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Abstract

The purpose of this research is to examine the opinions of mathematics teachers and secondary school students about the use of ChatGPT artificial intelligence application in mathematics education. The sample of the study, conducted according to the case study, one of the qualitative research methods, consisted of 16 mathematics teachers working in different schools in Van province and 17 students studying in a state secondary school in the autumn term of the 2023-2024 academic year. A semi-structured interview form was applied to the groups before and after the application and the collected data were content analyzed. The results obtained from the analyses show that teachers think that they can use ChatGPT artificial intelligence-based mathematics education to increase student achievement in mathematics courses. They also stated that ChatGPT can be presented as an innovative method that needs to be integrated into education, will support the learning process and can ensure that the courses are student-centered. Students, on the other hand, stated that they could support their individual learning, complete their subject deficiencies, and create a source of creativity and inspiration. In general, all participants stated that the application can help in many aspects of mathematics and increase collaboration. Similarly, the participants stated that in addition to the positive aspects such as accelerating the learning process and increasing the efficiency, there may be disadvantages such as being paid, creating dependency and reducing cooperation. Finally, when the opinions on the provision of artificial intelligence applications course in schools were analyzed, it was observed that the participants mostly expressed positive opinions. As a result, although there are some negative opinions about this new technology examined, it is understood that there are opinions that it will provide new opportunities for both teachers and students and has great potential.

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Investigation of Secondary School Students' and Teachers' Opinions on the Use of ChatGPT Artificial Intelligence Application in Mathematics Education [*]

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Abstract

The purpose of this research is to examine the opinions of mathematics teachers and secondary school students about the use of ChatGPT artificial intelligence application in mathematics education. The sample of the study, conducted according to the case study, one of the qualitative research methods, consisted of 16 mathematics teachers working in different schools in Van province and 17 students studying in a state secondary school in the autumn term of the 2023-2024 academic year. A semi-structured interview form was applied to the groups before and after the application and the collected data were content analyzed. The results obtained from the analyses show that teachers think that they can use ChatGPT artificial intelligence-based mathematics education to increase student achievement in mathematics courses. They also stated that ChatGPT can be presented as an innovative method that needs to be integrated into education, will support the learning process and can ensure that the courses are student-centered. Students, on the other hand, stated that they could support their individual learning, complete their subject deficiencies, and create a source of creativity and inspiration. In general, all participants stated that the application can help in many aspects of mathematics and increase collaboration. Similarly, the participants stated that in addition to the positive aspects such as accelerating the learning process and increasing the efficiency, there may be disadvantages such as being paid, creating dependency and reducing cooperation. Finally, when the opinions on the provision of artificial intelligence applications course in schools were analyzed, it was observed that the participants mostly expressed positive opinions. As a result, although there are some negative opinions about this new technology examined, it is understood that there are opinions that it will provide new opportunities for both teachers and students and has great potential.

Keywords: Mathematics education, artificial intelligence, ChatGPT, student opinions, teacher opinions

1. INTRODUCTION

Mathematics, one of the basic building blocks of education, is an important part of daily life and a common language used by societies and civilizations (Karaçay, 2008). The general purpose of mathematics, defined as abstract objects such as numbers, points, clusters, and the relationships between such objects, is to provide the individual with the mathematical knowledge and skills necessary in daily life, to teach him problem solving, and to gain a thinking method that evaluates events within the framework of a problem-solving approach (Altun, 2010). In this context, increasing the level of mathematics achievement of the society serves the development of individuals and countries. On the other hand, the fact that mathematics course is perceived as an abstract course by students and that they have difficulty in, it has made it compulsory to use additional methods such as technology in this course (Arslan & Bilgin, 2020; Kaya & Kutluca, 2024). Especially the growth of the new generation intertwined with technology since the first periods of their lives makes the

integration of technology into education and training inevitable. Technology integration is making technology accessible by making it a part of teaching functions in order to improve the learning process (ISTE, 2000). Therefore, the integration of technology into mathematics education supports students to make sense of mathematical concepts (Kaya et al., 2023). For this reason, one of the six principles of mathematics education is the use of technology, and the appropriate use of technology allows students to focus on problem solving and reasoning, as well as improve their deep understanding (NCTM, 2008). Technology helps students develop their mathematical thinking skills and mathematical concepts, while at the same time motivating them to learn mathematics and supporting them to take responsibility for their own mathematical development (Buteau & Muller, 2006).

In the 21st century, many different technologies are used in mathematics education, and one of them is artificial intelligence technology, which has recently come to the fore frequently. When different studies on the potential contributions of artificial intelligence technologies to education and training are examined, it is seen that artificial intelligence technologies have many contributions such as personalizing learning according to individual needs, increasing academic achievement, enabling collaborative learning, enabling teachers to organize lessons according to the situation, and providing students with personalized assignments (İşler & Kılıç, 2021). In this context, it can be said that the use of artificial intelligence technologies in education will make an important contribution to students in order to gain 21st century skills.

There are many artificial intelligence-supported tools in mathematics education today. Among these tools, ChatGPT, Google Gemini, Claude and Copilot stand out. However, the ChatGPT application was preferred in this study. It can be said that the advantages of the application such as having a large database, advanced natural language processing capabilities and being easily integrated into educational processes were effective in choosing the ChatGPT application in this study. In addition, the application's ability to develop its answers by taking into account users' feedback and providing personalized support in teaching processes also played an important role in choosing the application. Therefore, the role of artificial intelligence in teaching mathematics was examined in the study using ChatGPT.

ChatGPT is an artificial intelligence model developed by OpenAI. It is part of the GPT (Generative Pre-trained Transformer) series. ChatGPT is a language model that can interact with people, especially in text-based chats. Trained on large amounts of text data, this model has the ability to understand texts, produce logical answers and present information on various topics. For this reason, text-based language models such as ChatGPT appear to have the ability to be used for educational purposes. Therefore, it seems that the use of artificial intelligence has a great potential in providing more efficient and effective learning experiences in the field of education, in areas such as mathematics education, where abstract concepts are taught and individualized education is needed more.

In this context, it is thought that examining the knowledge levels of teachers and students about artificial intelligence technologies in mathematics teaching and revealing their opinions and thoughts can contribute to mathematics education.

1.1. Purpose and Importance of the Research

The purpose of this study is to determine the knowledge of middle school students and mathematics teachers about the ChatGPT artificial intelligence application and to examine their opinions about the application.

Artificial intelligence applications such as ChatGPT can contribute to the development of problem-solving, analytical thinking, and critical evaluation skills by adapting to students' individual learning styles. It can also play an important role in increasing students' mathematical achievement by providing instant feedback and personalized learning experiences. In this context, the study on the use

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of the artificial intelligence application ChatGPT in mathematics education is considered important. Although it is considered that artificial intelligence applications are so important, it is seen that there are very few studies on the use of artificial intelligence in secondary school mathematics education in the literature. In this context, it is thought that the study can contribute to the literature in terms of investigating the effect of this technology on the mathematics education of secondary school students and teachers, supporting future mathematics education studies, analyzing the current situation, and providing data to decision-making and implementing authorities.

1.2. Problem Statement and Sub Problems

In this study, the research problem was determined as 'What are the opinions and thoughts of secondary school students and mathematics teachers about the use of ChatGPT artificial intelligence application in mathematics education?'.

The sub-problems of the research are;

- What is the awareness of middle school students about the use of ChatGPT artificial intelligence application in mathematics education?

