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Determination of Middle School Students' Interest in Mathematics: The Case of Grades 7 and 8

Ortaokul Öğrencilerinin Matematiğe Yönelik İlgilerinin Belirlenmesi: 7 ve 8. Sınıflar

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Abstract

As in every field, interest is an important factor in learning mathematics. Determining students' interest in mathematics and implementation of activities according to the results could positively influence their achievement in this area. In Turkey, research into student interest is generally limited to scientific and vocational interest, with a limited number of studies having been conducted on the interest of middle school students with mathematics. Thus, this study was conducted to elicit middle school students' mathematical interest and designed as a mixed model. Within the scope of the study, the "Mathematical Interest Scale for Middle School Students" was developed by the researchers, taking into account the theoretical frame of interest for quantitative data and the relevant literature. In addition, a semi-structured interview form was prepared to elicit qualitative data to obtain in-depth knowledge about the factors affecting the middle school students' interest in mathematics. The quantitative and qualitative stages of the study were conducted with 1671 students (827 female, 844 male) and 17 students (10 female, 7 male), respectively. The results revealed that seventh-grade students had a high level and eighth-grade students had a moderate level of interest in mathematics. Furthermore, female students' interest in mathematics was at a high level and that of male students was at a moderate or high level. The students reported the factors that affected their interest in mathematics as themselves, their family, and their teachers.

Keywords: Interest, mathematics, middle school students, mixed model, scale development.

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Öz

Her alanda olduğu gibi matematiği öğrenmek için ilgi önemli bir unsurdur. Yapılan çalışmalar ilginin, öğrenmeyi pozitif yönde etkilediğini göstermektedir. Öğrencilerin matematiğe olan ilgilerinin tespit edilmesi ve bu tespitlere yönelik uygulamaların yapılması onların başarılarını etkileyebilir. Ülkemizde ilgi üzerine yapılan çalışmalar genellikle fen ve mesleki ilgi alana yönelik olmakla birlikte ortaokul öğrencilerinin matematiğe yönelik ilgileri ile ilgili sınırlı sayıda araştırma yapılmıştır. Bu düşünceden yola çıkarak, çalışmada ortaokul öğrencilerinin matematiğe yönelik ilgilerinin belirlenmesi amaçlanmıştır. Araştırma, karma model olarak tasarlanmıştır. Çalışma kapsamında; nicel veriler için ilginin kuramsal çerçevesi ve ilgili literatür dikkate alınarak "Ortaokul Öğrencileri için Matematik İlgi Ölçeği", araştırmacılar tarafından geliştirilmiştir. Ayrıca, nitel veriler için yarı yapılandırılmış görüşme formu hazırlanmış böylelikle ortaokul öğrencilerinin matematiğe olan ilgilerini etkileyen faktörler hakkında derinlemesine bilgi edinmek hedeflenmiştir. Araştırmanın nicel boyutuna 1671 (827 kız, 844 erkek) ve nitel boyutuna 17 (10 kız, 7 erkek), 7 ve 8. sınıf öğrencisi katılmıştır. Araştırma sonucunda; 7. sınıf öğrencileri matematik ilgileri yüksek düzey aralığında, 8. sınıf öğrencilerinin ise orta düzey aralığında olduğu ayrıca kız öğrencilerin matematik ilgileri yüksek düzey aralığında, erkek öğrencilerin ise orta ve yüksek düzey aralığında eşit oranda olduğu görülmüştür. Öğrenciler matematiğe yönelik ilgilerini etkileyen faktörleri kişinin kendisi, aile ve öğretmen olarak belirlemişlerdir.

Anahtar sözcükler: İlgi, ölçek geliştirme, matematik, ortaokul öğrencileri, karma yöntem

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Introduction

Interest, which has been considered to be an important part of learning and success for nearly a century (Oh, Jia, Lorentson, & LaBanca, 2013), has a strong influence on the cognitive and affective characteristics of an individual (Ainley, Hidi & Berndorff, 2002). As one of the preconditions and objectives of educational and training activities (Krapp, 1999), interest is an important motivational tool for learning mathematics (Carmichael, Callingham, & Watt, 2017). The area in which an individual is competent is often their field of interest. In a sense, interest is the pleasure of using and improving one's competencies; being in constant connection with an object or activity despite restricting conditions (Kuzgun, 2000). Achievement could affect interests, in that students who feel more competent could become more interested in a given subject (Köller, Baumert, & Schnabel, 2001). The results of the International Mathematics and Science Study (TIMSS, 2011, 2015) reveal that the average achievement of Turkish students interested in mathematics is higher than those who are not very interested in this area.

Some of the views about how interest is formed are mentioned in the inheritance and some of views the impact of the environment. According to Roe (1957), Super (1953), Holland (1973), they say that the source of interest is heredity and that the environment has developed under the influence of (cited in Kuzgun, 2006). Knapp (1994) based on Piaget's theory, the continuous interaction of individuals with objects and events causes them to create cognitive structures. These cognitive structures indicate that they are effective in the formation of interests. Interest has two dimensions; individual and situational (Hidi & Baird, 1988). Individual interest is formed by the knowledge and values acquired by a single person (Renninger, 2000). Individual interest often develops as a result of the reflection of events, experiences, preferences, and repetitions in sequence. Individual interest is a stable, underlying disposition activated in particular situations (Harackiewicz, Smith, & Priniski, 2016). Situational interest, in other respect, differs from individual interest in that it emerges with the influence of the environment (Hidi, Renninger, & Krapp, 1992). For example, environmental characteristics, such as laboratory experiences, classroom activities, technology-based projects, and social media are the main factors shaping situational interest (Schunk, Meece, & Pintrich, 2008). While situational interest can fluctuate from moment to moment, individual interest typically remains more or less stable over time (Frenzel, Goetz, Pekrun, & Watt, 2010). Both situational and individual interest contribute to an individual's attention, memory, efforts, and task awareness (Harackiewicz & Hulleman, 2010). As in every field, interest is an important factor in learning mathematics. Although children's fields of interest have not yet stabilized during the preschool period (Wigfield et al., 1997), the relationship between mathematics and interest begins around this time (Fisher, Dobbs-Oates, Doctoroff, & Arnold, 2012). While mathematics performance during primary school plays an important role in mathematical interest, after the transition of interest to a stable state, performance becomes less effective (Upadyaya & Eccles, 2014).

