BAŞKENT UNIVERSITY
JOURNAL OF EDUCATION

2020, 7(2), 180-188 ISSN 2148-3272

Middle School Students' Engagement in Mathematics

Ortaokul Öğrencilerinin Matematik Dersine Bağlılıkları

Yasemin Deringöl[a*]

[a]*Istanbul University-Cerrahpasa, Istanbul, Turkey*

Abstract

This research was conducted with students attending middle schools in Istanbul province to examine middle school students' engagement in mathematics course. Research data was collected using "Student Engagement in Mathematics Scale" and "Personal Information Form" prepared by the researcher. This study was conducted in survey model and research data was analyzed using SPSS 16 software. It was concluded that middle school students' engagement in mathematics was at a high level; their engagement scores did not differ according to gender; engagement scores in mathematics among fifth grade and sixth grade students were higher than those of eighth grade students; and engagement scores in mathematics among students loving mathematics and considering themselves successful in mathematics were higher than scores of those who did not consider themselves successful. At the same time, one of the findings obtained was the positive-oriented significant relationship between students' mathematics grades and their engagement in mathematics.

Keywords: Mathematics, middle school student, engagement, engagement in mathematics.

Öz

Bu araştırma, ortaokul öğrencilerinin matematik dersine bağlılıklarının incelenmesi amacıyla İstanbul ilindeki ortaokullarda öğrenim gören öğrencilerle gerçekleştirilmiştir. Araştırma verileri, "Matematik Dersine Bağlılık Ölçeği" ve araştırmacı tarafından hazırlanmış olan "Kişisel Bilgi Formu" ile toplanmıştır. Tarama modeli ile yürütülen bu araştırma verileri SPSS 16 ile analiz edilmiştir. Ortaokul öğrencilerinin matematik bağlılıklarının yüksek seviyede olduğu, cinsiyete göre değişmediği çıkarımlarına ek olarak beşinci ve altıncı sınıf öğrencilerinin matematik bağlılık puanlarının sekizinci sınıf öğrencilerinin puanlarından, matematiği seven öğrencilerin puanlarının, sevmeyenlerin puanlarından ve matematikte kendilerini başarılı gören öğrencilerin, başarılı görmeyen öğrencilerin puanlarından daha yüksek olduğu sonucuna ulaşılmıştır. Aynı zamanda öğrencilerin matematik notlarıyla matematik bağlılıklarının pozitif yönde ilişkili olduğu ulaşılan bir başka sonuçtur.

Anahtar Kelimeler: Matematik, ortaokul öğrencisi, bağlılık, matematiğe bağlılık.

1. Introduction

Learning mathematics is a must since it is a field that develops behaviors required for solving various problems encountered in our daily lives such as logical thinking and ability to communicate, recognizing relationships and ability to make generalization, generalize the relationships' recognition and develop creative thinking, mental independence, and ability to think through (Aksu, 1991). In most cases, individuals in their path of development may perceive mathematics as a compulsory path to destination, an obstacle on this path, or a means of standing out.

Among those experiencing this process, there may be people who give up mathematics and their objectives due to chronic failures experienced in mathematics (Durmaz & Akkuş, 2016). Unfortunately, individuals' such divergence from mathematics may even affect their choice of profession. As a result of failure in mathematics, this course is perceived as unpleasant, difficult, abstract, and boring by most students. Also, mathematics may be a feared and even hated course for many students (Deringöl, 2017). One of the most causes of low achievement rate in

[*] *This research is an extension of the report presented at the 1st International Congress on Seeking New Perspectives in Education (UEYAK-2018).*

