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The Relationship between Elementary Students' Achievement Emotions and Sources of Mathematics Self-efficacy

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Abstract

The current study examined the structure of achievement emotions (enjoyment, anxiety, boredom) and sources of self-efficacy (mastery experience, vicarious experience, social persuasions, and physiological state) of the elementary students by asking whether the two systems were related. Results revealed that the students enjoyed doing mathematics and felt less anxious and bored in different academic settings. Elementary students' sources of self-efficacy regarding mastery experience, vicarious experience and social persuasions were found to be sufficient. They held a low level of sources of self-efficacy regarding physiological state. Findings revealed that gender is not a distinguishing factor when explaining students' achievement emotions and sources of self-efficacy. A significant difference was found between students' achievement emotions and sources of self-efficacy regarding mathematics achievement. Results of the study revealed that achievement emotions and sources of mathematics self-efficacy were closely intertwined.

Introduction

The two constructs, emotions and mathematics self-efficacy have been used to explain the students' learning behaviors in relation to effective teaching. Research studies implied that emotions and sources of self-efficacy have impact on students' learning, achievement and performance (i.e., Ma, 1999; Pekrun, 2006; Usher, 2009). Although the bulk of the research has targeted the attributional antecedents of emotions (i.e., anxiety and self-efficacy) of older students and adults predominantly (e.g., Bekdemir, 2010; Ma & Kishor, 1997; Pekrun, 2006), studies on achievement emotions and mathematics self-efficacy experienced by elementary students are still emerging (Lichtenfeld, Pekrun, Stupnisky, Reiss & Murayama, 2012; Stipek & Gralinski, 1991). Considering the number of studies conducted with young students to examine their achievement emotions and sources of self-efficacy individually (e.g., Lichtenfeld et al., 2012; Klassen, 2004; Usher, 2009), further research is needed to examine the link between these variables. Also, research shows that emotions and sources of self-efficacy hold an essential role in students' learning and performance (e.g., Lichtenfeld et al., 2012; Pekrun, Goetz, Frenzel, Barchfeld & Perry 2011; Usher &Pajares, 2009). Therefore, this current study is intent to examine the relationship between achievement emotions and sources of self-efficacy in elementary students.

Previous Research on Elementary Students' Achievement Emotions

Achievement emotions refer to emotions experienced by students in learning, classroom instruction, and achievement settings (Lichtenfeld, et al., 2012; Pekrun, Goetz, Titz & Perry, 2002). This study concentrated on three achievement emotions: enjoyment, anxiety and boredom that are commonly experienced by individuals (e.g., Frenzel, Thrash, Pekrun, & Goetz, 2007; Goetz, Frenkel, Pekrun, Hall, & Ludtke, 2007; Haciomeroglu, 2017). Enjoyment is referring a pleasant activating emotion whereas boredom is described as an unpleasant deactivating emotion (Putwain, Becker, Symes & Pekrun, 2018). These emotions (i.e., enjoyment, anxiety, and boredom) experienced by students (Pekrun et al., 2002) have a great impact on their motivation, learning and performance (Ashcraft & Ridley, 2005; Gunderson, Park, Maloney, Beilock & Levine, 2018; Hembree, 1990; Pekrun, 2006). Among these different emotions, mathematics anxiety has been examined extensively in older students (Baloglu & Kocak, 2006; Birgin, Baloglu, Catlioglu, Gurbuz, 2010; Hill, Mammarella, Devine, Caviola, Passolunghi, Szucs, 2016). Although math anxiety develops as early as in elementary school years (Newstead, 1998) handful of research focused on investigating mathematics anxiety in elementary students (Haciomeroglu, 2017; Hill et al., 2016; Jackson & Leffingwell, 1999; Yuksel-Sahin, 2008). Mathematics anxiety defined by Richardson and Suinn (1972) as "feelings of tension and anxiety that interfere with the

manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p.551). Mathematics anxiety could take many forms such as simply disliking mathematics, being afraid of dealing with any mathematical tasks (Chipman, Krantz & Silver, 1992), fear of making mistakes (Dutton, 1951), and avoidance in taking any courses related to mathematics. Mathematics anxiety often leads to avoidance of situations related to problem solving (Ashcraft & Ridley, 2005) as well as struggle with performing mathematical tasks (Bekdemir, 2010; Hembree, 1990; Wigfield & Meece, 1988). In addition, math anxiety might occur in both ordinary life and academic settings. For instance, it might happen when paying a restaurant check or solving a math problem in class (Schleepen & Van Mier, 2016). Mathematics anxiety often leads to avoidance of mathematics classes. As a result, it can be seen as one of the most common factors preventing students from studying mathematics related careers (Ashcraft, 2002; Hembree, 1990; Ma, 1999). Students who enjoy while working on a problem tend to promote positive feeling towards mathematics. This feeling of joy in doing mathematics might lead to better performance and achievement for students.