Studies show that interest in an area is generally impressed by various factors, such as age, gender, culture, family, teachers, friends, attitude toward school, and technology. Mathematics also play a significant role in shaping the self-efficacy and interest of learners, as well as social and gender roles (Frome, Alfed, Eccles, & Barber, 2006). However, the interest of girls and boys in mathematics can change over time. For example, a study conducted with high school students reported that although mathematics was the most interesting course for both girls and boys, the latter had an increased level of interest in this area from the ninth grade onward, whereas the former started to lose interest during the transition from the 10th to the 11th grade (Yaman, Dervişoğu and Soran, 2004). Köller et al. (2001) study involving, boys were showed a higher level of interest in mathematics than girls (Köller et al., 2001). German girl students at grade 5 were found lower level of interest in mathematics than boys and gender differences continued to exist through grades 6–9 (Frenzel et al., 2010). In another study, mathematics was found to be one of the favorite courses of American female students at primary school level, but the authors concluded that this interest in mathematics certainly declined during adolescence ("Students' Interest in Mathematics," 1991).

Interest not only positively influences learning but also increases motivation (Deci, 1992; Harackiewicz et al., 2016; Wigfield & Eccles, 2000). Therefore, it is very important for teachers to design classroom environments in a way to improve the interests and motivation of students (Carmichael et al., 2017). Undertaking various activities is more effective than the traditional classroom environment in increasing the interest of students in a field. In addition, for effective learning, students should be assigned purposeful tasks in line with their personal goals and interests (National Research Council, 2004). It has been reported that middle school students are more likely to be bored than elementary school students during passive learning in mathematics courses (e.g., listening to the teacher) (Larson & Richards, 1991).

In order for an individual to be interested in a course or a topic, it is often necessary for them to be able to link it with real life. Children's perception that mathematics is a challenging course due to its abstract nature and their inability to associate it with real life result in difficulties in their learning and success in this area. Incorporating real-life problems into mathematics classes increases the persistence of interest, understanding, and knowledge of students (Chrestensen, 2007). However, ineffective classroom management, poorly designed course environments, and lack of students' full engagement in mathematics content reduce the opportunity for students to develop mathematical self-sufficiency and a positive attitude to mathematics (Rowan-Kenyon, Swan, & Creager, 2012).

In the process of an individual acquiring an interest in mathematics, the influence of teachers should not be disregarded. A study investigating the contribution of teachers' beliefs about student success to student interest in mathematics from the preschool period to the sixth grade showed that when teachers believed that their students were making considerable effort in learning mathematics in an academic year, the students' interest in mathematics in that year was increased (Upadyay & Eccles, 2014). In addition to teachers, the family environment in which an individual grows up is an important factor affecting their interest. Children's interest in mathematics is related to their parents' supportive behavior toward these areas (Jacobs & Bleeker, 2004). Family is one of the most essential parts of human life, and children are naturally influenced by their parents' areas of interest (Baker, Scher, & Mackler, 1997; Crowley, Barron, Knutson, & Martin, 2015; Jacobs & Bleeker, 2004). Despite the decreasing gender gap in achievement and interest in mathematics in recent years, the opportunities provided by parents, their attitudes as role models, and the activities they engage in with their children vary according to the gender of the child and the parent (Jacobs & Bleeker, 2004).

Moreover, adults' own anxiety and beliefs about mathematics affect those of their children depending on gender (Beilock, Gunderson, Ramirez, & Levine, 2010).

A sense of belonging affects the interests of individuals by exposing them to specific topics or activities through friends and peers (Bergin, 2016). Research has shown that having friends that are interested in mathematics positively influences mathematical reasoning (DeLay, Laursen, Kiuru, Poikkeus, Aunola, & Nurmi, 2016). Experimental studies have revealed that friends have an impact on one's academic success (Véronneau, Vitaro, Brendgen, Dishion, & Tremblay, 2010). Accordingly, in some cases, the negative attitudes of peers to learning may lead to learning difficulties (Rowan-Kenyon et al., 2012). The cultural environment in which an individual inhabits also has a role in determining their interests. For example, Greek undergraduate students were found to be less interested in mathematics and computer science than their American counterparts (Kitsantas, Kitsantas, & Kitsantas, 2013). Another study conducted with American, Japanese, and Taiwanese 11th-grade students showed that Japanese male students were less likely to prefer mathematics courses than the American and Taiwanese male learners (Evans, Schweingruber, & Stevenson, 2002). A study conducted in Germany reported that interest had no significant effect on learning from the seventh to the 10th grades, but the students who were interested in mathematics were more likely to choose advanced mathematics courses, and their success also had an impact on their interest (Köller et al., 2001).

