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Eğitimde Demokratik Değerlerin Rolü: Ortaokul

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Bir Araştırma

## The Role of Democratic Values in Education: A Quantitative Research on Social and Academic Development of Secondary School Students

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## Özet

Çalışmanın amacı, ortaokul öğrencilerinin matematiksel muhakeme becerileri ile demokratik değer ve tutumları arasındaki olası ilişkiyi ortaya çıkarmak ve bu bağlamda eğitim politikalarına katkı sağlamaktır. Araştırma, 2023-2024 eğitim-öğretim yılında İzmir'deki resmi ortaokullarda öğrenim gören 485 öğrencinin katılımıyla gerçekleştirilmiştir. Veriler, Kişisel Bilgi Formu, Matematiksel Muhakeme Değerlendirme Testi ve Demokratik Tutum Ölçeği kullanılarak toplanmış ve istatistiksel olarak analiz edilmiştir. Araştırmanın bulguları, öğrencilerin matematiksel muhakeme becerilerinin genel olarak düşük düzeyde olduğunu, ancak demokratik tutumlarının iyi bir seviyede olduğunu göstermiştir. Matematiksel muhakeme becerileri, öğrencilerin problem çözme, eleştirel düşünme ve analitik yeteneklerini kapsamakta ve bu becerilerin geliştirilmesi, akademik başarıyı doğrudan etkileyebilecek önemli bir unsur olarak değerlendirilmektedir ve bu çalışmada demokratik tutumun alt boyutları ile matematiksel muhakeme alt boyutları arasındaki bazı ilişkiler dikkat çekicidir. Özellikle, eleştirel düşünme yetenekleri ile demokratik değerlere olan bağlılık arasında anlamlı korelasyonlar tespit edilmiştir. Ayrıca, matematiksel muhakeme alt boyutlarının demokratik tutum üzerindeki etkileri incelendiğinde, aynı verinin farklı gösterimlerini tanımanın anlamlı etkisi olduğu tespit edilmiştir. Bulgular, eğitimde demokratik değerlerin ve matematiksel düşünme becerilerinin eşzamanlı olarak geliştirilmesinin önemini vurgulamaktadır. Öğrencilerin hem akademik hem de sosyal gelişimlerinin desteklenmesi, daha bilinçli ve demokratik bir toplumun inşası için kritik bir öneme sahiptir. Araştırma sonuçları, eğitimciler ve politika yapımcılar için öneriler sunmaktadır. Matematik eğitiminin müfredatına demokratik değerleri entegre edecek stratejiler geliştirilmesi, öğrencilerin hem akademik hem de sosyal becerilerini artırabilir. Çalışma, okul sosyal hizmetinin ve matematik eğitiminin, öğrencilerin hem akademik hem de sosyal gelişimlerini desteklemede önemli bir rol oynayabileceğini göstermektedir.

**Anahtar Kelimeler:** Matematiksel Muhakeme, Demokratik Tutum, Ortaokul Öğrencileri, Okul Sosyal Hizmeti, Eğitim Politikaları

## Abstract

The aim of the study is to reveal the possible relationship between secondary school students' mathematical reasoning skills and their democratic values and attitudes and to contribute to educational policies in this context. Data was collected and statistically analysed using Personal Information Form, Mathematical Reasoning Assessment Test and Democratic Attitude Scale. The findings of the study showed that students' mathematical reasoning skills were generally at a low level, but their democratic attitudes were at a good level. Mathematical reasoning skills include students' problem solving, critical thinking and analytical skills, and the development of these skills is considered as an important factor that can directly affect academic success and in this study, some relationships between the sub-dimensions of democratic attitudes and mathematical reasoning sub-dimensions are remarkable. In particular, significant correlations were found between critical thinking skills and commitment to democratic values. Additionally, when examining the effects of the sub-dimensions of mathematical reasoning on democratic attitudes, it was found that recognising different representations of the same data had a significant effect. The findings emphasise the importance of developing democratic values and mathematical reasoning skills simultaneously in education. The research results provide recommendations for educators and policy makers. Developing strategies to integrate democratic values into the curriculum of mathematics education can increase both the academic and social skills of students. The study shows that school social work and mathematics education can play an important role in supporting both academic and social development of students.

