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Research Article

Investigating the Mathematical Problem-Solving Attitudes of Gifted Students at Different Educational Levels

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Abstract

The purpose of this study was to investigate the perceptions of mathematics problem-solving attitudes of gifted middle school students in relation to various variables (gender, grade level, mathematics course performance, parents' education level). The study used the relational survey model, one of the quantitative research methods. The study sample consisted of 148 gifted students of different grades studying at The Science and Art Centre (BİLSEM). Participants were selected using the convenience sampling method. Data were collected using the Demographic Information Form (DIF) developed by the researchers and the Mathematics Problem Solving Attitude Scale (MPSAS) developed by Çanakçı (2008). The data obtained with the DIF were stratified according to the grade level of the students. Frequency, percentage, arithmetic mean, independent groups t-test, and Kruskal-Wallis test were used in the data obtained with the MPSAS. As a result of the study, it was found that the problem-solving attitudes of gifted middle school students in mathematics were positive and there was no significant difference according to variables such as gender, mathematics achievement, and parents' educational status. However, there was a significant difference in the variable of grade level in the final year. Several suggestions were made in accordance with the results of the study.

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Introduction

The term "problem" refers to general situations that arise during daily activities, where a person fails to achieve their goals and becomes confused. For this reason, problem-solving is a core component of educational programs worldwide, aimed at enhancing individual problem-solving skills. Clear definitions and accurate problem identification are vital for effective problem resolution. Effective problem-solving requires a systematic approach to identify problems, define them accurately, and develop appropriate solutions, regardless of their complexity or duration. For this reason, Polya (1985) emphasized that the

problem-solving process begins with understanding the problem. The problem-solving process concludes with the development of solutions to overcome the problem, along with the utilisation of control mechanisms to test these solutions (Polya, 1985). In the literature, various researchers have studied the planning of the problem-solving process (Gelbal, 1991; Pretz, Naples & Sternberg, 2003). When considering these methods, it is typically observed that the process of problem-solving relies on comprehending the issue and correctly identifying the strategies for solutions. Additionally, it is well-established that past experiences with similar problems are highly valuable in establishing solution strategies (Hendriana, Johanto & Sumarmo, 2018).

Developing problem-solving skills is a crucial aspect of nurturing individuals who possess innovative approaches in tackling life's challenges and have boosted self-confidence. Despite being regarded as a mental ability, problem-solving is highly emphasized in education. Research indicates that considering individual discrepancies in cultivating such a skill can yield desirable results (Tomlinson, 2007). In particular, planning training to take into account the personality, perception, ability, and intelligence that influence learning can help to establish the optimal learning style for an individual (Koçak, 2007).

Emotions play a significant role in the problem-solving process. The trend towards problem-solving skills is a significant factor in finding appropriate solutions to problems over time (Hannula, 2015). Emotions play a crucial role in self-regulation, focus, and use of cognitive processes during problem-solving. This highlights that a student's success in mathematics is related to their success in problem-solving (Wijayanti, Herman & Usdiyana 2017).

Attitude is one of the effective emotions in individuals' problem solving in mathematics or other disciplines. In fact, studies from past to present have shown that it is very effective in developing a certain behaviour towards situations in mathematics (Di Martino & Zan, 2001; Neale, 1969; Wen & Dubé, 2022). When this orientation is developed positively, individuals have a belief that mathematics is a very useful and useful discipline. Positively developed beliefs and attitudes support the healthy development of experiences in mathematics (Burrus & Moore, 2016). The negative development of this emotional tendency is seen as one of the reasons for failure in mathematics (McLeod, 1992). Negative attitudes lead to an increase in the anxiety level of the individual and the development of negative attitudes with failure as the education progresses. Positive or negative attitudes towards

mathematics greatly affect students' realisation of their mathematical competence. As a matter of fact, studies on this subject show that there is a strong and significant relationship between mathematics achievement and attitude (Cheng, Ren, Yu, Wang, Chen & Zhou, 2022).

The development of problem solving skills is sometimes shaped by the innate skills of individuals. It is known that such individuals have high intelligence potential and their problem solving skills are highly developed. So much so that such individuals can identify the problem and employ problem solving strategies and include creative thinking skills in the problem solving process (Clark, 2013). There is no specific definition in the literature that can clearly express these students who are called gifted. Because the existing talent in these individuals may include more than one component. This prevents a single definition (Sternberg & Davidson, 2005). However, when different qualities are taken into consideration, it can be said that these individuals show very strong performance in areas such as cognitive skills, academic ability, creativity and critical thinking.