The aim of mathematics education is to help children develop areas of interest (Rellensmann & Schukajlow, 2017). During elementary school, it is expected that students will get to know themselves, and discover and develop their interests, abilities and characteristics (Ministry of National Education [MoNE], 2017). Interest is an important factor in many aspects of our life, such as career, success, and making choices and decisions. In Turkey, the available research mostly focuses on career interests and scientific interests. Studies on Turkish student's interest in mathematics are insufficient. For example, scales have been developed to determine students' interest in science at primary school level (Laçin-Şimşek and Nuhoğlu, 2009); astronomy (Ertaş-Kılıç and Keleş, 2017), chemistry (Çiçek and İlhan, 2017), occupational field (Deniz, 2009; Otrar & Canel, 2015), and the teaching occupation (Yaman, Gerçek and Soran, 2008) at the undergraduate level; and mathematics at high school level (Aksu, 2010) and for eighth-grade students (Aybay, 2005). This study aimed to develop a scale to elicit middle school students' interest in mathematics and identify the factors that affect this interest. The study is limited to individual and situational interest. This scale was developed in this field aims to give a different perspective to that exist in the literature. In line with this objective, the following research questions were formulated:

1. How can we determine middle school students' interest in mathematics?
2. What is the level of interest of seventh- and eighth-grade middle school students in mathematics?
3. What is the level of interest of female and male students attending seventh and eighth grades at middle school?
4. What factors affect middle school students' interest in mathematics?

Method

Research Model

Quantitative and qualitative research methods were employed together to gain an in-depth understanding of middle school students' interest in mathematics; thus, a mixed model was used. In this model both the qualitative and quantitative data are convincingly meticulously gathered and analyzed based on research questions; then, the two data types are combined either simultaneously by placing one in the other or consecutively by building one upon the other (Creswell & Clark, 2015).

Study Group

The data of the study were collected from students attending seventh and eighth grades at 15 different middle schools located in varied provinces, in Turkey. To determine the participant of the study, criterion sampling, as one of the purposive sampling, was used for quantitative data and qualitative data. The data were collected from three different sample groups: (1) 892 students (470 girls, 422 boys) participating in the development process of the "Mathematical Interest Scale for Middle School Students", (2) 779 students (357 girls, 422 boys) whose mathematical interest was determined, and (3) 17 students (10 girls, 7 boys) interviewed to identify the factors affecting the mathematical interest of middle school students. In this context, a total of 1,671 students participated in the quantitative dimension and 17 students participated in the qualitative dimension of the research. The aim is to provide maximum diversity. Within the scope of the research, necessary permissions were obtained through correspondence with the Turkish Ministry of National Education.

Data Collection Tools

The data collection tools used in the study were developed by the authors. The quantitative data were obtained using the "Mathematical Interest Scale for Middle School Students" and qualitative data using a semi-structured interview form consisting of open-ended questions.

Mathematical interest scale for middle school students

This scale was developed using the following steps (Seçer, 2015). (1) Identifying the needs and reviewing the literature; (2) creating an item pool in consultation with experts; implementing a pilot application with 119 students (69 girls; 50 boys) for the selection of items; (3) exploratory factor analyses (EFA) based on principal component analyses were applied for construct validity of the scale, with 356 students (205 girls; 151 boys); (4) confirmatory factor analysis (CFA)was used to determine whether the construct validity with 417 students (196 girls, 221 boys); (5) conducting reliability; (6) administering the final version of the scale to 779 students. Participants completed it in approximately 10 minutes, but there was no time limits. The items were rated in a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). There were no negative statements.

Open-ended questions on mathematical interest

To determine the factors that affected the participants' interest in mathematics, an interview of approximately 15-25 minutes was conducted. The interviews were audio recorded and transcribed for analysis. The interviews started with buffer questions, such as "What is your favorite course?" and "Where do you rank mathematics among these courses and why?".

Subsequently, the students were posed semi-structured questions to deepen the inquiry concerning the personal and situational factors that had an effect on their interest in mathematics. Below are examples of questions included in the interview form: "Are there any members of your family who are interested in mathematics? If yes, how does this affect your interest in mathematics? If no, if there were members of your family who were interested in mathematics, how would this affect your interest in mathematics?"/"What is the contribution of the mathematics teacher to your interest (or lack of interest) in mathematics?"/"Do you follow social media pages on mathematics?"/"Is it interesting for you to work individually or in a group in mathematics courses?"/"Do you think you will choose an occupation related to mathematics in the future? Can you explain your reasons?"/"What are the factors that influence an individual's interest in mathematics?

Data Analysis

SPSS 22 was used for the analysis of quantitative data. An exploratory factor analysis (EFA) was performed to determine the number of different factors included in the "Mathematical Interest Scale for Middle School Students". In EFA, it is expected that the items included in a measurement tool will be placed under certain factors, which reduces the number of variables in the measurement tool and allows the comparison of the obtained results with the theoretical structure (Seçer, 2015). The construct validity of the scale was tested using a confirmatory factor analysis (CFA) in AMOS software.

The qualitative data were analyzed by content analysis, in which codes were combined under certain categories and made meaningful. During this process, the two researchers involved in this study performed coding (individual interest and situational interest) individually, then met at specific time intervals to discuss their individual classifications and reached a consensus. Interrater reliability was calculated using the following formula: reliability=agreement/agreement +disagreement (Miles & Huberman, 1994). The percentage of agreement between the researchers was calculated to be 95%.

