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Mathematics and Science Self-Efficacy Resources as the Predictor of Academic Success

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ABSTRACT

The basic aim of the study was to determine the power of mathematics and science self-efficacy resources as the predictors of academic success. The relational scanning model was used in the study, and the study was conducted with 492 students who were studying at sixth and seventh grades of a state school. The mathematics and science self-efficacy resources scales were used as the data collection tool. In addition, the school reports of the semester before the study was conducted were used to determine the academic success levels of the students. The Pearson moments multiplication correlation technique and multiple linear regression analysis were used in the analysis of the data. According to the results, there were significant relations between the mathematics and science self-efficacy resources and the academic success levels at high, medium and low levels. The personal experiences, indirect experiences and social persuasions, which have significant effects on academic success both for mathematics and for science, explained nearly 60% of the change in academic success. The physiological situations towards mathematics did not have any significant effects on academic success. According to the findings, some recommendations have also been made in the study.

Keywords:
Academic success, mathematics, science, self-efficacy resources

Introduction

With the overwhelming and fast increase in the demand for information, educational policy makers of many countries have started to catch for the qualities that are required by the modern age and to look for the answers for newly-emerging needs. No doubt, the basic justification for this situation is to raise the standards of education and improve the skill and knowledge levels of students. Especially raising individuals who are capable of forming mathematical meaningful deductions, who care for mathematics, who learn in a lifelong manner as science-literate individuals with the conscious of sustainable development is considered as extremely important in this process (Ministry of National Education [MNE], 2013). As a matter of fact, the need for scientific and mathematical skills may cover a wide area from many simple processes used in everyday life to upper-level academic studies. In this context, understanding the true nature of mathematics and science in the face of daily life situation is used as an important tool in making accurate decisions. In various studies conducted previously, it was emphasized that the science and technology education in the

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whole Europe, as well as the mathematics education, are giving alarm, and the interests of especially young people on science, technology and mathematics are decreasing at important levels; and in case efficient action plans are not established, the long-term innovative capacity of Europe will decrease at a significant level (Rocard et al., 2007). According to the 2015 report released on Trends in International Mathematics and Science Study (TIMSS), in which 39 countries participate at 8th grade level, by International Association for the Evaluation of Educational Achievement (IEA), the mathematics success levels of 21 countries including Italy, Turkey, Malta, Iran, Malaysia, and the science success levels of 20 countries were determined to be below the TIMSS scale midpoint [500 points] (TIMMS, 2016). Similarly, in the 2015 report, which was released by Program for International Students Assessment (PISA) in which 540.000 students at the age of 15 participate from 72 countries and economic areas, the science average of 40 countries and economic areas including Israel, Turkey, Greece, Qatar, Malta and Brazil and the mathematics average of 41 countries and economic areas were determined to be below the OECD average values [science average, 493; mathematics average, 490 points] (Organization for Economic Co-operation and Development [OECD], 2016). Similarly, the findings of many studies and the reports of many international research institutions indicate that science and mathematical knowledge and skill levels of students are not at the desired level (Eurydice, 2011; Howie, 2001; Center for Development in Education [CDE], 2004; National Center for Education Statistics [NCES], 2013; National Assessment of Educational Progress [NAEP], 2002, 2015; Sabah & Hammouri, 2010; OECD, 2016; TIMSS, 2016).

When the findings of many studies and the results of the reports of many international institutions are considered, important clues may be found to better know and understand the affective and cognitive properties whose effects on science and mathematics success of students are already known (Ağaç & Masal, 2015; Akkuş-İspir, Ay & Saygı, 2011; Singh, Granville & Dika, 2002; Tai, Leou & Hung, 2015; Yaman & Dede, 2007; Yurt, 2014). When the studies in the literature conducted on the cognitive-affective and social factors that affect the academic activities and learning of students are examined, it may be observed that the self-efficacy belief has come to the forefront (Bandura, 1997; Liang, 2010; Pajares, Britner & Valiante, 2000; Schunk, 2011; Zimmerman & Bandura, 1994). The most important justification of this situation is the fact that the beliefs of individuals in themselves affect their future achievements, academic success, and their career choices in science, technology, engineering and mathematics (STEM) (Hackett & Lent, 1992; Louis & Mistele, 2012; Pajares & Miller, 1997; Pajares & Valiante, 1999; Zeldin, Britner & Pajares, 2008). Especially the fact that affective properties have positive effects on science and mathematics success levels of students has been the subject matter of many previous studies, and the issue was explained based on hypothetical foundations (Bandura, 1997; Bloom, 1998; Chen & Zimmerman, 2007; OECD, 2006; Usher & Pajares, 2009). The findings of many studies conducted on the effect of affective properties on science and mathematics success support the hypothetical explanations in this field (Abalı-Öztürk & Şahin, 2015; Britner & Pajares, 2006; Chen & Usher, 2013; Pajares & Kranzler, 1995; Stevens, Olivarez, Lan & Tallent-Runnels, 2004; Usher & Pajares, 2006; Yurt, 2014; Zimmerman & Bandura, 1994).