- What are the opinions of middle school students about the use of ChatGPT artificial intelligence application in mathematics education?

- What is the awareness of secondary school mathematics teachers about the use of ChatGPT artificial intelligence application in mathematics education?

- What are the opinions of secondary school mathematics teachers about the use of ChatGPT artificial intelligence application in mathematics education?

2. METHOD

In this study, the case study model, which is one of the qualitative research methods, was used. McMillan (2000) refers to the case study as a method in which multiple events related to each other, social groups are examined in the finest detail. When this definition is considered, the case study pattern was used in the research in order to examine, determine and interpret the existing opinions about the use of ChatGPT application in mathematics education in detail.

2.1. The Universe and Sample of the Research

The population of the study consists of secondary school students studying in the 2023-2024 academic year in Van province and mathematics teachers working in secondary schools. While determining the sample, the convenience sampling technique was used. This technique is among the purposeful sampling methods. In the convenience sampling method, it is easy to reach, low cost, and useful for some situations in which research is conducted (Yıldırım & Şimşek, 2008). The study was conducted with 17 students studying in a public school in Ipekyolu district of Van province and 16 mathematics teachers working in public schools affiliated to MoNE in the same district. The students participating in the study were coded as S1, S2, S3...S17, and the teachers were coded as M1, M2, M3, ... M16 and their names were not included in the study.

Table 1. Some demographic characteristics of participating students

Factor	Group	f	%
Gender	Boy	10	59
	Girl	7	41
Grade	7. Grade	10	59
	8. Grade	7	41

As seen in Table 1, a total of 17 students, 7 girls and 10 boys from the 7th and 8th grades, participated in the study, and the age, grade and gender of the students are shown. Of the participant

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students, 41% were girls and 59% were boys. Similarly, 59% of the students were in the 7th grade and 41% were in the 8th grade.

Table 2. Some demographic characteristics of participating teachers

Factor	Group	f	%
Gender	Male	14	88
	Female	2	12
Education Status	Bachelor	8	50
	Master	8	50
Seniority	1-10 year	9	56
	11-20 year	7	44

As seen in Table 2, a total of 16 teachers, 2 females and 14 males, participated in the research and the teachers' gender, educational background and seniority are shown. 12% of the participating teachers are women and 88% are men. 50% have a bachelor's degree and 50% have a master's degree. When we look at the length of service in the Ministry of Education, 1-10 years is 56% and 11-20 years is 44%.

2.2. Data Collection Process

The study was conducted with students and teachers at different times. The collection of data via Google forms with the preliminary interview form and the analysis of the obtained data took one week. Then, the researcher provided information about artificial intelligence and the ChatGPT artificial intelligence system (working method, installation, membership, etc.) to the students and teachers in the school environment during two lesson hours at separate times. The ChatPT-4 version of the application was used in this process. During the activity, the mathematical questions prepared by obtaining expert opinions in advance were asked to the software and the in-class activities lasted for a total of three lesson hours. The answers given by the system and possible different solutions were discussed. Then, additional questions that the students and teachers wanted to ask were directed to the artificial intelligence application and positive or negative opinions were expressed and discussed regarding the answers given by the system. In this way, it was aimed to clarify the participants' thoughts about the artificial intelligence application. At the end of the training, teachers and students were also allowed to use the system at home in order to increase their readiness levels. After the participants used the application at home, interviews were held at appropriate times and places. Data was collected and analyzed for one week using a semi-structured interview form in the interviews. Thus, the data collection process was completed. Details about the data collection process used in the research are given in Table 3.

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Table 3. Data collection process

Date	Application	Duration
17.10.2023	Collection of interview form data before the application	1 week
25.11.2023	Analysis of interview form data before the application	1 week
07.11.2023	Informing the participating students about artificial intelligence and introducing the application	2 lesson hours
07.11.2023	Performing and discussing activities with participating students through the application	3 lesson hours
08.11.2023	Informing the participating teachers about artificial intelligence and introducing the application	2 lesson hours
08.11.2023	Performing and discussing the activities through the application for the participant teachers	3 lesson hours
10.11.2023	Collection of interview form data after the application	1 week
18.11.2023	Analysis of interview form data after the application	1 week

When Table 3 is analyzed, it is seen that the implementation process is discussed in detail. Looking at the table, it is seen that the interview periods before and after the application lasted 4 weeks in total, and the participants' applications with ChatGPT lasted 10 lesson hours in total.

2.3. Data Collection Instruments

In order to reveal how the ChatGPT artificial intelligence application of the data collection tool affects mathematics education and to reveal and evaluate the experiences of the participants, comprehensive interview questions were prepared by obtaining expert opinions. Four questions were used in the student and teacher interview form prepared to be used before the application. Similarly, six questions were prepared in the student interview form and teacher interview form to be used after the application.

2.4. Data Analysis

Content analysis method was used to analyze the data obtained from the results of the semi-structured interview form used as a data collection tool in the study. The data obtained were analyzed and divided into meaningful sections and codes were created. The codes were organized in a clear and understandable way. Then, in order to determine the consistency rates of the categories and codes, two Turkish teachers and an academician who is an expert in the field were asked to analyze the relevant data and the consistency rates were examined. The categories and codes that did not provide consistency were checked and examined, and the categories and codes were finalized by making a joint decision with two Turkish teachers and an expert academician.

2.5. Validity and Reliability

In order to increase the internal validity of the study, the opinions of experts should be taken into account, and the process should be presented objectively and the findings should be given directly without comment (Yıldırım & Şimşek, 2008). In this context, the method of the study, how the data are collected and how they are analyzed have been explained in detail and impartially in order to ensure their reliability. When analyzing the data obtained as a result of interviews with teachers and students, they were used directly without any comments by acting impartially and expert opinions were frequently consulted. In this way, reliability and validity have been tried to be increased.

In order to determine the reliability of the scoring and coding of the qualitative data, the data obtained in the semi-structured interview form were analyzed and scored by two Turkish teachers who are experts in their fields. Hubberman & Miles' formula [agreement / (agreement + disagreement) x 100] was used to calculate the agreement between the experts who analyzed and scored the data (Huberman & Miles, 2002). After the calculation, the percentage of agreement between the scores was determined as 85.22%. The percentage of agreement between the researcher and the expert who analyzed and scored the data was 88.63%.

3. FINDINGS

In this section, the findings obtained from the analysis of the data collected in the research are presented and interpreted. At the beginning of the research process, participants' opinions were taken before they were given information about the ChatGPT application. At this stage, the findings related to the opinions of 16 secondary school mathematics teachers and 17 secondary school students about the use of the artificial intelligence application ChatGPT in mathematics education are presented.

3.1. Teacher Interview Form Findings before ChatGPT Activities

The findings of the question 'Which methods do you use to increase student achievement in your mathematics lessons?' are given below. The methods that emerged as a result of the answers given by the participants to the related question are presented in Table 4.

Table 4. Findings on the methods used to increase student achievement

Methods Used	Participant Code	f	%
Interactive technology tools	M3, M12	2	10
Creative approaches	M1, M2, M4, M5, M9, M11, M12	7	33
Traditional teaching methods	M5, M7, M8, M9, M10, M14	6	29
Approaches suitable for individual learning styles	M11, M15	2	10
Problem solving-Applied learning	M6, M11, M13, M16	4	18

*Some teachers who participated in the study expressed more than one opinion.