Results

Results on the Development of a Mathematical Interest Scale

Scale development began with the creation of an item pool. At this stage, observations of the first researcher as a result of mathematics teaching experience, focus group interviews with middle school mathematics teachers, scale development studies on interest (Aksu, 2010; Aybay, 2005; Kier, Blanchard, Osborne, & Albert, 2014; Lamb, Annetta, Meldrum, & Vallett, 2014; Mazer, 2012; Mitchell, 1993; Oh et al., 2013; Stevens & Olivarez, 2005) and the theoretical frame on which interest is based were utilized. In the first pool, 49 items were proposed with the problem statements grouped into factors that determine individual interest and situational interest (classroom environment, family, teacher, peer, and profession). After consulting with experts, the number of proposed items was reduced to 22 due to repeated content and some items not being appropriate for the purpose of the study. During this process, expert opinion was received from six field expert and linguistic experts for language and expression understandability. The first analysis was conducted on a group of 119 students to assess whether the scale could be understood by the students, and after the necessary corrections were made, a application was undertaken with 356 students. At this stage, the content validity of the scale was tested. Prior to the analysis, the missing data were assigned the average values of the series. In order to perform a factor analysis on the scale, the value of Kaiser-Mayer-Olkin (KMO) should be greater than .60 and the result of the Bartlett sphericity test should be significant (Pallant, 2013). As a result of the analysis, the KMO value was found to be .914 and Bartlett's sphericity value was calculated as χ^2 = 2048.458; SD = 153; p = .000 < 0.1. Following this stage, the factor structure was evaluated using the maximum likelihood and Varimax orthogonal rotation techniques. The results of the first EFA showed that the scale items were aggregated under four factors with an eigenvalue greater than 1, and these factors accounted for 56.47% of the total variance. In factor analysis, it is recommended that items should be under the factor associated with the highest loading, and when removing the items that do not measure the same factor, factor loading should be at least .30 or greater and the difference between the loading values should be at least .10 (Büyüköztürk, 2006). The first analysis of the 22-item scale revealed that two items (11 and 14) were below the factor loading values of .30, and thus were removed from the scale. When the remaining data were subjected to factor analysis again, items 12 and 20 were removed due to cross-loading on more than one factor. Then, the 18-item scale was re-evaluated and the items were found to load on three factors with an eigenvalue greater than 1: 5.997, 1.525, and 1.404 for factors 1 to 3, respectively. The first factor explained 33.31% of the total variance alone and 41.78% of the variance together with the second factor. All three factors explained a total of 49.59% of the variance. The item factor loading values ranged from .755 to .414. Table 1 presents information on factor loadings and item-total correlation of the scale.

Table 1. Mathematical Interest Scale for Middle School Students Factor Loadings and Item-Total Correlation

No	Factor1	Factor2	Factor3	Item-Total Correlation
m1	.783			.634
m15	.744			.584
m16	.720			.588
m17	.715			.572
m10	.676			.572
m3	.659			.472
m9	.547			.400
m2	.514			.493
m4	.416			.485
m8		.760		.617
m6		.689		.536
m5		.641		.419
m7		.610		.558
m13		.589		.543
m18		.512		.424
m19			.755	.608
m21			.744	.555
m22			.542	.414

The EFA results revealed that the final scale consisting of 18 items were collected under three factors. Through the analysis of the items loaded on factors in terms of their content, the first, second and third factors were named *individual interest* (items 1,2,3,4,9,10,15,16,17), *situational interest* (items 5,6,7,8,13,18), and *situational interest (family and teacher)* (items 19,21,22), respectively.

Individual interest concerns the personal interest of an individual in mathematics. A high score in this dimension means that personal experiences are influential in an individual's mathematical interest. (e.g.,"I feel more comfortable during mathematics classes than other classes"/"I keep on trying until I find a solution to a mathematical problem")

Situational interest refers to the environmental factor that affects an individual's interest in mathematics. It is possible to reach the conclusion that people with a high score in this dimension are influenced by aspects such as classroom environment, mathematical interest of their friends and other people around them, and social media. (e.g.,"My role model for my career is a person / people working in the field of mathematics"/"I follow social media (Facebook, Twitter, YouTube, etc.) pages on mathematics")

Situational interest (family and teacher) indicates the influence of the family and teacher that have a role in the development of an individual's interest in mathematics. A high score in this dimension means that an individual's mathematical interest is considerably affected by their family and/or teacher. (e.g.,"My mathematics teacher encourages me to learn mathematics")

The scores obtained from the whole scale provide information about students' interest in mathematics.

CFA was performed using AMOS software to determine the extent to which the final construct of the scale was appropriate based on the findings obtained from EFA. According to the results of this analysis, the fit index values were calculated as follows: $\chi^2 = 333.437$; sd = 132, p = .000; $\chi^2 \div$ sd = 2.526; CFI = .955; GFI = .918; NFI =.902; AGFI = .894; RMSEA = .061. The ratio of chi-square value to the degree of freedom ($\chi^2 \div$ sd), a cutoff value less than 3 corresponds to a perfect model fit (Kline, 2011). The chi-square value and its p value alone cannot be adequate in the general case of model evaluation. need to investigating other fit indices, to obtain a better picture of model fit (Raykov & Marcoulides, 2000). CFI value being greater than .95 indicate a perfect fit (Thompson, 2004). In this study, the ratio of the chi-square value to the degree of freedom ($\chi^2 \div$ sd) was 2.526 and the CFI value was found to be .955. Furthermore, GFI and AGFI values range between 0 and 1 and generally accepted that values of 0.90 or greater indicate well-fitting models (Hooper, Coughlan, & Mullen, 2008). RMSEA being .05 to .08 means an acceptable fit (Büyüköztürk, Akgün, Kahveci and Demirel, 2004). Finally, an NFI value being $\geq$.90 indicates an acceptable fit (Tabachnick & Fidell, 2001; Thompson, 2004). In this study, the GFI, AGFI, RMSEA and NFI values were calculated as .918, .894, .061, and .902, respectively. Therefore, the results of CFA confirmed that the scale exceeded the required fit thresholds specified in the literature.