No doubt, one of the most important affective properties that affect the science and mathematics success of students is the self-efficacy belief. The self-efficacy belief consists of the judgments of individuals they have about actions including cognitive, affective, social, behavioral skills (Bandura, 1997; Schunk, 2011). In other words, self-efficacy belief is the belief of an individual in his/her own capacity in overcoming different situations and in performing an activity (Pajares, 1996). According to Bandura (1997), self-efficacy belief consists of four basic sources that are connected with each other, and these are *Personal Experiences, Indirect Experiences, Social Persuasions,* and *Physiological Situations.* Personal experiences are the most effective and most powerful of the self-efficacy belief resources (Bandura, 1997; Britner & Pajares, 2006). Individuals can overcome obstacles when they are persuaded to succeed, and may develop their performances (Bandura, 1997; Pajares, 1996; Zimmerman, 1995). By doing so, the belief in doing similar tasks is affected (Bandura, 1997). Another source that forms the self-efficacy is the indirect experiences. With the help of this source, an individual may make some judgments about what other people can do by observing them, and may acquire a source of knowledge that is not limited with his/her personal experiences. The performance results of the other individuals observed may have positive or negative effects on their own self-efficacy beliefs (Schunk, 2011). Especially when an individual observes successful performances of other individuals who have similar sufficiency to them, this may cause that a strong self-efficacy perception develops, and observing unsuccessful performances may cause that weak self-efficacy perceptions develop (Bandura, 1997). Social persuasions are positive or negative feedback coming from immediate surroundings of an individual (family, friends, teachers

etc.) (Pajares & Urdan, 2006). Social persuasions may cause that the self-efficacy beliefs of individuals increase and make it easy for them to start more difficult activities in a realistic manner (Bandura, 1997). Another self-efficacy source is the physiological situations that express the moods of individuals, i.e. the perceptual systems that are developed towards the efficacy systems of their own. For example, while positive emotional situations increase the perceived self-efficacy levels, negative and pessimistic emotional situations weaken the development of the psychological and affective self-efficacy perceptions (Bandura, 1997). As a result, the common aspect of the four basic sources and the results of previous experiences on a certain job affect the belief in fulfilling similar jobs (Bandura, 1997).

The strongest aspect of self-efficacy is the determination of high targets by individuals, their being resolute to reach their targets, and not giving up easily in the face of difficulties (Bandura, 1997; Pajares, 1996; Schunk, 2011). Self-efficacy is the strongest motivational predictor in achieving adequate success and coping with difficulties (Bandura, 1977; Bandura & Schunk, 1981; Heslin & Klehe, 2006). Self-efficacy is the strongest determinant of the efforts of humans and their achievements at work in their future lives as well as the stability and strategic activities. Especially individuals with strong self-efficacy perception determine more organizational targets to deal with and administrative rules and thus increase or harness their performance levels (Heslin & Klehe, 2006; Wood & Bandura, 1989). As a matter of fact, Zimmerman, Bandura and Martinez-Pons (1992) conducted a road analysis study with 102 high school students to determine the role of self-efficacy beliefs and academic targets on academic acquisitions, and they reported that efficacy perception indirectly motivated academic acquisitions and personal target situations for success. On the other hand, self-efficacy helps the individual to know himself/herself better and thus, to develop learning level, behaviors and performances (Bandura, 1997). The findings of many studies conducted for the same purpose support this viewpoint (Arslan, 2012; Britner & Pajares, 2006; Caprara, et al., 2011; Louis & Mistele, 2012; Pajares & Miller, 1994; Valentine, DuBois & Cooper, 2004). According to Bandura (1977), self-efficacy sources consisting of the efficacy expectations of the individual are the most obvious predictors of performance. Arslan (2012) conducted a study with 1049 students; the participating students stated that verbal persuasion and performance success (personal experiences) developed self-efficacy belief. Findings of the study indicate that the factor that showed the strongest correlation with self-efficacy beliefs of students and the factor that predicted self-efficacy beliefs is the performance success factor. Similarly, although Lopez and Lent (1992) conducted a study on 50 high school students and reported that personal experiences were more influential on performance than any other sources; they also reported that the results deduced from the experiences of others and the situations in which they individuals were experiencing were also influential in the formation of self-efficacy. In this context, we may claim that if the self-efficacy belief sources of students and how these sources affect self-efficacy beliefs are known, the self-efficacy beliefs in learning and performance may also be developed (Arslan, 2012). In the light of these findings, although there are many fields in which self-efficacy is influential, science and mathematics are the most prominent ones among them (Britner & Pajares, 2006; Hackett & Betz, 1989; Nur-Uzar, 2010; Usher & Pajares, 2009).

