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Investigation of Middle School Students' Attitudes towards Mathematics Course in the Context of Different Variables (Eskişehir-Türkiye Case)

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Abstract. It is believed that students' motivation and emotions have an important role in their understanding of mathematics teaching. In this context, this study aims to investigate middle school students' attitudes towards mathematics lessons in the light of various variables. A quantitative cross-sectional survey approach was used in the design of the study. It was tried to understand how these variables affect students' attitudes towards mathematics. In the study, various variables such as gender, grade level, school type, technology use, use of concrete materials/activities in lessons and use of Education Information Network (EBA), an online platform for distance education, were taken into consideration. According to the findings of the study, students' attitudes towards mathematics lessons are positively affected by educational policies, curriculum designs and the creation of concrete materials and activities in the classroom. In particular, a detrimental change was observed in the attitudes of students who used EBA less. The perspective provided by this study is crucial for understanding middle school students' attitudes about mathematics in learning environments. It is also recommended that the study be extended to cover more samples and regions, as the findings can serve as a basis for further research.

Keywords: Attitude, middle school, EBA, open and distance education, mathematics education.

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Today, it is seen that middle school students' attitudes, motivation and emotions towards mathematics have a significant effect on their achievements. Motivation and emotions play an important role in students' learning process and mathematical achievement (Fazlı & Avcı, 2022; Filiz & Gür, 2020; Çalık, 2024). Nolting (2007) states that students' performance in mathematics courses is related to their attitudes as well as their mathematical knowledge. Interestingly, research on students' attitudes towards mathematics has become more important in recent years (Schukajlow et al., 2023). Research that tries to identify the variables that contribute to the success of mathematics teaching typically considers students' abilities or attitudes towards the subject as an output (explained variable) and investigates the inputs that affect this output and the links between the inputs (Duran et al., 2023).

Students' attitudes are one of the most crucial markers of their emotive qualities in a course (Gardner & Lambert, 1972; Stern, 1983; Brown, 2001; Karasakal & Saracaloğlu, 2009; Kaya et al., 2009 quoted in Kazazoğlu, 2013). According to the Turkish Language Association (In Turkish TDK) (2023), the concept of attitude, which is briefly defined as the way, attitude, is also referred to as a method of finding a way that determines what people see, hear, think and do (Allport, 1935 quoted in Bohner & Dickel, 2011). Attitude, one of the main topics of social psychology, is also defined as a mindset or tendency to behave in a certain way depending on both the individual's experience and temperament, which is a combination of personality, beliefs, values, behaviors, and motivation (Pickens, 2005). Value systems further define attitude as the preconceived notion that categorizes anything, someone, the world, or a symbol as either good, bad, harmful or beneficial (Tavşancıl, 2014).

One of the key factors thought to be responsible for explaining pupils' willingness or inability to study is their attitudes (Hotaman & Okumuş, 2020). While middle school mathematics courses appear to be primarily cognitive, emotive qualities are also crucial to the mathematical learning process (Boz, 2017). Students' performance or lack thereof in mathematics, as well as their enthusiasm for the subject, are significantly influenced by their attitudes (Çoban, 1989). Affective traits are crucial for mathematical learning even if the middle school mathematics curriculum appears to be mostly a cognitive endeavor (Boz, 2017). Students' attitudes greatly impact whether they succeed or fail in math and how much they enjoy the subject. Demirgören (2010) cites research demonstrating that students in various nations have a fear of mathematics and that there are negative views toward the subject, as well as historical examples. Despite being a required and fundamental course in middle education, many students find mathematics to be a challenging subject to study.

Students' achievement suffers as a result of this circumstance, which makes them have a negative attitude toward mathematics (Kurbanoğlu & Takunyacı, 2012). Furthermore, it can be claimed that the middle school mathematics course is one of those that draws attention to procedures like the High School Entrance Examination (In Turkish LGS) because of things like the superiority of the mathematics score coefficient and how it affects students' success scores. It was reported that middle school students found mathematics to be the most challenging subject during the pandemic (Karataş, 2020). According to Ministery of National Education, [MoNE] (2018), the impact of cultivating a positive attitude towards mathematics on mathematical achievement is a significant consideration while implementing the middle school mathematics curriculum. In a study involving high school students, Sezgin (2013) found a strong correlation between students' attitudes toward mathematics and academic self-efficacy and their mathematical achievement. The correlation between mathematics achievement and attitudes toward mathematics courses, which are seen as essential courses for students to take, has been noted by Koca (2011) and by Cantürk-Günhan et al. (2019).

The COVID-19 epidemic is believed to have an impact on several variables, including pupils' academic performance, attitude, self-efficacy, anxiety level, and motivation in courses requiring numerical skills like science and mathematics that are taught in middle schools in Turkey (Bakioğlu & Çevik, 2020; Bakırcı, Doğdu & Artun, 2021; Çoban & Ellez, 2022). As a result of the literature review, it was understood that many studies determine students' attitudes towards mathematics courses from primary school to higher education and examine their attitudes in terms of different variables, but after the Covid-19 outbreak in Turkey, there were few studies such as Kılıç (2022), Kara and Özkaya (2022), which determined the mathematics attitudes of middle school students in Turkey and investigated the relationship with different variables such as LGS achievement scores of 8th-grade students and motivation. Nevertheless, no research has been done to ascertain the attitudes of middle school students at various grade levels toward mathematics courses and to investigate the impact of various factors, including the frequency of EBA usage and the integration of educational technologies in the classroom, on the attitudes of the students.