The education of gifted students who show above average ability (Renzulli, 1999) is planned with educational environments that will support their mental development and creativity. It should be ensured that gifted students can produce innovative and different solutions to problems and this potential should be developed. Especially in developed countries, it is seen that it is important for students to be aware of their abilities and to control their development by creating their learning styles with applications different from normal education prepared for gifted students (Renzulli, 1999). This situation shows that the importance given to problem solving in different student groups is increasing worldwide. In this context, when the literature on problem solving is examined, it is seen that some of the studies conducted are aimed at measuring and developing these skills (Özalkan, 2010) and some of them are aimed at teaching and using strategies (Koç-Koca & Gürbüz, 2021;2023).

The studies on attitude in problem solving are quite numerous in the literature (Tuncer, Berkant & Doğan, 2015). However, when the studies are examined, it is seen that the studies examining the mathematics attitudes of gifted students, who have a very sensitive importance in this regard, are very few in the literature (Deringöl & Davaslıgil, 2020; Kamarudin, Sharif & Kamarulzaman, 2022). For this reason, the current study aimed to examine the attitudes of gifted secondary school students at different education levels towards problem solving in mathematics. Since the studies conducted in this direction are

limited in the literature, it is thought that this study has original value and will contribute to the mathematics education of gifted students.

Method

The objective of this study was to examine the problem-solving attitudes of gifted secondary school students in mathematics across different education levels and to determine whether there are significant differences according to various variables. Quantitative research methods were used to achieve this goal. This study employs a descriptive design as it aims to provide a comprehensive and careful description of the existing situation. Technical terms will be explained upon first use, and an objective tone will be maintained throughout the text. Descriptive studies are a frequently used educational research method. The present study examines the relationship between problem-solving attitudes and math skills in gifted students in the context of various variables. The research employs a relational survey model, a methodology for determining how multiple variables differ in relation to one another (Karasar, 2013).

Population and Sample of the Study

The research population and sample are described below.

The research focuses on gifted students enrolled at one of the BİLSEM establishments located in the South-eastern Anatolia Region of Turkey. The study group was selected using a convenient sampling method to ensure easy access. This method minimises the loss of resources and provides the researcher with a sample that is readily accessible (Büyüköztürk, et al., 2012). Thus, a total of 148 gifted secondary school students from different education levels were included in this study. The scale was applied to assess the samples, which comprised of 56% girls (83 students) and 44% boys (65 students).

Data Collection Tools

Data collection occurred in two stages. The first stage employed the "Demographic Information Form (DIF)" designed by the researchers to gather general information on gifted students. This form consisted of questions aimed at obtaining data, including students' gender, grade level, mathematics course grades from the previous semester, and their parents' educational status. The form was reviewed by three mathematics educators and a Turkish language expert in their respective fields. The final version was developed based on the feedback provided by the experts.

In the second phase, we measured the problem-solving attitudes of gifted students using the "Mathematics Problem Solving Attitude Scale (MPSAS)." The MPSAS is a five-point Likert scale with 19 items that has been developed by Çanakçı (2008) to assess the mathematics problem-solving attitudes of secondary school students. The scale comprises two sub-factors, namely "Enjoyment" and " Learning" The first, fourth, seventh, tenth, twelfth, thirteenth, fourteenth, sixteenth, seventeenth, and eighteenth items of the scale comprise the enjoyment dimension, whilst the second, third, fifth, sixth, eighth, ninth, eleventh, fifteenth, and nineteenth items comprise the learning dimension. The scale's minimal score is 19, and the highest score is 95.