When the relevant literature is reviewed in the context of mathematics self-efficacy sources, the findings of many studies show that the most influential one among the mathematics self-efficacy sources is the personal experience (Collins & Usher, 2012; Kaya & Bozdağ, 2016; Lent, Lopez, Brown & Gore, 1996; Lopez & Lent, 1992; Matsui, Matsui & Ohnishi, 1990; Usher & Pajares, 2009; Yurt, 2014). On the other hand, it is observed in many of the studies conducted previously that relations at medium and low level are reported among the indirect experiences and social persuasions (Arslan, 2012; Kaya & Bozdağ, 2016; Lent, Lopez & Bieschke, 1991; Lent et al., 1996; Matsui et al., 1990; Özyürek, 2005; Usher & Pajares, 2006). No matter physiological situations indicate low and medium level relations with other sources in many mathematical studies (Joët, Usher & Bressoux, 2011; Kaya & Bozdağ, 2016), significant relations were not reported in some studies (Usher & Pajares, 2006; Hampton & Mason, 2003). When the studies conducted so far are evaluated in general terms, although personal experiences are in strong relations with both academic and mathematical success, indirect experiences and physiological situations vary in their relations with academic and mathematical success. For example, Nur-Uzar (2010) conducted a study with 491 students from 6th, 7th and 8th grades and reported that there is a significant and positive relation between mathematics self-efficacy and each source. According to the study, which reported that the highest relation was the personal experiences source, the mathematics self-efficacy of the students who had high grades at school reports was higher than the students whose grades were low. A similar study was conducted by Collins and Usher (2012) at 6th, 7th and 8th grade level with 1820

students. At the end of the study, it was reported that the self-rule support perceived by students at mathematics courses had a positive and significant relation with the four sources of self-efficacy (*personal experiences, indirect experiences, social persuasions, physiological situations*), and it explained most part of the variance in self-efficacy in students at mathematics courses. According to regression analysis, it was found that the highest correlation was between personal experiences (0.61) with mathematics self-efficacy; and there were significant relations between social persuasions (0.54), physiological situation (0.48) and indirect experiences (0.42) sources with mathematics self-efficacy. Usher and Pajares (2009) conducted a study with 803 students (408 female, 395 male) and reported that there was a correlation between personal experiences and math grade self-efficacy at a rate of 0.77, math skill self-efficacy at a rate of 0.62, math courses self-efficacy at a rate of 0.48; between indirect experiences and math grade self-efficacy at a rate of 0.44, math skill self-efficacy at a rate of 0.43, math courses self-efficacy at a rate of 0.32; between verbal persuasion and math grade self-efficacy at a rate of 0.61, math skill self-efficacy at a rate of 0.52, math courses self-efficacy at a rate of 0.44; between physiological situations and math grade self-efficacy at a rate of -0.55, math skill self-efficacy at a rate of -0.44, math courses self-efficacy at a rate of -0.35. Yurt and Sünbül (2014) conducted a study with 470 students at 8th grade, and reported that mathematics self-efficacy sources, which had direct and indirect effects on mathematical success, spatial ability, problem solving and reasoning skills, explained nearly 75% of the variance in the mathematical success. Kaya and Bozdağ (2016) conducted a study with 698 students from 6th, 7th and 8th grades found that aside from the indirect experiences, the other mathematics self-efficacy sources (*personal experiences, physiological situations, social persuasions*) were the determinants and predictors of academic success. In addition, it was also reported that there were significant relations between academic success and personal experience (0.55); indirect experiences (0.46); social persuasions (0.49); physiological situations (-0.30). Pajares and Miller (1994) conducted another study with 350 students (229 females, 121 males) by using path analysis and determined that there were significant relations between mathematics performance and mathematics self-efficacy (0.54). In addition to these, Yıldırım (2011) conducted a study by using the data obtained from PISA 2003 reports on Turkey, Japan and Finland, and showed that self-efficacy belief had a positive effect on mathematical success in these three countries.