ADDRESS FOR CORRESPONDENCE: Assoc. Prof. Dr. Yasemin Deringöl, Department of Basic Education, Hasan Ali Yucel Faculty of Education, Istanbul University-Cerrahpasa, Istanbul, Turkey. E- mail address: dyasemin@istanbul.edu.tr, Tel: +90 (532) 201 88 37, ORCID ID: 0000-0003-3030-7049. *Received Date: April 15th, 2019. Acceptance Date: February 28th, 2020.*

mathematics among exams conducted throughout Turkey is thought to be students' existing fear of mathematics and acceptance of failure in mathematics courses or inability in these courses (Başar, Ünal, & Yalçın, 2002). Engagement in learning is considered as an indicator of achievement (Connell & Wellborn, 1991; Skinner, Kindermann, Connell, & Wellborn, 2009). Engagement is also shown as an important component of learning mathematics in National Council of Teachers of Mathematics (NCTM) (2000) and National Research Council (2005). The studies have described engagement as a multi-dimensional structure: social, affective, and cognitive (Fredricks, Blumenfeld, & Paris, 2004; Jimerson, Campos, & Greif, 2003). Social engagement refers to students' actions and applications towards school and learning, includes positive behaviors (attendance and finishing school), learning and participation in academic tasks (effort and concentration) and extracurricular activities (Finn, Pannozzo, & Voelkl, 1995; Finn & Voelkl, 1993). Affective engagement shows students' affective reactions regarding school and perception of identity (Skinner & Belmont, 1993). Cognitive engagement, however, refers to students' self-governing and strategic approach towards learning (Fredricks, Blumenfeld, & Paris, 2004). These three components are dynamically interrelated among individuals and they are not isolated processes. Students with high level of engagement tend to participate in class discussions, make effort in class activities, and exhibit interest and motivation towards learning (Fredricks, Blumenfeld, & Paris, 2004; Marks, 2000; Skinner & Belmont, 1993). Students with weaker engagement are more passive learners, and they report their anxiety and anger in terms of being in class (Skinner & Belmont, 1993). Therefore, effective learning depends on how much students are engaged in in-class learning activities (Chen, 2005). Student engagement is defined as "commitment to learning process and involvement, identifying oneself with school, feeling belonging, besides participation in school environment and reaching conclusions associated with expected academic, social and affective learning outcomes" (Cited from Christenson et al., 2008 by Akar et al., 2017, p.30).

Students' belief in ability of mathematics and having positive emotions towards mathematics course increase their mathematics achievement (İlhan & Öner Sünkür, 2012; Yücel & Koç, 2011). On the other hand, negative feelings towards mathematics course results in decrease in students' mathematics achievement (İlhan & Öner Sünkür, 2012; Minato & Yanese, 1984; Reyes, 1984).

One of the factors affecting students' mathematics success is the concept of engagement which is observed in studies conducted. There is a relationship between students' engagement in mathematics and their achievement in this course (Baroddy et al., 2016; Leis, Schmidt & Rimm-Kaufman, 2014; Kong, Wong, & Lam, 2003; Rimm-Kaufman et al., 2015). There are many studies in the literature examining the engagement of middle school students to mathematics (Baroddy, et al., 2016; Bodovski & Farkas, 2007; Kong, Wong, & Lam, 2003; Leis, Schmidt, & Rimm-Kaufman, 2014; Martin, Way, Bobis, & Anderson, 2015; Park, 2005; Rimm-Kaufman, et al., 2015). When the national literature is examined, it is seen that there are only 6, 7 and 8th grade students (Özkal, 2018, 2019) and all middle school students (Birgin, Mazman-Akar, Uzun, Göksu, Peker, & Gümüş, 2017; Mazman Akar, Birgin, Göksu, Uzun, Gümüş, & Peker, 2017). When the national researches were examined, it was seen that the 2 researches (Birgin, et al, 2017; Mazman Akar, et al, 2017) conducted at all grade levels were not examined in terms of the engagement of middle school students to 'like or not', 'which level they liked the course more' and 'to see themselves successful in mathematics'.

Based on this deficiency in the literature, this study aimed to analyze the engagement of middle school students in mathematics in detail. Accordingly, this research was conducted to analyze middle school students' engagement in mathematics course in terms of different variables. Sub-problems determined for this purpose are as follows:

1. What are students' levels of engagement in mathematics?
2. Does students' engagement in mathematics differ significantly according to gender?
3. Does students' engagement in mathematics differ significantly according to grade level?
4. Does students' engagement in mathematics vary based on whether they love this course or not, at which grade they love this course most, and whether they consider themselves successful in mathematics?
5. Is there a relationship between students' engagement in mathematics and their scores in mathematics?

