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The relationship between secondary school students' mathematics anxiety and self-regulation

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One of the basic aims of education is to facilitate students' learning and to make it permanent. Researching and identifying the factors which can positively or negatively affect students' learning hold a great deal of importance in terms of actualizing learning. The aim of this study is to determine whether or not there is a relationship between elementary school students' (5th, 6th, 7th, and 8th grades) mathematics self- regulation abilities and their mathematics anxiety. The sample of the research was composed of a total of 283 students (141 males and 142 females) who went to public school located in Erzurum. Both Mathematics Anxiety Scale and Self-Regulation Skill Scale for elementary school students were used as data collection tools of the study in which causal research design was used. SPSS 18.0 package program, the Pearson Product-Moment Correlation Coefficient Analysis and the Multilinear Regression Analysis were used in analyzing the data. In view of the obtained findings, a negative relationship was found between mathematics anxiety and self-regulation skill [r=-.27].

Key words: Mathematics Anxiety, Self-Regulation, Anxiety and Self-Regulation.

INTRODUCTION

As science and technology progressively develop, our education system has been reviewed constantly and necessary changes have been applied along with these developments in order to cope with scientific and technological developments, to raise future individuals in an effective way and to provide them with high quality mathematics instruction.As it is known, education is the foundation of a country's social, cultural and technological developments. With humanity's transition to the information age, rapid scientific and technological developments have considerably affected the way people are designed for the future. Many occupations will require a solid foundation in the fields of mathematics, science and computer in the future. These three necessitate mathematics-based knowledge and skills (Baykul, 1999).

One of the basic aims of education is to facilitate students' learning and make it permanent. In this regard, researching and finding out the factors that can positively or negatively affect students' learning hold a great importance in terms of actualizing this learning. We should not only focus on the factors that affect learning in a negative way, but also find a solution to the problems that arise from these factors. In order to narrow the scope of our context, we should highlight mathematics that is considered to be the primary course in which students usually experience difficulty. We should also pay

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attention to students' prejudices against mathematics. Researching the factors that affect mathematics education must be prioritized in order to facilitate mathematics learning. Mathematics is among the courses in which affective characteristics have a considerable influence on the learning-teaching process (Suinn and Edwards, 1982). Mathematics, which is considered to be an important part of education, is also a discipline which has a quality that evokes anxiety in people. Why do we experience difficulties in learning mathematics? How can we overcome mathematics anxiety and fear? Many researches conducted in the last thirty years (Aiken,1970; Izard, 1972; Tobias, 1978; Posamentier and Stepelman, 1986; Hembree, 1990; Skiba, 1990; Tobias, 1990; Bessant, 1992; Chipman, et al., 1992; Gierl and Bisanz, 1995; Campbell and Evans, 1997; Baloğlu, 1999; Zettle and Raines, 2000; Ma and Xu, 2004; Şahin, 2004 and Alkan, 2009) have set forth that some students exhibit reactions like fear, hate and anxiety against mathematics course from an elementary school level to a university level. Furthermore, it is observed that there is a widespread belief in our country, which argues that mathematics course is difficult (Başar et al., 2002).

Students' academic success is based on their cognitive and affective characteristics. Problems arising from cognitive characteristics can be spotted more easily in the learning-teaching process, and it is easy to eliminate these problems. In this aspect, it is considered that cognitive behaviors are open to change (Senemoğlu, 2005). Spotting problems arising from affective characteristics is more difficult than those arising from cognitive characteristics, and it takes time to change these characteristics (Erden and Akman, 2011). As a result of these facts, it is important to spot students' affective characteristics regarding the learning-teaching process earlier. Thus, after students' affective characteristics are identified, it becomes easier to eliminate these characteristics that affect students' success in a negative way. When students believe that they can perform mathematics and exhibit positive emotions towards mathematics course, their mathematics success increases (Yücel and Koç, 2011). On the other hand, negative emotions toward mathematics course cause a decrease in students' mathematics success (Aiken, 1970; Çoban, 1989; Minato and Yanese, 1984). Mathematics anxiety is one of the affective characteristics that cause a decrease in students' mathematics success (Ho, 2007; Wadlington and Wadlington, 2008; Zakaria and Nordin, 2008).