**Keywords:** Mathematical Reasoning, Democratic Attitudes, Secondary School Students, School Social Work, Educational Policies



## Highlights

What we have revealed from the results of the research is that there is no significant difference between mathematical reasoning and democratic attitudes.

1. A significant relationship was found between democratic values and simple mathematical reasoning sub-dimensions in students.
2. Independent decision-making and developing potential are very low in students.
3. There is a need for a program in which mathematics, reasoning and democratic values are internalized in the mediation of social work.

## INTRODUCTION

Democracy and social work are inherently interconnected concepts. The term "democracy" originates from the Greek words "demos" (people) and "kratos" (power) (Heywood, 2007: 52). As a political and social system, democracy provides individuals with the broadest possible framework to freely make political, economic, and social choices, and it is widely regarded as a value that must be protected by the international community (UN Vienna Declaration, 1993: 3). Abraham Lincoln famously defined democracy as "government of the people, by the people, for the people" (Schmidt, 2002: 16). In this context, social work, which aims to address issues such as poverty, inequality, and child abuse, finds a more effective operational ground within democratic societies.

The foundations of social work rest upon advocacy and democratic participation (Biesta, 2014: 50). Social services play a critical role in fostering democratic engagement by facilitating public discourse and bringing individual problems to the collective agenda. This underscores the necessity for social services to align with democratic values, as advocacy efforts cannot be sustained without fostering an emancipatory environment. A closely related concept to democracy is citizenship, which can be examined in two dimensions: political citizenship and social citizenship. While political citizenship pertains to participation in decision-making processes, social citizenship is associated with the principle of absolute equality and social solidarity (Marshall, 1950). The historical expansion of democratic principles has been shaped by various philosophical and political developments, such as Montesquieu's insights regarding the balance of power (Yolcuoğlu, 2021: 32).

Economic and educational dimensions also play a pivotal role in the development of democracy. In the absence of democratic governance, the suppression of information flow facilitates the spread of propaganda. Although social media is widely used by younger

generations, it presents both opportunities and challenges, particularly in its role as a propaganda tool (Köseoğlu & Al, 2013: 122). Projections suggest that social media will become an increasingly dominant and influential medium in shaping public discourse.

Although democracy is institutionally enshrined in legal frameworks, its true essence is realized through practice and lived experience (Baştaymaz, 2016: 25). It is often conceptualized as a welfare and redistribution mechanism aimed at reducing social inequalities. Democracy enables individuals to exercise control over their leaders by freely expressing their political will. Historically, marginalized groups such as enslaved individuals, women, and disadvantaged populations were excluded from citizenship rights in both Europe and America. However, significant advancements in human rights and civil liberties have been made in the 21st century. The enfranchisement of women in Turkey in 1934 serves as a notable example of the expansion of political rights. Social work fosters democratic citizenship and contributes to the sustainability of democratic attitudes (Baştaymaz, 2016: 26-30). Democratic societies are fundamentally committed to ensuring that individuals possess free thought and conscience. Popper (1989: 169) argues that the transition from a closed to an open society constitutes one of the most significant revolutions in human history. Within this framework, democratization efforts in education, particularly in mathematics education, hold considerable importance. Issues such as gender inequality, mathematics anxiety, and the absence of democratic classroom environments are among the key challenges that social work can help address.

Mathematics and democracy are mutually reinforcing phenomena; while mathematics enhances cognitive and analytical skills, democratic education fosters social cohesion and peace. Aguilar and Zavaleta (2012: 5) identify three key intersections between mathematics education and democracy. Firstly, mathematical education equips students with the skills necessary to critically analyze their social environment and discern both the appropriate and manipulative uses of mathematics in society. Secondly, the way mathematics is taught in classrooms has the potential to either promote or inhibit the development of values essential for sustaining democratic societies. Lastly, mathematics education can function as a social filter that either facilitates or restricts individuals' opportunities for civic engagement and development.

Ball et al. (2005: 2) highlight that mathematics education, particularly through pedagogical approaches, is a vital resource for fostering social justice and a diverse democracy. While multiple disciplines contribute to democratic education, mathematics uniquely advances these objectives. Strengthening mathematics and science education is essential to achieving

developmental goals and supporting economic growth. In developing countries, enhancing educational quality, particularly in mathematics, is critical to sustaining democratic structures (Vithal, 2012).