2. Method

This study was designed in a quantitative survey model towards analyzing engagement in mathematics course among middle school students. As stated by Karasar (2005), survey model aims at "describing a situation existing in the past or recently as it is (p.77)". As it was aimed to examine the current status of middle students, it was decided to conduct this research in a survey model.

2.1. Study Group

Research sample constituted of a total of 412 middle school students attending in Istanbul-Turkey province and selected with simple random sampling method. Research data were collected from 4 middle schools in 2 districts. Distribution of students in the study group based on genders and grade levels is presented below.

Table 1
Distribution of Students Based on Gender and Grade Levels

Grades	Girl		Boy		Total	
	f	*%*	*f*	*%*	*f*	*%*
Fifth Grade	64	61.0	41	39.0	105	25.5
Sixth Grade	44	43.1	58	56.9	102	24.8
Seventh Grade	54	55.1	44	44.9	98	23.8
Eighth Grade	58	54.2	49	45.8	107	26.0
Total	220	53.5	192	46.5	412	100.0

The sample constituted of a total of 412 students including 220 (53.5%) girls and 192 (46.5%) boys. Among these students, 105 (25.5%) of them attended the fifth grade; 102 (24.8%) of them attended the sixth grade; 98 (23.8%) of them attended the seventh grade; and 107 (26.0%) of them attended the eighth grade.

2.2. Data Collection Tools

In the research, "Personal Information Form" and "Student Engagement in Mathematics Scale" were used.

Personal Information Form: The first data collection tool is "Personal Information Form" developed by the researcher. This form consists of demographic information related to students and questions towards whether students love this course or not, at which grade they love this course most and whether they consider themselves successful in this course.

Student Engagement in Mathematics Scale: Developed by Rimm-Kauffman (2010) and adapted in Turkish language by Mazman-Akar et al. (2017). This scale consisted of 13 items and included 3 sub-dimensions. These dimensions included "cognitive engagement", "emotional engagement" and "social engagement". The scale was prepared in 4-point Likert type, items were evaluated between "I Do not Agree" and "I Completely Agree". Since an item was written in reverse in the scale, the item was scored in reverse while scoring the scale. The maximum score that can be obtained from the scale is 52, the minimum score is 13. High score obtained from the scale shows high level of engagement in mathematics course (Mazman-Akar et al. (2017). Internal consistency coefficient of the scale was found as .87, also as .87 in this research.

2.3. Data Analysis

Statistical solutions of measurement tools were conducted using SPSS 16.0. Before starting analyses, Kolmogorov-Smirnov test was conducted in normality testing of data distributions, at the same time, skewness-kurtosis values of scores were evaluated. Since significance value was found lower than .05 according to Kolmogorov-Smirnov test results, and skewness coefficient was between +2.0 and -2.0 according to George and Mallery (2010), it was observed that data showed normal distribution, and parametric tests were used. Accordingly, in data analysis, Independent Sample t Test, One Way Analysis of Variance (ANOVA) and Pearson Moment Correlation technique were applied and calculated.

3. Findings

Findings obtained related to middle school students' engagement based on variables are presented below. Findings belonging to the first problem are presented in Table 2.

Table 2
Score averages related to engagement in mathematics in the sample

Scale	N	Mean	S
Cognitive Engagement	412	2.99	.81
Emotional Engagement	412	2.64	.77
Social Engagement	412	3.09	.68
Student Engagement in Mathematics Scale	412	2.91	.64

Average scores obtained from 5-item "Cognitive Engagement", 4-item "Emotional Engagement" and "Social Engagement" dimensions are presented in Table 2. To determine students' levels as per their scores obtained from scales, range width of the scale was calculated by using "array width/number of groups to be applied" (3/4=0.75) formula (Tekin, 1993). Arithmetic average ranges of the scale were determined as 1.00-1.74 'Low', 1.75-2.49 'Medium', 2.50-3.24 'High' and 3.25-4.00 'Very High'. Accordingly; analyzing 'Cognitive Engagement', 'Emotional Engagement' and 'Social Engagement' and scale average scores, it can be seen that students achieve high level of scores.

Findings belonging to the second problem are presented in Table 3.