When Table 4 is analyzed, it is seen that the methods used by the participants to increase student achievement consist of five main elements. When the frequencies of the preference of these methods are examined, it is seen that the use of interactive technology 2 (10%), creative approaches 7 (33%), traditional teaching methods 6 (29%), approaches suitable for individual learning styles 2 (10%), problem solving and applied learning 4 (18%). Some of the answers given by the participants are as follows:

M3: I use interactive applications on the smart board and questions and activities in Z book applications (Interactive technology tools).

M2: I use storytelling and concrete to abstract method (Creative approaches).

M7: I usually use the lecture method, and in the intermediate classes I also use the discussion method. (Traditional teaching methods)

The opinions that emerged as a result of the answers given by the participants to the question 'What do you think about artificial intelligence-based mathematics education?' are presented in Table 5.

Table 5. Findings related to opinions on AI-based mathematics education

Participant Opinions	Participant Code	f	%
Integration of technology into the course	M1, M12, M16	3	19
Lack of knowledge and inadequate methods	M2, M3, M13	3	19
A tool that can be used in the lesson	M4, M8, M11	3	19
An innovative method in teaching	M5, M9, M14, M15	4	24
A need for integration into education	M6, M7, M10	3	19

When Table 5 is analyzed, it is seen that the participants' opinions about artificial intelligence supported mathematics education consist of five main elements. When the frequencies of the participants' opinions are examined, it is seen that the integration of technology into the lesson is 3 (19%), lack of knowledge and inadequate method is 3 (19%), a tool that can be used in the lesson is 3 (19%), an innovative method in teaching is 4 (24%), a method that should be integrated into education is 3 (19%). Some of the answers given by the participants are as follows:

M3: I think that it will provide practical and fast solutions, but I think that it will not realise some meanings in some questions, that is, it will be inadequate. (Lack of knowledge and inadequate method)

M5: I believe that artificial intelligence-based mathematics education will bring a different breath to mathematics teaching and learning, and will also bring a different breath to teaching methods with this method. (An innovative method in teaching)

M6: I think it can be integrated into lessons (A method that should be integrated into education).

'Have you used artificial intelligence-based educational tools before? If you have, could you share your experiences?' The categories obtained from the participant responses to the question are presented in Table 6.

Table 6. Findings on the use and experience of AI-based educational tools

Participant Opinions	Code	Participant Code	f	%
Has experience	Test creation	M1, M6, M10, M12	3	17
	Creating in-class activities	M13, M15	2	11
	Identify the deficiency of the student	M14, M16	2	11
No experience	No previous use	M2, M3, M4, M5, M7, M8, M9	10	56
Inability to find an application	Inability to find an application for the course	M11	1	6

When Table 6 is examined, it is seen that there are three categories that emerged as a result of the answers given by the participants to the question. When the frequencies of the preference of these categories are examined, there are 5 (38%) people with usage experience, 10 (56%) people with no usage experience, and 1 (6%) people with difficulty in finding an application. Some of the answers given by the participants are as follows:

M15: I use artificial intelligence-based educational tools when preparing activities that the student can understand the learning outcome in the best way. When I don't like the options it offers me, I tell it to create new options or to elaborate further. Thus, based on the sample activities, I prepare activities that I can use in the lesson and this makes my job easier. (Has experience/Creating activities)

M3: Unfortunately, I have not used it before.

M11: I use most of the applications, but I cannot find artificial intelligence-based applications for my course (Inability to find an application).

The findings that emerged as a result of the answers given by the participants to the question 'What do you hope to achieve in the name of mathematics teaching by using ChatGPT application?' are presented in Table 7.

Table 7. Findings related to the expectations of ChatGPT in mathematics teaching

Participant Expectations	Participant Code	f	%
Question generation and practical solutions	M1, M3, M11	3	25
Helping in the learning process	M5, M6, M9, M15	4	34
Providing effective methods in education	M7, M8, M16	3	25
Supporting individual learning	M10	1	8
Understandability of mathematical concepts	M12	1	8
Innovative approaches in education	M13, M14	2	16
Lack of information or no opinion	M2, M4	2	16

When Table 7 is analyzed, it is seen that the participant expectations that emerged as a result of the answers given by the participants to the question consist of seven main elements. When we look at the frequencies of the preference of these expectations, we see that they are as follows: generating questions and practical solutions 3(25%), helping in the learning process 4(34%), providing effective methods in education 3(25%), supporting individual learning 1(8%), comprehensibility of mathematical concepts 1(8%), innovative approaches in education 2(16%), lack of knowledge or no idea 2(16%). Some of the answers given by the participants are as follows:

M7: I do not know the exact content of ChatGPT, but I hope that it will provide more effective methods for the subjects I teach in the classroom. (Providing effective methods in education)

M10: I hope that the application will support students' individual learning and provide benefits in solving complex questions (Supporting individual learning).

M14: I hope that it will bring a new teaching method by combining mathematics and virtuality (Innovative approaches in education).

M4: I don't know anything about ChatGPT. So I cannot say anything. (Lack of knowledge or no opinion)

3.2. Student Interview Form Findings Before ChatGPT Activities

The categories and codes that emerged as a result of the answers given by the participants to the question 'What do you think about artificial intelligence supported mathematics education?' are presented in Table 8.

Table 8. Findings related to opinions on artificial intelligence supported mathematics education

Participant Expectations	Participant Code	f	%
Student-centered mathematics lesson	S1, S2, S3, S4	4	24
Support for the learning process	S5, S8, S10, S11, S12,	7	41
Negative opinions	S14, S15	5	29
No idea	S6, S7, S9, S13, S16	1	6

When Table 8 is analyzed, it is seen that the opinions that emerged as a result of the answers given by the participants to the question consist of four main elements. When the frequencies of the preference of these opinions are examined, student-centered mathematics lesson is 4 (24%), support for the learning process is 7 (41%), negative opinions are 5 (29%) and no opinion is 1 (6%). Some of the answers given by the participants are as follows:

S14: I think that artificial intelligence supported mathematics will help students to reach different and easy solutions while solving the questions. (Support to the learning process)

S16: I have never taken a math lesson in an artificial intelligence environment before, and I don't think it will be efficient because it cannot be as warm and sincere as a teacher would explain. (Negative opinions)

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'Have you used artificial intelligence-based educational tools before? If you have, could you share your experiences?' The categories and codes that emerged as a result of the answers given by the participants to the question are presented in Table 9.

Table 9. Findings on the use and experience of AI-based educational tools

Category	Code	Participant Code	f	%
Has experience	Helping coding	S4, S5, S8,	3	18
	Fast access to data	S10, S12	2	12
	Ensuring language learning	S14, S15, S17	3	18
	Using homework research	S13, S16	2	12
No experience	Not using before	S1, S2, S3, S6, S7, S9, S11,	7	40

Table 9 shows that the categories that emerged as a result of the answers given by the participants to the question consist of two main elements. When the frequencies of the preference of these categories are analyzed; 10 (60%) people with usage experience and 7 (40%) people without usage experience. Some of the answers given by the participants are as follows:

S4: I have used it before. When I went to robotic coding, I coded in these applications. I made tools such as cars, light sensors, etc. Thanks to it, I learnt some artificial intelligence-based applications. These were Code.org and Tinkercard. I had a fun time. (Has experience/ Helping coding)

S17: Yes, I did, I used an application to improve my English (Has experience)

S13: Sometimes I find the homework assignments given at school by searching on Bing artificial intelligence application. (Has experience / Using in homework research)

The categories and codes that emerged as a result of the participants' responses to the question "What are your priorities and expectations in mathematics education before using the application?" are presented in Table 10.