Beyond its cognitive contributions, mathematics serves as a powerful tool for understanding social structures and the inequalities embedded within them. Moreover, the symbolic language of mathematics can be effectively utilized to advocate for a more just society. Consequently, mathematics curricula have the potential to fortify democratic values and drive societies toward greater social justice. By applying mathematical concepts to real-world social issues, students are inspired to connect mathematics with their lived experiences, thereby fostering their active participation in democratic processes (Gonzalez, 2024).

Mathematics education plays a crucial role in shaping democratic citizenship (Kollosche, 2024). Dewey asserts that the knowledge gained in schools should be directly applicable to real life, thus establishing a strong connection between democratic education and mathematical literacy. Kasap et al. (2013) emphasize that mathematical thinking facilitates democratization by enabling individuals to develop rational problem-solving abilities. Moreover, research suggests that mathematics education, when integrated with social services, positively influences teacher job satisfaction (Wright, 2016).

In sum, education, particularly mathematics education, serves as a cornerstone in the development and sustainability of democratic societies. By integrating democratic values into the mathematics curriculum, educational institutions can equip students with the cognitive and ethical competencies necessary for active and informed citizenship.

Given the critical role of democratic values in education, this study holds significant importance in understanding how mathematical reasoning skills relate to students' democratic attitudes. By examining this relationship within the context of school social work, this research contributes to the broader discourse on how educational experiences shape democratic citizenship. The findings of this study have the potential to inform educational policies and pedagogical practices that foster both cognitive development and social responsibility in students.

The primary aim of this research is to examine the relationship between mathematics self-reasoning and students' democratic attitudes in the context of school social work. To achieve this objective, the study seeks to address the following research questions:

1. What are the mathematical reasoning skill levels of secondary school students?

2. What are the democratic attitude levels of secondary school students?
3. Are there significant relationships between the sub-dimensions of mathematical reasoning skills and the sub-dimensions of democratic attitudes?
4. Do mathematical reasoning skills significantly influence democratic attitude?

By exploring these questions, the study aims to provide empirical insights into the role of mathematical education in fostering democratic values, thereby contributing to the development of more effective educational strategies that align with the principles of democratic engagement and social equity.

## METHODOLOGY

This study employs a relational survey model to examine the relationship between mathematics self-reasoning skills and democratic attitudes within the context of school social work. As defined by Karasar (2016: 81), this model seeks to identify potential relationships between two or more variables and to determine the extent of these relationships, if present.

The population of the study comprises students enrolled in public secondary schools in Izmir during the 2023-2024 academic year. Given the accessibility of students, the sample was drawn from 11 secondary schools in the Buca district, selected through convenience sampling (Tuna, 2016: 14). A total of 485 seventh-grade students participated in the study, representing a diverse range of sociodemographic backgrounds. Seventh-grade students were chosen as they are at an optimal stage of cognitive and social development; while fifth and sixth graders may not yet have fully developed the necessary reasoning skills, eighth-grade students are primarily focused on high-stakes examinations, which could impact their engagement in the study. The selection of schools in Buca was specifically based on the researcher's professional affiliation with this district, allowing for a more effective data collection process. These schools were chosen for their capacity to reflect the broader student population, and participants were randomly selected to ensure a balanced representation.

The data for this study were collected using three measurement tools:

1. **Personal Information Form:** Developed by the researcher, this form gathers demographic and background information on students, including gender, preschool education status, parental relationship status, parental education level, class size, and the gender of the mathematics teacher.
2. **Mathematical Reasoning Skills Assessment Test (MMRAT):** Developed by Çoban and

Tezci (2020), this test comprises 23 items designed to measure students' mathematical reasoning skills. The test includes both multiple-choice and open-ended questions and is structured into seven sub-dimensions: Forecasting, Generalization, Deciding on the Accuracy of the Solution and the Result, Recognizing Patterns, Recognizing Different Representations of the Same Data, Developing Logical Pathways to Solutions, and Solving Non-Routine Problems. Scoring is based on a binary system, where correct answers receive 1 point, and incorrect answers receive 0 points. Evaluations are conducted using mean scores, with overall scores and sub-dimension scores ranging between 0 and 1. A higher mean score indicates a higher level of mathematical reasoning skills.