Reliability Analysis

The reliability of the "Mathematical Interest Scale for Middle School Students" was determined using Cronbach's alpha internal consistency coefficient. Reliability is concerned with how accurately a test measures the attribute to be measured (Büyüköztürk, 2006). As a result of the analyses, Cronbach's alpha was calculated as .88 for the whole scale.

Quantitative Results on Middle School Students' Interest in Mathematics

In order to interpret the data obtained from the "Mathematical Interest Scale for Middle School Students", the averages of the total and sub-dimension scores of the scale were calculated, and the score range was determined using the formula, "range width = class width / number of groups" (Tekin, 2000). Based on a class width of 4 and three groups, the range width was calculated as 1.33. Accordingly, the score ranges for the interpretation of the scale were 1.00 to 2.33 (low), 2.34 to 3.67 (moderate) and 3.68 to 5.00 (high).

Table 2 reveals that the mathematical interest levels of seventh and eighth graders participating in the study were moderate for the sub-dimensions of individual interest and situational interest, and high for the sub-dimension of situational interest (family and teacher). For the total scale, mathematical interest levels were high among seventh graders and moderate for eighth graders.

Table 2. Mathematical Interest Levels of Middle School Students by Grade

		Mathematical interest levels							
		Low		Moderate		High		Total	
Sub-dimension	Grade	n	%	n	%	n	%	n	%
Individual interest	7	59	13.4	226	51.3	155	35.2	440	100
	8	72	21.2	157	46.3	110	32.4	339	100
Situational interest	7	102	23.2	211	48.0	127	28.9	440	100
	8	89	26.3	174	51.3	76	22.4	339	100
Situational interest	7	15	3.4	71	16.1	354	80.5	440	100
(family and teacher)	8	14	4.1	71	20.9	254	74.9	339	100
Total scale	7	24	5.5	188	42.7	228	51.8	440	100
	8	23	6.8	160	47.2	156	46.0	339	100

Table 3 presents the mathematical interest levels of the participants according to gender. Both male and female students who participated in the study had a moderate level of mathematical interest concerning the sub-dimensions of individual interest and situational interest, and a high level of mathematical interest regarding the sub-dimension of situational interest (family and teacher). For the total scale, female students had a high level of mathematical interest, whereas moderate and high levels of mathematical interest were equally distributed among the male students

Table 3. Mathematical Interest Levels of Middle School Students by Gender

		Mathematical interest levels							
		Low		Moderate		High		Total	
Sub-dimension	Gender	N	%	n	%	n	%	n	%
Individual interest	F	46	12.9	182	51.0	129	36.1	357	100
	M	85	20.1	201	47.6	136	32.2	422	100
Situational interest	F	73	20.4	185	51.8	99	27.7	357	100
	M	118	28.0	200	47.4	104	24.6	422	100
Situational interest	F	7	2.0	56	15.7	294	82.4	357	100
(family and teacher)	M	22	5.2	86	20.4	314	74.4	422	100
Total scale	F	13	3.6	154	43.1	190	53.2	357	100
	M	34	8.1	194	46.0	194	46.0	422	100

Qualitative Results on Middle School Students' Interest in Mathematics

In the qualitative dimension of the research, the participants were interviewed to gain an understanding of the factors that affected their interest in mathematics course. The categories and codes obtained from these interviews are shown in Figure 1.