When the literature was reviewed in terms of physical sciences, it attracts attention that there are several studies conducted on science self-efficacy and science success (Andrew, 1998; Lau & Roeser, 2002), self-efficacy sources (Britner & Pajares, 2006), career choice (Lent et al., 1991), participation to science activities (Zeldin & Pajares, 2000), motivation and academic success (Britner & Pajares, 2001; Lau & Roeser, 2002; Pajares, Britner & Valiente, 2000) and the attitude (Çelikkaleli & Akbaş, 2007). For example, Chen and Usher (2013) conducted a study with 1225 students and aimed to determine the science self-efficacy sources of secondary school students and high school students and the relation between science successes. Although the findings of the study indicate that personal experiences are the strongest self-efficacy source, it is also emphasized that all of the self-efficacy sources are needed for more science self-efficacy and success. Britner and Pajares (2006) conducted a study with 319 secondary school students and according to the correlation results of this study, there are significant relations between self-efficacy and each self-efficacy source, personal experiences (0.55), social persuasions (0.42), physiological situations (0.40) and indirect experiences (0.34). In addition to these, according to the regression analysis, out of the four sources, only the personal experiences (ß=.494) predicted the science self-efficacy in a clear manner. Aside from these, Çelikkaleli and Akbaş (2007) conducted a study with 491 students (253 females, 238 male) and reported that self-efficacy beliefs of the students explained 39% of the attitude variance towards science courses. Ilgaz (2011) conducted a study with 1286 students from 6th, 7th and 8th grades, and reported that the science self-efficacy levels of the students were high levels both in general terms and in sub-dimensions of the scale. Kıran (2010) conducted a study with 1932 students and reported that personal experiences, social persuasions, physiological situations predicted the self-efficacy levels of students for science courses at a significant level. According to the study data, the self-efficacy beliefs of primary school students have positive relations with competence approach target tendency, achievement-approach target tendency, competence-avoidance target tendency, metacognition and effort regulation. Yüksel and Geban (2016) conducted a study with 207 high school students and reported similar results. In this context, there is a significant and high relation between academic self-efficacy and student self-efficacy (0.83), and significant and positive relation between chemistry (0.33), mathematics (0.35), physics (0.36) and biology success levels (0.30). On the other hand, significant and positive relations were reported between self-efficacy of students and chemistry (0.28), mathematics (0.30), physics (0.32) and biology success (0.31). In addition,

Hwang, Choi, Lee, Culver and Hutchison (2016) conducted a longitudinal study for five years to determine the causal relation between the past academic performances of Korean students and self-efficacy beliefs and academic success levels. According to the findings of the study, which included 1177 students from 8th grades until 12th grades, the academic success of the first semester of 8th grade predicted the self-efficacy beliefs of 8th grade second semester; the self-efficacy beliefs of the second semester of 8th grade predicted the academic success of the first semester of 9th grade, and this situation continued until 12th grade. In addition, a mutual relation between self-efficacy and academic success was also determined.

The effect of the individual factors in mathematics and science are important in success, as it is the case in all fields (Britner & Pajares, 2006; Usher, 2009). When individual factors are considered, it is known that each student does not succeed at the same level (MNE, 2013; NAEP, 2015; NCTM, 2000). In this context, controlling whether or not students show success at their skill levels, investigating the factors that affect success, making recommendations to students and teachers about experience are extremely important. In this context, it was considered as a topic that deserved investigation to examine the self-efficacy beliefs of the students when the multi-dimensional self-efficacy and sensitive measurement of performance changes were evaluated (Zimmerman, 1995).

Purpose of the Study

In this study, the existing relations between the mathematics and science self-efficacy sources and the issue of which source is/are more important for academic successes of students are investigated. By doing so, it is expected that contributions are made to better understand the different and controversial findings reported in the literature. In the light of the findings so far, the basic aim of the study was to determine the prediction power of sciences and mathematics self-efficacy sources for academic success. For this purpose, answers for the following questions were sought in the study:

1. What kind of a relation is there between mathematics and science self-efficacy sources?
2. What kind of a relation is there between mathematics and science self-efficacy sources and academic success levels?
3. What is the prediction power of mathematics and science self-efficacy sources for academic success?
4. What is the relative importance order of mathematics and science self-efficacy sources on academic success?

Method

The Study Model

Since the relation between sciences and mathematics self-efficacy sources and academic success was investigated in the present study, a descriptive approach in relational review model was adopted. Relational review models are known as the models that aim to determine the existence or level of any changes between two or more variables (Karasar, 2013).

The Study Group

The study was conducted with a total of 492 students from sixth grade (267, 54.3%) and seventh grade (225, 45.7%), who were studying at a state secondary school in Izmir. The mean age of the students was 12.47, and 51.8% were male (n=255) and 48.2% were female (n=237).

Variables

Science Self-Efficacy Sources: In order to determine the science self-efficacy sources of students, the Sources of Science Self-Efficacy Scale (SSSE), which was used by Lent, Lopez and Bieschke (1991) to evaluate the mathematics self-efficacy beliefs sources of the college students, and adopted for science by Kıran (2010), was used in the study. According to the scale, which is in the form of 5-point Likert scale, each statement has maximum 5 points and minimum 1 point. In the original scale, there are 10 items on personal experiences, 10 items on indirect experiences, 10 items on social persuasion and 10 items on physiological situations, which makes a total of 40 items. The internal consistency coefficient of the scale, which was conducted on 138 (53 males, 85 females) students, was found as .86 for personal experiences, .56 for indirect experiences, .74 for social persuasions and .90 for physiological situations. The adaptation of the scale into Turkish was conducted by Kıran (2010), and there are 7 items on personal experiences, 10 items on indirect experiences, 8 items on social persuasions and 10 items on physiological situations, which makes a total of 35 items. The lowest possible point that may be taken from the scale for personal experience source is 7, and the highest point is 35;

the lowest point for indirect experiences and physiological situations are 10, and the highest is 50; and the lowest point for social persuasion is 8, and the highest is 40 points. The scale was applied to the students in one session by the author of the study, and the application time lasted nearly half an hour.