3. **Democratic Attitude Scale (DAS):** Developed by Şimşek (2011), this 5-point Likert-type scale measures students' democratic attitudes across five sub-dimensions: Following the Rules, Tolerance, Sense of Trust, Social Engagement, and Independent Movement. The scale yields both overall and sub-dimension scores, ranging from 1 to 5, where higher scores indicate stronger democratic attitudes. The reliability of the scale, as determined by Cronbach's Alpha, was reported as 0.86 (Şimşek, 2011), demonstrating strong internal consistency.

The data collected were analyzed using quantitative statistical methods in SPSS 26 software. In addition to descriptive statistics, the following inferential statistical techniques were employed: Independent Samples t-Test – To compare differences between two independent groups. One-Way Analysis of Variance (ANOVA) and Tukey HSD Post-Hoc Test – To analyze differences between multiple groups and identify significant group-wise variations. Simple Linear Regression Analysis – To examine the predictive relationship between mathematical reasoning skills and democratic attitudes. The effect sizes of significant differences were calculated using formulas recommended by Field (2009) to assess the practical significance of the findings.

Furthermore, the study was conducted between October and November 2023. The administration of measurement tools was limited to a single class period (40 minutes) to minimize disruption to the students' academic schedule. Prior to data collection, students were fully informed about the purpose and procedures of the study, and necessary parental consent documents were obtained in accordance with ethical research guidelines.

## FINDINGS

The study, which was conducted with the participation of 485 seventh grade students, aims to

determine the effect of mathematics self-reasoning skills on democratic attitude in the context of school social work.

53% of the participants were female and 47% were male. While 72% of the students received pre-school education, 28% did not. 53% of the students study in classes of 20-30 students, 46.4% in classes of 31-40 students and 0.6% in classes of 41-50 students. The mathematics teachers of 57.5% of the students participating in the study were female and 42.5% were male. In general, it is seen that the students receive pre-school education, are educated in classes of 20-30 students and their mathematics teachers are mostly female (Table 1).

**Table 1.**

*Descriptive findings about the students*

Variables	n	%
Gender		
Woman	257	53.0
Male	228	47.0
Preschool Education Status		
Got it	349	72.0
Not taken	136	28.0
Class Size		
20-30	257	53.0
31-40	225	46.4
41-50	3	0.6
Gender of the Maths Teacher		
Woman	279	57.5
Male	206	42.5
<b>Total</b>	<b>485</b>	<b>100</b>

The educational levels of the students' mothers are distributed as follows: 6.8% (n=33) were illiterate, 21.6% (n=105) were primary school graduates, 20.8% (n=101) were secondary school graduates, 30.5% (n=148) were high school graduates and 20.2% (n=98) were university graduates. The education levels of the fathers are as follows: 3.1% (n=15) were illiterate, 17.3% (n=84) were primary school graduates, 23.7% (n=115) were secondary school graduates, 34.6% (n=168) were high school graduates and 21.2% (n=103) were university graduates. In terms of parental relationship status, 85.8% (n=416) of the students' parents were married and living together, 8.5% (n=41) were divorced, 3.7% (n=18) were married but living separately, and 2.1%



(n=10) had a deceased spouse. In general, it was observed that the parents of the students mostly had high school education level and above and were married and living together (Table 2).

**Table 2.**

*Descriptive findings related to the family characteristics of the students*

Variables	n	%
Education Level of the Mother		
Illiterate	33	6.8
Primary School	105	21.6
Middle School	101	20.8
High School	148	30.5
University	98	20.2
Father's Education Level		
Illiterate	15	3.1
Primary School	84	17.3
Middle School	115	23.7
High School	168	34.6
University	103	21.2
Cohabitation Status of Parents		
Married and Together	416	85.8
Divorced	41	8.5
Married and Separated	18	3.7
One of the Spouses Deceased	10	2.1
<b>Total</b>	<b>485</b>	<b>100</b>

To assess students' mathematical reasoning skill levels, descriptive statistics of the Mathematical Reasoning Skills Assessment Test (MMRAT) scores were analyzed. As shown in Table 3, the students' overall mathematical reasoning skill scores ranged from 0.00 to 0.91, with a mean score of 0.28 ( $\pm 0.17$ ). This indicates that students, on average, demonstrated a low level of mathematical reasoning skills, achieving only 28% of the maximum possible score. When examining the sub-dimensions, the highest mean score was observed in Forecasting ( $0.43 \pm 0.37$ ), suggesting that students performed relatively better in making estimations. This was followed by Generalisation ( $0.42 \pm 0.33$ ), Deciding on the Accuracy of the Solution and the Result ( $0.34 \pm 0.29$ ), Recognising Patterns ( $0.31 \pm 0.28$ ), and Recognising Different Representations of the Same Data ( $0.28 \pm 0.27$ ).