Table 3
Independent Sample t Test Results of Scores in Engagement in Mathematics Course as per Gender Variable of the Sample

Scale	Gender	N	Mean	S	t	*p*
Cognitive Engagement	Girl	220	14.90	3.99	-.250	.802
	Boy	192	15.01	4.21		
Emotional Engagement	Girl	220	10.82	3.05	1.625	.105
	Boy	192	10.32	3.10		
Social Engagement	Girl	220	12.42	2.79	.196	.845
	Boy	192	12.36	2.67		
SEMS	Girl	220	38.15	8.33	.540	.590
	Boy	192	37.70	8.41		

No significant differences were found between genders in the sample and scores obtained from "Student Engagement in Mathematics Scale (SEMS)" 'Cognitive Engagement' (t =-.250; *p*>.05), 'Emotional Engagement' (t=.196; *p*>.05), 'Social Engagement' (t=1.625; *p*>.05) dimensions and scale total (t=.540; *p*>.05).

Findings belonging to the third problem are presented in Table 4.

Table 4
One-Way Analysis of Variance (ANOVA) Results of Scores in Engagement in Mathematics Course as per Grade Level in the Sample

	Grades	N	Mean	S		Sum squares	Mean squares	F	*p*
CE	5th Grade	105	15.56	3.77	Between groups	322.200	107.400	6.673	.000
	6th Grade	102	15.96	3.81	Within groups	6567.013	16.096		
	7th Grade	98	14.64	4.40	Total	6889.214			
	8th Grade	107	13.69	4.04					
EE	5th Grade	105	10.54	2.93	Between groups	41.190	13.730	1.444	.230
	6th Grade	102	10.91	2.77	Within groups	3880.305	9.511		
	7th Grade	98	10.83	3.31	Total	3921.495			
	8th Grade	107	10.11	3.27					

SE	5th Grade	105	12.94	2.35	Between groups	126,729	42,243	5.838	.001
	6th Grade	102	12.70	2.70	Within groups	2951,989	7,235		
	7th Grade	98	12.46	2.89	Total	3078,718			
	8th Grade	107	11.50	2.78					
SEMS	5th Grade	105	39.04	7.55	Between groups	1143,623	381,208	5.629	.001
	6th Grade	102	39.57	7.77	Within groups	27629,202	67,719		
	7th Grade	98	37.94	8.91	Total	28772,825			
	8th Grade	107	35.30	8.62					

Scores obtained from "Student Engagement in Mathematics Scale (SEMS)" and its dimensions of 'Cognitive Engagement (CE)' [$F_{(4-408)}$ =6.673; p<.01], 'Social Engagement (SE)' [$F_{(4-408)}$ =5.838; p<.01] and from scale total [$F_{(4-408)}$ =5.629; p<.01] were statistically significant as per grade level. According to results of Post-hoc Turkey HSD test conducted to determine the range of significance among groups, scores among the fifth and six graders were found to be higher than those of eight graders. Scores obtained from 'Emotional Engagement (EE)' [$F_{(4-408)}$=1.444; p>.05] dimension were not statistically significant as per grades of students (Table 4).

Findings belonging to the fourth problem are presented in Table 5, Table 6, and Table 7.

Table 5

Independent Sample t Test Results of Scores in Engagement to Mathematics Course as per Answers Given to Question "Do you like mathematics?" in the Sample

Scale	Ans	N	Mean	S	t	*p*
Cognitive Engagement	Yes	244	16.95	3.09	14.712	.000
	No	168	12.05	3.60		
Emotional Engagement	Yes	244	11.60	2.90	8.696	.000
	No	168	9.12	2.74		
Social Engagement	Yes	244	13.46	2.17	10.768	.000
	No	168	10.85	2.73		
SEMS	Yes	244	42.01	6.49	14.678	.000
	No	168	32.03	7.17		

Significant difference was found among answers given to the question "Do you like mathematics?" and scores obtained from "Student Engagement in Mathematics Scale (SEMS)" 'Cognitive Engagement' (t=14.712; p<.01), 'Emotional Engagement' (t=8.696; p<.01) and 'Social Engagement' (t=10.768; p<.01) dimensions and from scale total (t=14.678; p<.01). Accordingly, engagement in mathematics scores among students who like mathematics in all dimensions and scale total are higher than scores among students who do not like mathematics (Table 5).