The overall reliability of the scale, as measured by Cronbach's alpha coefficient, was calculated as 0.848. Similarly, the Cronbach's alpha coefficient for the liking dimension among the sub-dimensions is 0.869. The teaching factor had a Cronbach's alpha coefficient of 0.777 and its reliability coefficient was calculated at 0.856 for this study. The enjoyment dimension showed a Chronbach's Alpha value of 0.897, while the learning dimension had a Chronbach's Alpha value of 0.515. When assessing the reliability of a scale, a Cronbach's Alpha value between 0.80 and 1.00 is considered highly reliable, between 0.60 and 0.79 is considered moderately reliable, and between 0.40 and 0.59 is considered low in reliability. When assessing the reliability of a scale, a Cronbach's Alpha value between 0.80 and 1.00 is considered highly reliable, between 0.60 and 0.79 is considered moderately reliable, and between 0.40 and 0.59 is considered low in reliability. A scale with a criterion value less than 0.39 is considered unreliable (Özdamar, 2010). When compared to the criterion values for reliability coefficients, it can be concluded that the scale exhibits a very high level of reliability in this study, as the value of 0.856 exceeds 0.80.

Data Analysis

In this study, the attitudes of gifted secondary school students towards solving mathematical problems were examined using various variables. Firstly, the data obtained in the study were analysed by two researchers, and incomplete or incorrectly completed forms and forms completed according to a particular system were excluded from the evaluation. As a result of these eliminations, the data from 148 participants were transferred to the digital environment using Microsoft Office Excel and prepared for data analysis.

Skewness and kurtosis values were analysed for the mean scores in order to examine the conformity of the data obtained in the study to the normal distribution. McKillup (2012) recommends that when the number of participants is greater than 35, the conformity of the data to the normal distribution should be determined using the Kolmogorov-Smirnov normality test. Therefore, the Kolmogorov-Smirnov normality test was used to determine the normality of the data. The normality scores of the scale participants' total scores are shown in Table 2. In addition, the t-test, Kruskal-Wallis test and ANOVA were used to analyse the significance of the difference between paired groups in independent samples, in order to examine whether attitudes to mathematical problem solving change according to the variables of gender, grade, mathematics achievement, mother's educational status and father's educational status. The tests were applied both to the overall mean scores of the scale and to the mean scores of each dimension. In the study, the attitude levels of the students were determined according to the scoring system proposed by the developer of the scale, Çanakçı (2008). In other words, those with mean scores of 4.21 and above were scored as "very positive", those in the range of 3.41-4.20 as "positive", those in the range of 2.61-3.40 as "undecided", those in the range of 1.81-2.60 as "negative", and those in the range of 1.80 and below as "very negative".

Findings

This section presents the results of the analysis of the socio-demographic characteristics of gifted students using DIF, alongside the descriptive statistical results of MPSAS and the analysis of the attitudes of gifted students towards solving mathematical problems based on independent variables. Abbreviations will be explained upon their first instance of use.

The results obtained from the scale are presented based on the study's sub-problems. The distribution of socio-demographic characteristics among gifted students, based on the study's independent variable, is displayed in Table 1.

Table 1. Distribution of independent variables by socio-demographic variables

Variable	Groups	Total			Percentage(%)
Gender	Female (F)	83			%56
	Male (M)	65 65			%44
	Total		148		%100
Grade Level		Female	Male	Total	
	5th Grade	22	7	29	%20
	6th Grade	32	21	53	%36
	7th Grade	23	23	46	%31
	8th Grade	6	14	20	%13
	Total	83	64	148	%100
Mother's Education Level	Primary Education		12		%8
	Secondary		55		%37
	Associate degree		36		%24
	Undergraduate		45		%31
	Total		148		%100
Father's Education Level	Primary Education		16		%11
	Secondary		44		%30
	Associate degree		21		%14
	Undergraduate		67		%45
	Total		148		%100

When analysing the distribution of the middle school gifted students participating in the study according to socio-demographic variables, it can be seen that 44% of the participants are male and 56% are female. Twenty per cent of the participants were in fifth grade, 36% in sixth grade, 31% in seventh grade and 13% in eighth grade. It was found that 8% of the mothers of gifted pupils had primary education, 37% had high school education, 24% had college education and 31% had a bachelor's degree. In addition, 11% of the fathers of gifted students had primary education, 30% had high school education, 14% had college education and 45% had a bachelor's degree. It was also found that the parents of gifted pupils did not have a Master's degree.

Findings Related to Gifted Students' Attitudes and Levels of Mathematics Problem-Solving

The first aspect explored in this research concerns the problem-solving attitudes and corresponding levels of gifted students in mathematics. The findings pertaining to this aspect are presented in Table 2 below.

Table 2. Attitude levels of gifted students towards solving mathematics problems.