Table 10. Findings on priorities and expectations in mathematics education

Priorities and Expectations	Participant Code	f	%
Understanding basic mathematical concepts	S1, S5, S8, S11, S16	5	29
Overcoming the fear of maths	S2, S4, S9, S12, S17	5	29
Practical problem solving	S3, S10	2	12
Using mathematics in daily life	S6, S7, S14	3	18
Gaining personalised learning experiences	S13, S15	2	12

When Table 10 is analysed, it is seen that the priorities and expectations that emerged as a result of the participants' answers to the question consist of five main elements. The frequencies of these priorities and expectations are as follows: understanding basic mathematical concepts 5 (29%), overcoming the fear of mathematics 5 (29%), practical problem solving 2 (12%), using mathematics in daily life 3 (18%), gaining personalized learning experience 2 (18%). Some of the answers given by the participants are as follows:

S12: My priority is to learn mathematics without being afraid of mathematics and to use what I have learnt in my life (overcoming the fear of mathematics).

S3: Solving complex problems in simpler ways and getting answers to questions in a short time are among my priorities. (Practical problem solving)

S7: Permanence, practical learning, adequate motivation, regular assessments and mathematical explanations related to daily life are my expectations. (Using mathematics in daily life)

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The categories and codes that emerged as a result of the answers given by the participants to the question 'What do you hope to achieve on behalf of mathematics teaching by using ChatGPT application?' are presented in Table 11.

Table 11. Findings related to the expectations of ChatGPT in mathematics teaching

Participant Expectations	Participant Code	f	%
Completing the missing subjects	S1, S5, S11, S12, S14	5	25
Providing creative solutions	S3, S4, S8, S10, S14, S16	6	30
Creativity and inspiration	S3	1	5
Providing self-confidence	S2, S15	2	10
Application to daily life	S2, S6, S7, S9, S13, S15	6	30

* Some students participating in the study expressed more than one opinion.

According to Table 11, it is seen that the expectations in mathematics teaching that emerged as a result of the participants' answers to the question consist of five main elements. When the frequencies of the preference of these opinions are examined; completing the missing subjects 5 (25%), providing creative solutions 6 (30%), being a source of creativity and inspiration 1 (5%), providing self-confidence in mathematics 2 (10%), application to daily life 6 (30%) people. Some of the answers given by the participants are as follows:

S1: I hope that they will identify our deficiencies and provide support in accordance with our individual differences. (Completing the missing subjects)

S4: I expect him to answer questions related to mathematics or provide information on mathematics-related topics. I also hope that he will explain complex questions to me with different solutions in a way that I can understand. (Creative solutions)

S2: By using the ChatGPT application, I hope to better understand mathematical concepts and solve mathematical problems more effectively. (Providing self-confidence)

3.3. Student Interview Form Findings After ChatGPT Activities

The categories and codes that emerged as a result of the answers given by the participants to the question 'In which mathematics subjects do you think ChatGPT application will help you more?' are presented in Table 12.

Table 12. Findings on the mathematics subjects that ChatGPT can help

Mathematic Subjects	Participant Code	f	%
General math support	S4, S5, S6, S8, S10, S15, S16	7	27
Forming and solving equations	S1, S2, S3, S9, S11, S17	6	23
Graph drawing and interpretation	S7, S12, S13, S14, S17	5	19
Detailed lecturing	S1, S3, S9, S13	4	15
Logic and reasoning question solution	S3, S5, S12, S14	4	15
Special topics (Multi-step operations,	S14, S15, S16	3	13

* Some students participating in the study expressed more than one opinion.

When Table 12 is analyzed, it is seen that the mathematics topics that emerged as a result of the participants' answers to the question consist of six main elements. When the frequencies of these topics are examined, it is seen that general mathematics help/addressing individual deficiencies 7 (27%), setting up and solving equations 6 (23%), graph drawing and interpretation 5 (19%), detailed subject expression 4 (15%), logic and reasoning question solution 4 (15%), special topics (multi-step operations, measurement etc.) 3 (13%). Some of the answers given by the participants are as follows:

S1: I can say that it will be helpful in many other mathematics subjects, especially in solving and setting up equations. (Setting up and solving equations)

S17: ChatGPT application will also help in drawing and interpreting graphs. (Graph drawing and interpretation)

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S5: The application will be especially helpful in solving difficult questions that require logic and reasoning. (Logic and reasoning question solution)

The categories and codes that emerged as a result of the answers given by the participants to the question 'How do you think the application will affect teacher and student cooperation?' are presented in Table 13.

Table 13. Findings related to the evaluation of the effect of the application on collaboration

Opinions	Participant Code	f	%
Positive effect	S1, S3, S4, S5, S7, S8, S9, S10, S11, S13, S14, S15, S16, S17	14	82
Negative effect	S2, S6, S12	3	18

Table 13 describes that the opinions that emerged as a result of the answers given by the participants to the question consist of two main elements. When the frequencies of the preference of these opinions are analyzed, it is seen that the positive effect is 14 (82%) and the negative effect is 3 (18%). Some of the answers given by the participants are as follows:

S5: I think ChatGPT supports collaboration between teachers and students. Students can use the app to provide access to maths resources, while teachers can provide additional resources and guidance to students (Positive impact).

S2: I think it will reduce co-operation a lot. Because it will be difficult for a teacher to follow and guide many students. As such, the student may not trust the teacher (Negative effect).

The categories and codes that emerged as a result of the answers given by the participants to the question 'How do you think ChatGPT application will affect and support your mathematics learning process?' are presented in Table 14.

Table 14. Findings related to the opinions on the effect of ChatGPT on the learning process

Participant Opinions	Participant Code	f	%
Providing detailed solutions	S4, S5, S6, S9,	3	18
Ensuring fast learning	S9, S10, S12, S14	4	24
Providing funny and interesting learning	S1, S2, S6, S9, S13,	5	28
Problem solving support	S1, S3, S7, S13	3	18
Providing question variety	S4, S12	2	12
Explaining and understanding difficult subjects	S5, S7, S10, S15	4	24
Efficiency in the learning process	S8, S11	2	12
Providing supportive roles and methods	S16, S17	2	12

* Some students participating in the study expressed more than one opinion.

It is seen on table 14 that the opinions that emerged as a result of the answers given by the participants to the question consist of eight main elements. When the frequencies of these opinions are examined, it is seen that providing detailed solutions 3 (18%), providing fast learning 4 (24%), fun and interesting learning 5 (28%), problem solving support 3 (18%), providing question diversity 2 (12%), explaining and understanding difficult subjects 4 (24%), efficiency in the learning process 2 (12%), providing supportive roles and methods 2 (12%). Some of the answers given by the participants are as follows:

S9: I think it will make my learning process more effective, enjoyable and accelerate the process because it provides logical explanations and detailed solutions. (Providing detailed solutions/enabling fast learning)

S2: Since I will be more active in the learning process, it can make learning more fun by making it less boring. (Fun and interesting learning)

S15: Explaining difficult subjects that I do not understand in a way that I can understand and making sample questions can help me to reinforce the subject. (Explaining and understanding difficult subjects)

The categories and codes that emerged as a result of the answers given by the participants to the question 'What do you think about the disadvantages of ChatGPT application in mathematics education?' are presented in Table 15.