One of the online learning platforms utilized by Turkish middle school pupils is the Education and Informatics Network (In Turkish EBA). During the COVID-19 pandemic, the MoNE advised using this platform, which has also been used for conducting online learning courses (Vahit, 2019; Çoban & Ellez, 2022). Known as the integrated distance education process, it is the process by which schools take a break from providing face-to-face instruction beyond 2020. EBA TV and the EBA live classroom application have grown to be valuable tools for teachers in this regard. Some middle school

courses, such as mathematics, were provided to pupils via the EBA live classroom application for around a year. Teachers attempted to incorporate many tools and resources, like Web 2.0 tools and augmented reality applications, into real-time classroom applications during this phase (Çıray-Özkara, 2023). While it is acknowledged that the use of technology in learning environments affects students' arithmetic achievement and attitudes, the majority of studies have focused on teachers' perceptions of ICTs (Higgins et al. 2017; Vahit, 2019; Viberg et al. 2023). Studies that involve students thinking about related topics in mathematics education are needed. Teachers should be the target audience for these studies, which also measure students' attitudes toward mathematics and look at the relationship between variables influencing attitudes toward mathematics from various angles, like the use of technology.

In the context of all this information, the aim of this study is to examine the attitudes of middle school students in Eskişehir province towards mathematics lessons by considering demographic factors such as gender, school type, and frequency of using educational technologies, frequency of participating in applied activities in mathematics lessons and frequency of using EBAs. The study also aims to provide suggestions for improving these attitudes. In this framework, the study aims to address the following questions:

1. What is their attitude level?
2. Do their attitudes vary according to gender?
3. Do their attitudes vary according to school type?
4. Do their attitudes vary according to their grade level?
5. Do their attitudes vary according to the frequency of EBA use?
6. Do their attitudes vary according to the use of educational technologies in lessons?
7. Do their attitudes change according to the situation of performing concrete activities in lessons?

Method

The research will be designed in the cross-sectional survey model of the quantitative research method (Büyüköztürk et al., 2012). The cross-sectional survey model aims to take a picture of the situation collecting data simultaneously to illuminate a situation, variable, phenomenon and to reveal

the situation, variables and relationships between variables by examining this photograph (Barış, 2015).

The Study Group

The population of the study is all middle school pupils (N=72,145) enrolled in Eskişehir during the 2022–2023 academic year. By getting approval from the appropriate units, the mathematics teachers of every middle school in Eskişehir distributed the link to the data collection tool to the students as part of the study. In the process of data collection, the 'online survey' technique was utilized and the data collection tool was uploaded to the online survey platform called Google Forms. Within the scope of the study, data were collected from 501 (n=501) middle school students. The calculation made through the Rao soft sample size calculation program shows that the data obtained from at least 384 students represent the universe, and Creswell (2013) states that 360 or more participants in survey studies generalize the universe. In this context, it is concluded that the data collected within the scope of the study is sufficient.

Data Collection

To gather data, a questionnaire form that aligned with the study's objectives was created. The initial section of the survey asks about the personal details of the students, including their gender, grade level, type of school, use of educational technologies, use of the Education Information Network (In Turkish EBA), and performance of concrete activities during math lessons. In the second part, the Mathematics Attitude Scale developed by Gülburnu and Yıldırım (2015) was included. The 5-point Likert-type scale consists of 5 sub-dimensions and 27 items. In order to reveal the reliability of the scale, Cronbach Alpha internal consistency coefficient was calculated. Cronbach Alpha coefficient was found to be .880 for all items. As a result of the factor analysis, it was seen that the scale items reflected the dimensions of 'In-Course, Nature of Mathematics, Problem Solving, Understanding and Self-Efficacy' towards mathematics. According to the findings obtained, it was concluded that the ITS has a reliable structure with measurement validity that measures primary and middle school students' attitudes towards mathematics and consists of five sub-dimensions. In this context, the scale, whose validity and reliability tests have been conducted, is applicable to middle school students.

Sub-factor averages, factor correlations, and diagnostic statistics about the study group are all included in the analysis of the quantitative data from the questionnaire form that was administered to 501 students (281 female and 220 male) in the 2022–2023 academic year using the IBM SPSS 25

package program. In addition, in the comparison of quantitative data, the normality assumption for the data was first tested and then parametric tests were applied. This study employed a t-test to compare variables with two categories. For variables with three or more categories, a one-way analysis of variance (ANOVA) was used. If the ANOVA indicated a significant difference, post-hoc tests were conducted to pinpoint specific group differences.

Data Collection Tools

Form for participant information. Completing concrete activities in math lessons, using educational technology frequently, *gender, grade level and type of school attended, frequency of using EBA, and performing activities* in math classes were all questions on the Participant Information Form, which was created per the research's objectives.

Math attitude scale. A study was conducted by Gülburnu and Yıldırım (2022) developed a mathematics attitude scale. The scale demonstrated good internal consistency with a Cronbach's Alpha of .880 for all items and above .7 for subscales. The Kaiser-Meyer-Olkin (KMO) measure was .888, indicating suitability for factor analysis. The analysis revealed that the scale items effectively capture five dimensions related to student attitudes towards mathematics: In-Course, Nature of Mathematics, Problem Solving, Understanding, and Self-Efficacy. These findings suggest the scale is a reliable and valid measure of middle school students' mathematics attitudes. The scale consists of 27 items across five sub-dimensions and utilizes a 5-point Likert format. Overall, the scale appears appropriate for use with middle school students to assess their mathematics attitudes.

Data Analysis

The researchers used the SPSS software package to analyze the collected data. They set a significance level of 5% and a confidence interval of 95% to interpret the results. Analyses focused on sub-factor averages, factor correlations, and incorporating the study group's diagnostic data. For quantitative data comparisons, one-way ANOVA was used for variables with more than two categories, while the t-test was employed for variables with two categories. If the ANOVA indicated a significant difference, post-hoc tests were conducted to pinpoint specific group variations.