Table 6

Independent Sample t Test Results of Scores in Engagement to Mathematics Course as per Answers Given to Question "When did you like mathematics most?" in the Sample

Scale	Grade	N	Mean	S	t	*p*
Cognitive Engagement	Primary	266	14.34	4.14	-4.192	.000
	Middle	146	16.07	3.75		
Emotional Engagement	Primary	266	10.21	3.05	-3.360	.001
	Middle	146	11.27	3.05		
Social Engagement	Primary	266	12.05	2.80	-3.466	.001
	Middle	146	13.02	2.50		
SEMS	Primary	266	36.61	8.42	-4.454	.000
	Middle	146	40.36	7.71		

Significant difference was found among answers given to the question "When did you like mathematics most?" and scores obtained from "Student Engagement in Mathematics Scale (SEMS)" 'Cognitive Engagement' (t =-4.192; p<.01), 'Emotional Engagement' (t=-3.360; p<.01) and 'Social Engagement' (t=-3.466; p<.01) dimensions and from scale total (t=-4.454; p<.01). Accordingly, it can be seen from Table 6 that engagement in mathematics course scores among students who love mathematics course in the middle school are higher than scores among students who reported loving this course during primary school.

Table 7.

Independent Sample t Test Results of Scores in Engagement to Mathematics Course as per Answers Given to Question "Do You Consider Yourself Successful in Mathematics Course?" in the Sample

Scale	Ans.	N	Mean	S	t	*p*
Cognitive Engagement	Yes	171	17.04	3.48	9.628	.000
	No	241	13.47	3.84		
Emotional Engagement	Yes	171	11.98	2.68	8.348	.000
	No	241	9.60	2.97		
Social Engagement	Yes	171	13.77	2.20	9.462	.000
	No	241	11.42	2.66		
SEMS	Yes	171	42.80	6.60	11.361	.000
	No	241	34.50	7.76		

Significant difference was found among answers given to the question "Do you consider yourself successful in mathematics course?" and scores obtained from "Student Engagement in Self Mathematics Scale (SEMS)" 'Cognitive Engagement' (t =9.628; p<.01), 'Emotional Engagement' (t=8.348; p<.01) and 'Social Engagement' (t=9.462; p<.01) dimensions and from scale total (t=11.361; p<.01). Accordingly, scores of students who consider themselves successful in mathematics are higher in all dimensions and scale total compared to scores of students who do not consider themselves successful (Table 7).

Table 8

Pearson Product Moment Correlation Analysis Results for Score of Mathematics Scores and Engagement in Mathematics Course

Scale	*N*	*r*	p
Mathematic grade Cognitive Engagement	*412*	*.421*	*.000*
Mathematic grade *Emotional Engagement*	*412*	*.422*	*.000*
Mathematic grade *Social Engagement*	*412*	*.416*	*.000*
Mathematic grade *SEMS*	*412*	*.498*	*.000*

As can be understood from Table 8, a positive-oriented significant relationship was determined between middle school students' scores from "Student Engagement in Mathematics Scale (SEMS)" 'Cognitive Engagement' (r=.421 p<.01), 'Emotional Engagement' (r=.422; p<.01), 'Social Engagement' (r=.416; p<.01) and scale total (r=.498; p<.01) and their scores from mathematics course.

4. Conclusion and Discussion

In this study conducted towards analyzing middle school students' engagement in mathematics, it was concluded that students had high level of engagement in mathematics. Students with high levels of participation can not only get high scores but can try to achieve more than they have learned. Level of engagement is high among students