	N	Min	Max	M	sd	Skewness	Kurtosis
Mathematics Problem-Solving Attitude Scale	148	1.79	4.79	3.62	0.63	-0,477	-0,291

Looking at Table 2, it can be seen that the mean of the total scores of the mathematics problem solving attitude scale of gifted students is 3.62, the standard deviation is 0.63, the lowest score is 1.79 and the highest score is 4.79. According to the results of the mathematics problem solving attitude scale of gifted students, the mean total score of 3.62 corresponds to the range of 3.41-4.20 on an item basis. Therefore, it can be seen that the students' general attitude towards mathematics problem solving is positive.

Table 2 displays the normal distribution conformity findings. The Skewness value was -0.477 and the Kurtosis value was -0.291, indicating normal data distribution. As Morgan, Leech, Gloeckner, and Barret (2004) suggested, the skewness and kurtosis values within ±1 are enough to infer normal distribution in the data. However, despite the normal distribution of the data, parametric tests were opted for with regards to the gender variable, whereas nonparametric tests were favoured for grade, mathematics achievement, mother's education level, and father's education level due to the small sample size of participants falling below 30 in the relevant variable distributions.

Findings on the Attitudes of Gifted Students towards Mathematical Problem Solving Based on Gender, Grade Level, Parental Education and School Performance Variables

The second sub-issue of the research is to establish whether attitude scores of gifted students towards problem-solving in mathematics differ significantly across gender, grade level, parents' education level and school achievement. In this context, an independent group t-test was performed for the gender variable. The Kruskal-Wallis Test was used to analyse the effects of other variables, namely class level, parents' education level and school achievement variables. The distribution of MPSAS data based on student gender is displayed in Table 3, categorized by the respective sub-factors.

Table3. Attitude towards mathematics problem solving according to gender variables

	Groups	N	X	sd	t test		
					t	sd	p
General Average	Female	83	3,66	,604	0,758	146	0,450
	Male	65	3,58	,665			
Enjoyment	Female	83	3,61	,911	0,758	146	0,450
	Male	65	3,60	,890			
Learning	Female	83	3,71	,437	1,822	146	0,071
	Male	65	3,56	,592			

Looking at Table 3, we can see that the attitude scores of gifted students towards mathematical problems do not show a significant difference according to the gender variable (t=0.758, p>0.05). In addition, it can be seen that both gender groups scored at the level of positive attitudes both in the general average and in the dimensions of enjoyment and learning, but the scores differed.

The results of the Kruskal-Wallis test, which was used to determine whether the attitude scores of gifted students towards mathematics problems differed significantly according to the grade level variable, are presented in Table 4 within the framework of the sub-dimensions.

Table 4. Kruskal-Wallis test results according to class variable

	Grade	N	S O	χ^2	p	Post Hoc
Enjoyment	5[a]	29	76,86	10,760	0,013*	a>d, b>d, c>d
	6[b]	53	78,52			
	7[c]	46	80,98			
	8[d]	20	45,53			
	Total	148				
Learning	5[a]	29	78,88	27,149867	<0,001**	a>d, b>d, c>d
	6[b]	53	80,91			
	7[c]	46	84,37			
	8[d]	20	28,48			
	Total	148				
General	5[a]	29	76,72	20,835172	<0,001**	a>d, b>d, c>d
	6[b]	53	80,79			
	7[c]	46	83,35			
	8[d]	20	34,25			
	Total	148	76,86			

Table 4 displays the results of the Kruskal-Wallis and Post-hoc tests for the overall score and sub-dimensions of MPSAS. The Kruskal-Wallis test revealed a significant difference in the general average (p=0.000) as well as the liking (p=0.013) and learning (p=0.000) dimensions. The Post-hoc results show that the general attitude of the students in grades 5, 6, and 7 is higher than that of the students in grade 8. Furthermore, this trend is also observed in the liking and learning dimensions.

The findings of the Kruskal-Wallis Test have been presented in Table 5 to examine if gifted students' attitude scores toward mathematics problems vary significantly depending on their achievement level in the mathematics course, categorized by sub-dimensions.