To assess the reliability of the scale used in the study, the researchers calculated Cronbach's Alpha. A value of .936 suggests the scale has very high internal consistency.

Results

The results of the Mathematics Attitude Scale showed that the scores' skewness and kurtosis coefficients ranged from +1.5 to -1.5. The data are considered to fit the normalcy assumption based on the values obtained (De Carlo, 1997). Table 1 displays descriptive statistics according to the students' Mathematics Attitude Scale scores.

Table 1.

Results Associated with Students' Attitude Scale Scores in Mathematics

Variables	n	Min.	Max.	Average	Sd	Skewness	Kurtosis
Math Course	501	1.00	5.00	3.63	.873	-.455	-.553
Attitude						.109	.218

This table presents the average scores and standard deviations obtained by students on a math attitude scale. The scale uses a Likert-type format, where scores are assumed to be evenly spaced across the range. An average score range factor of 0.79 is applied (Çokluk et al., 2010). To determine the actual score range, the lowest possible score (1) is subtracted from the highest possible score (which depends on the number of items in the scale). The result is then divided by the number of scale items, and this value represents the width of each score range (Erkuş, 2012). Table 2 shows the resulting score ranges for this particular scale.

Table 2.

Math Attitude Scale Item Rating Intervals

Level	Item Value Ranges
1 - Very Low	1.00 – 1.79
2 - Low	1.80 – 2.59
3 - Medium	2.60 – 3.39
4 - High	3.40 – 4.19
5 - Very High	4.20 – 5.00

Considering the scoring ranges explained in Table 2, the average score of 3.63 suggests a "high" level of mathematics attitude among the students.

Findings Related to the Study Group

This section presents the background information collected from participants. Table 3 specifically details the gender breakdown of the student population.

Table 3.

Table of Distribution Based on Student Gender

Variables	Groups	Frequency	Percentages
Gender	Female	281	56.1
	Male	220	43.9
	Total	501	100

Table 3 indicates that female participants made up 56.1% of the study group that replied to the relevant scale within the study's scope, while male participants made up 43.9%. It is assumed that female students engaged in the study to a greater extent than male students.

Table 4 shows the distribution of students according to school type.

Table 4.

Table of Distribution Based on School Type

Variables	Groups	Frequency	Percentages
School Type	Middle Schools	371	74.1
	IHSS	130	25.9
	Total	501	100

As seen in Table 4, it is seen that 74.1% of the study group responding to the relevant scale within the scope of the study consisted of students studying in middle schools and 25.9% in Imam Hatip middle schools.

Table 5 shows the distribution of students according to their grade levels.

Table 5.

Class Level of Students

Variables	Groups	Frequency	Percentages
Class Level	Grade 5	136	27.1
	Grade 6	95	19.0
	Grade 7	184	36.7
	Grade 8	86	17.2
	Total	501	100

Table 5 shows the participation rates for the study according to grade level. Among the respondents who completed the relevant scale, 7th graders had the highest participation rate at 36.7%, followed by 5th graders at 27.1%. Participation was lowest among 8th graders at 17.2%.

Table 6 shows the frequency of students' use of the Education Information Network (In Turkish EBA).

Table 6.

Students' Frequencies of Using EBA

Variables	Groups	Frequency	Percentages
EBA Frequency of Use	Never	153	30.5
	Rarely	179	35.7
	Once a week	46	9.2
	Several times a week	101	20.2
	Every day	22	4.4
	Total	501	100

As seen in Table 6, when the responses of middle school students regarding the frequency of weekly EBA usage are examined; 30.5% of the students stated that they never use EBA, while 35.7% stated that they rarely use it. While 4.4% of the students answered that they use EBA every day, it is

seen that these students are the least number of students in the study. It is understood that students generally use EBA rarely or never.

Findings Related to Research Questions

Do the attitudes of the study group towards mathematics courses change according to gender?. To assess students' mathematical attitudes across different genders, researchers utilized an attitudes scale encompassing five components: course content, the perceived nature of mathematics, problem-solving skills, comprehension, and self-efficacy in math. An independent samples t-test was then employed to analyze potential gender differences in these attitudes.

Table 7.

Independent Samples t-Test Table according to the Gender of the Students Participating in the Study

Variables	**Groups**	**Average**	**F**	**P**
Course Content	Female	3.53	1.446	0.230
	Male	3.59		
The Nature of Mathematics	Female	3.51	1.963	0.162
	Male	3.57		
Problem-Solving Skills	Female	3.74	.593	0.442
	Male	3.73		
Understanding	Female	3.71	.410	0.552
	Male	3.58		
Self-efficacy	Female	3.79	.045	0.832
	Male	3.75		

According to Table 7, no significant difference was found in the attitudes of middle school students towards mathematics courses in all sub-factors of the mathematics attitude scale in the context of gender variables.

Do the attitudes of the study group toward mathematics courses change according to the type of school?. To assess if students' school background (public vs. private) influenced their perception of math classes, an independent samples t-test was conducted to compare attitudes between the two groups. Table 8 presents the findings regarding the second sub-question of the study, the effect of school type on students' attitudes toward mathematics courses.

Table 8.