The lowest mean scores were recorded in Developing Logical Pathways to Solutions ( $0.16 \pm 0.17$ ) and Solving Non-Routine Problems ( $0.16 \pm 0.26$ ). These findings suggest that students struggled the most with complex reasoning processes and problem-solving strategies that require unconventional approaches. The results highlight potential areas for improvement in mathematical reasoning education, particularly in fostering students' ability to develop logical solutions and tackle non-routine problems.

**Table 3.**

*Descriptive statistics of students' mathematical reasoning skill scores*

Scores	n	Min.	Max.	$\bar{x}$	s
Mathematical Reasoning Skills	485	0.00	0.91	0.28	0.17
Forecasting	485	0.00	1.00	0.43	0.37
Generalisation	485	0.00	1.00	0.42	0.33
Deciding on the Accuracy of the Solution and the Result	485	0.00	1.00	0.34	0.29
Recognising Patterns	485	0.00	1.00	0.31	0.28
Recognising Different Representations of the Same Data	485	0.00	1.00	0.28	0.27
Developing Logical Pathways to Solutions	485	0.00	0.83	0.16	0.17
Solving Non-Routine Problems	485	0.00	1.00	0.16	0.26

To assess students' democratic attitude levels, descriptive statistics of the Democratic Attitude Scale (DAS) scores were analyzed, and the findings are presented in Table 4. The overall democratic attitude scores ranged from 2.28 to 4.84, with a mean score of 3.85 ( $\pm 0.38$ ). Given that the scale ranges from 1 to 5, this indicates that students demonstrated a relatively high level of democratic attitudes, achieving approximately 71.2% of the maximum possible score.

When examining the sub-dimensions, the highest mean score was observed in Following the Rules ( $4.38 \pm 0.57$ ), suggesting that students showed the strongest democratic attitude in adhering to established rules and regulations. This was followed by Tolerance ( $3.96 \pm 0.61$ ), Sense of Trust ( $3.86 \pm 0.66$ ), and Social Engagement ( $3.77 \pm 0.56$ ), indicating that students generally exhibited positive attitudes toward cooperation, trust, and participation in social settings.

The lowest mean score was recorded in Independent Movement ( $3.25 \pm 0.64$ ), suggesting that students felt less confident in acting autonomously within democratic contexts. This finding may indicate the need to foster independent decision-making skills and critical thinking abilities to further strengthen students' democratic attitudes.

**Table 4.***Descriptive statistics of students' democratic attitude scores*

Score	n	Min.	Max.	$\bar{x}$	s
Democratic Attitude	485	2.28	4.84	3.85	0.38
Following the Rules	485	1.80	5.00	4.38	0.57
Tolerance	485	1.50	5.00	3.96	0.61
Sense of Trust	485	1.50	5.00	3.86	0.66
Social Engagement	485	1.40	5.00	3.77	0.56
Independent Movement	485	1.00	5.00	3.25	0.64

Following the descriptive findings, correlation analyses were conducted to examine whether there are significant relationships between the sub-dimensions of mathematical reasoning skills and the sub-dimensions of democratic attitudes. The results of these analyses are presented in Table 5.

**Table 5.***Relationships between the sub-dimensions of mathematical reasoning skills and the sub-dimensions of democratic attitudes*

Sub-Dimensions		Sense of Trust	Following the Rules	Tolerance	Social Engagement	Independent Movement
Forecasting	r	0.012	0.025	0.008	<b>-0.108*</b>	-0.027
Recognising Different Representations of the Same Data	r	-0.041	0.007	-0.078	-0.075	-0.011
Recognising Patterns	r	-0.020	0.077	0.031	0.032	-0.031
Deciding on the Accuracy of the Solution and the Result	r	0.023	<b>0.150**</b>	0.065	-0.030	<b>0.108*</b>
Generalisation	r	-0.002	<b>0.108*</b>	0.042	-0.023	0.060
Developing Logical Pathways to Solutions	r	-0.034	0.068	-0.015	<b>-0.107*</b>	-0.058
Solving Non-Routine Problems	r	0.004	<b>0.107*</b>	0.022	-0.088	0.048

\*  $p < 0,05$ ; \*\* $p < 0,01$ .