Table 5. Kruskal-Wallis test results for mathematics course achievement variable

	Grade	N	S O	χ^2	p
Enjoyment	3	5	64,60	0,491	0,782*
	4	35	77,76		
	5	108	73,90		
	Toplam	148			
Learning	3	5	76,70	0,094	0,954
	4	35	76,20		
	5	108	73,85		
	Toplam	148			
General	3	5	66,90	0,323	0,851
	4	35	77,29		
	5	108	73,95		
	Toplam	148	64,60		

Table 5 shows the results of the Kruskal-Wallis test for the overall score and sub-dimensions of the MPSAS according to the grade variable. No statistically significant difference was found for either the total score or the sub-dimensions. The results of the Kruskal-Wallis test to determine whether the attitudes of gifted students towards mathematics problems differed significantly according to the variable of mother's educational status are presented in Table 6 within the framework of the sub-dimensions.

Table 6. Kruskal-Wallis test results for the mother's education status variable

	Grade	N	S O	χ^2	p
Enjoyment	Primary Education	12	95,42	3,526	0,317
	Secondary	55	69,91		
	Associate degree	36	75,47		
	Undergraduate	45	73,76		
	Total	148			
Learning	Primary Education	12	85,67	2,743	0,433
	Secondary	55	79,38		
	Associate degree	36	71,29		
	Undergraduate	45	68,12		
	Total	148			
General	Primary Education	12	96,21	3,413	0,332
	Secondary	55	73,11		
	Associate degree	36	73,38		
	Undergraduate	45	71,31		
	Total	148	95,42		

The overall score and the sub-dimensions were analysed by Kruskal-Wallis test according to the educational status of the mother, and the results are shown in Table 6. No statistically significant difference was found for either the total score or the sub-dimensions.

The results of the Kruskal-Wallis test to determine whether the attitudes of gifted students towards mathematics problems differed significantly according to the educational status of the father are presented in Table 7 within the framework of the sub-dimensions.

Table 7. Kruskal-Wallis test results for father's education level variable

	Grade	N	S O	χ^2	p	Post-hoc
Enjoyment	Primary Education	16	59,63	2,745	,433	
	Secondary	44	75,77			
	Associate degree	21	70,40			
	Undergraduate	67	78,50			
	Total	148				
Learning	Primary Education	16	67,25	9,048	,029*	2>3, 4>3
	Secondary	44	79,42			
	Associate degree	21	50,43			
	Undergraduate	67	80,54			
	Total	148				
General	Primary Education	16	61,88	4,227	,238	
	Secondary	44	77,49			
	Associate degree	21	62,17			
	Undergraduate	67	79,42			
	Total	148	59,63			

Table 7 presents the findings of Kruskal-Wallis and Post-hoc assessments for both the overall score and sub-dimensions of the variable for the father's educational level. Based on the results, there is no notable distinction among the groups regarding the mean score and the enjoyment aspect. On the other hand, concerning the learning sub-dimension, a significant difference was found in the disadvantage of fathers with associate's degrees compared to fathers with both high school and undergraduate degrees.

Discussion and Conclusion

The study investigated the socio-demographic traits of gifted high school students and evaluated their attitudes towards mathematical problem solving across different variables. The statistical analysis revealed a favourable disposition towards mathematics problem solving among gifted students. However, it can be expected that the problem-solving attitudes of gifted students are positive due to the high-level skills required, alongside the willingness of these students to solve mathematical problems (Jabůrek, Cígler, Portešová & Ťápal, 2021). The acquired result from the study can be explained by both the personal characteristics of the students and the education they receive. This indicates that it is important to support the education of gifted students with appropriate mathematical activities (Leikin, 2021) and enhance their problem-solving capabilities (Lin, 2023). This can be accomplished by utilising reinforcers that boost students' mathematics attitudes and motivation levels during the problem-solving process. Furthermore, it is essential to investigate the factors contributing to gifted students' negative perceptions of problem-solving in mathematics and implement appropriate measures.

There was no statistically significant distinction between the attitudes of male and female students towards solving mathematical problems. This corresponds with findings from some of the studies in the literature (Polinsky, Flynn & Uttal, 2023). Conversely, certain studies in the literature have revealed results that favour males (Starns & Starns, 2023). In studies where males are found to have a statistical advantage, the explanation often given is that females are not given adequate support by society in certain numerical fields. As a result, the impact of gender varies across studies. The disparity in problem-solving abilities between males and females is intricately linked to social pressures, cultural values, and socialisation. Educators should implement steps to enhance problem-solving proficiency in students by acknowledging these social dissimilarities.