Mathematics Self-Efficacy Sources: In order to determine the mathematics self-efficacy sources of the students, the Mathematics Self-Efficacy Sources Scale was used in the study. The scale was developed by Usher and Pajares (2009) as based on the social cognitive hypothesis of Bandura (1997) and was adapted into Turkish by Yurt and Sünbül (2014) the scale consists of 24 items. There are 6 items in each source (personal experiences, indirect experiences, verbal persuasions and physiological situations). The points given for each item varies between 1-100 in the scale. 1 and any other points close to 1 show that the participation level is low, and 100 and any other points close to 100 show that the participation level is high. Only the 3rd item is negative in the scale. The lowest point that may be received for each source in the scale is 6, and the highest possible point is 600. The Exploratory and Confirmatory Factor Analysis methods were used to examine the structural validity of the scale. The Cronbach alpha values of the sources in the scale vary between 0.80 and 0.94, and the corrected item total point correlations vary between 0.77 and -0.25. The scale was applied to the students in one session and the application time lasted nearly half an hour.

Academic Success: The averages of the grades (for all classes) of the students in the school report for the previous semester were used. In this context, three terms for sixth grade and five terms were considered in the study. The mean academic grade of the students is 64.13, standard deviation is 17.70, mode is 45, median is 64 and the variance is 313.53.

The Analysis of the Data

In the present study, the relation between mathematics and science self-efficacy sources and academic success were calculated with Pearson moments multiplication correlation technique. In order to examine the effect of mathematics and science self-efficacy sources on academic success, multiple linear regression analysis was made. However, before the multi-variate analyses, it is necessary that some assumptions like *(i)* the effects of end-value, *(ii)* the agreement between numeration, *(iii)* multiple connection problems are covered first (Çokluk, Şekercioğlu & Büyüköztürk, 2014). Whether normal distribution assumption is covered or not may be examined by calculating the mahalanobis distance values (Büyüköztürk, 2011). The mahalanobis distance values of the dataset, which consisted of 493 participants, were examined by comparing them with the chi-square value, and one value that made linearity and normality assumption difficult was excluded from the dataset. In addition, the linearity assumption of the dataset was tested by examining the mass dispersion matrix graphics of the dependent and independent variables. Another assumption of regression analysis is the absence of multiple connection problems between the predictive variables. Multiple connection problem is the existence of strong relations between independent variables (r>0.90 and above) (Çokluk et al., 2014). In the literature, generally, it is recommended that variance increase factors (VIF) are examined, and the tolerance values (TV), case index (CI) and the correlations between the variables are calculated in order to test the multiple relation problems (Büyüköztürk, 2011; Çokluk et al., 2014). In this context, if the VIF values are equal of higher than 10 (VIF≥10), if the TV values are equal to or lower than 0.10 (TV≤0.10) and if the CI value is equal to or higher than 30 (CI≥30), there is a multiple relation problem (Çokluk et al., 2014). The highest correlation between the independent variables in this study is 0.74. The VIF value of the variables varies between 1.05-2.60; CI values vary between 1.00-29.62 and TV values vary between 0.39-0.95. As a conclusion, when the VIF, CI and TV values are considered, it may be suggested that there is no multiple connection problem between the independent variables. The pre-analysis showed that the dataset met the necessary assumptions for multiple regressions analysis. In this context, the regression analysis was made with 492 data (SPSS 22.0 package).

Findings

In Table 1, the correlation values are given for the relations between mathematics and science self-efficacy sources also academic success. According to the findings, significant relations at high, medium and low levels between the mathematics, science self-efficacy source and academic success were found. The relation between academic success and personal experiences of mathematics self-efficacy sources has the highest correlation value (r=0.730, p<0.001). The relations between social persuasions (r=0.667, p<0.001), indirect experiences (r=0.611, p<0.001) in academic success and mathematics; and the relations between social

persuasions (r=0.402, p<0.001), physiological situations (r=-0.394, p<0.001), personal experiences (r=0.372, p<0.001) and indirect experiences (r=0.171, p<0.001) in science courses follow them respectively. In addition to these, the relations between the other sources except for physiological situations of mathematics self-efficacy sources were found to be significant (p<0.01; p<0.05; p<0.001) and values between -0.04 and 0.73.