In academic settings, students might enjoy attending mathematics classes but they may not necessarily enjoy the challenge of taking exams. Helmke (1993, cited in Lichtenfeld et al., 2012) found that enjoyment of learning mathematics decreased from kindergarten through 5th grade. In the same way, the results of the study of Stipek and Gralinski (1991) indicated that girls were less proud about their success rather they were more concerned about public humiliation in comparison to boys. This finding shows it was more important how their success or failure appear to public for girls than boys in early grades. This brings out the question about how little we know about young students' feelings towards mathematics as well as how their success/failures perceived by them. This brings the question about how essential it is to know more about students' emotions regarding enjoyment, boredom, and anxiety related to mathematics in early grades since these feelings towards the subject affects their performance and achievement. Lichtenfeld et al. (2012) stated that emotions related to achievement could be related to different academic settings such as attending class, studying, and taking tests and exams. For instance, students who may feel bored in math classes are not likely to enjoy taking exams or learning mathematics. In the same way, students who enjoy being part of the class may not enjoy taking an exam. As a consequence, students' emotions regarding mathematics may differ across these settings (i.e., attending class, studying, and taking exams) should be taken into considerations (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). Although research on emotions in older students has been growing over the last decade (Efklides & Volet, 2005; Linnenbrink-Garcia & Pekrun, 2011; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010), a few studies focused on examining the achievement emotions experienced by elementary students (Helmke, 1993, cited in Lichtenfeld et al., 2012; Lichtenfeld et.al, 2012; Stipek & Gralinski, 1991). Studies focusing on achievement emotions (enjoyment, boredom, and anxiety) in young students are emerging (Hill et al., 2016; Ramirez, Chang, Maloney, Levine, Beilock, 2016; Yuksel-Sahin, 2008). Therefore, it is essential to examine elementary students' achievement emotions for mathematics in different settings (i.e., class-related, learning-related and test-related).

Previous Research on Elementary Students' Sources of Mathematics Self-efficacy

Self-efficacy is defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, p. 391). Self-efficacy beliefs are derived as individuals interpret information from four sources: master experience, vicarious experience, social persuasions, and emotional and physiological state (Bandura, 1997).

Mastery Experience. In school, mastery experience refers to individual's interpretation of their performance after completing an academic task (Klassen & Usher, 2010; Usher & Pajares, 2008). When students overcome (or fail to do) difficult tasks or obstacles that might be difficult for others, still the mastery experiences become very essential for students. Successful performances of the students have lasting effects on their self-efficacy (Usher & Pajares, 2009). Results of the research studies revealed that mastery experience was the most influential sources of self-efficacy since this experience includes evidence whether or not students were able to master the necessary tasks (e.g., Britner & Pajares, 2006; Hampton, 1998; Usher & Pajares, 2006). A meta-analytic study of Talsma, Schuz, Schwarzer, and Noris (2018) revealed that the relations between self-efficacy and performance were unidirectional for young students. This means young students' performance uniquely affects self-efficacy beliefs but not the reverse. The study of Phan (2012) revealed that there was a significant positive relationship between enactive performance of young students and their mathematics self-efficacy.

Vicarious Experience. It is developed through observing others' capabilities in relation to performance. This way, students construct their efficacy beliefs through observing results of others' actions. They compare themselves to individuals (e.g., classmates, peers, and adults) for the evaluation their own academic capabilities. Students' beliefs are likely to be altered by the success or failure of the performance that they feel similar to the

current situation (Shunk, 1987). For instance, a classmate is succeeded at a challenging mathematics problem. This might convince other students in class to overcome the challenge too. Another type of vicarious experience is called self-comparative information that could also alter students' self-efficacy. Since either cognitively or by recoding, students could review their current and past performances (Usher & Pajares, 2009). However, there are no absolute measures of proficiency in academic activities. It other words, it is not clear observing others capabilities or/and recording individual's current or past performances is effective in altering students' self-efficacy. Nevertheless, results of the research studies (Gainor & Lent, 1998; Lent, Lopez & Bieschke, 1991) revealed that vicarious experience did not predict self-efficacy.

Social Persuasions. The third source of self-efficacy is called social persuasions. Encouragement received by the individuals such as parents, teachers, and peers improve students' confidence in their academic capabilities. Supportive messages serve as an encouragement to boost students' effort and confidence when it is accompanied by proper instruction that might help to carry success for them (Bandura, 1997; Hattie & Timperley, 2007). Social persuasions can be seen as limited in increasing one's self-efficacy. it may serve well to young students whom eagerly attend the messages that came from those close to them (Bandura, 1997). Social persuasions involve students' descriptions of whether their teachers provided them with regular feedback about their performances (Usher & Pajares, 2008). Study of Phan (2012) revealed that a significant positive relationship was found between students' verbal persuasions and self-efficacy. Lopez, Lent, Brown and Gore, (1997) also found that social persuasions predicted mathematics self-efficacy for students. Results from these two study suggested that the significant relationship between verbal persuasions and self-efficacy should be taken into consideration for the students' mathematical performance.