Independent Samples t-Test Table according to the School Type of the Students Participating in the Study

Variables	**Groups**	**Average**	**F**	**p**
Course Content	Middle School	3.58	.809	0.230
	İmam Hatip S.S.	3.47		
The Nature of Mathematics	Middle School	3.57	.262	0.162
	İmam Hatip S. S.	3.45		
Problem-Solving Skills	Middle School	3.72	.206	0.442
	İmam Hatip S.S.	3.77		
Understanding	Middle School	3.65	.559	0.552
	İmam Hatip S.S.	3.67		
Self-efficacy	Middle School	3.79	.948	0.832
	İmam Hatip S.S.	3.74		

According to Table 8, no significant difference was found in all sub-factors of the mathematics attitude scale in the attitudes of middle school students towards mathematics courses in the context of the school-type variable.

Do the attitudes of the study group toward mathematics course change according to the grade levels of the students?. One-way ANOVA is performed to analyze the significant difference in the attitudes of middle school students studying in Eskişehir towards mathematics courses according to the grade levels they study. Table 9 shows the findings regarding the third sub-question of the research, the effect of the grade level variable on students' attitudes towards Mathematics courses.

Table 9.

ANOVA Table Summarizing Differences in Student Performance by Class Level

Variables	**Groups**	**Average**	**F**	**P**	**Difference**
Math Course Attitude	Grade 5	3.76	3.029	.028*	1-3
	Grade 6	3.72			
	Grade 7	3.48			
	Grade 8	3.62			

The analysis (likely referring to an ANOVA test) revealed significant differences ($p < .05$) in student attitudes towards math courses depending on their grade level. To pinpoint these differences between groups, follow-up tests were conducted. Due to unequal variances among groups ($p= .012 <.05$) and potentially unequal sample sizes, the Games-Howell test was chosen for further analysis.

According to the Post-Hoc test results related to the grade levels of the students; it is seen that the attitudes of the 5th-grade students are significantly different from the attitudes of the 7th grade students. In addition, it is seen that 5th-grade students developed higher attitudes towards mathematics courses compared to other groups, while 7th-grade students had the lowest attitudes in the group.

Do the attitudes of the study group toward mathematics course change according to the frequency of EBA usage?. One-way ANOVA is performed to analyze the significant difference in the attitudes of middle school students studying in Eskişehir towards mathematics courses according to their EBA usage status. Table 10 shows the findings regarding the fourth sub-question of the research, the effect of the variable of EBA usage frequency of students on their attitudes towards Mathematics courses.

Table 10.

ANOVA Table According to the Frequency of EBA Usage of the Students Participating in the Study

Variables	**Groups**	**Average**	**F**	**p**	**Difference**
Math Course Attitude	Never (1)	3.47	4.758	.001*	1-3
	Rarely (2)	3.48			1-4
	Once a week (3)	3.57			
	Several times a week (4)	3.83			
	Every day (5)	4.09			

The ANOVA analysis (likely from Table 10) showed a significant difference ($p < 0.05$) in student attitudes towards the math course based on their EBA usage. To identify which groups differed, follow-up tests were necessary. Because the variances between groups were similar ($p = 0.147 > 0.05$), but the sample sizes might be unequal, the Hochberg's GT2 test was chosen for further analysis.

According to the Post Hoc test results regarding the frequency of EBA use, there is a significant difference between students who never use EBA and students who use it several times a week and every day. It is seen that as the frequency of students' use of EBA increases, the mean attitudes towards mathematics courses also increase.

Do the attitudes of the study group towards mathematics course change according to the use of educational technologies in the lessons?. To determine if middle school students in Eskişehir have significantly different views toward mathematics courses based on the Use of Educational Technologies in Lessons, a one-way ANOVA is conducted. The results for the fifth sub-question of the study, which examines how students' attitudes toward mathematics courses are impacted by the variable of their usage of educational tools in the classroom, are displayed in Table 11.

Table 11.

One-way ANOVA Table According to the Use of Educational Technologies in the Courses of the Students Participating in the Study

Variables	**Groups**	**Average**	**F**	**p**	**Difference**
Math Course Attitude	Never	3.42	1.040	.375	
	Rarely	3.48			
	Often	3.50			
	Always	3.61			

According to Table 11, no significant difference was found as a result of the analysis of students' attitudes towards Mathematics course in the context of the frequency of using educational technologies in lessons (P= .375> .050).

Do the attitudes of the study group towards mathematics lesson change according to the status of performing concrete activities in lessons?. A one-way ANOVA test was conducted to see if using concrete materials in math lessons affected the attitudes of students towards the subject. Table 12 presents the results related to the research question about the impact of incorporating concrete activities (sixth sub-question) on student attitudes.

Table 12.

ANOVA Table according to the Participating Students' Performing Concrete Activities in Lessons

Variables	**Groups**	**Average**	**F**	**P**	**Difference**
Math Course Attitude	Never (1)	3.42	9.659	.000*	
	Rarely (2)	3.48			3-1, 3-2
	Often (3)	3.75			4-1, 4-2
	Always (4)	4.09			

The analysis (likely referring to a one-way ANOVA test in Table 12) revealed a significant difference ($p < 0.05$) in student attitudes towards math based on whether concrete activities were used in lessons. To pinpoint which groups differed in their attitudes, further tests were conducted. Because the variances between groups were similar ($p = .496 > .05$), but the sample sizes might be unequal, the Hochberg's GT2 test was chosen for further analysis.

According to the Post-Hoc test results related to the frequency of using concrete activities in the lessons, there is a significant difference between the students of teachers who frequently or always use concrete materials, activities, etc. in the lessons and the students of teachers who rarely or never use them. It is seen that as the use of concrete materials in the lessons increases, the mean attitudes of the students towards mathematics lessons also increase.