Table 15. Findings on the disadvantages of ChatGPT in mathematics education

Disadvantages of the Application	Participant Code	f	%
Misunderstanding the command - giving wrong information	S1, S3, S7, S8, S10, S12, S13, S17	8	46
High subscription fee	S2, S14, S15, S16	4	24
Limited interaction and feedback	S5, S6, S9	3	18
Technological dependency	S4	1	6
No disadvantages	S11	1	6

Table 15 shows that the disadvantages that emerged as a result of the answers given by the participants to the question consist of five main elements. When the frequencies of the preference of these disadvantages are examined, it is seen that 8 (46%) people misunderstand the command-giving wrong information, 4 (24%) people have high subscription fees, 3 (18%) people have limited interaction and feedback, 1 (6%) people have technological dependency, and 1 (6%) people have no disadvantages. Some of the answers given by the participants are as follows:

S7: ChatGPT application has the risk of providing wrong or incomplete information. It is possible for students to learn wrong information because of this (misunderstanding the command-wrong information).

S16: ...Also, the fact that it is paid will make it difficult for everyone to access it, I think there is no disadvantage other than that. (High subscription fee)

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S4: The fact that we will always work with computer or telephone may cause us to be dependent after a while. This is a disadvantage for us students. (Technological dependence)

'How did you find the answers given by the ChatGPT application to the mathematics activities? Explain.' The categories and codes that emerged as a result of the answers given by the participants to the question are presented in Table 16.

Table 16. Findings related to the evaluation of the answers given to the activities

Participant Opinions	Participant Code	f	%
Detailed and understandable answers	S1, S2, S4, S9, S11, S12, S15	7	40
Fast and correct answers	S6, S7, S10, S13	4	24
Impressive and different solutions	S8, S17	2	12
Too detailed and boring	S3, S5, S14, S16	4	24

Table 16 states that the opinions that emerged as a result of the answers given by the participants to the question consist of four main elements. When the frequencies of these opinions are examined, detailed and understandable answers are 7 (40%), fast and correct answers are 4 (24%), impressive and different solutions are 2 (12%), too detailed and boring answers are 4 (24%). Some of the answers given by the participants are as follows:

S2: I found it good because it explains in detail and in an understandable way. When the command is clear, I like the fact that he always gives correct and detailed answers. (Detailed and understandable answers)

S8: I mean, I think it was good in general, it solved some questions in a very long way, but I think it gave very good answers. I came across effective and different solutions and lectures. (Effective and different solutions)

S16: It was very deep and detailed. I found it very boring to go into so much depth and detail. (Too detailed and boring)

'Would you like artificial intelligence applications course to be given in schools? Explain.' The categories and codes that emerged as a result of the answers given by the participants to the question are presented in Table 17.

Table 17. Findings related to the opinions on the provision of AI applications course

Category	Code	Participant Code	f	%
	Innovation and development in education	S1, S4, S9, S10, S15	5	29
	Development of student learning process	S3, S12	2	12
	Technological literacy and problem solving	S6, S14, S16	3	18
	skill	S2, S7, S8, S11,		
Yes	The importance in future years	S13	5	29

The analysis of table 17 shows that the category that emerged as a result of the answers given by the participants to the question is one. It was determined that this category was yes, and its frequency was 17 (100%). In the table, it was determined that the codes of the participants' answers to the relevant category were innovation and development in education, development of student learning process, technological literacy and problem-solving skills, importance in the coming years, labor opportunities. Some of the answers given by the participants are as follows:

S9: Personally, I would like to because artificial intelligence can help in many subjects. And since we are now in the age of technology, I think we should know this technology. (Yes/Innovation and development in education)

S2: I would, because artificial intelligence will be used more in the coming years and will be a part of our lives. (Yes/Importance in the coming years)

3.4. Teacher Interview Form Findings after ChatGPT Activities

The categories and codes that emerged as a result of the answers given by the participants to the question 'Which mathematics subjects do you think ChatGPT Application will help you in teaching?' are presented in Table 18.

Table 18. Findings on the mathematics subjects that ChatGPT can help

Mathematics Subjects	Participant Code	f	%
General math and problem solving	M1, M3, M9, M11, M14, M15	6	37
Solving and setting up equations	M2, M4, M8	3	19
Creating math materials	M5, M10	2	13
Advanced topics (Statistics, algebra, calculus etc.)	M6, M7, M12, M13, M16	5	31

When Table 18 is analyzed, it is seen that the mathematics topics that emerged as a result of the participants' answers to the question consist of four main elements. When the frequencies of these mathematics topics are examined; general mathematics and question solution 6 (37%), solving and setting up equations 3 (19%), creating mathematics materials 2 (13%), advanced topics (statistics, analysis, etc.) 5 (13%). Some of the answers given by the participants are as follows:

M1: It helps a lot in solving new generation questions and solving questions with different methods (General maths and question solution)

M2: It can help in solving equations and equations that students have difficulty in understanding (solving and constructing equations).

M12: I think it will be more verbal, that is, help in the algebra part (Algebra topics).

M16: It can be useful in teaching advanced mathematics subjects such as analysis, statistics and probability. (Advanced subjects (Statistics, analysis, etc.).

The categories and codes that emerged as a result of the answers given by the participants to the question 'How do you think the implementation will affect teacher and student collaboration?' are presented in Table 19.

Table 19. Findings on the evaluation of the effect of the application on collaboration

Participant Opinions	Participant Code	f	%
Positive interaction	M1, M2, M3, M4, M5, M6, M7, M8, M9, M10, M11, M15, M16	13	81
Negative interaction	M12, M13, M14	3	19

After analyzing Table 19 in detail, it is seen that the opinions that emerged as a result of the answers given by the participants to the question consist of two main elements. When the frequencies of the preference of these opinions are analyzed; positive interaction is 13 (81%) and negative interaction is 3 (19%). Some of the answers given by the participants are as follows:

M1: If the student will be active in the process and the teacher will support the student as a guide, cooperation will increase. (Positive interaction)

M14: The teacher remains passive in this regard because he/she is already working with an application that explains everything he/she wants to learn in detail. I think it will have a negative effect (Negative interaction).

The categories and codes that emerged as a result of the answers given by the participants to the question 'How do you think ChatGPT application will affect and support your mathematics teaching process?' are presented in Table 20.

Table 20. Findings related to the opinions on the effect of ChatGPT on the learning process

Participant Opinions	Participant Code	f	%
Practicality and speed	M1, M2, M3, M10	4	25
Improving the learning process	M4, M5, M11	3	19
Providing guidance and support	M6, M12, M15	3	19
Supporting teacher and student development	M7, M16	2	12
Negative impact (potential risk and limitation)	M8, M9, M13, M14	4	25

When Table 20 is analysed, it is seen that the opinions that emerged as a result of the answers given by the participants to the question consist of five main elements. When the frequencies of these opinions are analysed; practicality and speeding up 4 (25%), improving the learning process 3 (19%), providing guidance and support 3 (19%), supporting teacher and student development 2 (12%), negative impact 4 (25%) (potential risk and limitation). Some of the answers given by the participants are as follows:

M3: There is never only one way in the process of learning mathematics. The application can make the learning process more practical and impressive with more than one solution ways and different thinking skills. (Practicality and acceleration)

M8: It may affect negatively because it may cause readiness. Students may try to learn every information from there and have their homework prepared from there without making any effort. (Negative impact (potential risk and limitation)

The categories and codes that emerged as a result of the answers given by the participants to the question 'What do you think about the disadvantages of ChatGPT application in mathematics education?' are presented in Table 21.