Emotional and Physiological State. The last source of self-efficacy is called emotional and physiological state. This source was informed by the physiological states such as anxiety, stress, and fatigue as an indicator of students' competency. "Students learn to interpret their physiological arousal as an indicator of personal competence by evaluating their own performances under differing conditions" (p.90, Usher & Pajares, 2009). The study of Klassen (2004) revealed that emotional and physiological state negatively predicts mathematics self-efficacy. This finding shows that emotional and physiological state plays an important role in student' self-efficacy.

As it can be seen, previous studies have explored the students' self-efficacy from four sources: mastery experience, vicarious experience, social persuasions, and emotional and physiological state (e.g., Gainor & Lent, 1998; Lent et al., 1991; Usher, 2009). Students construct their self-efficacy beliefs by interpreting from these four sources (Bandura, 1986). The studies of Klassen (2004) and Stevens, Wang, Olivarez, and Hamman (2007) examined the relationship between students mathematics self-efficacy and mathematics performance. The study of Klassen (2004) revealed that self-efficacy beliefs strongly predicted 7^{th} grade students' mathematics performance. Stevens et al. (2007) found that the relationship between mathematics self-efficacy and mathematics achievement was stronger for males than females. There was no significant difference between males and females regarding their mathematics self-efficacy.

The two constructs, self-efficacy and emotions play a vital role in students' mathematical competency and performance (Bandura, 1986; Usher & Pajares, 2009). Studies focusing on achievement emotions and mathematics self-efficacy in elementary students is still emerging research area (Lichtenfeld, et al., 2012; Stipek & Gralinski, 1991). A few studies examined young students' achievement emotions (Lichtenfeld et al., 2012; Putwain et al., 2018) and sources of mathematics self-efficacy individually (Klassen, 2004; Usher, 2009). Therefore, this present study takes a closer look at the relationship between elementary students' achievement emotions and sources of mathematics self-efficacy. Given the long-lasting effects of the emotions, it is essential to examine the consequences of emotions can have on elementary students' sources of mathematics self-efficacy. To address this issue, the present study investigated the relationship between achievement emotions and sources of self-efficacy in elementary students. More specifically, the present study aims to answer the following research questions:

1. What is the relationship between achievement emotions and sources of mathematics self-efficacy in elementary students?
2. Are there differences among elementary students' achievement emotions, gender and mathematical performance that can be attributed to sources of mathematics self-efficacy?
3. How well do the measure of control (achievement emotions) predict sources of mathematics self-efficacy?

Method

Participants

In this study, data were collected from 349 fourth grade students enrolled in three public schools located in northwest part of Turkey. Sample of this study consists of 174 female and 175 males.

Instruments

In this study, two instruments, Achievement Emotions Questionnaire-Elementary (AEQ-ES) and the Sources of Self-efficacy Scale (SSES) were administered to elementary students.

Sources of Self-efficacy Scale (SSES). This scale was developed by Usher and Pajares (2009) and adapted to Turkish by Yurt and Sunbul (2014). This instrument was used to determine students' sources self-efficacy. This instrument included 24 items in a five point Likert type ranging from "strongly agree" to "strongly disagree" (See Appendix A for sample items). SSES consists of four sub-scales: mastery experience, vicarious experience, social persuasions, and physiological state. The Cronbach alpha reliability coefficient for the subscales, calculated as .87 for mastery experience, .80 for vicarious experience, .93 for social persuasions and .94 for physiological state. This instrument was used to measure elementary students' perceptions of sources of mathematics self-efficacy.

Achievement Emotions Questionnaire-Elementary School (AEQ-ES). This questionnaire was developed by Lichtenfeld et al. (2012) and adapted to Turkish by Haciomeroglu and Bilgen (2013). The AEQ-ES consists of 28 items on a five-point Likert type of scale ranging from "strongly agree" to "strongly disagree" (See Appendix B for sample items). Within this instrument, AEQ-ES involves 3 subscales: enjoyment, anxiety, and boredom. The reliability coefficient for the overall instrument was calculated as .79. For the subscales, the Cronbach alpha reliability coefficient was calculated as .89 for enjoyment, .89 for anxiety, and .72 for boredom. In this study, AEQ-ES was utilized to measure students' achievement emotions.

Mathematics Achievement. At the end of the school year, students' grades as documented in the report card were gathered (M=4.68, SD=.62). Grades in Turkey range from 1 (poor) through 5 (excellent).

Procedure

In this study, AEQ-ES and SSES were administered to elementary students. These instruments were given to students to complete during their regular class hours. It took approximately 20-25 minutes for them to complete the instruments.

Data Analysis

Elementary students' scores on the AEQ-ES and the SSES were analyzed by using descriptive and inferential statistics. MANOVA test was performed to examine the relationship between gender, achievement, achievement emotions and sources of self-efficacy in mathematics. Pearson correlations were calculated to examine the bivariate relations between students' achievement emotions and sources of self-efficacy in mathematics. Then, standard multiple regression analysis was utilized to explore whether students' achievement emotions was a predictor of their sources of self-efficacy. The set of potential antecedents of achievement emotions for sources of self-efficacy were entered in multiple regression analysis. The variables that were significant at the 0.05 levels were allowed to enter the equation.

