interpreted in a manner consistent with the research objectives. To minimize researcher bias during the data analysis process, the coding was conducted cyclically, and the principles of transparency and reflexivity were maintained throughout the analysis.

Validity and Reliability

Various strategies were employed in this study to ensure the validity and reliability of the data. First, during the data analysis process, the researcher familiarized themselves with the data by transcribing the interview recordings verbatim. The transcribed texts were read multiple times, salient statements were annotated as margin notes, and recurring meaningful units were identified. The open coding process was conducted manually, and the data were coded with meaningful labels. While organizing the codes under themes, the integrity of the data was preserved. These themes were structured in relation to the research question. To ensure the validity of the themes, all themes generated were reviewed in collaboration with a field expert; ambiguous or overlapping codes were discussed and revised accordingly. Throughout this process, the principle of transparency in the code-theme relationship was upheld.

Regarding reliability, direct quotations from the students' interviews were included, and each finding was supported with the participants' own words. Additionally, the raw data and coding scheme obtained during the research process were preserved and documented for potential use in future similar studies. Thus, the study's adherence to the principles of auditability and replicability was ensured.

Results and Discussion

This study was designed to explore the mathematics learning experiences of two seventh-grade students through ChatGPT. Individual semi-structured interviews were conducted with the participants, and thematic analysis was performed. The data obtained were classified under four main themes. The themes were tabulated to present the findings systematically. At the end of the coding process, the data were grouped under four main themes. Additionally, each theme, along with its related subthemes and sample codes, is presented in Table 2.

Table 2. Students' perspectives on ChatGPT

Theme No	Theme Title	Subthemes	Sample Codes
1	Ease and Limits of Learning	Conceptual Clarity, Risk of Surface Learning	Long explanations, getting answers directly, solution imitation
2	Emotional Responses	Changes in Motivation, Insecurity, Boredom	Initial excitement, later boredom, feeling of inadequacy
3	Usage Difficulties and Perceptions	Technological Challenges, Trust Issues	Not knowing what to write, incorrect answers, doubting
4	Conflict with Educational Environments	Conflict with Teacher, Access Limitations	Different solutions, internet disconnection, device access problems

Theme 1: Learning Facilitation and Limitations

Students found ChatGPT useful for understanding mathematical concepts, especially when it provided step-by-step solutions. However, they also expressed confusion due to overly complex and lengthy explanations. Student A's opinion on this matter is given below.

Student A: "I didn't understand equations. When I asked [ChatGPT], it explained, but sometimes the explanations were too long. It mixes too many steps in one sentence, and I can't follow which step comes when. Still, the examples help."

It was noted that receiving direct answers without process explanations led to shallow understanding. Students acknowledged becoming passive recipients of information rather than actively participating in problem-solving. When Student A was asked to provide an example of an AI application related to this opinion, they presented the problem and solution method shown in Figure 1 as an example.

When the students in the classroom sit two per desk, 4 students remain standing; when they sit three per desk, one desk remains empty. How many students are there in this classroom?

This problem asks us to determine the total number of students in a classroom based on two different seating arrangements. We are told that when students sit **two per desk**, 4 students remain standing, and when they sit **three per desk**, one desk remains empty. To solve this, we will introduce a variable for the number of desks, create equations for both situations, and then solve step by step for the total number of students.

Step 1: Define the unknown

Let the number of desks in the classroom be x. Using this variable allows us to express the total number of students algebraically.

Step 2: Model the situation when students sit two per desk

If students sit **two per desk**, then $2x$ students can sit.

Since **4 students remain standing**, the total number of students must be:

$$\text{Total students} = 2x + 4$$

Step 3: Model the situation when students sit three per desk

If students sit **three per desk**, but **one desk remains empty**, then only $x - 1$ desks are used.

Each desk holds 3 students, so the total number of students is:

$$\text{Total students} = 3(x - 1)$$

Step 4: Set the two expressions equal

Both expressions represent the same total number of students, so we have:

$$2x + 4 = 3(x - 1)$$

Step 5: Solve the equation

$$2x + 4 = 3x - 3$$

$$2x - 3x = -3 - 4$$

$$-x = -7$$

$$x = 7$$

Thus, there are **7 desks** in the classroom.