Discussion and Conclusion

This study aimed to ascertain the attitudes of middle school students in the province of Eskişehir toward mathematics courses following the COVID-19 pandemic. The attitudes of the participants were analyzed concerning various variables, including gender, type of school attended, and frequency of EBA use. According to their results on the mathematical attitude scale, 501 pupils were determined to have a "high" level of mathematics attitude, with an average of 3.63. Similar findings were obtained in studies by Deniz and Cıtdır (2020) with middle school students and Çavdar (2019) with 4th-grade primary school pupils. The mathematical attitude levels of the eighth-grade students in Kılıç's (2022) study were found to be medium level. The relevance of mathematics courses is reflected in the high degree of student attitudes about them.

The reliability level of the scale used in this study was .936 and it is understood that the scale has very high reliability. As a result of the meta-analysis study of Cantürk Günhan et al., (2019), it was stated that students' achievement in mathematics will increase as a result of developing positive attitudes towards mathematics. As a result of this study, it is thought that students' high levels of mathematics attitude will positively affect many factors such as students' academic achievement and self-efficacy.

It was found that 56.1% of the students in the study group were females and 43.9% were males, 74.1% of them were studying in middle school and 25.9% in Imam Hatip Middle School, and students were participating in the study at all grade levels in the middle school level. When the participation status of the study group according to grade levels was examined, it was seen that the highest participation in the study was at the 7th-grade level with 36.7% and the lowest participation was from

the 8th-grade with 17.2%. It is believed that this circumstance results from eighth-grade kids getting ready for LGS. The information regarding middle school pupils' weekly EBA usage frequency is astounding. It is acknowledged that most students use EBA infrequently or never.

In line with the first sub-question of the research, it was revealed that the mathematics attitudes of middle school students did not show a significant difference in terms of gender variables. This result is similar to the results of the studies conducted by Koca (2011), Tuncer and Yılmaz (2016), Çavdar (2019), Deniz and Cıtdır (2020) before the Covid-19 pandemic, and Kılıç (2022) and Kara and Özkaya (2022) after the Covid-19 pandemic. One could argue that middle school pupils' attitudes toward mathematics are not much influenced by their gender. It was reported that female students' attitudes were positive than male students' attitudes in Demirgören's (2010) study including high school students. Similar sentiments on mathematics were shown by female students in Ergin's (2022) survey of middle school pupils. In Saracoğlu's (2016) study conducted with 6th-grade middle school students, it was stated that male students had positive attitudes toward mathematics courses than female students. These different results may have been caused by many factors such as the region where the study was conducted and the study groups. A similar situation was observed in terms of the second sub-question of the study, which was the students' attitudes towards mathematics in terms of school type. In this study, it was understood that the school-type variable did not affect students' attitudes toward mathematics. In Saracoğlu's (2016) study, there was no difference between the attitude towards middle school mathematics courses and the school type variable, while Deniz and Cıtdır (2020) concluded that middle school students' interest in mathematics was significantly higher than Imam Hatip Middle School students.

Within the scope of the third sub-question of the research, it was concluded that students' attitudes towards Mathematics courses differed according to their grade levels. It was seen that 5th-grade students' attitudes differed significantly from 7th-grade students' attitudes and 5th-grade students developed higher attitudes towards mathematics courses compared to other groups, while 7th-grade students had the lowest attitude in the group. The reflections of the adolescence period, which is the developmental period in which the students are, and the COVID-19 process may be the reason for this situation. In the study conducted by Deniz and Cıtdır (2020) with middle school students, it was stated that the scores of middle school students from the attitude scale differed according to their grade levels. In the aforementioned study, it was stated that 8th-grade students' interests, studies, and attitudes toward mathematics were significantly lower than other grade levels. Unlike the study in which it was stated that students' attitudes towards mathematics decreased as the

grade level increased, in this study, it was understood that 8th-grade students exhibited higher attitudes towards mathematics compared to 7th-grade students. However, when a comparison is made from 5th grade to 7th grade, it is seen that there is a similar result to Deniz and Cıtdır's (2020) study. According to Boz (2017), for mathematics teaching to achieve its goals, the development of students' attitudes towards mathematics and the formation of positive changes in attitudes towards mathematics as the grades progress should be one of the main tasks of schools.

As a result of the analysis conducted within the scope of the fourth sub-question of the research, it was seen that as the frequency of students' use of EBA increased, their average attitudes toward mathematics increased. In Özbey's study conducted in 2019, it was concluded that an EBA-supported learning environment did not affect middle school students' attitudes toward mathematics. This situation may have resulted from students' online education and integration into distance education after the COVID-19 pandemic process. EBA can also be characterized as a platform that provides e-learning to its users. According to Etlioğlu and Tekin (2020), students need to acquire positive affective behaviors to achieve easy and permanent learning and success in the e-learning process. The research data also reflect the effect of increasing the frequency of EBA usage on students' attitudes, suggesting that this situation facilitates the learning process.

Within the scope of the fifth sub-question of the research, no significant difference was found in the attitudes of students towards Mathematics courses in the context of the frequency of using educational technologies in lessons. In the study conducted by Eryiğit and Kılıç (2022) with primary school 4th-grade students during the pandemic period, it was stated that attitude towards technology is one of the important predictors of mathematics achievement and that students' attitudes towards technology negatively affect their mathematics achievement. The results of this study showed that the frequency with which instructional resources were utilized in the classroom had no bearing on students' attitudes about mathematics.

In line with the sixth sub-question of the research, it was concluded that as the use of concrete materials increased in the lessons, the average attitudes of the students towards the mathematics course also increased. To realize permanent learning, it is also important to design materials that appeal to students' affective characteristics (Etlioğlu & Tekin, 2020). Consequently, to improve students' attitudes about the course in middle school mathematics classes, it is imperative to promote the usage of actual materials.