Findings

Elementary students' scores on the AEQ-ES and SSES were analyzed to investigate the relationship between achievement emotions and sources of self-efficacy (mastery experience, vicarious experience, social persuasions, and physiological state) in mathematics. Elementary students' responses revealed that they enjoyed (M=4.22; SD=.84), mathematics but they also felt less anxious (M=1.93; SD=.84), and bored (M=1.54; SD=.85)

across the three achievement settings (i.e., attending class, doing homework, and taking tests and exams). In addition, students' responses to the SSES revealed that they generally held a sufficient level of sources of self-efficacy regarding mastery experience (M=3.71; SD=.65), vicarious experience (M=3.87; SD=.82), and social persuasions (M=3.78; SD=1.03). However, students held a low level of sources of self-efficacy regarding physiological state (M=1.92; SD=1.03).

A two-way multivariate analysis of variance was conducted to compare the mean scores of the nine dependent variables (i.e., enjoyment, anxiety, boredom, mastery experience, vicarious experience, social persuasions, and physiological state) and two independent variables (i.e., gender and mathematics achievement). There was a statistically significant difference between boys and girls on the combined dependent variables, F (7, 335) = 1.28, p = .026; Wilks' Lambda = .97; partial eta squared = .02. When the results for the dependent variables were considered separately, the only difference to reach statistical significance, using a Bonferroni adjusted alpha level of .007, was boredom, F (7, 341) = 5.59, p = .019, partial eta squared = .01. The effect size, calculated using partial eta square, was small (Cohen, 1988). An inspection of the mean scores indicated that male students (M =2.28, SD =.13) found mathematics classes more boring than female students (M =1.66, SD =.22). The difference favored female students. There was no significant difference between female and male students regarding sources of self-efficacy (i.e., mastery experience, vicarious experience, social persuasions, and physiological state).

In addition, there was a statistically significant difference between the students regarding mathematics achievement on the combined dependent variables, F (7, 335) = 5.5, p = .000; Wilks' Lambda = .72; partial eta squared = .10. When the results for the dependent variables were considered separately, the variables that reach statistical significance, using a Bonferroni adjusted alpha level of .007, were enjoyment, anxiety, boredom, mastery experience, vicarious experience, social persuasions, and physiological state. There was a statistically significant difference between students' enjoyment, [F (7, 341) =9.17, p = .000; partial eta squared = .07], anxiety [F (7, 341) = 10.75, p = .000; partial eta squared = .08], and boredom [F (7, 341) = 9.09, p = .000; partial eta squared = .07] regarding mathematics achievement. Despite reaching statistical significance, the effect size, calculated using partial eta square, was small (Cohen, 1988). Post-hoc comparisons using the Tukey HSD test indicated that there was a significant difference between high and low mathematics achievement scores of the elementary students regarding achievement emotions. Furthermore, there was a statistically significant difference between students' mastery experience [F (7, 341) = 25.84, p = .000; partial eta squared = .18], vicarious experience [F (7, 341) = 5.18, p = .002; partial eta squared = .04], social persuasions [F (7, 341) = 17.20, p = .000; partial eta squared = .13], and physiological state [F (7, 341) = 14.17, p = .000; partial eta squared = .11] regarding mathematics achievement. However, the effect size was small (Cohen, 1988). Post-hoc comparisons using the Tukey HSD test indicated that there was a significant difference between high and low mathematics achievement scores of the elementary students regarding sources of self-efficacy (mastery experience, vicarious experience, social persuasions, and physiological state).

In order to compare the measures of students' achievement emotions and sources of mathematics self-efficacy scores, correlations were calculated for the subscales of each instrument. The relationship between achievement emotions (as measured by the AEQ-ES) and sources of mathematics self-efficacy (as measured by SSES) was investigated using Pearson product-moment correlation coefficient.

Table 1. Correlations between achievement emotions and sources of self-efficacy

		SSES			
		Mastery experience	Vicarious experience	Social persuasions	Physiological state
AEQ-ES	Enjoyment	.552**	.488**	.637**	-.432**
	Anxiety	-.256**	-109**	-.349**	.737**
	Boredom	-.203**	-.228**	-.328**	.633**

N=349; **p<.01

As it can be seen in Table 1, there were significant correlations between the achievement emotions (i.e., enjoyment, anxiety and boredom) and sources of self-efficacy (i.e., mastery experience, vicarious experience, social persuasions, and physiological state). Findings showed that achievement emotions and sources of mathematics self-efficacy are closely intertwined.

Multiple regressions were used to assess the ability of the control measure (AEQ-ES) to predict levels of sources of self-efficacy (SSES). In this case, enjoyment, anxiety, and boredom were entered into equation as a control measure.