Step 6: Find the total number of students

Substitute $x = 7$ into either expression:

$$2(7) + 4 = 14 + 4 = 18$$

Or check with the other arrangement:

$$3(7 - 1) = 3 \cdot 6 = 18$$

✅ **Final Answer:**

There are **18 students** in the classroom.

Figure 1. Student A's conversation with ChatGPT

If the students in the classroom sit in pairs, 4 students are left standing. If they sit in groups of three, one row is left empty. How many students are there in this class?

This type of problem is great for developing algebraic thinking skills because it involves both setting up an equation and comparing more than one scenario. Let's now solve this question step by step in a clear and detailed way:

Question: When students in the classroom sit in pairs, 4 students are left standing.
When they sit in groups of three, one row is left empty.
So, how many students are there in the class?

Step 1: Define the Unknown
Since we don't know the number of desks in the classroom:
Let the number of desks be x.
We'll express the number of students in terms of x.

Step 2: Set Up the Equation for the Paired Sitting Scenario
If students sit in pairs, each row seats 2 students, so 2x students would be seated. However, since 4 students are still standing, the total number of students in the classroom must be:
Total number of students =2x +4   (1)

Step 3: Let's Formulate the Triple Seating Scenario
In the triple seating arrangement, 3 students sit in each row. However, in this case, one row is left empty, meaning only x - 1 rows are used. So, the number of seated students is 3(x - 1), which is equal to the total number of students in the class:
Total number of students = 3(x - 1) = 3x – 3   (2)

Step 4: We Have Two Equations, Let's Equalize Them
Both expressions (1) and (2) give the total number of students. So we equate them: 2x + 4 = 3x – 3

Step 5: Solving the Equation
To solve this equation, we bring variables to one side and constants to the other: 2x + 4 = 3x - 3
4 + 3 = 3x - 2x
7 = x

Step 6: We Found the Value of x — Let's Calculate the Number of Students
Since the number of rows is x = 7:
In the double seating scenario: 2x = 14 students sit, 4 students remain standing → total: 14 + 4 = 18
In the triple seating scenario: 1 row is empty, 6 rows are used → 6.3 = 18 students sit → again, total: 18 students
Result: There are 18 students in the class.

The students' statements indicate that while ChatGPT is helpful in explaining certain concepts, in some cases the explanations are above the developmental level of middle school students. The participants expressed that receiving some answers in a direct solution form prevented them from engaging in critical thinking. This suggests that due to the ease of accessing ready-made information, students struggle to develop habits of thinking and questioning. Below is the perspective of Student B regarding this issue.

Student B: "[ChatGPT] gave me the answer directly. I just copied it. But I didn't understand why it was that way, and I couldn't solve the same question in class."

An example of a question Student B asked ChatGPT, where only the answer was given without showing the solution steps, is provided in Figure 2.

> There are 44 passengers on a bus. When four married couples get off at the first stop, the number of women on the bus becomes twice the number of men. Accordingly, how many women were on the bus at the beginning?

16

Figure 2. Student B's conversation with ChatGPT

There are 44 passengers on a coach. At the first stop, four married couples get off. After this, the number of women on the bus becomes twice the number of men. According to this, how many women were there on the bus initially?
16.

Theme 2: Emotional Responses

It was also observed that while students' motivation initially increased, their interest gradually declined over time. This indicates that the temporary motivational effect provided by the technological novelty may fade over time. This artificial intelligence tool, which initially seemed like an invaluable asset, may eventually be used only when it is truly useful. Below is the perspective of Student A regarding this matter.

Student A: "At first, I was excited. I kept asking questions on ChatGPT. I asked about everything I was curious about, whether related to school or my daily life. Then I realized that it gave the same kind of answers to similar questions. This became boring day by day. After that, I started using it only when I really needed it."