who love and are motivated towards learning, who solve problems, and who can analyze information (Kuh, 2009). In the study, middle school students' engagement in mathematics does not vary significantly as per their gender. In a study conducted by Baroddy et al. (2016) in which they analyzed variables affecting fifth-grade students' engagement in mathematics, no significant differences were found between gender and engagement in mathematics as in this study. Analyzing 'Cognitive Engagement' and 'Social Engagement' dimensions and scale total scores as per students' grade levels, it was concluded that scores among fifth and sixth grade students were higher than those of eighth grade students. The fact that decrease in students' engagement in mathematics as grade-level increases may be associated with that there is an increase in exams entered for passage to high schools in Turkey, and thus, there is an increase in students' anxieties. However, the difference in 'Emotional Engagement' dimension is not significant. Similar to the results of this study, Martin et al. (2015), in their study conducted with middle school students, concluded that students' engagement in mathematics increased as their grade level increased, and indicated that there was a decrease in students' engagement in mathematics especially during passages from primary to middle education. Birgin et al. (2017), in their study, also found out that fifth grade students had the highest, eight grade students had the lowest level of engagement in mathematics, and as grade level increased, level of engagement declined. Many studies have supported the finding that there is a decrease in engagement in mathematics as grade level increases (Brown, Brown, & Bibby, 2008; Sullivan, Mousley, & Zevenbergen, 2005).

Students were asked the question "Do you love mathematics?", and their answers were analyzed as per their scores. Engagement in mathematics scores among students who love mathematics were found to be higher than those of students who did not like mathematics. It can be said that state of loving mathematics will increase students' motivations, and engagement as a concept closely associated with motivation will be affected positively. Many studies (Fredricks, Blumenfeld, & Paris, 2004; Marks, 2000; Skinner & Belmont, 1993) have concluded that participation in a course is related to motivation. Middle school students were asked the question "When did you like mathematics course most?", and analyses were carried out based on answers they gave. Engagement in mathematics scores among students who reported loving mathematics in middle school were higher than those of students who reported loving mathematics more in primary school. The fact that middle school students love mathematics is expected to increase their participation in this course because the liking status of a course may have a positive effect on the participation in that course. In a study conducted by Midgley, Anderman, and Hicks (1995), it was revealed that students achieved higher scores of engagement in mathematics in middle school than those in primary school. Another finding of the study is that students considering themselves successful in mathematics course have higher scores in engagement in mathematics compared to those who do not consider themselves successful. Not only this study but also many studies have concluded that students' state of considering themselves successful in mathematics course is positively associated with their engagement in mathematics course (Birgin et al., 2017; Brown, Brown, & Bibby, 2008; Middleton & Spanias, 1999).

The final finding of the study is that middle school students' scores in mathematics are associated with their scores of engagement in mathematics. In other words, it can be said that the higher students' grades in mathematics are, the higher their engagement in mathematics will be, or students with high level of engagement in mathematics have high levels of achievement in mathematics as well. Academic achievement in primary and middle school depends on student's engagement (Bodovski & Farkas, 2007; Günüç & Kuzu, 2015; Hughes, Luo, Kwok, & Loyd, 2008; Leis, Schmidt, & Rimm-Kaufman, 2014; Wang & Holcombe, 2010; Weiss, Carolan, & Baker-Smith, 2010). There are many studies reporting that mathematics achievement is associated with engagement in mathematics (Baroody et al., 2016; Birgin, et. al., 2017; Bodovski & Farkas, 2007; DiPerna, Volpe, & Elliott, 2005; Fredrick et al., 2004; Hughes, Luo, Kwok, & Loyd, 2008; Park, 2005; Rimm-Kaufman et al., 2015).

Consequently, students' lack of engagement leads to low achievement, alienation from school, behavioral problems and even school dropout (Marks, 2000). When teachers are sensitive to their students' both academic and social-emotional needs, their students will be more successful academically (Reyes et al., 2012; Jennings & Greenberg, 2009). As can be seen, teachers have high level of effect on students' engagement in mathematics. In that case, both classroom teachers and mathematics teachers in higher grades should prepare environments that support students' engagement in mathematics.

References

Akar, S. G. M. Birgin, O., Göksu, B., Uzun, U. Gümüş, B., & Peker, E. S. (2017). Adaptation of Student Engagement in Mathematics Scale into Turkish. *Turkish Journal of Computer and Mathematics Education, 8*, 1, 28-51.

Aksu, M. (1991). The Aims and Principles of Mathematics Teaching. B. Özer (Ed.), Teaching mathematics (2-15). Eskişehir: Anadolu University Open Education Faculty Publications.