Predicting Students' Mastery Experience from Their Enjoyment, Anxiety, and Boredom

Bivariate correlations among enjoyment and mastery experience (r(349)=.552, p<.01), anxiety and mastery experience (r(349)=-.246, p<.01), and boredom and mastery experience (r(349)=-.203, p<.01) were significant. Therefore, these variables were included in regression. Results of the standard multiple regression analysis were demonstrated that overall there was a significant relationship between predictors (i.e., enjoyment, anxiety, and boredom) and mastery experience at F (5, 343) =64.47, p<.001, R^2=0.65 respectively. The predictors explain 65% of the variance in mastery experience. This criterion meets for a large effect size (Cohen, 1988). Individually, these variables, enjoyment (β=-0.49, p< .05), anxiety (β =-0.11, p < .05) and boredom (β =0.30, p <.05) significantly predicted mastery experience of the elementary students. Enjoyment variable makes the strongest contribution for explaining the mastery experience.

Predicting Students' Vicarious Experience from Their Enjoyment, Anxiety, and Boredom

The predicted variables (enjoyment, anxiety and boredom) were entered for the regression analysis for the students' vicarious experience. Results of the standard multiple regression analysis was demonstrated that overall there was a significant relationship between enjoyment and vicarious experience at F (3, 256) =25.46, p<0.05 respectively. However, there was no significant difference between anxiety and enjoyment, and boredom and enjoyment at F (3, 256)=25.46, p>0.05. It was found that anxiety and boredom were unrelated to students' vicarious experience. Therefore, these predictors (anxiety and boredom) were excluded from the analysis. Next, enjoyment entered in regression. Results showed that there was a significant relationship between enjoyment and vicarious experience at F (2, 346) =64.47, p<.001, R^2=0.51 respectively. This criterion meets for a large effect size (Cohen, 1988). The control measure, enjoyment was statistically significant (β=0.56, p < .001) and predicted vicarious experience of the elementary students. This is the only predictor makes a strong contribution for explaining vicarious experience of the students.

Predicting Students' Social Persuasions from Their Enjoyment, Anxiety, and Boredom

The set of potential antecedents of achievement emotions for social persuasions were entered in multiple regressions. Results revealed that there was a significant relationship between predictors and social persuasions F (5, 343) =58.64, p<.001, R^2=0.75 respectively. Thus, a large proportion (75%) of the variability in students' social persuasion related to sources of self-efficacy was predicted by enjoyment, anxiety, and boredom. This criterion meets for a large effect size (Cohen, 1988). Individually, these variables, enjoyment (β=-.22, p<.001), anxiety (β =.71, p<.001) and boredom (β =.16, p<.001) significantly predicted their social persuasions. Enjoyment predicted students' physiological state in a negative direction. The predictor, anxiety makes a strong contribution for explaining social persuasion.

Predicting Students' Physiological State from Their Enjoyment, Anxiety, and Boredom

Results of the regression analysis demonstrated that the relationships between enjoyment and physiological state were not significant at F (6, 342) =76.38, p>.005 respectively. However, there was a significant relationship between anxiety and physiological state, and boredom and physiological state at F (6, 342) =76.38, p<.005. As a result, enjoyment was removed. Next, anxiety and boredom was entered in regression. Findings revealed that a significant relationship was found between anxiety and physiological state and boredom and physiological state at F (5, 343) =71.23, p<.001, R^2=0.75, respectively. Thus, a large proportion (75%) of the variability in students' physiological state was predicted by anxiety and boredom. Individually, anxiety (β =.71, p<0.05) and boredom (β =.17, p<0.05) predicted students' physiological state in a positive direction. However, anxiety makes a strong contribution for explaining physiological state of the students.

Conclusions

This present study examined the relationship between achievement emotions and sources of mathematics self-efficacy in elementary students. In general, this study showed that not only students felt less anxiety and boredom but also it seems they enjoyed doing mathematics in in different settings (i.e., attending class, doing homework, and taking tests and exams). There was no significant difference between students' achievement emotions (enjoyment and anxiety) regarding gender. This finding suggests that gender is not a distinguishing

factor when explaining students' achievement emotions related to mathematics. Regarding achievement emotions, there was a significant difference between male and female students regarding boredom. It seems female students felt less bored when learning, doing and taking tests in mathematics. Considering the effect size, this finding suggests that female students enjoy math slightly more than male students. In the line with previous research (Lichtenfeld et al., 2012; Putwain et al., 2018), elementary students' enjoyment of learning seems to reduce negative activity emotions, such as boredom and anxiety. There was a significant difference between students' achievement emotions and sources of mathematics self-efficacy regarding mathematics achievement. It seems students who held a higher level of mathematics achievement do well in mathematics. Not only they felt less bored and anxious but also enjoy mathematics in different achievement settings. Along with the previous research (e.g., Pinxten, Marsh, De Fraine, Noortgate & Dame, 2014; Putwain et al., 2018), this study supported the relationship between emotions and mathematics achievement. Previous research (e.g., Ahmed, can der Werf, Kuyper, & Minnaert, et al., 2013; Frenzel, Pekrun & Goetz, 2007a; Pekrun et al., 2011; Putwain, Sander & Larkin, 2013) posited boredom was negatively related to mathematics achievement. Along with the research studies, the study findings support the hypothesis that achievement emotions particularly boredom is significantly related to students' mathematics achievement. This study showed a significant but small difference between female and male students regarding boredom.