The students also reported experiencing feelings of "inadequacy" at times during their interactions with artificial intelligence. This suggests that AI-based tools, which provide responses without considering cognitive levels, may lead to decreased self-confidence in some students. Therefore, it is believed that platforms like ChatGPT should provide answers in clear and simple language. Below is the perspective of Student B regarding this matter.

Student B: "Sometimes ChatGPT explains things in a very long way, and I don't understand. When I talk with my friends at school, they always brag and say they can learn everything from there. It's like it writes as if everyone understands, but I'm the only one who doesn't, as if I'm the only one asking the questions. It makes me feel bad."

Theme 3: Usage Difficulties and Perceptions

It appears that the fact that students are still new to artificial intelligence technologies may cause feelings of inadequacy in some of them. The participants expressed that they did not know what to write or how to phrase their questions while using ChatGPT. This situation resulted in students not being able to fully benefit from AI due to not knowing how to ask their questions properly. Below is the perspective of Student A regarding this issue:

Student A: "Sometimes I don't know how to write (to ChatGPT). I get confused about what to ask. For example, I don't know if I should ask questions one by one like our teacher does or ask everything at once like in textbooks. If I get an incomplete answer because of something missing in my first question, I don't know how to correct it."

Students also noticed that ChatGPT sometimes provides incorrect answers and began to develop doubts accordingly. This indicates that using AI without developing critical media literacy skills may increase the risk of encountering misinformation. It can even sometimes lead to learning incorrect information. Below is a student's view related to trust issues:

Student B: "Sometimes ChatGPT gives correct answers, sometimes wrong ones. I can't always notice these mistakes myself, but when I go to school, I ask my friends or teacher. I realized it makes mistakes in some calculations. After that, I understood that not all the answers I get are going to be correct."

An example of a question Student B asked ChatGPT is provided in Figure 3 below. In this example, although the solution steps mostly followed the correct answer, an error in the final part led to an incorrect final answer.

Mrs. Güliz gives her daughter Birce a piggy bank. She puts 30 TL into the piggy bank and asks her daughter to save 3 TL every week. How much money will Birce have in her piggy bank after 7 weeks?

First, we know the starting amount in the piggy bank: 30 TL.

Birce saves 3 TL every week. After 7 weeks, she will save:

$7 \times 3 = 21$ TL

But if we forget to add the starting amount correctly, the total would be:

7 + 30 = 37 TL

So, after 7 weeks, she would have **37 TL.**

Figure 3. Student B's conversation with ChatGPT

Ms. Güliz gives her daughter Birce a piggy bank as a gift. She puts 30 TL into the piggy bank and asks her daughter to save 3 TL every week. According to this, how much money will Birce have in her piggy bank after 7 weeks?

We know the initial amount in the piggy bank: 30 TL.
Birce saves 3 TL each week. If she continues for 7 weeks:
7×3=21 TL saved.
But we must not forget to add the initial amount:
Total: 21+30=37 TL

So, after 7 weeks, Birce will have 37 TL in her piggy bank.

Theme 4: Conflict with Real Educational Environments

Situations where some of ChatGPT's explanations conflicted with what the teacher presented in class led students to experience confusion. Students who believe that a question has only one correct answer, in particular, may become bewildered when they encounter different solutions. Below is the perspective of Student A regarding this issue:

Student A: "ChatGPT solved it one way, the teacher another. Both confused me. I didn't know which one was correct. Then the teacher said, 'It can be solved that way too.'"
An example of a question Student A asked ChatGPT, which differed from the solution used in class, is provided in Figure 4 below.

What is the general term of the number pattern 4, 10, 16, 22, ...?

The given number pattern:
4, 10, 16, 22, ...

This is an **arithmetic sequence** because each term increases by a constant difference.

- First term: $a_1 = 4$
- Common difference: $d = 10 - 4 = 6$

The general term of an arithmetic sequence is given by:

$$a_n = a_1 + (n-1)d$$

Substitute the values:

$$a_n = 4 + (n-1) \cdot 6 = 4 + 6n - 6 = 6n - 2$$

Answer:

$$a_n = 6n - 2$$

Figure 4. Student A's conversation with ChatGPT

What is the general term of the number pattern:
4, 10, 16, 22, ...