Mathematics anxiety, which is one of the factors that positively or negatively affect success in education, was first defined by Drejer and Aiken (1957) as the emotional reaction syndrome that is exhibited against the fields of mathematics and arithmetic. Although the first studies on mathematics anxiety began in the 1950s with the individual observations of mathematics teachers, education researchers did not take interest in mathematics anxiety until the 1970s (Baloğlu, 2001). Richardson and Suinn (1972) defined mathematics anxiety as the feelings of tension that interferes with manipulating numbers and solving mathematical problems, and they conducted many researches on this issue. Hembree (1990) stated that mathematics anxiety causes a decrease in mathematics success and an emergence of an anxiety towards abstaining from mathematics. Therefore, mathematics anxiety is a serious problem that is mostly observed in students of early education, and its solution is not easy (Hannula, 2005). Students under the influence of such anxiety are unable to gain mathematical knowledge at a desired level and they choose to memorize the mathematical knowledge that they gain without internalizing and comprehending this knowledge (Işık et al., 2008). Mathematics anxiety is defined as feeling the emotions of anxiety and tension in solving mathematics problems using numbers in daily and academic life (Altun, 1994). Şahin (2000) defined mathematics anxiety as feeling the emotions of anxiety and tension in solving mathematics problems and using numbers in daily and academic life. Mathematics anxiety is one of the reasons that negatively affect an individual's mathematics performance (Wadlington and Wadlington, 2008; Ho, 2007).

It is stated that students gain mathematics anxiety generally from the mathematics courses that they took in the past. Therefore, mathematics teachers learn how to minimize elementary school students' mathematics anxiety using their own school experiences (Wilson and Thornton 2007). Mathematics anxiety begins in the first years of education. In addition to teachers' attitude, parents' attitude also constitutes an important factor in the emergence of mathematics anxiety. Children can pick up the fear and anxiety from their parents. Thus, the individual gets mathematics anxiety from teachers and parents through intuition and taking them as models (Tanyolaç, 1996). Mathematics anxiety is one of the affective variables that can prevent both learning (Fiore, 1999; Stuart, 2000) and performance (Hembree, 1990; Ho et al., 2000; Liebert and Morris, 1967; Richardson and Suinn, 1972; Wigfield and Meece, 1988).

In recent years, there were some exciting explorations related to how students can organize own nature, sources, and progress of their learning processes (Zimmerman and Schunk, 2001). Self-regulation, which is considered among the factors that affect success and academic performance the most, was defined and modeled from many theoretical perspectives (Sağırlı, et al., 2010). According to Bandura, who pioneered the social cognitive theory, self-regulation focuses on individuals' thinking on their abilities and capacity regarding the behaviors that they will exhibit (Çiltaş and Bektaş, 2009). Zimmerman, who first set forth the necessity of structuring the self-regulated learning in education, defined the self-regulated learning as a learning process incorporating the skills of organization, evaluation, management and control that the students put into practice

to obtain information (Cheng, 2011). Pintrich (2000) defined self-regulation as“an active and constructive process whereby students set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation and behavior, guided and constrained by their goals and contextual features of the environment”. Risemberg and Zimmerman (1992) defined self-regulation as “setting objectives, developing strategies to actualize these objectives and monitoring what they gained through these strategies”. Kauffman (2004) defined self-regulation as “learner’s effort to control and manage complicated learning activities”.

The concept of self-regulation, which means students organizing the learning process as they wish, has become the primary subject of the latest studies conducted on academic success. Many of the studies, which were conducted on self-regulation skill, set forth that there is a positive significant relationship between self-regulation based learning strategies, motivational beliefs and course success. Cervone and Pervin (2008) stated that self-regulations include specific cognitive and metacognitive abilities such as changing a behavior that is continuing, planning strategies, and tending to be a goal-setting. The common profile formed upon self-regulations is shaped as that “students play effective role in learning processes behaviorally, cognitively, and motivationally” (Zimmerman, 1986; Zimmerman and Schunk, 1989). Boekaerts et al. (2005) indicated that self-regulated learning is a kind of self-management process that is repetitive and has many variables changing environmental, cognitive, affective, and behavioral elements. Pintrich (2004) mentioned four conjectures composing a base on self-regulated learning theory to provide component process and its relation with self-regulated learning. These are as follows. First of all, it is supposed that learners are active in meaning construction and goal-setting in self-regulated learning. Secondly, learners have potential of controlling their own learning. Thirdly, learning behavior is not random, instead it is purposive. Lastly, self-regulated activities have mediator role between personal and contextual characteristics and real achievement or performance.