Expressed as the ninth objective within the scope of special objectives in the curriculum of the Middle School Mathematics course: "Students will develop a self-confident approach to mathematical problems by developing a positive attitude towards mathematics through their experiences in learning mathematics" (MoNE, 2018), it can be said that the change in students' attitudes towards mathematics after the COVID-19 outbreak will also affect their approach to mathematical problems. The stated goal of the mathematics course is believed to be accomplished if the middle school pupils included in this study have favorable attitudes about mathematics and constructively tackle mathematical issues.

Recommendations

In the aftermath of the COVID-19 pandemic, the attitudes towards mathematics of students studying at different educational levels such as primary and middle education in Turkey can be examined. With the use of measures that can be implemented through EBA, it is possible to periodically assess students' attitudes toward subjects like science and math.

In this study, variables that came to the forefront during the COVID-19 pandemic process such as school type, frequency of EBA use, and use of technology in education were associated with students' attitudes towards mathematics, while middle school students' attitudes towards mathematics course can be interpreted by taking into account different variables such as students' learning styles, learning methods and techniques, and educational staff in schools.

In this study, a quantitative method was used and the research was designed in a cross-sectional survey model. In future studies, detailed studies can be conducted by including students' opinions and mixed methods can be used. Experimental studies can also be conducted to focus on the relationship between variables such as students' use of technology in lessons and concrete activities with attitudes toward mathematics courses. In addition, in this study, students' attitudes toward mathematics courses were determined. In another study, comparative studies can be conducted by examining students' attitudes towards different processes such as distance education process, technology use, and attitudes towards online education. The data presented in the study are limited to 501 students studying at middle school level in Eskişehir. In order to determine the attitudes towards mathematics course of more students studying at different grade levels at the middle school level in Eskişehir or to obtain general results by overcoming the stated limitation, the attitudes of students studying in similar school types from different cities towards mathematics course can be determined.

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Conflict of Interest

It has been reported by the authors that there is no conflict of interest.

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Ethical Standards

This research adhered to all ethical guidelines. Approval was granted by the Eskişehir Provincial Directorate of National Education's research commission on March 6, 2023 (decision number E-88074293-605.01-71604229), with the Governorate's consent.

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References

Ardıç, M. A. (2023). Matematik öğretmenlerinin Covid-19 sürecinde gerçekleştirdikleri uzaktan eğitimlerin teknolojiye yönelik tutumlarına etkisi [The effect of distance education provided by mathematics teachers during the Covid-19 period on their attitudes towards technology]. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, *20*(1), 48-78. https://doi.org/10.33711/yyuefd.1120418.

Bakırcı, H., Doğdu, N. & Artun, H. (2021). Covid-19 pandemi dönemindeki uzaktan eğitim sürecinde fen bilgisi öğretmenlerinin mesleki kazanımlarının ve sorunlarının incelenmesi. *Ahi Evran Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *7*(2), 640-658.

Bakioğlu, B. & Çevik, M. (2020). Covid-19 pandemisi sürecinde fen bilimleri öğretmenlerinin uzaktan eğitime ilişkin görüşleri. *Turkish Studies, 15*(4), 109-129.

Barış, M. F. (2015). Üniversite öğrencilerinin uzaktan öğretime yönelik tutumlarının incelenmesi: Namık Kemal Üniversitesi örneği [Examining university students' attitudes towards distance education: Namık Kemal University example]. *Sakarya University Journal of Education*, *5*(2), 36-46. https://doi.org/10.19126/suje.38758

Bohner, G., & Dickel, N. (2011). Attitudes and attitude change. *Annual Review of Psychology, 62*(1), 391-417. https://doi.org/10.1146/annurev.psych.121208.

Boz, H. (2017). Matematiğe yönelik tutum gözlem formunun geliştirilmesi [Development of attitude observation form towards mathematics]. [Unpublished master's thesis]. Necmettin Erbakan University.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2012). *Bilimsel Araştırma Yöntemleri* [*Scientific Research Methods*]. (11th ed.). Pegem Akademi.

Cantürk-Günhan, B., Topuz, F. & Bedir, D. (2019). Türkiye'deki öğrencilerin matematik dersine yönelik tutumları ile matematik başarıları arasındaki ilişki: Bir Meta-Analiz çalışması [The relationship between students' attitudes towards mathematics in Turkey and their mathematics achievement: A Meta-Analysis study]. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi, 21*(3), 148-164. https://doi.org/10.17556/erziefd.483521

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Sage.

Çalık, B. (2024). The relationship between mathematics achievement emotions, mathematics self-efficacy, and self-regulated learning strategies among middle school students [Unpublished Master's Thesis]. Middle East Technical University.

Çavdar, D. (2019). Matematik dersinde akademik başarı, öz yeterlik ve matematik dersine yönelik tutum arasındaki ilişkinin incelenmesi [Examining the relationship between academic success, self-efficacy and attitude towards mathematics course]. [Unpublished master's thesis]. Balıkesir University.

Çıray-Özkara, F. (2023). Covid-19 pandemi sürecinde uzaktan fen eğitiminde kullanılan örnek uygulamalar. In E. Özen (Ed.). *Kalite bağlamında uzaktan eğitim* [*Distance education in the context of quality*]. (p.125-156). Kriter Yayınevi.

Çoban, A. (1989). Ankara Merkez ortaokullarındaki son sınıf öğrencilerinin matematik dersine ilişkin tutumları [Attitudes of senior students in Ankara Central middle

schools towards mathematics course]. [Unpublished master's thesis]. Gazi University.