Table 1. The correlation values between mathematics, science self-efficacy sources and academic success

Variables		Mean	Sd.	D1	D2	D3	D4	D5	D6	D7	D8	D9
Mathematic	D1	64.13	17.70	1								
	D2	65.09	21.61	0.73***	1							
	D3	68.01	23.41	0.61***	0.63***	1						
	D4	56.17	26.35	0.67***	0.74***	0.65***	1					
	D5	40.33	24.72	-0.06	-0.10*	-0.06	-0.04	1				
Science	D6	2.72	.80	0.37***	0.36***	0.26***	0.35***	-0.15***	1			
	D7	2.82	.73	0.17***	0.19***	0.16***	0.23***	-0.12**	0.39***	1		
	D8	3.01	.82	0.40***	0.41***	0.33***	0.38***	-0.19***	0.55***	0.53***	1	
	D9	2.70	.97	-0.39***	-0.41***	-0.34***	-0.41***	0.17***	-0.63***	-0.41***	-0.56***	1

*p<0.05, **p<0.01, ***p<0.001, N=492; D1: Academic achievement; D2 and D6: Mastery experiences; D3 and D7: Indirect experiences; D4 and D8: Social persuasions; D5 and D9: Physiological states

As a result of the multiple regression analysis in which self-efficacy sources were predicted, which is considered to be influential on academic success of the students, it was observed that the variables except for the physiological situations in mathematics had significant relations with academic success. It is observed that the personal experiences, indirect experiences and social persuasions explain 60% of the academic success ($F_{6\text{-}485}$=123.64, p<0.05, p<0.001). On the other hand, personal experiences and social persuasions source in science and mathematics courses explain 58% of the academic success ($F_{4\text{-}487}$=171.80, p<0.05, p<0.001). Personal experiences, which has the strongest relation in self-efficacy sources, explain 54% of academic success ($F_{2\text{-}489}$=295.72, p<0.001). According to the standardized regression coefficients, the relative importance order of predictive variables on academic success; personal experiences in mathematics courses (β=0.412), social persuasions (β=0.211), indirect experiences (β=0.177). In science courses, it was defined as personal experiences (β=0.085), social persuasions (β=0.079) and indirect experiences (β=-0.060). The "*B*" coefficients in the regression equation also give us the change formed by each predictor with academic success (when the other predictors are kept stable). For example, when the other predictors are kept stable, a standard deviation increase in personal experiences in model 3 causes an increase of 0.338 units in academic success in mathematics, a 1.863 unit increase in science. Similarly, when the other predictors are kept stable, a standard deviation increase in social persuasions will cause an increase at a rate of 0.142 in mathematics; and an increase at a rate of 1.695 in science. A standard deviation increase in indirect experiences will cause 0.134 increases for mathematics; a standard deviation decrease will cause an increase in academic success at a rate of 1.453 for science.

Table 2. The results of multiple regression analysis on predicting academic success by mathematics and science self-efficacy sources

Model	Variables		R	R^2	Adjusted (R^2)	*B*	Std. β	t	F
1	Mastery experiences	Mathematics	0.740	0.547	0.546	0.561	0.68	21.01**	
		Science				2.783	0.12	3.90**	295.72**
2	Mastery experiences	Mathematics				0.388	0.47	10.61**	
		Science				1.587	0.07	2.04**	
	Social persuasions	Mathematics	0.765	0.585	0.582	0.186	0.27	6.29**	171.80**
		Science				1.335	0.06	1.70*	
3	Mastery experiences	Mathematics				0.338	0.41	9.09**	
		Science				1.863	0.08	2.42*	
	Indirect experiences	Mathematics	0.778	0.605	0.600	0.134	0.17	4.51**	123.64**
		Science				-1.453	-0.06	-1.76	
	Social persuasions	Mathematics				0.142	0.21	4.59**	
		Science				1.695	0.07	2.01*	

*p<0.05, **p<0.001, N=492

Result and Discussion

In the present study, the relation between mathematics and science self-efficacy sources and academic success was investigated. When the results of the study were examined it was observed that there were significant and high-level relations in personal experiences, indirect experiences and social persuasion dimensions for mathematics; and low-level relations in physiological situations dimensions. Relations close to medium level were found in personal, social persuasions and physiological situations in science, and low-level significant relations were determined in indirect experiences. For mathematics, the strongest source was personal experiences; however, the social persuasions source in science showed high-level relations with academic success when compared with the other sources. The findings show similarities with some results reported in the literature. When the findings are evaluated in terms of mathematical self-efficacy sources, they confirm the personal experiences assumption, which is considered as an important and strongest source by Bandura (1997). In addition, these findings are supported by the results of different studies (Collins & Usher, 2012; Kaya & Bozdağ, 2016; Lent et al., 1996; Lopez & Lent, 1992; Matsui et al., 1990; Usher & Pajares, 2009; Yurt, 2014). On the other hand, social persuasions and indirect experiences sources showed significant relations close to high level. Similar results were reported as significant relations at medium and high-level in the literature (Arslan, 2012; Kaya & Bozdağ, 2016; Lent et al., 1991; Lent et al., 1996; Matsui et al., 1990; Usher & Pajares, 2006). Physiological situations showed extremely low-level relations with academic success. As a matter of fact, although physiological situations showed low and medium-level relations with the other sources in many studies (Joët et al., 2011; Kaya & Bozdağ, 2016), no significant relations were detected in some studies (Usher & Pajares, 2006; Hampton & Mason, 2003).