Elementary students' sources of self-efficacy regarding mastery experience, vicarious experience and social persuasions were found to be sufficient. These findings might mean that students were capable of interpreting their mastery experiences in learning mathematics whether or not they are succeeded /failed in completing a mathematical task. Not only they gain from their own experiences but also students were able to build their self-efficacy through vicarious experience by observing particular individuals (i.e., classmates, peers, adults). Also, these findings suggested that their own mastery experiences as well as mastery models were able to guide students for making judgments about their academic capabilities (Schunk, 1983, 1987; Schunk & Hanson, 1985, 1988). Findings related to social persuasions revealed that students were positively affected by the encouragement received from parents, teachers and peers. It seems supportive messages accompanied by proper instruction could bring success for students (Usher & Pajares, 2008; Evans, 1989) as well as sufficient level of self-efficacy. Students held a low level of self-efficacy regarding physiological state. This present study revealed that the students felt less anxious about mathematics. This finding can be interpreted as students' physiological state was informed by their other emotional states (e.g., stress, fatigue, and mood) that had an important role in learning mathematics. Usher and Pajares (2008) emphasized that it is essential to focus on developing students' physical and emotional well-being to decrease negative emotional states. There was no significant difference between students' sources of mathematics self-efficacy (mastery experience, vicarious experience, social persuasions, and physiological state) regarding gender. This finding suggests that both male and female students seem to have similar experiences in learning elementary mathematics when considering the sources of their self-efficacy. In contrast, previous research showed that there was a significant difference between students' sources of self-efficacy regarding gender (Lent et al., 1996; Stevens et al., 2007; Usher & Pajares, 2006). Align with previous study of Klassen (2004) a significant difference was found between high and low mathematics achievement scores of the students regarding sources of self-efficacy. This finding suggested that students with high level of sources of self-efficacy seem to do well in mathematics.

Results showed that achievement emotions and sources of mathematics self-efficacy were closely intertwined. Achievement emotions, enjoyment, anxiety, and boredom were strong predictors of students' sources of mathematics self-efficacy. In learning mathematics, students seem to enjoy doing mathematics. While being part of learning process, they felt less anxious and bored about mathematics. This finding suggested that enjoyment in mathematics initiated positive development in students' sources of self-efficacy. Whether students were succeeded/failed in doing a mathematical task, it seems they were able to sufficiently learn from these experiences. Also, students were able to foster emotions in a positive direction. They felt less anxious and bored about mathematics. It is likely that these emotions were endured by the support and encouragement from parents, teachers and peers.

In conclusion, majority of previous research focused on examining number of other emotions such as hope, anger, and anxiety in older students (Birgin et al., 2010; Frenzel, Pekrun, & Goetz, 2007a, 2007b; Putwain et al., 2018; Zeidner, 1998). For future research, studies examining the achievement emotions and sources of self-efficacy in young students are still emerging. Therefore, this study addressed this limitation by examining the relationship between achievement emotions and sources of mathematic self-efficacy in a sample of elementary school children. A longitudinal research study should be conducted using mixed method approach to examine elementary students' achievement emotions and sources of self-efficacy in mathematics. For instance, emotions and sources of self-efficacy could be examined more intensively over longer durations. This particular type of approach would allow researchers to investigate students' emotions and sources of self-efficacy in details. This

research might unfold the factors that are influential in developing the elementary students' achievement emotions and sources of mathematics self-efficacy.

References

Ahmed, W., can der Werf, G., Kuyper, H., & Minnaert, A. (2013). Emotions, self- regulated learning, and achievement in mathematics: A growth curve analysis. *Journal of Educational Psychology*, *105*(1), 150-161.

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, *2*(5), 181-185.

Ashcraft, M. H., & Ridley, K. S. (2005). Math anxiety and its cognitive consequences: A tutorial review. In J. I. D. Campbell (Ed.), *Handbook of Mathematical Cognition* (pp. 315-327). New York, NY: Psychology Press.

Baloglu, M., & Kocak, R. (2006). A multivariate investigation of the differences in mathematics anxiety. *Personality and Individual Differences*, *40*, 1325-1335.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Bekdemir, M. (2010). The pre-service teachers' mathematics anxiety related to depth of negative experiences in mathematics classroom while they were students. *Educational Studies in Mathematics*, *75*(3), 311-328.

Birgin, O, Baloglu, M., Catlioglu, H., Gurbuz, R. (2010). An investigation of mathematics anxiety among sixth grade students in Turkey. *Learning and Individual Differences*, *20*, 654-658.

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal for Research in Science Teaching, 43*, 485-499.

Chipman S., Krantz D., & Silver R. (1992). Mathematics anxiety and science careers among able college women. *Psychological Science, 3*, 292-295.