In a study conducted by Pintrich and De Groot (1990), the relationship among motivation, learning self-regulation and classroom academic performance were examined. It has been discovered that self-regulation and intrinsic value have a positive relationship with cognitive connection and performance, and self-regulation, self-efficacy and test anxiety are the best predictors of performance.In their study conducted on mathematics course, Alcı and Altun (2007)determined that there were significant differences between students’ self-regulation and metacognition skills in terms of their gender and high school class level whereas there was no difference among these skills in terms of fields. In a study conducted by Haşlaman and Aşkar (2007), it was found that the students’ self-regulated learning strategies explained 71% of success which incorporated assigning values, gravitating towards the external aim, setting aims, repeating, self-reflection, self-efficacy perception, endeavoring, working with others and time management. In their study, Üredi and Üredi (2005) examined predictive power of 8th grade students’ self-regulation strategies and motivational beliefs on their mathematics success. They discovered that self-regulation strategies and motivational beliefs explained 30% of the total variance regarding mathematics success, and the use of cognitive strategy is the most powerful predictive variable. Azevedo et al. (2008) investigated how self-regulation based learning and external effect with self-regulated learning affect students in multiple environment. They subjected the self-regulation based learning and external effect with self-regulated learning to 128 students who were enrolled in middle and high schools. Self-regulation based learning group with external effect learnt the self-regulation abilities with the help of special teaching software, while the others learnt them on their own. According to the analysis of the results gathered from pre-and post-tests and interviews during experimental processes, those who learnt with the help of self-regulation based learning with external effect had more knowledge than others and post-test results indicated that development of their intellectual abilities increased substantially. In a study conducted on students who were unsuccessful in mathematics and reading comprehension lessons, they were taught how to use self-regulation strategies on the way to follow, how to manage their understandings and how to fulfill their inadequacies when necessary. At the end of the study, it was observed that students’ achievements and self-regulation perceptions increased sharply.

Many activities can be performed in elementary education level, in which the foundations of learning are laid, for the mental development of students. Thus, students’ attitudes, interests, success and self-self-regulation skills towards mathematics course can develop. Mathematics knowledge, which has not developed at an adequate level in elementary education, may cause students to encounter difficulties in their forthcoming educational lives. Therefore, students’ anxiety towards mathematics and their self-regulated learning must be determined in their elementary education years in order for them to get mathematics instruction in the best manner. In this context, the aim of this study is to determine whether or not there is a relationship between secondary school students’ self-regulation and mathematics anxiety.

METHOD

Design

The research was planned in a causal design in order to examine the predictive power of secondary school students’ level of anxiety towards mathematics course on their self-regulation skills. Causal design is a research design that examines cause-and-effect relationships that emerge or exist among certain variables. Causal research design is used when it is considered that the relationship between research variables is a cause-and-effect relationship

Table 1. Distribution of demographic information of the sample group.

Options						Total
Gender		**Male**	**Female**			-
	n	142	141			283
	%	50.2	49.8			100
		5th grade	6th grade	7th grade	8th grade	-
Class level	*n*	82	54	72	69	283
	%	31.10	19.08	25.44	24.38	100

(Karadağ, 2009).Therefore, the concept of anxiety towards mathematics course was taken as the independent variable whereas the concept of self-regulation was taken as the dependent variable.

Sample

Sample of the research is composed of a total of 283 5th-6th-7th-8th grade students who were selected from a state secondary school located in Erzurum. Convenience sampling was used in the research. In convenience sampling (also called available sampling) a group of subjects is selected on basis of being accessible or expedient (McMillan and Schumacher, 2010, p.137). Information about the participants on genders in class levels of the students are given in Table 1.

There were 283 participants in this study; 142 were males and 141 of were males. Among them, 82 participants were 5th grade, 54 participants were 6th grade, 72 participants were 7th grade and 69 participants were 8th grade students.

Data collection tools

Mathematics anxiety scale

In the study, Mathematics Anxiety Scale towards elementary school students was used to determine students' mathematics anxiety levels. Mathematics Anxiety Scale, which was developed by Şentürk (2010) towards elementary school students and validity and reliability studies of which were also conducted by him, is composed of five sub-dimensions, namely as mathematics anxiety rooted from attitude towards mathematics (1 to 4 items), mathematics anxiety rooted from the inadequacy of self-confidence (5 to 9 items), mathematics anxiety rooted from field knowledge (10 to 13 items), learning anxiety (14 to 17 items) and exam anxiety (18 to 22 items).The scale is of 5-point Likert type. Students graded the items in the Mathematics Anxiety Scale towards elementary school students as1:I never get anxious, 2: I hardly get anxious, 3: I occasionally get anxious, 4: I frequently get anxious, 5: I always get anxious, according to in what degree students felt anxiety about the feeling, thought, and behaviors that items proposed. Then, the total score was calculated. Total score gathered was considered as each student's mathematics anxiety score at the end. The scale is composed of 22 items. Cronbach's Alpha value, which was calculated was .92.