In addition to these, personal experiences, indirect experiences and social persuasions, which constitute the mathematics self-efficacy sources, are the significant predictors of academic success. Relations that are close to high-level were found between personal experiences and indirect experiences; personal experiences and social persuasions; indirect experiences and social persuasions. Similarly, Nur-Uzar (2010) conducted a study and reported that personal experiences are the strongest source and there are positive significant relations between each source and other sources. Arslan (2012) conducted a study and pointed out that personal experience and social persuasions sources were the strongest sources on the performances of students, and reported that the weakest relation was physiological situations. In addition, Usher and Pajares (2009) conducted a study and reported that the correlation values between personal experiences and math grade self-efficacy, indirect experiences and math grade self-efficacy, and verbal persuasion and math grade self-efficacy were parallel. Kaya and Bozdağ (2016) conducted another study and reported that the self-efficacy sources (expect the indirect experiences) were the predictors of academic success, which shows parallelism with the results of the present study. However, different from these studies, it was determined that indirect experiences were also the predictors of academic success, and physiological situations were found to have no significant effects. On the other hand, there are studies in the literature reporting that the relations between personal experiences and indirect experiences (Matsui et al., 1990), indirect experiences and physiological situations (Usher & Pajares, 2006), social persuasions and physiological situations (Usher & Pajares, 2006) are not significant. Aside from these, it is also possible to see some studies in literature reporting different results between self-efficacy sources and performance results. For example, Hampton (1998) conducted a study and reported that verbal persuasion had the highest average; however, he also reported that the lowest average belonged to indirect experiences points.

Another finding of the study is the whole of the sciences self-efficacy sources having significant relations with academic success. However, these relations were close to medium level in personal experiences, social persuasions and physiological situations dimensions, and were low in indirect experiences dimension. A relation between medium levels was found between personal experiences and indirect experiences, which are among the science self-efficacy sources, a relation over were found between social persuasions at medium level, and a significantly high-level negative relation was found between the physiological situations. The social persuasions source, which is from the science self-efficacy sources, had significant relation with academic success when compared with the other sources. Although this situation was reported as being the strongest self-efficacy source of personal experiences by Chen and Usher (2013), the idea claiming that the whole of the self-efficacy sources are needed for more science self-efficacy and success show parallelism with this claim. Similarly, Kıran (2010) conducted a study and reported that personal experiences, social

persuasions, physiological situations predicted self-efficacy beliefs of students in science courses in a significant manner. In addition, it was reported that although there were significant relations for indirect experiences source, this relation was at a low level. It is also possible to see results in the literature that contradict with the results of the present study. For example, Ilgaz (2011) conducted a study with 1286 students and the findings of this study showed that students had high self-efficacy levels both in general and in the sub-dimensions of the scale. Britner and Pajares (2006) conducted a study with 319 secondary school students and according to the correlation results of the study, significant relations were detected between self-efficacy and personal experiences, social persuasions, physiological situations and indirect experiences. In addition, according to the regression analysis, among the four sources only the personal experiences source predicted science self-efficacy. Similarly, Yüksel and Geban (2016) conducted a study and detected a high relation between academic self-efficacy and student self-efficacy, and significant and positive relations between chemistry, mathematics, physics and biology success. On the other hand, a positive and significant relation was reported between student self-efficacy and chemistry, mathematics, physics and biology success.