Çoban, C. & Ellez, A. M. (2022). Covid-19 pandemi sürecinde uzaktan eğitimde ve sonrasında öğretmen olmak: ortaokul matematik öğretmenlerinin görüşleri In H. Şahin (Ed.). *Eğitim Bilimleri Çalışmaları*. (p. 25-58). Livre de Lyon.

Çokluk, O., Şekercioglu, G., & Büyüköztürk, S. (2010). *Sosyal bilimler için çok degişkenli istatistik SPSS ve LISREL uygulamaları* [*SPSS and LISREL applications of multivariate statistics for social sciences*]. Pegem A.

De Carlo, L. T. (1997). On the meaning and use of Kurtosis, *Psychological Methods*, *2*, 292-307. Retrieved March 5, 2023, from http://www.columbia.edu/~ld208/psymeth97.pdf.

Demirgören, D. (2010). İzmir ili öğretmen lisesi öğrencilerinin Matematik dersine yönelik tutumları ve kullandıkları öğrenme stratejileri [Attitudes of teacher high school students in Izmir towards Mathematics and the learning strategies they use]. [Unpublished master's thesis]. Dokuz Eylül University.

Deniz, L. & Cıtdır, N. (2020). Ortaokul öğrencilerinin matematiğe yönelik tutumlarının incelenmesi [Examining middle school students' attitudes towards mathematics]. *Anadolu University Journal of Education Faculty*, *4*(3), 294-322. https://doi.org/10.34056/aujef.704071.

Duran, S., Berk, Ş., & Köklü, O. (2023). Matematik öğretmenlerinin görüşlerine göre ortaokul matematik öğretiminde karşılaşılan sorunların ve çözüm önerilerinin incelenmesi [Examining the problems and solution suggestions encountered in middle school mathematics teaching according to the opinions of mathematics teachers]. *Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi, 57*(57), 128-150. https://doi.org/10.15285/ maruaebd.1181564.

Ergin, G. (2022). Ortaokul öğrencilerinin matematik öz yeterlik, kaygı, tutum ve algılanan öz düzenlemeler arasındaki ilişkinin incelenmesi [Examining the relationship between middle school students' mathematics self-efficacy, anxiety, attitude and perceived self-regulation]. [Unpublished master's thesis]. Alanya Alaaddin Keykubat University.

Erkuş, A. (2012). Varolan ölçek geliştirme yöntemleri ve ölçme kuramları psikolojik ölçek geliştirmede ne kadar işlevsel: Yeni bir öneri [How functional are existing scale development methods and measurement theories in psychological scale development: A new proposal]. *Journal of Measurement and Evaluation in Education and Psychology*, *3*(2), 279-290. Retrieved July 5, 2022, from https://dergipark.org.tr/tr/ download/article-file/65963

Eryiğit, K. & Kılıç, R. (2022). Predictors of Mathematics Achievement in Pandemic: Academic Grit and Technology Attitude. *OPUS Journal of Society Research*, *19*(49), 762-770. https://doi.org/10.26466/ opusjsr.1170924

Etlioğlu, M. & Tekin, M. (2020). Elektronik öğrenmede öğrenci tutum ve akademik başarı arasındaki ilişkide öğrenci merak ve kaygısının aracılık rolü [The mediating role of student curiosity and anxiety in the relationship between student attitudes and academic achievement in electronic learning]. *Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (43), 34-48. https://dergipark.org.tr/tr/pub/ susbed/issue/ 61825/925046.

Fazlı, E. & Avcı, O. (2022). Matematik eğitiminde motivasyon ve öz-düzenleme: Tek bir durum çalışması. *Harran Maarif Dergisi*, *7*(1), 1-45. http://dx.doi.org/10.22596/hej.976349.

Filiz, A., & Gür, H. (2020). Matematikte özyeterlik algılar, motivasyonlar, kaygılar ve tutumlar arasında ilişki. *Balıkesir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 23*(44), 783-804. https://doi.org/10.31795/baunsobed.704334

Gülburnu, M., & Yıldırım, K. (2015). İlkokul ve ortaokul öğrencilerine yönelik matematik tutum ölçeği geliştirilmesi ve uygulanması [Development and implementation of a mathematics attitude scale for primary and middle school students]. *VI. Uluslararası Türkiye Eğitim Araştırmaları Kongresi* içinde (s.568-581). Hacettepe University.

Higgins, K., Huscroft-D'Angelo, J. & Crawford, L. (2017). Effects of technology in Mathematics on achievement, motivation, and attitude: A Meta-analysis. *Journal of Educational Computing Research*, *0*(0), 1-37.

Hotaman, D., & Okumuş, H. N. (2020). Oyunla matematik öğretiminin 5. sınıf öğrencilerinin matematik dersine karşı tutumları üzerindeki etkisinin incelenmesi [Examining the effect of teaching mathematics through games on 5th grade students' attitudes towards mathematics course]. *Uluslararası Sosyal Araştırmalar Dergisi, 13*(70). 736-744.

Kara, Y. & Özkaya, A. (2022). Ortaokul öğrencilerinin matematik motivasyonları, tutumları ve başarıları arasındaki ilişkinin incelenmesi [Examining the relationship between middle school students' mathematics motivation, attitudes and achievement]. *International Journal of Educational Studies in Mathematics, 9*(1), 33-48. https://doi.org/10.17278/ijesim.1032457.

Karakuş, G., & Erşen, Z. B. (2021). Öğretmenlerin uzaktan eğitime yönelik tutumları ve Covid-19 korkularının farklı değişkenler açısından incelenmesi [Examining teachers' attitudes towards distance education and their fears of Covid-19 in terms of different variables]. *Manisa Celal Bayar Üniversitesi Eğitim Fakültesi Dergisi, 9*(2), 66-85. https://doi.org/10.52826/mcbuefd.954341.