Baroody A. E., Rimm-Kaufman S. E, Larsen R.A, & Curby T.W. (2016). A multi-method approach for describing the contributions of student engagement on fifth grade students' social competence and achievement in mathematics. *Learning and Individual Differences*, *4*, 54-60. DOI: 10.1016/j.lindif.2016.02.012

Başar, M., Ünal M., & Yalçın, M. (2002). *The reasons for the fear of mathematics beginning at the primary school level*. 5th National Science and Mathematics Education Congress, National Education Printing, Ankara, Turkey.

Birgin, O., Mazman-Akar, S. G., Uzun, K., Göksu, B., Peker, E. S., & Gümüş, B. (2017). Investigation of factors affected to mathematics engagement of middle school students. *International Online Journal of Educational Sciences*, *9*(4), 1093-1110.

Bodovski, K. & Farkas, G. (2007). Mathematics growth in early elementary school: The roles of beginning knowledge, student engagement, and instruction. *The Elementary School Journal*, *108*, 2, 115-130.

Brown, M., Brown, P., & Bibby, T. (2008). 'I would rather die': Reasons given by 16-year-olds for not continuing their study of mathematics. *Research in Mathematics Education*, *10*, 3-18.

Chen, J. J. L. (2005). Relation of academic support from parents, teachers, and peers to Hong Kong adolescents' academic achievement: The mediating role of academic engagement. *Genetic, Social, and General Psychology Monographs*, *131*, 77-127. doi:10.3200/MONO.131.2.77-127

Connell, J. P., & Wellborn, J. G. (1991). *Competence, autonomy, and relatedness: A motivational analysis of self-system processes.* In M. R. Gunnar & L. A. Sroufe (Eds.), The Minnesota symposia on child psychology, Vol. 23. Self-processes and development (pp. 43-77). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

Deringöl, Y. (2017). *Mathematics worries me!*. Psychology of special talented children theoretically. Ed. Taşcılar, M. L. Z. Nobel Publications, 155-186.

DiPerna, J. C., Volpe, R. J., & Elliott, S. N. (2005). A Model of academic enablers and mathematics achievement in the elementary grades. *Journal of School Psychology*, *43*(5), 379-392. DOI: 10.1016/j.jsp.2005.09.002

Durmaz, M. & Akkuş, R. (2016). Mathematics anxiety, motivation and the basic psychological needs from the perspective of Self-Determination Theory. *Education and Science*, *41*, 183, 111-127.

Finn, J. D., & Voelkl, K. E. (1993). School characteristics related to school engagement. *Journal of Negro Education*, *62*, 249-268.

Finn, J. D., Pannozzo, G. M., & Voelkl, K. E. (1995). Disruptive and in attentive withdrawn behavior and achievement among fourth graders. *Elementary School Journal*, *95*, 421-45

Fredericks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*, 59-109.

George, D. & Mallery, M. (2010). *Spss for windows step by step: A Simple guide and reference*. 17.0 update, Boston: Pearson.

Günüç, S. & Kuzu, A. (2015). Student Engagement Scale: development, reliability and validity. *Assessment & Evaluation in Higher Education*, *40*(4), 587-610.

Hughes, J. N., Luo, W., Kwok, O., & Loyd, L. K. (2008). Teacher-student support, effortful engagement, and achievement: A three-year longitudinal study. *Journal of Educational Psychology*, *1*, 1-14.

İlhan, M. & Öner Sünkür, M. (2012). Math anxiety is the power to predict mathematical success of positive and negative perfectionism. *Journal of Mersin University Education Faculty*, *1*(8), 178-188.

Jennings, P. A., & Greenberg, M. T. (2009). The prosocial classroom: Teacher social and emotional competence in relation to student and classroom outcomes. *Review of Educational Research*, *79*, 491-525. Doi:10.3102/0034654308325693

Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward an understanding of definitions and measures of school engagement and related terms. *California School Psychologists*, *8*, 7-27.

Karasar, N. (2005). *Scientific research method.* Ankara: Nobel Publishing.

Kong, Q. P., Wong, N. Y., & Lam, C. C. (2003). Student engagement in mathematics: development of instrument and validation of construct. *Mathematics Education Research Journal*, *15*(1), 4-21.

Kuh, G. D. (2009). What student affairs professionals need to know about student engagement? *Journal of College Student Development*, *50*, 683-706.