When analysing the attitudes of mathematically gifted students towards problem-solving at different grade levels, a significant difference was found between those in grades 5, 6, and 7 and those in grade 8. Consequently, the general attitudes of students in grades 5, 6, and 7 towards problem-solving in mathematics are higher compared to those of grade 8 students. In the studies investigating students' attitudes towards problem solving in mathematics across different grade levels, noteworthy variations were discovered. A significant variance was highlighted in favour of the 6th grade by Çanakçı and Özdemir

(2011), while Işık and Kar (2011) observed significant differences across all grade levels. There may have been no discernible discrepancy between students in years 5, 6 and 7 in this study because talented students are provided with a dedicated curriculum for improving problem-solving at BİLSEMs. Conversely, senior students may have experienced a different outcome due to their current status as exam preparation candidates in Turkey (Koç-Koca & Gürbüz, 2019).

When examining the impact of mathematics course achievement on the problem-solving attitude of gifted students, no significant difference was observed between these two variables. This could be attributed to the fact that gifted students generally excel in mathematics (Capuno et al., 2019). Chandra Handa (2019) reported in his study that gifted students possess the ability to solve problems that their peers cannot and can confront difficult problems with ease. Therefore, gifted students displaying high levels of attainment in mathematics and problem solving ought to be provided with environments that enhance their attitudes towards mathematics. In this regard, teachers wield considerable influence. It is recommended that study programs are designed for gifted children within the mathematical fields they are interested in or are prepared for. In addition, broadening the scope of mathematics instruction and encouraging greater student participation in the learning process can foster more favourable attitudes towards mathematics.

When examining the impact of parental education levels on the mathematics problem-solving attitudes of gifted students, it was observed that there was no difference in the education levels of mothers. However, fathers who were associate degree graduates exhibited a negative relationship in comparison to those with high school and bachelor's degree qualifications within the education level sub-dimension. These findings demonstrate that parental education levels do not significantly impact students' attitudes towards problem-solving in mathematics. Nevertheless, it could be argued that parents can shape their offspring's attitudes towards mathematics through their level of education. In fact, research literature supports this notion (Gün, Bossé & Tîrnovan, 2023; Hwang & Son, 2021). However, it has been found that certain studies in the literature have yielded results akin to those obtained in this study (Yenilmez & Özabacı, 2003). Students may be influenced by the social environment in which they are raised and their families in adopting certain attitudes. Therefore, measures must be taken to create environments that enhance students' maths performance and help them cultivate positive attitudes towards the subject. The

collaboration between teachers and families can guarantee that pupils learn these behaviours with a comprehensive strategy and cultivate affirmative stances.

Ethical Committee Permission Information

Name of the board that carries out ethical assessment: Adıyaman University Social and Humanities Scientific Research Ethics Board

The date and number of the ethical assessment decision: 16/11/2022 - 343

Author Contribution Statement

Aygen KOÇ KOCA: *Conceptualization, methodology, implementation, data analysis and writing, reporting, translation, editing.*

Mustafa Özgür KELEŞ: *Conceptualization, methodology, implementation, data analysis and writing, reporting, translation, editing.*

References

Burrus, J., & Moore, R. (2016). The incremental validity of beliefs and attitudes for predicting mathematics achievement. *Learning and Individual Differences*, 50, 246-251.

Capuno, R., Necesario, R., Etcuban, J. O., Espina, R., Padillo, G., & Manguilimotan, R. (2019). Attitudes, study habits, and academic performance of junior high school students in mathematics. *International Electronic Journal of Mathematics Education*, 14(3), 547-561.

Chandra Handa, M. (2019). Leading differentiated learning for the gifted. *Roeper Review*, 41(2), 102-118. https://doi.org/10.1080/02783193.2019.1585213

Cheng, D., Ren, B., Yu, X., Wang, H., Chen, Q., & Zhou, X. (2022). Math anxiety as an independent psychological construct among social-emotional attitudes: An exploratory factor analysis. *Annals of the New York Academy of Sciences*, *1517*(1), 191-202. https://doi.org/10.1111/nyas.14902

Clark, B., (2013). Üstün zekâlı olarak büyümek: evde ve okulda çocukların potansiyellerini geliştirmek. [Growing up gifted: Developing the potential of children at home and at school.] (F. Kaya ve Ü. Ogurlu, Trans. Ed.). Ankara: Nobel Akademik

Çanakçı, O. (2008). *Matematik problemi çözme tutum ölçeğinin geliştirilmesi ve değerlendirilmesi [The development and the evaluation of mathematics problem solving attitude scale]* (Doctoral dissertation, Marmara University, Turkey). İstanbul, Turkey

Çanakçı, O., & Özdemir, A. Ş. (2011). Matematik problemi çözme tutum ölçeğinin geliştirilmesi [The construction of mathematics problem solving attitude scale] *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*,11(1),119-136.