Table 21. Findings related to the opinions on the effect of ChatGPT on the learning process

Participant Opinions	Participant Code	f	%
Limitation and reliability problem	M1, M2, M3, M11, M12, M16	6	35
Passivizing the student	M4, M5, M8, M10, M13	5	29
Accessibility and high cost	M3, M6, M9	3	18
Reducing teacher-student interaction	M7, M14, M15	3	18

* Some students participating in the study expressed more than one opinion.

Table 21 reveals the answers given by the participants to the question and shows that the disadvantages consist of four main elements. When the frequencies of these disadvantages are examined; limitation and reliability problem 6 (35%), student-induced risks 5 (29%), accessibility and high cost 3 (18%), reducing teacher-student interaction 3 (18%). Some of the answers given by the participants are as follows:

M1: Intuition is weak in the questions, that is, when a question is very clear, it gives the correct answer, but it may be missing in questions that are probabilistic or we need to add comments. (Limitation and reliability problem)

M8: It can prevent the student from thinking. In other words, the student can get used to the ready-made (passivizing the student).

The categories and codes that emerged as a result of the answers given by the participants to the question 'How did you find the answers given by the ChatGPT application to the mathematics activities? Explain' are presented in Table 22.

Table 22. Findings related to the evaluation of the answers given to the activities

Participant Opinions	Participant Code	f	%
Detailed and clear answers	M1, M4, M6, M7, M11, M16	6	23
Fast and correct answers	M2, M3, M6, M9, M15, M16	6	23
Effective and different solutions	M2, M4, M6, M8	4	15
Compatible and usable answers to the question	M3, M5, M10, M11, M12, M14	6	23
Poor answers to visual questions	M10, M13	4	15

* Some students participating in the study expressed more than one opinion.

Table 22 shows that the opinions that emerged as a result of the answers given by the participants to the question consist of five main elements. When the frequencies of these opinions are examined; detailed and understandable answers 6 (23%), fast and correct answers 6 (23%), effective and different solutions 4 (15%), compatible and usable answers 6 (23%), weak answers in visual questions 4 (15%). Some of the answers given by the participants are as follows:

M2: In general, its answers were satisfactory and I liked that it gave fast and correct answers. Also, it was very good that it could produce similar questions (fast and correct answers).

M6: The application gave the correct answers to the maths activities in a short time. However, the most remarkable thing was that it explained the answers in detail. Detailed explanation is the most positive aspect of the application. Again, when we asked the application for solutions in different ways, it gave us solutions in different ways. This also affects learning positively. I can say that I found it effective (effective and different solutions).

M5: The answer to the maths activities was satisfactory. I think that the answers of the application can be used and are suitable for the question asked. (Compatible with the question and can be used)

M10: I think it is weak in visual questions. When there is a visual question, the problem needs to be explained verbally in detail for the solution. However, over time, it will respond at the desired level in visual data. It is a good application for maths teachers and students. (Weak in visual questions)

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Would you like artificial intelligence applications course to be given in schools? Explain.' The categories and codes that emerged as a result of the answers given by the participants to the question are presented in Table 23.

Table 23. Findings related to the opinions on giving AI applications course

Category	Code	Participant Code	f	%
Yes	Technological progress	M2, M4, M5, M9, M10, M14, M15, M16	8	36
	Artificial intelligence in education	M3, M5, M11, M13	4	18
	Job and career opportunities	M2, M4, M6, M10, M16	5	23
	Providing motivation	M1, M7, M8, M15	4	18
No	Ethical problems	M12	1	5

* Some students participating in the study expressed more than one opinion.

When Table 23 is analyzed, it is seen that there are two categories that emerged as a result of the answers given by the participants to the question. When the frequencies of the preference of these categories are examined; yes 15 (95%), no 1 (5%) person. Some of the answers given by the participants are as follows:

M2: Of course. Because our age is the age of technology and it can be an inevitable source of work for students in the future. (Yes/ Technological progress)

M4: Yes. Artificial intelligence will be much more popular in the future and will be used in many business lines. Therefore, I would like it to be taught as a course at school. (Yes/ Job and career opportunities)

M12: No, I think that an application that will get in front of us should not be left to the school environment. Students should be prevented from knowing these applications and taking the easy way out. Then, artificial intelligence will be able to do the homework (No/ Ethical problems).

4. DISCUSSION and CONCLUSION

The main purpose of this study is to determine the views of secondary school students and mathematics teachers on the use of ChatGPT artificial intelligence application in mathematics education. In this regard, it was aimed to reveal the awareness levels of secondary school students and mathematics teachers participating in the research about the use of ChatGPT artificial intelligence application in mathematics education and their opinions about the application. In this context, the conclusions drawn from the findings obtained before the artificial intelligence activities are presented in this section.

4.1. Results Obtained for Student Opinions Before Implementation

When the findings obtained in the study regarding the pre-application student views on artificial intelligence-supported mathematics education are examined, the student views are given below:

- Artificial intelligence-supported mathematics education can provide the opportunity to teach mathematics lessons in a student-centered manner.
- Artificial intelligence-supported mathematics education can support learning processes by making positive contributions.

On the other hand, some students think that artificial intelligence-supported mathematics education may negatively affect the mathematics lesson. When the literature is reviewed (Chen et al., 2020; Garbage et al., 2021; Davies, et al., 2021), there have been many studies investigating students' views and attitudes towards the use of technology and artificial intelligence in mathematics teaching.

Based on this result of the study, it can be said that secondary school students are willing to use artificial intelligence applications in mathematics teaching. Deo et al. (2020) found in their research that students who were willing to use modern artificial intelligence applications in mathematics teaching exhibited better academic performance and achieved success during the application and lesson. In another study, Tedre et al. (2021) determined that teaching algebra operations using artificial intelligence applications is more fun and permanent, and it was stated that such a teaching method is pedagogically suitable for learning processes. From this point of view, it can be said that the researches are in parallel with the results obtained in the study. In parallel with the results obtained in the study, McCarthy (2022) also revealed in his research that the most basic goal of students who aim to learn mathematics and increase academic success with artificial intelligence applications is to have practical problem-solving skills and learn basic concepts in mathematics. On the other hand, Sohail (2023), in his research on calculations and algorithms, found that students tried to make complex calculations in the use of artificial intelligence in mathematics and tried difficult methods for advanced mathematical calculations outside of basic concepts. When examined from this perspective, it can be seen that the results of this research do not coincide with the results of the conducted study.

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Based on the findings obtained from the study, student expectations for mathematics teaching supported by ChatGPT artificial intelligence application are presented below;

- To be able to complete the missing subjects in maths lesson.
- To find creative solutions to maths questions.
- To be able to develop students' creativity.
- To be able to create inspiration and self-confidence for knowledge production.
- To be able to adapt mathematics to daily life

It is seen that there are generally expectations for skill acquisition and academic success in mathematics education with the application of artificial intelligence. When looking to the study of

Wardat et al. (2023), about artificial intelligence in mathematics it is seen that learning is largely used in relation to academic success or that there is an expectation in this direction. Moreover, Zafrullah et al. (2023) in their study on the use of the ChatGPT artificial intelligence application by students studying mathematics, they found that the students had a desire to gain skills by using the artificial intelligence application. From this perspective, the results of many studies (Aydın & Karaarslan, 2023; Botana & Recio, 2024) are parallel to the data obtained as a result of this study. In this context, it can be said that students' interest in the use of artificial intelligence is focused on forward-looking development and success.