Cohen, J. (1988). Statistical power analysis for the behavioural sciences (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Dutton. W.M. (1951) Attitudes of prospective teachers towards mathematics. *Elementary School Journal*, *5*(2), 84-90.

Efklides, A., & Volet, S. (Eds.). (2005). Feelings and emotions in the learning process [special issue]. *Learning and Instruction*, *15*, 377-515.

Evans, R.I. (1989). *Albert Bandura: The man and his ideas a dialogue.* New York: Praeger.

Frenzel, A. C., Pekrun, R., & Goetz, T. (2007a). Girls and mathematics - A "hopeless" issue? A control-value approach to gender differences in emotions towards mathematics. *European Journal of Psychology of Education*, *22*, 497-514.

Frenzel, A. C., Pekrun, R., & Goetz, T. (2007b). Perceived learning environment and students' emotional experiences: A multilevel analysis of mathematics classrooms. *Learning and Instruction*, *17*(5), 478-493.

Frenzel, A. C., Thrash, T. M., Pekrun, R., & Goetz, T. (2007). Achievement emotions in Germany and China: A cross-cultural validation of the Academic Emotions Questionnaire-Mathematics (AEQ-M). *Journal of Cross-Cultural Psychology*, *38*, 302-309.

Gainor, K.A. & Lent, R.W. (1998). Social cognitive expectations and racial identity attitudes in predicting the mathe choice intentions of Black college students. *Journal of Counselling Psychology*, *45*, 403-413.

Goetz, T., Frenzel, A. C., Pekrun, R., Hall, N. C., & Ludtke, O. (2007). Between- and within-domain relations of students' academic emotions. *Journal of Educational Psychology*, *99*, 715-733.

Gunderson, E. A., Park, D., Maloney, E. A., Beilock, S.L., & Levine, S. C. (2018). Reciprocal relations among motivational frameworks, math anxiety, and math achievement in early elementary school, *Journal of Cognition and Development*, *19*(1), 21-46.

Haciomeroglu, G. (2017). Reciprocal Relationships Between Mathematics Anxiety and Attitude Towards Mathematics in Elementary School Students. *Acta Didactica Napocensia Journal*, *10*(3), 59-68.

Haciomeroglu, G. & Bilgen, S. (2013). Turkish adaptation of the achievement emotions questionnaire-elementary. *Marmara University Ataturk Faculty of Educational Sciences Journal*, *38*, 85-96.

Hampton, N. Z. (1998). Sources of academic self-efficacy scale: An assessment tool for rehabilitation counsellors. *Rehabilitation Counselling Bulletin*, *41*, 260-277.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*, 81-112.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education, 21*, 33-46.

Hill, F., Mammarella, I.C., Devine, A., Caviola, S., Passolunghi, M.C., Szucs, D. (2016). Maths anxiety in primary and secondary school students: Gender differences, developmental changes and anxiety specificity. *Learning and Individual Differences, 48*, 45-53.

Jackson, C., & Leffingwell, R. (1999). The role of instructors in creating math anxiety in students from kindergarten through college. *Mathematics Teacher*, *92*, 583-587.

Klassen, R. (2004). A cross-cultural investigation of the efficacy beliefs of South Asian immigrant and Anglo non-immigrant early adolescents. *Journal of Educational Psychology*, *96*, 731-742.

Klassen, R. M., Usher, E. L. (2010). Self-efficacy in educational settings: Recent research and emerging directions. In T. C. Urdan & S. A. Karabenick (Eds.), *The Decade Ahead: Theoretical Perspectives on Motivation and Achievement (Advances in Motivation and Achievement, Volume 16 Part A*. Bingley, UK: Emerald Group Publishing.

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Mathematics self-efficacy: Sources and relation to science-based career choice. *Journal of Counselling Psychology*, *38*, 424-430.

Lent, R. W., Lopez, F. G., Brown, S. D., & Gore, P. A. (1996). Latent structure of the sources of mathematics self-efficacy. *Journal of Vocational Behaviour*, *49*, 292-308.

Lichtenfeld, S., Pekrun, R., Stupnisky, R.H., Reissi K. & Murayama, K.(2012). Measuring students' emotions in the early years: The Achievement emotions questionnaire-elementary school (AEQ-ES). *Learning and Individual Differences*, *22*, 190-201.

Linnenbrink-Garcia, L., & Pekrun, R. (Eds.). (2011). Students' emotions and academic engagement [Special issue]. *Contemporary Educational Psychology*, *36*, 1-70.

Lopez, F. G., Lent, R. W., Brown, S. D., & Gore, P. A. (1997). Role of social-cognitive expectations in high school students' mathematics-related interest and performance. *Journal of Counselling Psychology*, *44*, 44-52.

Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. *Journal for Research in Mathematics Education*, *30*(5), 520-540.

Ma, X, & Kishor, N. (1997). Assessing the relationship between attitude toward mathematics and achievement in mathematics: A meta-analysis. *Journal for Research in Mathematics Education*, *28*(1), 26-47.

Newstead, K. (1998). Aspects of children's mathematics anxiety. *Educational Studies in Mathematics*, *36*(1), 53-71.