Çetin, A., & Doğan, A. (2018). Bılım ve sanat merkezlerinde görev yapan matematık öğretmenlerinin karşılaştıkları sorunlar [Problems that mathematics teachers encounter in science and art centers] *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, *19*(4), 615-641.

Deringöl, Y., & Davaslıgil, Ã. (2020). The effect of differentiated mathematics programs on the mathematics attitude of gifted children. *MOJES: Malaysian Online Journal of Educational Sciences*, *8*(1), 27-37.

Di Martino, P., & Zan, R. (2001, July). Attitude toward mathematics: Some theoretical issues. In PME conference (Vol. 2, pp. 3-351).

Gelbal, S. (1991). Problem çözme [Problem solving] *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *6*(6).

Gün, Ö., Bossé, M. J., & Tîrnovan, D. (2023). Exploration of relationships between teacher and parent attitudes and student affective characteristics in mathematics. *International Journal for Mathematics Teaching and Learning*, 24(1), 74-112.

Hannula, M. S. (2015). Emotions in problem solving. In S. J. Cho (Ed.), Selected Regular Lectures from the 12th International Congress on Mathematical Education (pp. 269–288). Berlin: Springer.

Hendriana, H., Johanto, T., & Sumarmo, U. (2018). The role of problem-based learning to improve students' mathematical problem-solving ability and self-confidence. *Journal on Mathematics Education*, *9* (2), 291-300. https://doi.org/10.22342/jme.9.2.5394.291-300

Hwang, S., & Son, T. (2021). Students' attitude toward mathematics and its relationship with mathematics achievement. *Journal of Education and e-Learning Research*, *8*(3), 272-280. https://doi.org/10.20448/journal.509.2021.83.272.280

Işık, C., Kar, T., Yalçin, T., & Zehir, K. (2011). Prospective teachers' skills in problem posing with regard to different problem posing models. *Procedia Social and Behavioral Sciences*, 15, 485-489.

Jabůrek, M., Cígler, H., Portešová, Šárka, & Ťápal, A. (2021). Searching for a more valid form of parental rating scales of preschoolers' intellectual giftedness – development and validation of the preschooler's ability rating scale (PARS). *Československá Psychologie*, *65*(4), 317-335. https://doi.org/10.51561/cspsych.65.4.317

Kamarudin, M. F., Sharif, M. S. A. M., & Kamarulzaman, M. H. (2022). Differentiated instruction: Exploring the attitudes of gifted and talented students in mathematics. *Asian Journal of Research in Education and Social Sciences*, *4*(1), 146-160.

Karasar, N. (2013). *Bilimsel araştırma yöntemi [Scientific research methods]*, Ankara: Nobel.

Koç-Koca, A. & Gürbüz, R. (2019). Üstün yetenekli ve diğer 4. sınıf öğrencilerinin matematik problemlerini çözme stratejileri üzerine bir araştırma. [An investigation of the mathematics problem solving strategies developed by the 4th grade gifted and other students] *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, *16*(1), 1638-1667.

Koç-Koca, A. & Gürbüz, R. (2021). Problem solving strategies used by gifted secondary school students to solve math problems. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *21*(1), 348-359.

Koç-Koca, A. & Gürbüz, R. (2023). Özel yetenekli öğrencilerin problem çözme süreçlerinin ve süreçte kullandıkları stratejilerin DPA'lar yardımıyla değerlendirilmesi [Evaluation of gifteds' problem solving process and the strategies used in the process with the help of rubrics]. *Bayburt Eğitim Fakültesi Dergisi*, *18*(37), 177-197. https://doi.org/10.35675/befdergi.1159717

Koçak, T. (2007). *İlköğretim 6.7. 8. sınıf öğrencilerinin öğrenme stilleri ve akademik başarıları arasındaki ilişkinin incelenmesi [An analysis of the relationship between learning styles and the academic achievement of the 6th 7th 8th grade primary school students (a case study in greater Gaziantep area)]* (Master's thesis), Gaziantep University, Gaziantep.