4.2. Results Obtained Regarding Student Opinions after the Implementation

According to the findings obtained as a result of the post-application interviews with secondary school students, students plan to use the ChatGPT artificial intelligence application for the following purposes for Mathematics education:

- To get help with general maths, to set up and solve equations.
- To be able to draw and interpret graphs.
- To have detailed lectures.
- Solving logic and reasoning questions.
- To get help for special topics of mathematics such as multi-step operations (measuring length, etc.).
- To receive general maths help such as setting up and solving equations, drawing and interpreting graphs.

Wardat et al. (2023) also found in their study that when they examined the students' purposes of using artificial intelligence in mathematics lessons, the purposes of understanding the basic subjects of mathematics and establishing formulas and equations generally came to the fore. However, again Zafrullah et al. (2023) in their study investigating student interest in using ChatGPT in mathematics education, they found that most of their students thought of using artificial intelligence to understand basic subjects in mathematics. Looking at the results of these studies, it can be said that they overlap with the results of the research.

In light of the data obtained from the interviews after the activities with secondary school students, it was determined that the students thought that the ChatGPT application could contribute to the mathematics learning process in the following ways:

- It can offer detailed solutions to questions in mathematics education.
- It can support fast learning in mathematics education.
- It can make mathematics education interesting and offer fun learning opportunities.
- It can provide problem solving support in mathematics education.
- It can provide question diversity and knowledge acquisition in mathematics education.
- It can provide explanation and understanding of difficult subjects in mathematics education.
- It can provide efficiency in the process of learning mathematics and provide a supportive role and method.

In the study conducted by Supriyadi and Kuncoro (2023) on the use of ChatGPT in mathematics teaching, it was seen that students found ChatGPT interesting and stated that it provided a time advantage in learning difficult subjects, and these results are similar to the results obtained in the study. From this perspective, it can be said that secondary school students have positive attitudes towards artificial intelligence application and find the application useful.

In the interviews conducted with secondary school students after the activities, it was determined that the students thought that they might have the following disadvantages in using the ChatGPT application in mathematics education:

The command may be misunderstood and therefore give incorrect information

- It may give incorrect and incomplete information.
- May cause technological addiction.
- It has limitations in interaction and feedback.
- It may be difficult for students to access because it is paid and expensive.

Kalla and Kuraku (2023) stated that the use of ChatGPT can reduce the social interaction between students and affect their learning experiences, and that students avoid researching information and resort to technological convenience, thus increasing their technological dependence. When the results obtained are analysed, it can be said that the students look at the information provided by the ChatGPT application as definitive information, so the false information provided by artificial intelligence due to incomplete and incorrect command negatively affects learning.

In the post-activity interviews with secondary school students, it was determined that the students described the answers given by the ChatGPT application to the mathematics activities as follows:

- Provides detailed and understandable answers
- Provides fast and accurate answers.
- It offers impressive and different solutions.
- Additionally, some students stated that they could give too detailed and boring answers.

Considering the research conducted on this subject (Çağlar et al., 2023; Fergus et al., 2023), it has been revealed that students say that ChatGPT gives very long and unnecessary answers and therefore they sometimes hesitate to use it. Looking at these results, it can be said that ChatGPT has negative features as well as positive ones, and these features are noticed and expressed by secondary school students.

According to the findings obtained from the opinions of the students on the teaching of artificial intelligence applications in schools, the opinions of the students are as follows:

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- It can make a positive contribution to the education and training process
- It can provide innovation and development in education.
- It can provide students with technological literacy and problem-solving skills by improving the learning process.
- It may provide workforce opportunities as it may gain importance in the coming years.

Studies on the benefits of artificial intelligence applications in education (Meylani, 2024; Sok & Heng, 2023), it is striking that artificial intelligence innovates educational processes, students adopt technology-integrated teaching and gain new skills. These results are in parallel with the results obtained in the study. Based on this result obtained in the study, it can be said that middle school students are willing to use artificial intelligence applications in mathematics teaching. Doe et al. (2020) determined in their research that students who are willing to use modern artificial intelligence applications in mathematics teaching exhibited better academic performance and achieved success during the application and lesson.

4.3. Results Obtained Regarding Teacher Opinions Before Implementation

In the study, the methods, techniques and artificial intelligence application ChatGPT used by secondary school mathematics teachers were examined. The following results were determined regarding the findings obtained regarding the methods used by mathematics teachers to increase student achievement:

- It has been determined that secondary school mathematics teachers state that they use interactive technology tools, creative approaches and traditional teaching methods to increase student success
- However, it was determined that they stated that they used approaches appropriate to their individual learning styles, applied learning and problem solving techniques

- It has been observed that teachers prefer creative approaches and traditional teaching methods more than other methods.

Saralar et al. (2023) found in their study that traditional methods such as reading books and doing a lot of exercise increased mathematics achievement by encouraging students to do so by teachers. On the other hand, when looking at the studies conducted on teachers who managed to increase mathematics achievement by using current and creative approaches (Karataş et al., 2020; Rehman et al., 2023), it can be seen that students actively participate in creative activities and often solve problems. It is seen that they gain practical knowledge in mathematics by using solving and case study techniques. From this point of view, it has been determined that creative approaches increase student achievement in mathematics course in parallel with the results of the studies conducted in recent years. However, on the other hand, in the studies on traditional methods used to increase student achievement in mathematics lessons (Fernández-Gutiérrez et al., 2020; Kutluca, & Gündüz, 2022; Lo & Hew, 2020), it was stated that the traditional method was not used much, did not affect student achievement much more than other methods and therefore lagged behind other methods. In this context, it can be said that traditional methods are less preferred to increase student achievement in mathematics lessons and the results differ from the results obtained in this study.

Within the scope of the research, it was determined that secondary school mathematics teachers had the following opinions regarding artificial intelligence-based mathematics education:

- Artificial intelligence applications should be integrated into mathematics lessons.
- Artificial intelligence is a tool that can be used in mathematics lessons.
- It is an innovative method in artificial intelligence-supported mathematics education.

On the other hand, it has been determined that there are teachers who state that artificial intelligence-based mathematics education is an inadequate method that may cause a lack of knowledge. It can be said that mathematics teachers think that the use of artificial intelligence, in addition to some benefits, leads students to laziness and is an inadequate method that is not comprehensive. Similarly, in his research on the effects of ChatGPT, Etike (2023) revealed that the artificial intelligence application keeps people away from doing research by making effort, offers superficial information, and in terms of research and education processes, the information offered by the artificial intelligence application is not sufficient. On the other hand, Baidoo et al. (2023), in their research on the application of artificial intelligence in education, stated that teachers have a positive attitude towards ChatGPT and emphasize that it should be integrated into the teaching process by giving an innovative perspective to education.