As seen in Table 5, the analysis reveals several significant relationships:

- **Deciding on the Accuracy of the Solution and the Result and Following the Rules ( $r=0.150$ ,  $p<0.01$ ):** A moderate positive relationship was found between students' ability to evaluate the correctness of a solution and their tendency to follow rules. This suggests

that students who can critically assess the validity of mathematical solutions are also more likely to adhere to established rules in a democratic context.

- ***Deciding on the Accuracy of the Solution and the Result and Independent Movement ( $r=0.108, p<0.05$ ):*** A weak but significant positive correlation was observed, indicating that students with higher skills in verifying solutions also demonstrate greater independence in decision-making within democratic settings.
- ***Generalisation and Following the Rules ( $r=0.108, p<0.05$ ):*** The ability to generalise mathematical concepts is positively correlated with rule-following. This suggests that abstract reasoning and pattern recognition may contribute to an individual's understanding of social norms and regulations.
- ***Forecasting and Social Engagement ( $r=-0.108, p<0.05$ ):*** A weak but significant negative correlation was found between forecasting skills and social engagement, implying that students with stronger predictive reasoning skills may engage less in social activities.
- ***Developing Logical Pathways to Solutions and Social Engagement ( $r=-0.107, p<0.05$ ):*** A similar negative relationship was detected between developing logical pathways for solutions and social engagement, suggesting that students who focus on constructing logical solutions might be less inclined toward participatory social activities.
- ***Solving Non-Routine Problems and Following the Rules ( $r=0.107, p<0.05$ ):*** A weak but significant positive correlation indicates that students who are adept at solving complex and unconventional problems tend to follow rules more strictly.

These findings suggest that specific mathematical reasoning skills, particularly evaluating solution accuracy, generalisation, and solving non-routine problems, are positively associated with adherence to rules and independent decision-making in a democratic context. However, certain reasoning abilities, such as forecasting and developing logical pathways, appear to have a negative association with social engagement. These results highlight the complex interplay between cognitive skills and democratic attitudes, emphasizing the need for further investigation into the underlying mechanisms of these relationships.

Moreover, multiple linear regression analysis was performed to investigate the effect of students' mathematical reasoning skills on their democratic attitudes. The variance inflation factor (VIF) values for all independent variables were below the critical threshold ( $VIF < 10$ ), indicating that multicollinearity was not a concern in the model (Table 6).

**Table 6.***The effect of mathematical reasoning skills on democratic attitude*

Dependent Variable	Independent Variables	b	S.E.	$\beta$	t	p	VIF
Democratic Attitude	(Constant)	3.848	0.035		110.858	0.000	
	Forecasting	-0.047	0.051	-0.046	-0.917	0.359	1.225
	Generalisation	0.078	0.063	0.067	1.240	0.216	1.446
	Deciding on the Accuracy of the Solution and the Result	0.112	0.069	0.086	1.620	0.106	1.387
	Recognising Patterns	0.041	0.069	0.030	0.596	0.551	1.259
	Recognising Different Representations of the Same Data	0.157	0.075	0.109	2.105	<b>0.036</b>	1.318
	Developing Logical Pathways to Solutions	-0.140	0.116	-0.061	-1.205	0.229	1.261
	Solving Non-Routine Problems	0.028	0.079	0.019	0.351	0.726	1.370

\*  $F(7-477) = 1.565$ ;  $p = 0.144$ ;  $R^2 = 0.022$ .

When examining the sub-dimensions of mathematical reasoning skills, it was observed that most did not have a statistically significant effect on democratic attitude. Forecasting ( $p = 0.359$ ), generalisation ( $p = 0.216$ ), deciding on the accuracy of the solution and the result ( $p = 0.106$ ), recognising patterns ( $p = 0.551$ ), developing logical pathways to solutions ( $p = 0.229$ ), and solving non-routine problems ( $p = 0.726$ ) were all found to be non-significant predictors.

However, the ability to recognise different representations of the same data was found to have a statistically significant positive effect on democratic attitude ( $b = 0.157$ ,  $p = 0.036$ ). This finding suggests that as students' ability to identify different ways of representing the same data increases, their democratic attitude score also increases. While the effect size ( $\beta = 0.109$ ) is relatively small, this relationship highlights a noteworthy association between cognitive flexibility in mathematical reasoning and democratic attitudes.