Self-regulation skill scale

The scale, which was developed by Arslan (2008) and validity and reliability studies of which were also conducted by him, is composed of three sub-dimensions, namely as effort organization and time and study organization.The scale is of 5-point Likert type [completely disagree (1), disagree (2), partially agree (3), agree (4) and completely agree (5)]. The negative items in the scale are calculated by being graded inversely.They were calculated as completely agree (1), agree (2), partially agree (3), disagree (4), and completely agree (5). Cronbach's Alpha value was calculated for all sub-dimensions and the overall scale in this research-was.87.

Data analysis

The *Pearson Product-Moment Correlation Coefficient Analysis* was used in finding the relationships among the scores obtained in mathematics anxiety scale and self-regulation skill scale in analyzing the data obtained from the research.The *Multilinear Regression Analysis* was used in determining the degree to which the scores obtained from the mathematics anxiety scale predicted the scores obtained from the self-regulation skill scale. In the analyses, sub-dimensions of mathematics anxiety scale [(*i*) attitudes, (*ii*)self-confidence, (*iii*) field knowledge, (*iv*) learning (*v*) exam] were taken as the independent variable whereas self-regulation skill was taken as the dependent variable.

FINDINGS

The results of the correlation analysis, which was conducted to set forth the relationship between mathematics anxiety and self-regulation skill, are given in Table 2.

When Table 2 was examined, it was concluded that there was a negative significant relationship among attitude, cognitive organization [*r*=-.30], effort organization [*r*=-.13] and time and study organization [*r*=-.17] which are among the sub-dimensions of mathematics anxiety. A negative significant relationship was found among self-confidence, cognitive organization[*r*=-.36], effort organization [*r*=-.11], time and study organization [*r*=-.22] and self-regulation skilltotal score [*r*=-.31] which are among the sub-dimensions of mathematics anxiety. Similarly, a relationship was found among field knowledge,cognitive organization[*r*=-.30], effort organization [*r*=-.12], time and study organization [*r*=-.22]and self-regulation skilltotal score [*r*=-.28]. A relationship was found among learning anxiety,cognitive organization[*r*=-.10], effort organization [*r*=-.07],time and study organization [*r*=-.12]and self-regulation skilltotal score [*r*=-.05]. It was found that there was a negative significant relationship was discovered among exam anxiety, cognitive organization[*r*=-.26], effort organization [*r*=-.04], time and study organization [*r*=-.21]and self-regulation skilltotal score [*r*=-.21].A negative significant relationship was found between mathematics

Table 2. Correlation matrix between mathematics anxiety and self-regulation skill.

Variables	1	2	3	4	5	6	7	8	9	10
1-Attitude	-									
2-Self-Confidence	.64*	-								
3-Field Knowledge	.55*	.67*	-							
4-Learning	.38*	.46*	.37*	-						
5-Exam	.60*	.70*	.57*	.56*	-					
6-Cognitive organization	-.30*	-.36*	-.30*	-.10*	-.26*	-				
7-Effort Organization	-.13*	-.11*	-.12*	-.07*	-.04*	.35*	-			
8-Time and Study Organization	-.17*	-.22*	-.21*	-.12*	-.21*	.33*	.54*	-		
9-Self-Regulation Skill [Total]	-.27*	-.31*	-.28*	-.05*	-.21*	.82*	.80*	.66*	-	
10-Mathematics Anxiety [Total]	.76*	.88*	.76*	.71*	.87*	-.32*	-.08*	-.23*	-.27*	-

η=283, *p<.01.

Table 3. Multilinear regression matrix between mathematics anxiety and self-regulation.

Individual values	*B*	SH_B	β	*t*	*p*
Constant	84.231	2.412		34.924	.000
Attitude	-.529	.330	-.124	-1.603	.110
Self-Confidence	-.578	.245	-.219	-2.357	.019
Field Knowledge	-.461	.316	-.114	-1.459	.146
Learning	.439	.201	.149	2.188	.030
Exam	-.018	.233	-.007	-.077	.938

η=283, R=.36, R^2=.13, F=8.151, p<.01.

anxiety and self-regulation skill[r=-.27].