Another finding of the study is the personal experiences, indirect experiences and social persuasions sources are significant predictors of academic success both for mathematics and science courses. The three sources together explained 60% of the academic success. Although physiological situations self-efficacy source is not significant predictor of academic success for mathematics courses, it is a significant predictor of academic success for science class. This result overlaps with the viewpoint claiming that there is a mutual relation between self-efficacy and academic success mentioned by Hwang et al. (2016) as a result of the longitudinal study. The strongest proof for this is the fact that seldom failures and successes coming right after many successes or failures are not influential; the successes that need to be increased are important tools for the failures that need to be decreased (Schunk & Pajares, 2009). Especially personal experiences source is an extremely important influence area for mathematics courses and has revealed the importance of acquiring successful experiences in mathematics. In other words, we may claim that students with high mathematics self-efficacy beliefs have more successful experiences. This efficient and strong source alone explains 54% of the academic success. This rate provides us clues in understanding the importance of the activities of students consisting of personal experiences like participation of students in courses, task and responsibility concepts, mathematics and sciences performances. Similarly, social persuasions and personal experiences explained 58% of the academic success. In this context, positive feedbacks coming from the surrounding of students (family, friends, teachers, etc.) and admiration and encouraging discourses constitute important triggers of social persuasions (Britner & Pajares, 2006; Usher & Pajares, 2009). In addition to these, physiological situations were a significant effect for science class; however, this situation did not create a similar effect for mathematics class. When the negative effect for science courses is considered, it is possible to claim that a negative physiological situation decreased the beliefs of students in themselves and in their skills, and affected their performances in a negative manner. In this study, psychological and affective self-efficacy perceptions of the students do not pose a significant predictor for mathematics courses, and this contradicts with the hypothetical explanations (Bandura, 1997; Schunk, 2011). Although this situation has many reasons, we may claim that the most important justification stems from the age groups of the participating students. For example, these students, who experience pessimistic emotional situations instead of positive emotional situations, may be affected more. Especially the effect of the mixed emotions brought by teenage period may trigger this situation. In this study, the socio-economic situation of the students and the limitations in learning experiences provided by the school for students may have limited the formation of positive physiological situations by students at a certain level. In addition, the inadequate mathematical strategy uses of the students and few mathematical experiences may have caused that they formed a negative attitude. In order to increase the self-efficacy beliefs of students in science and mathematics courses and to make students acquire efficient personal experiences, awareness must be aroused on relevant courses, and learning media must be formed for the purpose of developing curiosity and success perception. Students must be provided with opportunities that make them acquire efficient, reliable and successful experiences in science and mathematics courses. For all these purposes, class learning medium must care for individual developments, and the experiences of each student must be supported. As the first order of business, the opportunities to enable students to develop self-confidence and express their opinions without hesitation for the purpose of improve self-efficacy beliefs. One of the important sources that affect academic success levels of students is the social persuasions source for mathematics and science courses. Social persuasions consist of encouraging and positive statements received

from immediate environment by students. Meanwhile, social persuasions may also include negative feedback. This situation brings important responsibilities for class teachers and families. The quality of the messages that will be given by them may prevent them from acquiring positive belief as well as develop their beliefs in themselves. Close environment may ensure that the belief of students increases, and may help that they know themselves better (Bandura, 1997; Usher & Pajares, 2006). In this context, the tasks that is not suitable for the development of student and meaningless feedbacks may affect self-efficacy beliefs in a negative manner (Bandura, 1997). As a last item, indirect experiences are another predictor for academic success in mathematics and science courses, and are a physiological situations source for science class. While the indirect experiences pose a high-level influence area for mathematics courses, it has a low level but positive and significant effect on science courses. Indirect experiences consist of internalization processes based on observation. The performance results of the individuals who are observed by students may have positive or negative effects on their own self-efficacy beliefs (Schunk, 2011). The experiences of students obtained by observing their families and friends may have important effects on their indirect experiences. In this context, the equipment and efficient communicative skills of the teachers who are in the position of being the model for students may cause that a strong self-efficacy perception occurs in the students. As a matter of fact, in situations where students have limited experience to reveal the necessary performance for a new task or when there are no evaluations on their capacity for the relevant task, it is known that indirect experiences are more influential on performance (Bandura, 1997). Although physiological situations have significant relations for science courses, they do not have significant relations for mathematics courses, and they have formed an extremely low-level influence area. As it is already well-known, physiological situations indicate positive or negative situations like anxiety, stress, excitement, fear, fatigue, and worry (Usher & Pajares, 2009). In this context, students cannot fulfill the tasks and responsibilities expected from them when they are under excessive stress and pressure. This situation may affect the self-efficacy beliefs of students in a negative manner. However, physiological situations may cause different results for self-efficacy beliefs. For example, very high-level and excessive anxiety may trigger a negative self-efficacy belief; on the other hand, a medium-level anxiety may have positive effects. For this reason, forming learning media that will enable students to control their positive moods, providing an efficient communication mechanism, showing them a model profiles, and having timely and positive feedbacks are necessary. In this way, students will have positive moods and experience less anxiety, worry and stress. Students who can control their feelings and who have healthy moods will also have higher self-efficacy beliefs (Bandura, 1997).

As a conclusion, it is observed that there is a relation that is close to the one observed in this study between self-efficacy beliefs of the students and performance/and academic success levels, which is reported in relevant studies (Britner & Pajares, 2006; Hampton, 1998; Hampton & Mason, 2003; Lopez & Lent, 1992; Usher & Pajares, 2006; Yurt, 2014). Since the individuals who have high self-efficacy levels struggle more for a specific activity, their academic success levels may be higher. The findings obtained in the study show that self-efficacy sources especially mathematics self-efficacy sources have important effects on performances of students. It is important to form a strong connection between the knowledge to be taught and the skills to be acquired by students according to the performance, which is the strongest factor especially for mathematics class. For this reason, making an individual taste success has critical importance. Preparing learning environments in a style that will support the interests and skills of students me contribute at an important level in this context.

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