These findings suggest that while most aspects of mathematical reasoning skills do not directly influence democratic attitudes, the ability to recognise different representations of the same data has a small but statistically significant positive effect. This relationship may be linked to cognitive adaptability, problem-solving flexibility, and the ability to consider multiple perspectives—skills that are essential in both mathematical reasoning and democratic engagement.

## DISCUSSION

This study aimed to investigate the relationship between mathematical reasoning skills and democratic attitudes of secondary school students in Izmir. The findings show that students' mathematical reasoning skills are generally at a low level and their democratic attitudes are at a good level. These findings provide important clues about the current education system and students' development.

First of all, the low mathematical reasoning skills of students point to the inadequacies of the education system in this area. Mathematical reasoning is a combination of problem solving, critical thinking and analytical skills, and the development of these skills can increase students' academic achievement as well as their daily life skills. Students' low mathematical reasoning scores indicate that these skills are not sufficiently supported and developed. This situation indicates that there are areas that need more focus in mathematics education.

In the study, it was determined that the sub-dimension with the highest mean score was guessing, while the sub-dimensions with the lowest mean scores were developing logical ways for solution and solving non-routine problems. These findings show that students can cope with more superficial and routine problems but have difficulty with deeper and more complex problems. This suggests that critical and analytical thinking skills should be emphasised more in mathematics teaching. Teachers can increase students' ability to approach more complex problems by using strategies and activities that help students develop these skills.

When democratic attitudes are analysed, it is seen that students generally obtained high scores. Especially, high scores were obtained in the sub-dimensions of obeying rules, tolerance, sense of trust and social participation. These findings show that students are committed to democratic values and social norms. However, lower scores were observed in the sub-dimension of acting independently. This may indicate that students need more support in terms of individual freedoms and independent thinking. The education system should support students both to adapt to social norms and to develop their independent thinking skills.

When examining the relationship between mathematical reasoning skills and democratic attitudes, notable patterns emerged. The ability to assess the correctness of a solution was positively associated with both adherence to rules and independent decision-making, suggesting that analytical thinking may contribute to both structured and autonomous behavior in social contexts. Similarly, students who demonstrated strong generalisation skills were more likely to follow rules, indicating a possible link between abstract reasoning and the internalisation of

societal norms.

Interestingly, a negative correlation was found between forecasting skills and social engagement, as well as between developing logical pathways to solutions and social participation. These findings suggest that students who focus on analytical and predictive thinking may be less engaged in social activities, possibly due to a preference for individual problem-solving over collaborative interactions. Conversely, those adept at solving non-routine problems were more likely to adhere to rules, implying that complex problem-solving skills may foster an appreciation for structured guidelines.

Overall, these results indicate that different aspects of mathematical reasoning relate to democratic attitudes in distinct ways. While certain cognitive abilities may reinforce rule-following and independent thinking, others could influence social participation patterns. These findings highlight the nuanced interplay between cognitive development and social behavior, suggesting that fostering both reasoning skills and democratic attitudes in education requires a balanced approach.

Bourdieu and Passeron (2015) argue for the teaching of interdisciplinary political and humanitarian issues in education programmes so that students can be sensitive to social problems. Aguilar and Zavaleta (2012) evaluate mathematics education in a socio-cultural and economic context and advocate critical education based on justice and equity. Skovsmose (1990), on the other hand, argues that the political order raises individuals who obey based on power and that democratic values cannot be fully developed when mathematical literacy is low.

In the Enlightenment period, different views among thinkers such as Kant and Mendelssohn discuss the effects of individual enlightenment on social enlightenment. In countries such as Turkey, it is emphasised that political enlightenment is an obstacle to progress towards true emancipation (Cundioğlu, 2021). Dewey (1930), from a pragmatist perspective, argued that mathematics education should be a mirror of society and emphasised the effects of teachers' democratic attitudes on student achievement and motivation

Gifted students can solve mathematical problems quickly, but their flexible thinking skills and emotional intelligence can sometimes be weak (Çınargil, 2022). Students' emotional intelligence and self-confidence can affect their mathematical achievement (Küçükoba, 2023). In addition to academic achievement, emotional intelligence is also important in mathematics education (Atalay, 2014). The development of emotional intelligence in adolescence should be supported and students should be guided for healthy emotional development.