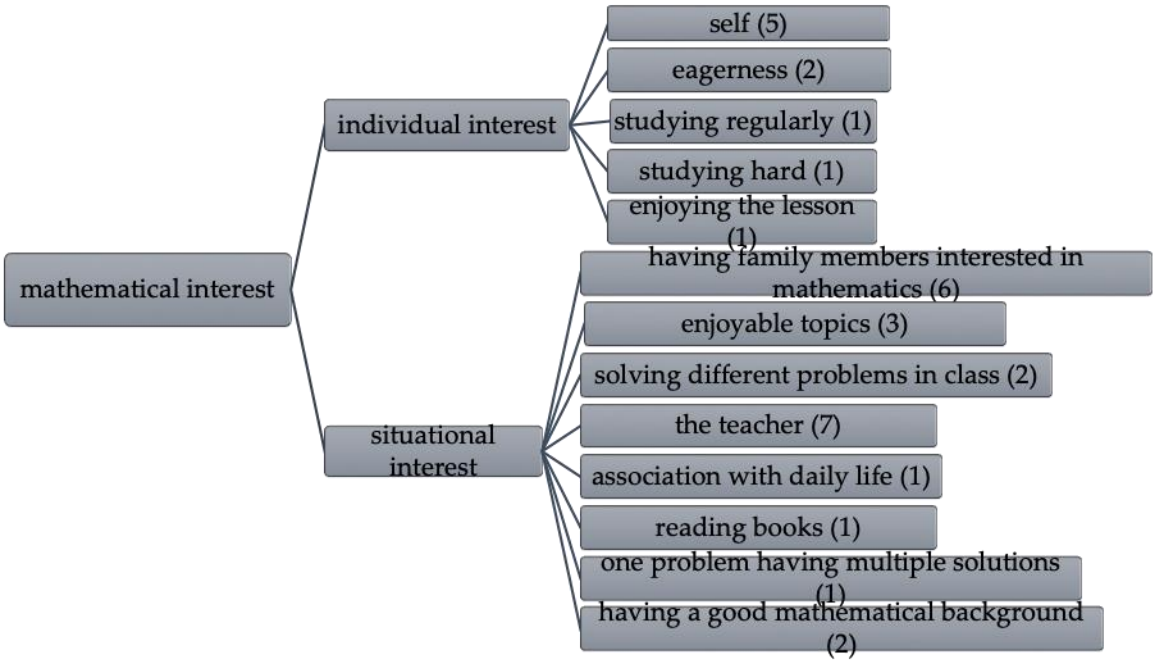

Figure 1. **Factors affecting the participants' interest in the mathematics course**

As shown in Figure 1, the factors that influenced the participants' interest in mathematics were grouped under the two categories of individual and situational interest. The former category consisted of factors related to the self (5), eagerness (2), studying regularly (1), studying hard (1), and enjoying the lessons (1). The situational interest category comprised factors related to having family members interested in mathematics (6), enjoyable topics (3), solving different problems in class (2), the teacher (7), association with daily life (1), reading books (1), one problem having multiple solutions (1), and having a good mathematical background (2).

In the interview, a student with low mathematical achievement in the school focused on situational interest, rather than individual interest: *"First, the family should be interested in mathematics. Topics should not be boring. Mathematical topics should be enjoyable. In the class, different mathematical problems should be solved, not always the same type. The teacher should be entertaining. S/he should not always ask the students to note down everything. S/he should engage them in different activities."* Another student who could be described as having low mathematical success emphasized the importance of the teacher's role in determining students' mathematical interest as follows: *"I think the teacher has the most influence."* In contrast, a participant with moderate level of mathematical achievement described the importance of individual interest as, *"I can't associate liking a course with the teacher. I think it is related to the person themselves".*

A student who was successful in mathematics focused on the effect of first situational then individual interest: *"A person would be interested in mathematics if s/he is ambitious and first competes with the teacher, and then her/himself. S/he can also have a personal interest in it".* Similarly, another student successful in mathematics believed that mathematical interest resulted from oneself and the teacher: *"A person should like the course and the teacher. The person should first like the course, but the teacher also has a great effect on whether a student likes or dislikes a course. If a teacher says negative things about the course, it negatively affects the student."* Another student successful in mathematics referred to situational interest stating, *"If you have a good background, you can solve mathematical problems. This is effective in developing a liking for mathematics".* A student with a very high mathematical achievement underlined the importance of understanding what has been read, thus indicating the effect of situational interest: *"Reading a book makes it easier for a person to understand problems when solving them. This shows that you are successful in this course and increases your self-esteem".*

Discussion and Conclusion

This study aimed to determine the mathematical interest of middle school students. Determining factors that affect students' interest in mathematics is very significant for both their academic success and understanding of mathematics. Within the scope of the study, first, the "Mathematical Interest Scale for Middle School Students" was developed to elicit the participants' interest in mathematics. In this context, a valid and reliable measurement instrument consisting of 18 items under three sub-dimensions was obtained and the analyses revealed that this scale had an internal consistency coefficient of .88. Most studies have generally been limited to interest in the teaching profession and science, with only a small amount of research having been undertaken to develop scales to measure mathematical interest, in Turkey. In the literature, developed studies on mathematics interest (Aksu, 2010; Aybay, 2005; Mitchell, 1993; Stevens & Olivarez, 2005; Wininger, Adkins, Inman, & Roberts, 2014). Mitchell (1993), who developed a mathematical interest scale for secondary mathematics classroom students including 38 items under the sub-dimensions of personal interest, situational interest, meaningfulness, involvement, group work, puzzles and computers. Stevens and Olivarez (2005), who developed a mathematical interest scale for grades 4 to 10 consisting of 27 items under the sub-dimensions of positive valence, negative valence and time. For her master's thesis, Aybay (2005) developed a five-item mathematical interest scale to measure the students' interest in mathematical activities. Aksu (2010) developed the scale targeted high school students that were about to take the university entry test. This scale consisted of five-point Likert-type 22 items under the sub-dimensions of liking mathematics, preferring mathematics, orientation toward mathematics, and the teacher as an internal stimulant. Wininger et al. (2014), developed a mathematics interest scale focusing on individual interest for elementary students. In contrast to these scales in the literature, the current study took into consideration the individual and situational sub-dimensions of interest. This resulted in a scale that is able to examine factors affecting middle school students' interest in mathematics in a multidimensional way. Therefore, it is considered that the current research will contribute to the literature on mathematics education.

The "Mathematical Interest Scale for Middle School Students" was administered to 779 seventh- and eighth graders in different provinces in Turkey to obtain information about their mathematical interest levels. As a result of this application, it was found that the scores calculated for individual and situational interest sub-dimensions for both seventh- and eighth-grade students were within the moderate level range while those for situational interest (family and teacher) were within the high-level range. This indicates that for both grades, the family and teacher sub-dimension has an effect on the students' interest in mathematics. Similarly, Upadyay and Eccles (2014) emphasized that the teacher was an important factor in children's mathematical interest. In addition, consistent with our results, other studies in the literature reported the effect of parents on their children's interests (Baker et al., 1997; Jacobs & Bleeker, 2004). For the total scale, the mathematical interest level was high for seventh graders and moderate for eighth graders. From this result, it can be inferred that as the class level increases, the mathematical interest level of students tends to decrease. Other researchers have suggested that there is a change in students' interest in mathematics depending on their grade level (Frenzel et al., 2010; Köller et al., 2001; Yaman et al., 2004).