Leikin, R. (2021). When practice needs more research: the nature and nurture of mathematical giftedness. *ZDM–Mathematics Education*, *53*(7), 1579-1589.

Lin, C.-Y. (2023). Creative problem-solving ability does not occur by chance: Examining the dynamic system model of creative problem solving ability. *Gifted Education International*, 39(2), 168-182. https://doi.org/10.1177/02614294221149478

Lubinski, D. & Benbow, C. P. (1992). Gender differences in abilities and preferences among the gifted: Implications for the math-science pipeline. *Current Directions in Psychological Science*, 1(2), 61-66. https://doi.org/10.1111/1467-8721.ep11509746

McKillup, S. (2012). Statistics explained: An introductory guide for life scientists. United States: Cambridge University Press.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. *Handbook of research on mathematics teaching and learning*, 1, 575-596.

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barret, K. C. (2004). SPSS for introductory statistics: Use and interpretation, London: Lawrance Erlbaum Associates

Neale, D. (1969). The role of attitudes in learning mathematics. *The Arithmetic Teacher*, Dec, 631-641.

Özalkan, B. E. (2010). *Fonksiyonlar konusunda problem çözme yönteminin problem çözme performansına, problem çözme ve matematiğe yönelik tutumlara etkisi*. [*The effects of problem solving on the topic of functions on problem solving performance, attitude toward problem solving and mathematics*.](Master's thesis, Orta Doğu Teknik Üniversitesi, Ankara.

Özdamar, K. (2010). *Paket programlar ile istatiksel veri analizi 2: Çok değişkenli analizler* (7th ed.). Eskişehir: Kaan Kitabevi.

Polinsky, N., Flynn, R., & Uttal, D. H. (2023). How children's app play could facilitate spatial skill development. *Translational Issues in Psychological Science*, *9*(3), 228–237. https://doi.org/10.1037/tps0000360

Polya, G. (1985). How to solve it. A new aspect of mathematical method (2nd ed.). New Jersey: Princenton University Press.

Pretz, J. E., Naples, A. J., & Sternberg, R. J. (2003). Recognizing, defining, and representing problems. *The Psychology of Problem Solving*, *30*(3), 3-30.

Renzulli, J. S. (1999). What is this thing called giftedness, and how do we develop it? A twenty-five year perspective. *Journal for the Education of the Gifted*, *23*(1), 3-54.

Starns, E. A., & Starns, M. (2023). Attrition and retention factors of dual-appointment athletic trainers. *Journal of Sports Medicine and Allied Health Sciences: Official Journal of the Ohio Athletic Trainers Association*, *9*(1), 2.

Sternberg, R. J., & Davidson, J. E. (Eds.). (2005). Conceptions of giftedness (Vol. 2). New York, NY: Cambridge University Press.

Tomlinson, C. A. (2014). *Öğrenci gereksinimlerine göre farklılaştırılmış eğitim [The differentiated classroom: Responding to the needs of all learners].* İstanbul, Turkey: SEV Publishing.

Tuncer, M., Berkant, H. G. & Dogan, Y. (2015). The validity and reliability of the scale of attitude toward English lesson. *Journal of Research in Education and Teaching*, *4*(2), 260-266.

Yenilmez, K., & Özabacı, N. Ş. (2003). Yatılı öğretmen okulu öğrencilerinin matematik ile ilgili tutumları ve matematik kaygı düzeyleri arasındaki ilişki üzerine bir araştırma. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi*, *14*(14), 132-146. Retrieved from https://dergipark.org.tr/tr/pub/pauefd/issue/11129/133098

Wen, R., & Dubé, A. K. (2022). A systematic review of secondary students' attitudes towards mathematics and its relations with mathematics achievement. *Journal of Numerical Cognition*, *8*(2), 295-325.

Wijayanti, A., Herman, T., & Usdiyana, D. (2017, January). The implementation of CORE model to improve students' mathematical problem solving ability in secondary school. in international conference on mathematics and science education (pp. 89-93). Atlantis Press.