Karataş, Z. (2020). COVID-19 pandemisi sürecinin LGS ve YKS sınavına hazırlık sürecinde olan çocuk ve ergenlerin psikolojilerine yansımalarının incelenmesi. In B. Gençdoğan (Ed.), *Pandemi döneminde çocuk ve ergen psikolojisi* [*Child and Adolescent Psychology during the Pandemic Period*]. (1st ed., p. 54–74). Türkiye Klinikleri.

Kazazoğlu, S. (2013). Türkçe ve İngilizce derslerine yönelik tutumun akademik başarıya etkisi [The effect of attitude towards Turkish and English lessons on academic success]. *Eğitim ve Bilim, 38*(170), 294-307.

Kılıç, F. (2022). Sekizinci sınıf öğrencilerinin matematiğe ilişkin tutum ve motivasyon düzeyleri ve LGS başarı puanları arasındaki ilişki [The relationship between eighth grade students' attitudes and motivation levels towards mathematics and LGS success scores]. [Unpublished master's thesis]. Aydın Adnan Menderes University.

Koca, S. (2011). İlköğretim 8. sınıf öğrencilerinin matematik başarı, tutum ve kaygılarının öğrenme stillerine göre farklılığının incelenmesi [Examining the differences in mathematics achievement, attitudes and anxiety of primary school 8th grade students according to their learning styles]. [Unpublished master's thesis]. Afyon Kocatepe University.

Kurbanoğlu, N. İ., & Takunyacı, M. (2012). Lise öğrencilerinin matematik dersine yönelik kaygı, tutum ve öz-yeterlik inançlarının cinsiyet, okul türü ve sınıf düzeyi açısından incelenmesi [Examining high school students' anxiety, attitude

and self-efficacy beliefs towards mathematics in terms of gender, school type and grade level]. *Uluslararası İnsan Bilimleri Dergisi*, *9*(1). 111-130.

MoNE. (2018). İlkokul ve *ortaokul matematik dersi (1, 2, 3, 4, 5, 6, 7 ve 8. sınıflar) öğretim programı* [Primary and middle school mathematics course (1st, 2nd, 3rd, 4th, 5th, 6th, 7th and 8th grades) Curriculum]. Milli Eğitim Bakanlığı. Retrieved March 10, 2023, from http://mufredat.meb.gov.tr/ProgramDetay. aspx?PID=329

Nolting, P. (2007). Manage math and test anxiety for success in math. Bradenton, FL: Academic Success Press, Inc.

Özbey, A. (2019). EBA destekli öğrenme ortamının ortaokul öğrencilerinin eşitlik ve denklem konusundaki başarı, tutum ve motivasyonlarına etkisi [The effect of EBA supported learning environment on middle school students' success, attitude and motivation regarding equality and equation]. [Unpublished master's thesis]. Zonguldak Bülent Ecevit University.

Pickens, J. (2005). Attitudes and perceptions. *Organizational Behavior in Health Care*, *4*(7), 43-76.

Polat, H. & Baysal, E. (2022). Ortaokul öğrencilerinin Covid-19 salgın sürecinde yürütülen uzaktan matematik öğretimine yönelik görüşlerindeki farklılıkların incelenmesi [Examining the differences in middle school students' opinions about distance mathematics teaching during the Covid-19 epidemic]. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi*, *24*(2), 319-332. https://doi.org/10.17556/erziefd. 975190.

Saracoğlu, F. (2016). İlköğretim altıncı sınıf öğrencilerinin matematik başarıları ve matematik dersine yönelik tutumlarının incelenmesi [Examination of primary school sixth grade students' mathematics achievements and attitudes towards mathematics course]. [Unpublished master's thesis]. Ahi Evran University.

Schukajlow, S., Rakoczy, K., & Pekrun, R. (2023). Emotions and motivation in mathematics education: Where we are today and where we need to go. *Mathematics Education*, *55*, 249–267. https://doi.org/10.1007/s11858-022-01463-2.

Sezgin, M. (2013). Öğrencilerin Matematiğe yönelik tutumlarının akademik özyeterlik algıları ve algıladıkları öğretmen davranışları açısından incelenmesi [Examining students' attitudes towards Mathematics in terms of their academic self-efficacy perceptions and perceived teacher behaviors]. [Unpublished master's thesis]. İstanbul University.

Tavşancıl, E. (2014). *Tutumların Ölçülmesi ve SPSS ile Veri Analizi* [*Measurement of Attitudes and Data Analysis with SPSS*]. (5th ed.). Nobel Yayın Dağıtım.

TDK. (2023). *Tutum* [*Attitude*]. Retrieved April 4, 2023, from https://sozluk.gov.tr/

Tuncer, M. & Yılmaz, Ö. (2016). Ortaokul öğrencilerinin matematik dersine yönelik tutum ve kaygılarına ilişkin görüşlerinin değerlendirilmesi [Evaluation of middle school students' opinions regarding their attitudes and concerns towards mathematics course]. *KSÜ Sosyal Bilimler Dergisi*, *13*(2). 47-64.

Vahit, H. R. (2019). EBA etkinlikleriyle yapılan matematik öğretiminin başarıya ve tutuma etkisi [The effect of mathematics teaching with EBA activities on success and attitude]. [Unpublished master's thesis]. Kastamonu University.

Viberg, O., Grönlund, Å. & Andersson, A. (2023) Integrating digital technology in mathematics education: a Swedish case study, *Interactive Learning Environments*, *31*(1), 232-243, DOI: 10.1080/10494820.2020.1770801