According to Bal and Ersoy (2018), students need to strengthen their reasoning skills before developing problem solving skills. Students generally use deep thinking and inductive reasoning skills in the process of deciding on the correctness of the solution. In this process, students' ability to understand the problem, express it in mathematical form and develop strategies are important. In order to develop students' reasoning skills, teachers should present different problem situations and provide interaction among students (Umay, 2003).

When examining the relationships between mathematical reasoning skills and democratic attitude sub-dimensions, the findings indicate that while certain cognitive abilities are linked to democratic behaviors, these relationships are generally weak. This suggests that the development of democratic attitudes is influenced by a broader set of factors beyond mathematical reasoning alone.

Regression analysis further supports this interpretation, revealing that most sub-dimensions of mathematical reasoning skills did not have a significant predictive effect on democratic attitudes. This lack of significance may stem from the complex interplay between cognitive and socio-emotional skills in shaping democratic dispositions. However, one notable exception was observed: the ability to recognise different representations of the same data had a small but significant positive effect on democratic attitudes. This finding underscores the potential role of cognitive flexibility in fostering democratic values, as the ability to view information from multiple perspectives may enhance openness to diverse viewpoints, a key component of democratic engagement.

These results show that different factors play a role in the development of democratic values and attitudes in educational environments. Some views in the literature emphasise that cultural dimensions of mathematics education may be important and that cultural influences play a role in moral structure (Bishop, 2007; Nickson, 1994).

## CONCLUSION

This study comprehensively examined the relationship between mathematical reasoning skills and democratic attitudes among secondary school students in Izmir. The findings revealed that students' mathematical reasoning skills were generally at a low level, but their democratic attitudes were at a relatively good level. Some relationships between the sub-dimensions of these two variables are noteworthy. For example, a significant correlation was found between students' critical thinking ability and their commitment to democratic values.

These findings emphasise the potential of the education system to develop both academic



achievement and democratic values together. Mathematics education is an important tool for developing students' systematic thinking skills and these skills can support concepts such as participation, critical thinking and equality, which are the core values of a democratic society. In this context, educators and policy makers can develop strategies to integrate democratic values into the mathematics curriculum.

The findings of the study also emphasise the role of school social work in supporting both academic and social development of students. School social work can offer programmes and interventions that can improve students' mathematical thinking skills while at the same time reinforcing their democratic attitudes. This can make a significant contribution to the process of building a more humane and democratic society.

The findings of the study also provide important clues for future research. In particular, a more in-depth examination of the relationships between mathematical reasoning and democratic attitudes may improve the effectiveness of educational and intervention programmes in these areas. Furthermore, examining how these relationships vary across different demographic groups may help to make educational policies and programmes more inclusive and effective.

Overall, this research shows that the integration of mathematics education and democratic values can contribute to both the individual development of students and the general welfare of society. If the education system addresses these two areas together, it will make a significant contribution to the goal of raising individuals who are more conscious, critical thinkers and committed to democratic values.

The findings of the study offer several suggestions for educators and policy makers. Activities to develop critical thinking and problem-solving skills should be integrated into the curriculum of mathematics education. Students should be exposed to more complex and non-routine problems to increase their analytical thinking skills. In addition, emphasis should be placed on educational programmes to develop democratic values and independent thinking skills. School social work can offer programmes to support both the academic and social skills of students. Continuous feedback mechanisms should be established to monitor and evaluate students' progress in mathematical thinking and democratic values.

In conclusion, this study shows that the relationships between mathematical reasoning skills and democratic attitudes are complex and multidimensional. The education system needs to adopt more holistic and integrated approaches to improve both students' academic achievement and their social values. Educators and policy makers should create strategies and programmes

that will develop both students' analytical thinking skills and their democratic values. In this way, individuals who are more conscious, critical thinkers and committed to democratic values can be raised.

## Conflict of Interest and Ethics Statement

The authors do not declare any conflict of interest. This research study complies with research publication ethics. The research has the permission of the ethics committee with the decision of Bandırma Onyedi Eylül University dated 21.06.2023 and numbered 2023-102.

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Author 1: Research, References, Formal Analysis, and Spelling-original draft. Author 2: Consulting.

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