It was observed in the current study that the scores of both female and male students were within the moderate-level range for the individual and situational interest sub-dimensions, and within the high-level range for situational interest (family and teacher). The findings obtained from the quantitative stage of the study showed that family and teacher were important factors affecting students' interest in mathematics for both grade level and gender. The interviews with the students revealed that the self, family and teacher were most influential elements for the mathematical interest of students. Similarly, studies in the literature showed that individual and situational factors had an effect on mathematical interest. As mentioned in the introduction to this paper, researchers reported the influences of the teacher (Upadyay & Eccles, 2014), family (Beilock et al., 2010; Jacobs & Bleeker, 2004) and the individual themselves (Renninger, 2000) on interest.

The quantitative and qualitative results of the research support each other in that they both revealed the effect of the teacher and family influence on the students' interest in mathematics. This is also consistent with social cognitive theory. Based on this theory, Lent, Brown, and Hackett (1994) created a model on the development of interest, which suggested that a person who believes they are competent in an area will be interested in that area. Social cognitive theory advocates that an individual's behavior is influenced by their cognitive, behavioral and social environment (Bandura, 1986). Furthermore, according to social cognitive career theory that originated from social cognitive theory, the innate characteristics of a person, such as gender, race, ethnicity and predispositions, as well as background characteristics, including socioeconomic status, language, and area of residence affect their learning. In addition, the learning experiences of an individual have a role in determining their self-sufficiency and expectations from the future, which both have a strong effect on their interests (Kier et al., 2014; Lent, Brown, & Hackett, 1994, 2000).

Recommendations

1. “The Mathematical Interest Scale for Middle School Students” developed within the scope of this research can be used by researchers and teachers in experimental and screening studies.
2. The mathematical interest of students at different grade levels can be determined.
3. Teachers and parents should be informed about the factors that affect the interest of students in mathematics.
4. Research should be undertaken with teacher candidates in the mathematics education department of the education faculty to examine interest as an affective area that influences learning.
5. Determining mathematical interest levels depending on grade level and gender and informing teachers about the results are important in minimizing factors that adversely affect children’s academic achievement in both cognitive and emotional senses.

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Genişletilmiş Özet

Giriş

Yaklaşık yüz yıldır öğrenme ve başarının önemli bir parçası olarak düşülen ilgi (Oh, Jia, Lorentson & LaBanca, 2013), bireylerin bilişsel ve duyuşsal özellikleri üzerinde güçlü etkiye sahiptir (Ainley, Hidi & Berndorff, 2002). Eğitim-öğretim faaliyetlerinin ön şart ve amaçlarından biri olan ilgi (Krapp,1999), matematik öğrenmek için önemli bir motivasyon aracıdır (Carmichael, Callingham & Watt, 2017). Bireyin yetenekli olduğu alan genellikle ilgi duyulan faaliyet alanıdır. İlgi bir bakıma yetenekleri kullanmaktan ve onları geliştirmekten duyulan zevk; bir nesne veya bir faaliyete karşı, kısıtlayıcı koşullara karşın sürekli bir bağlanma durumudur (Kuzgun, 2000). Başarı, ilgiyi etkileyebilir. Diğer bir değişle kendini belli bir konuda yetkin hisseden birey belli bir konu ile daha fazla ilgilenebilir (Köller, Baumert & Schnabel, 2001). Uluslararası Matematik ve Fen Eğilimleri Araştırması (Trends in International Mathematics and Science Study [TIMSS]) sonuçlarına göre matematik dersine ilgi duyan Türk öğrencilerin başarı ortalamalarının matematik dersine pek ilgi duymayanlardan daha yüksek olduğunu göstermektedir (TIMSS, 2011, 2015).

İlginin nasıl oluştuğuna dair görüşlerin bir kısmı kalıtımın bir kısmı ise çevrenin etkisinden bahsetmektedir. Roe (1957), Super (1953), Holland (1973) göre ilginin kaynağın kalıtım olduğunu ve çevrenin etkisiyle geliştiğini söylemektedirler (Akt. Kuzgun, 2006). Krapp (1999) ise Piaget'in kuramına dayanarak bireyler nesne ve olayla sürekli etkileşim içinde olması bilişsel yapılar oluşturmasına neden olduğunu bu bilişsel yapıların ilgi alanlarının oluşmasında etkili olduğunu belirtmektedir. İlginin bireysel ilgi ve durumsal ilgi olmak üzere iki boyutu bulunmaktadır (Hidi & Baird, 1988). Bireysel ilgi, kişinin edindiği bilgi ve değerler sonucunda oluşmakla (Renninger, 2000) birlikte çoğu zaman olayların, deneyimlerin, tercihlerin ve tekrarların bir yansıması sonucunda sırayla geliştiği söylenebilir. Bireysel ilgi, belli durumlarda aktif olan istikrarlı, temel bir eğilimdir (Harackiewicz, Smith & Priniski, 2016). Durumsal ilgi ise bireysel ilgiden farklı olarak çevrenin etkisiyle ortaya çıkan bir yapıdadır (Hidi, Renninger & Krapp, 1992). Örneğin; laboratuvar deneyimleri, sınıf etkinlikleri, teknoloji tabanlı projeler, sosyal medya gibi çevresel özellikler durumsal ilginin oluşmasında başlıca özelliklerdir (Schunk, Meece & Pintrich, 2008). Durumsal ilgi zaman zaman dalgalanma gösterirken, bireysel ilgi genellikle zaman içinde sabit kalma eğilimindedir (Frenzel, Goetz, Pekrun & Watt, 2010). Hem durumsal hem de bireysel ilgi kişinin dikkat, hatırlama, çaba ve görev bilincine katkı sağlamaktadır (Harackiewicz & Hulleman, 2010). Her alanda olduğu gibi matematiği öğrenmek için ilgi önemli bir unsurdur.