Looking at the results of the findings regarding the experiences of secondary school mathematics teachers participating in the study with artificial intelligence before the application, it was determined that most of the teachers had not used artificial intelligence before, while some teachers had used artificial intelligence before. It has been observed that teachers who have used artificial intelligence in the past have used it to create tests, create in-class activities and detect students' lack of knowledge. In addition, it was determined that the participating teachers stated that they could not find applications to use in mathematics lessons or that they had difficulty in finding applications.

Based on this result, it can be said that the use of artificial intelligence among secondary school mathematics teachers is not very widespread.

4.4. Results Obtained Regarding Teacher Opinions After the Implementation

The following results were determined regarding the use of the artificial intelligence application ChatGPT in mathematics lessons and the expectations of mathematics teachers:

- It can be used as a tool for generating questions and finding practical solutions.
- It can help teachers in the learning process.
- It can offer effective methods in education.

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In their research, Elbanna and Armstrong (2024) stated that the main objectives of teachers' use of artificial intelligence in their lessons were that it provides more comfortable and easy presentation, offers practical and fast solutions, and is more effective than traditional methods. According to this result, it can be concluded that teachers who use artificial intelligence in their lessons aim to facilitate the teaching process as well as accessing fast and practical information.

The following results were determined regarding the findings of the secondary school mathematics teachers who participated in the research on artificial intelligence supported mathematics education:

- It can offer student-centred mathematics lessons.
- It can provide support for the learning process.

On the other hand, it was observed that some participant teachers stated that it would not contribute to the teaching and efficiency of the lesson.

From this point of view, it can be concluded that secondary school mathematics teachers do not agree on the efficiency of artificial intelligence-supported mathematics education in mathematics lessons and even some mathematics teachers think that artificial intelligence cannot contribute much to mathematics education compared to other fields.

It was found that the teachers who participated in the research thought that the ChatGPT application could support the mathematics teaching process in the following ways:

- It can bring practicality and speed to mathematics teaching.
- It can improve the learning process in mathematics teaching.
- It can guide students and teachers in mathematics teaching.
- It can support teacher and student development.

However, it was determined that they stated that it may also have negative effects as it also harbours certain risks. Similar studies on this subject (Elbanna & Armstrong, 2024; Sharma & Yadav, 2022; Sok & Heng, 2023) have revealed that the use of ChatGPT artificial intelligence application in the educational environment offers many supports to teachers in terms of time, process and practicality in addition to the advantages it offers to students. Therefore, it can be said that the results of the studies conducted in the literature in terms of the conveniences provided by the artificial intelligence application to teachers and the results of this study are in parallel.

The teachers who participated in the research have the following thoughts about the potential disadvantages that may arise from the use of ChatGPT artificial intelligence application in mathematics education:

- It may make students passive because it makes them accustomed to the ready.
- It may cause reliability problems because it provides limited information.
- Its accessibility is difficult due to its high cost.
- It may reduce teacher and student interaction.

In this respect, Karthikeyan (2023) found that the ChatGPT artificial intelligence application has many disadvantages as well as the advantages it offers to teachers and students, and stated that these negativities distract the teacher from practice and research over time, ready-made information is presented without questioning, and mutual discussion to determine the accuracy of information is reduced. The teachers who participated in the research on the disadvantages of the artificial intelligence application, in addition to similar negativities, stated that there may be limitations and reliability problems, there may be student-induced risks, it is an accessible and high-cost application, and it may reduce teacher-student interaction, and they have revealed similar results with the studies conducted in the literature on the negative aspects of ChatGPT.

In the study, it was determined that teachers' opinions about the responses of ChatGPT artificial intelligence application to mathematics activities were as follows:

- Provides detailed and understandable answers to the activities.

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- Provides fast and accurate answers to the activities.
- Provides different solutions by giving effective answers to the activities.
- Provides usable answers that are compatible with the question.

While the participant teachers generally stated that the artificial intelligence application provided good service, it was determined that there were also teachers who stated that it was weak in visual questions and did not provide service at the desired level.

Wardat et al. (2023) stated in their study that ChatGPT creates satisfaction among the users in terms of the services it offers in general, but it is weak in terms of some usage services and this is the biggest deficiency of the artificial intelligence application. In addition, Frieder et al. (2024), in their study on the mathematics capacity of ChatGPT, concluded that the artificial intelligence application could not provide sufficiently effective services in geometric services and visual capacity in the field of mathematics compared to other disciplines. From this point of view, it can be said that the application is generally effective, but its effectiveness in visual questions should be increased.

When the opinions of the secondary school mathematics teachers participating in the study on the legal teaching of artificial intelligence applications course in schools in the future were analysed, the following opinions were determined:

- Due to the necessity of using artificial intelligence in education, artificial intelligence applications course should be taught in schools.
- Artificial intelligence should be taught in schools for reasons such as offering job and career opportunities and increasing student motivation.

However, despite all these positive reasons, some of the teachers who participated in the research stated that they did not want to teach the artificial intelligence applications course in schools because it could cause various ethical problems.

Many studies in the literature (Ağmaz, 2024; Karabulut, 2023) have revealed the ease of use of artificial intelligence application in schools. Sincar (2023), in his study investigating the effects of artificial intelligence application, stated that the use of ChatGPT in schools will have some negative effects on teachers and especially school administrators, and that privacy violations and ethical problems that may arise may disrupt the educational process. Therefore, it can be said that the legal teaching and use of ChatGPT in schools may offer many conveniences, but it may create some violations and therefore privacy and ethical problems.

In general, it can be said that teachers and students express positive opinions about the use of the ChatGPT artificial intelligence application, the services it offers in mathematics education, and the benefits it will provide in education and training. On the other hand, it has been revealed that it may have some negative effects such as creating ethical problems in its use in education and training, reducing student-teacher collaboration, and sometimes disrupting the mathematics education process. However, in the study of Voskoglou and Salem (2020), it was determined that artificial intelligence tools are effective in developing problem solving, analytical thinking, and critical evaluation skills in mathematics education. In addition, it was emphasized that these applications personalize mathematics learning and adapt to students' individual learning styles and needs. In this context, it can be said that the research findings in question do not coincide with previous studies.

Recommendations for Educators/Practitioners

- In undergraduate departments that train teachers, trainings can be given on the use, services and teaching of ChatGPT artificial intelligence application.
- Sections that will facilitate the training of ChatGPT artificial intelligence application can be added to MoNE education programmes or new programmes can be prepared.
- ChatGPT artificial intelligence application guidebooks can be prepared for mathematics teachers.

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ChatGPT may face significant obstacles in its effective use in schools. First of all, the lack of sufficient technological infrastructure may make it difficult for AI-based education to become widespread, especially in regions where internet access is limited. However, some teachers may be prejudiced against such innovations due to concerns about moving away from traditional pedagogical approaches. Another risk factor that can negatively affect learning processes is students' excessive dependence on AI tools. In order to overcome these difficulties, comprehensive training programs can be organized for teachers. In addition, studies can be carried out to provide students with the skills to use AI consciously and responsibly. In addition, infrastructure investments can be prioritized and improvement and development studies can be carried out.

Suggestions for Researchers

- The level of use of ChatGPT artificial intelligence application by secondary mathematics teachers can be examined.
- Research can be conducted to examine how student attitudes and the use of ChatGPT artificial intelligence application affect the development of mathematics skills.

Examples of educational models for the effect of ChatGPT artificial intelligence application on the development of applicable mathematics skills can be created by examining mathematics education programs in different countries.

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Ethics Committee Decision

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