Leis, M., Schmidt, K. M., & Rimm-Kaufman, S. E. (2014). Using the partial credit model to evaluate the student engagement in Mathematics Scale. *Journal of Applied Measurement*, *16*(3), 251-267.

Marks, H. M. (2000). Student engagement in instructional activity: Patterns in the elementary, middle, and high school years. *American Educational Research Journal*, *37*(1), 153-184.

Martin, A. J., Way, J, Bobis, J., & Anderson, J. (2015). Exploring the ups and downs of mathematics engagement in the middle years of school. *Journal of Early Adolescence*, *35*(2), 199-244 DOI: 10.1177/0272431614529365

Mazman Akar, S., Birgin, O., Göksu, B., Uzun, K., Gümüş, B., & Peker, E. (2017). Adaptation of Student Engagement in Mathematics Scale into Turkish. *Turkish Journal of Computer and Mathematics Education*, *8*(1), 28-51.

Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: findings, generalizations, and criticisms of the research. *Journal for Research in Mathematics Education*, *30*, 65-88.

Midgley, C., Anderman, E. M., & Hicks, L. H. (1995). Differences between elementary and middle school teachers and students: A Goal Theory Approach. *Journal of Early Adolescence*, *15*, 90-113.

Minato, S. & Yanase, S. (1984). On the relationship between students attitudes toward school mathematics and their levels of intelligence. *Educational Studies in Mathematics*, *15*, 313-320.

National Research Council (2005). *How students learn: History, mathematics, and science in the classroom*. Washington, DC: The National Academies Press. https://doi.org/10.17226/10126.

NCTM, (2000). *Principles and standards for school mathematics.* Reston, VA: National Council of Teachers of Mathematics.

Özkal, N. (2018). Relationships between students' math engagement and math teachers' motivational support. *Turkish Journal of Education*, *7*(2), 86-98. DOI:10.19128/turje.339944

Özkal, N. (2019). Relationships between self-efficacy beliefs, engagement and academic performance in math lessons. *Cypriot Journal of Educational Science*, *14*(2), 190-200.

Park, S. Y. (2005). Student engagement and classroom variables in improving mathematics achievement. *Asia Pacific Education Review*, *6*, 1, 87-97.

Reyes, L. H. (1984). Affective variables and mathematics education. *The Elementary School Journal*, *84*, 558-580.

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *Journal of Educational Psychology*, *104*(3), 700-712. Doi:10.1037/a0027268

Rimm-Kaufman, S. E., Baroody, A. E., Larsen, R. A., Curby, T. W., & Abry, T. (2015). To what extent do teacher-student interaction quality and student gender contribute to fifth graders' engagement in mathematics learning?. *Journal of Educational Psychology*, *107*(1), 170-185.

Skinner, E. A. & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effect of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, *85*, 571-581.

Skinner, E. A., Kindermann, T. A., Connell, J. P., & Wellborn, J. G. (2009). *Engagement and disaffection as organizational constructs in the dynamics of motivational development*. In K. R. Wenzel & A. Wigfield (Eds.), Educational psychology handbook series. Handbook of motivation at school (pp. 223-245). New York, NY, US: Routledge/Taylor & Francis Group.

Sullivan, P., Mousley, J., & Zevenbergen, R. (2005). Teacher actions to maximize mathematics learning opportunities in heterogeneous classrooms. *International Journal of Science and Mathematics Education*, *4*, 117-143.

Tekin, H. (1993). Measurement and evaluation in education. Ankara: Yargı Publications.

Wang, M. T. & Holcombe, R. (2010). Adolescents' perceptions of school environment, engagement, and academic achievement in middle school. *American Educational Research Journal*, *47*, 633-662. Doi:10.3102/ 0002831209361209

Weiss, C. C., Carolan, B. V., & Baker-Smith, E. C. (2010). Big school, small school: (Re) testing assumptions about high school size, school engagement and mathematics achievement. *Journal of Youth and Adolescence, 39*, 163-176.

Yücel, Z. & Koç, M. (2011). The relationship between the prediction level of elementary school students' math achievement by their math attitudes and gender. *Elementary Education Online*, *10*(1), 133-143.