The results of the multi-linear regression analysis, which was conducted to determine the degree to which secondary school students' mathematics anxiety predicted their self-regulation skill in accordance with their perceptions, are given in Table 3. The compatibility of the scores on the variables to the regression model was found by determining that D-W (1.946), VIF (1<VIF<5) values and Q-Qplot exhibited a normal distribution.

The collective predictive power of all sub-dimensions of mathematics anxiety on self-regulation skill score was found statistically significant [$F_{(5-277)}$=8.151, p<.01]. Five predictive variables can collectively explain 13% of the change in self-regulation skill score[R=.36, R^2=.13]. Furthermore, when the independent variables were separately examined, it was found that the sub-dimensions of self-confidence [β=-.219] and learning anxiety [β=-.149]had the power to single-handedly explain self-regulation skill in order of importance.

DISCUSSION AND CONCLUSION

The study concluded that there was a negative significant relationship among attitude,cognitive organization, effort organization and time and study organization which are among the sub-dimensions of mathematics anxiety of secondary school students. Therefore, we can state that the secondary school students, who had high level of cognitive organization, effort organization and time and study organization, had low level of attitudes.

A negative significant relationship was discovered among self-confidence,cognitive organization, effort organization, time and study organization and self-regulation skill total score which are among the sub-dimensions of mathematics anxiety.Therefore, we can state that the secondary school students, who had high level of cognitive organization, effort organization, time and study organization and self-regulation skills, had low level of self-confidence. Similarly, a negative significant relationship was discovered among field knowledge, cognitive organization, effort organization, time and study organization and self-regulation skill total score. In view of these findings, we can state that the secondary school students, who had high level of cognitive organization, effort organization, time and study organization and self-regulation skills, had low level of field knowledge.

A negative significant relationship was discovered among learning anxiety, cognitive organization, effort organization, time and study organization and self-

regulation skill total score. In view of these findings, we can state that the secondary school students, who had high level of cognitive organization, effort organization, time and study organization and self-regulation skills, had low level of learning anxiety.

It was found that there was a negative significant relationship among exam anxiety, cognitive organization, effort organization, time and study organization and self-regulation skill total score. In view of these findings, we can state that the secondary school students, who had high level of cognitive organization, effort organization, time and study organization and self-regulation skills, had low level of exam anxiety.

A negative significant relationship was also found between mathematics anxiety and self-regulation skill. Therefore, it was observed that the secondary school students, who had high level of mathematics anxiety, had low level of self-regulation skills. In their study, Üredi and Üredi found that self-regulation positively and significantly predicted mathematics success whereas exam anxiety negatively and significantly predicted mathematics success. Similarly, in a study conducted by Chye et al. (1997) on university students, it was found that there was a high level of relationship among the use of self-regulation strategy, self-efficacy and academic success. In a study conducted by Pintrich and De Groot (1990) on elementary 7th grade students, they found that self-regulation, self-efficacy and exam anxiety were important variables in predicting the students' performance.

In a study conducted by Young and Vrongistinos (2002) on prospective teachers, they found that intrinsic objective orientation, value attached to duty, self-efficacy belief,interpretation and level of the use of metacognition strategy of the students with high level of success were higher than those of the students with low level of success.Similarly, in a study conducted by Andrew and Wialle (1998) on nursing students, they found that there were significant relationships among nursing-related academic self-efficacy, scientific self-efficacy, value attached to duty,self-efficacy for learning and performance, critical thinking, self-regulation of metacognition and academic performance.In a research conducted by Malpass,et al. (1999) on secondary school students, they found that there was a negative relationship between anxiety and mathematics success whereas there was a positive relationship between self-regulation and mathematics success.

The collective predictive power of all sub-dimensions of mathematics anxiety on self-regulation skill score was found statistically significant. Five predictive variables can collectively explain 13% of the change in self-regulation skill score. Furthermore, when the independent variables were separately examined, it was discovered that self-confidence and learning anxiety sub-dimensions had the power to single-handedly explain self-regulation skill order of importance.

It is considered that comparing the predictive power of self-regulation on success in different age groups; examining self-regulation in other courses such as science, social sciences and Turkish apart from mathematics course; and making comparisons according to subject areas are among the activities that are required in this field.

Conflict of Interests

The author has not declared any conflict of interest.

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