Given number pattern:

4, 10, 16, 22, ...

This type of number pattern is called an arithmetic sequence because each term is found by adding a fixed number to the previous one.

First term $a_1 = 4$

Common difference $d = 10 - 4 = 6$

The general formula of an arithmetic sequence is:

$a_n = a_1 + (n-1) \cdot d$

Substituting the known values:

$a_n = 4 + (n-1) \cdot 6 = 4 + 6n - 6 = 6n - 2$

Conclusion:

The general term of the sequence is $a_n = 6n - 2$

The solution shown by the teacher in class for the question Student A asked ChatGPT is provided in Figure 5 below.

Figure 5. The solution in Student A's notebook (Translated by authors to English)

Lack of internet access at home or insufficient devices have hindered continuous access to artificial intelligence. This situation indicates that AI-supported learning can only be sustainable when infrastructure and device equality are ensured. Below is the perspective of Student B regarding this issue:

Student B: "My sibling plays on the phone at home, so I don't get a turn. Besides, the Wi-Fi keeps cutting out."

Conclusion

The findings of this study reveal that the impact of ChatGPT on middle school students' mathematics learning experiences is multidimensional. The results reached under each theme are discussed below.

In the theme of ease and limitations of learning, students noted that ChatGPT provided conceptual clarity on some topics and that being able to follow the solution steps step-by-step particularly contributed to their learning processes. This aligns with the cognitive support potential of artificial intelligence emphasized by Stahl (2023) and Zawacki-Richter et al. (2019). However, the fact that some responses were sometimes above the students' level and that detailed explanations imposed cognitive load could cause conceptual confusion. This supports the need for "age-appropriate content" highlighted by Chen et al. (2020). In the theme of emotional responses, students initially showed high motivation but noted a decline in their interest in using ChatGPT over time. This can be associated with the temporary motivational effect of artificial intelligence discussed by Holmes et al. (2019). Additionally, some students reported feeling inadequate and overwhelmed by the explanations, indicating that AI use has not only cognitive but also affective effects (Luckin, 2018).

In the theme of usage difficulties and perceptions, one student expressed uncertainty about how to ask questions effectively when using ChatGPT. This points to a lack of critical digital literacy. While Mishra and Koehler (2006) emphasize the importance of teacher guidance within the technological pedagogical content knowledge framework, the findings of this study suggest that mere access to technology without sufficient pedagogical support may not translate into meaningful learning for students.

In the theme of conflict with educational environments, contradictory answers from ChatGPT compared to the teacher's explanations caused trust issues among students. Such cognitive conflicts can create dilemmas in learning. Selwyn (2016) states that technology in education cannot be considered independent of its social context. Furthermore, the inadequacy of technological resources at home may be considered an indicator of the digital divide (Holmes et al., 2022). In conclusion, while ChatGPT is a powerful tool that can contribute to students' conceptual understanding, its effective use requires a pedagogical framework, digital skills, and the principle of social equity. These findings demonstrate that a multi-layered approach is necessary for the integration of AI tools into the education system.

Recommendations

Based on the research findings, the following recommendations are proposed:

- The use of AI tools should be accompanied by pedagogical guidance.
- AI-based learning platforms like ChatGPT need to be used with teacher supervision, aligned with students' cognitive levels and learning objectives. Students should be equipped with digital literacy skills.
- Students should receive critical digital literacy education from an early age to enable meaningful communication with AI, learn proper questioning techniques, and evaluate the consistency of the information in the responses.
- Attention should be paid to the affective outcomes of AI tools. Such technologies can both increase motivation and cause feelings of inadequacy among students. The process should be managed with psychological support applications, especially for students with low academic self-efficacy.

Scientific Ethics Declaration

Conflict of Interest

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Author(s) Information

Aysenur Guven	**Esref Hatir**
Necmettin Erbakan University, Ahmet Kelesoglu Education Faculty, Meram, Konya, Turkiye	Necmettin Erbakan University, Ahmet Kelesoglu Education Faculty, Meram, Konya,Turkiye
Contact e-mail: *guvenaysenur2000@gmail.com*	

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