Araştırmanın Amacı

Türkiye'de ilgi üzerine yapılan çalışmalar genellikle mesleki ve fen bilimleri alanlarına yönelik olmakla birlikte matematik ilgisi üzerine yapılan ölçek geliştirme çalışmalarının sınırlı sayıda ve yetersiz olduğu görülmüştür. Bu araştırmada; ortaokul öğrencileri için matematik ilgi ölçeği geliştirmek ayrıca öğrencilerin matematiğe yönelik ilgilerini etkileyen faktörlerin neler olduğunun tespit edilmesini amaçlamaktadır. Çalışma kapsamında geliştirilen ölçek ilginin bireysel ve durumsal ilgi boyutları ile sınırlandırılmıştır. Bu bakımda geliştirilen bu ölçek literatürde var olan ölçeklere farklı bir bakış açısı kazandırmayı hedeflemektedir. Bu doğrultuda çalışmada,

1. Ortaokul öğrencilerinin matematiğe yönelik ilgileri nasıl belirlenebilir?
2. Ortaokul 7 ve 8. sınıf düzeyinde öğrenim gören öğrencilerin matematiğe yönelik ilgileri ne düzeydedir?
3. Ortaokul 7 ve 8. sınıf düzeyinde öğrenim gören kız ve erkek öğrencilerin matematiğe yönelik ilgileri ne düzeydedir?
4. Ortaokul öğrencilerin matematiğe yönelik ilgilerini etkileyen faktörler neleredir?

sorularına cevap aramak amaçlanmıştır.

Yöntem

Ortaokul öğrencilerinin matematiğe yönelik ilgileri hakkında derinlemesine bilgi edinmek amacıyla nicel ve nitel araştırma yöntemleri birlikte yürütülmüştür. Yöntem olarak karma model kullanılmıştır. Çalışmaya katılan öğrencilerin seçiminde ölçüt örnekleme tekniğine başvurulmuştur. Araştırma verileri üç farklı grup üzerinden toplanmıştır: (1) "Ortaokul Öğrencileri için Matematik İlgi Ölçeği" geliştirme sürecine katılan öğrenciler (892 öğrenci; 470 kız, 422 erkek), (2) Ortaokul öğrencilerinin matematik ilgilerinin belirlenmesi sürecine katılan öğrenciler (779 öğrenci; 357 kız, 422 erkek) (3) Ortaokul öğrencilerin matematiğe yönelik ilgilerini etkileyen faktörlerin belirlenmesi için görüşme yapılan öğrenciler (17 öğrenci; 10 kız 7 erkek). Bu bağlamda çalışmanın nicel boyutuna 1671 öğrenci, nitel boyutuna ise 17 öğrenci katılmıştır.

Tartışma ve Sonuç

"Ortaokul Öğrencileri için Matematik İlgi Ölçeği" ortaokul öğrencilerin matematiğe yönelik ilgilerini belirleyebilmek amacıyla geliştirilmiştir. Bu bağlamda, yapılan analizler sonucu üç alt boyut ve 18 maddeden oluşan, Cronbach Alfa iç tutarlılık katsayısı .88 olan geçerli ve güvenilir bir ölçme aracı elde edilmiştir. Uygulama sonucunda, hem 7 hem de 8. sınıf öğrencileri için bireysel ve durumsal ilgi boyutları için hesaplanan puanların orta düzeyde aralığında olduğu görülürken, durumsal ilgi (aile ve öğretmen) boyutunda alınan puanların ise yüksek düzey aralığında olduğu sonucuna ulaşılmıştır. Sonuç olarak hem 7 hem de 8. sınıf öğrencileri için aile ve öğretmen boyutunun matematik ilgisi üzerinde etkili olduğu söylenebilir.

Hem kız hem de erkek öğrenciler için bireysel ve durumsal ilgi boyutlarından alınan puanların orta düzey aralığında olduğu, durumsal ilgi (aile ve öğretmen) boyutundan alınan puanın yüksek düzey aralığında olduğu görülmektedir. Çalışmanın nicel boyutundan elde edilen bulgular hem sınıf seviyesi hem de cinsiyet için matematiğe yönelik ilgiyi etkileyen önemli faktörlerin aile ve öğretmen olduğunu göstermektedir. Yapılan görüşmeler sonucunda öğrenciler matematiğe yönelik ilgiyi etkileyen etmenleri kişinin kendisi, aile ve öğretmen olduğunu belirtmişlerdir. Benzer bir şekilde literatürde bireysel ve durumsal faktörlerin matematiğe yönelik ilgiyi etkilediğini gösteren çalışmalar mevcuttur. Literatürde öğretmenin (Upadyay, & Eccles, 2014), ailenin (Beilock, Gunderson, Ramirez, & Levine, 2010; Jacobs, & Bleeker, 2004) ve bireyin kendisinin (Renninger, 2000) ilgiliyi etkilediğine dair çalışmalar mevcuttur.