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, *18*(4), 315-341.

Pekrun, R., Goetz, T., Daniels, L. M., Stupnisky, R. H., & Perry, R. P. (2010). Boredom in achievement settings: Exploring control-value antecedents and performance outcomes of a neglected emotion. *Journal of Educational Psychology*, *102*(3), 531-549.

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, *36*, 36-48.

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self- regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist*, *37*, 91-106.

Phan, H.P. (2012) The development of English and mathematics self-efficacy: A latent growth curve analysis. *The Journal of Educational Research*, *105*(3), 196-209.

Pinxten, M., Marsh, H. W., De Fraine, B., Noortgate, W. V. D., & Dame, J. V. (2014). Enjoying mathematics or feeling competent in mathematics? Reciprocal effects on mathematics achievement and perceived math effort expenditure. *British Journal of Educational Psychology*, *84*(1), 152-174.

Putwain, D.W., Becker, S., Symes, W., & Pekrun, R. (2018). Reciprocal relations between students' academic enjoyment, boredom, and achievement over time. *Learning and Individual Differences*, *54*, 73-81.

Putwain, D. W., Sander, P., & Larkin, D. (2013). Using the 2x2 framework of achievement goals to predict achievement emotions and academic performance. *Learning and Individual Differences*, *25*(1), 80-84.

Ramirez, G., Chang, H., Maloney, E. A., Levine, S. C., & Beilock, S. L. (2016). On the Relationship between Math Anxiety and Math Achievement in Early Elementary School: The Role of Problem Solving Strategies. *Journal of Experimental Child Psychology*, *141*, 83-100.

Richardson, F. C. & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counselling Psychology*, *19*, 551-554.

Schleepen, T. M. J., & Van Mier, H. I. (2016). Math anxiety differentially affects boys' and girls' arithmetic, reading and fluid intelligence skills in fifth graders. *Psychology*, *7*, 1911-1920.

Schunk, D. H. (1983). Ability versus effort attributional feedback: Differential effects on self-efficacy and achievement. *Journal of Educational Psychology*, *75*, 848-856.

Schunk, D. H. (1987). Peer models and children's behavioural change. *Review of Educational Research*, *57*, 149-174.

Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology*, *77*, 313-322.

Schunk, D. H., & Hanson, A. R. (1988). Influence of peer-model attributes on children's beliefs and learning. *Journal of Educational Psychology*, *81*, 431-434.

Stevens, T., Wang, K., Olivarez, A., Jr., & Hamman, D. (2007). Use of self-perspectives and their sources to predict the mathematics enrollment intentions of girls and boys. *Sex Roles, 56*, 351-363.

Stipek, D. J., & Gralinski, J. H. (1991). Gender differences in children's achievement-related beliefs and emotional responses to success and failure in mathematics. *Journal of Educational Psychology*, *83*, 361-371.

Talsma, Schuz, Schwarzer, and Noris (2018). I believe, therefore I achieve (and vice versa): A meta-analytic cross-lagged panel analysis of self-efficacy and academic performance. *Learning and Individual Differences*, *61*, 136-150.

Usher, E. L. (2009). Sources of middle school students' self-efficacy in mathematics: a qualitative investigation. *American Educational Research Journal*, *46*(1), 275-314.

Usher, E. L., & Pajares, F. (2006). Inviting confidence in school: invitations as a critical source of the academic self-efficacy beliefs of entering middle school students. *Journal of Invitational Theory & Practice*, *12*, 7-16.

Usher, E. L. & & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research*, *78*(4), 751-796.

Usher, E. L. & & Pajares, F. (2009). Sources of self-efficacy in mathematics: A validation study. *Contemporary Educational Psychology*, *34*(2), 89-101.

Wigfield, A. & Meece, J. L. (1988). Math anxiety in elementary and secondary school students. *Journal of Educational Psychology*, *80*(2), 210-216.

Yuksel-Sahin, F. (2008). Mathematics anxiety among 4th and 5th grade Turkish elementary school students. *International Electronic Journal of Mathematics Education*, *3*, 179-192.

Yurt, E., & Sunbul, A. M. (2014). The adaptation of the sources of mathematics self-efficacy scale for Turkish context. *Education and Science*, *39*(176), 145-157.

Zeidner, M. (1998). *Test Anxiety: The State of the Art*. New York, NY: Plenum Press.

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Appendix A. Achievement Emotions Questionnaire-Elementary (AEQ-ES): Sample Items

- I enjoy math class. (Enjoyment)
- When I do math homework, I am in a good mood. (Enjoyment)
- When I think about math class, I get nervous. (Anxiety)
- When I do math homework, I worry If I will ever understand it. (Anxiety)
- Math homework bores me to death. (Boredom)
- I find math class so boring that I would rather do something else. (Boredom)

Appendix B. Sources of Self-efficacy Scale (SSES): Sample Items

- I make excellent grades on math tests. (Mastery experience)
- I have always been successful with math. (Mastery experience)
- I compete with myself in math. (Vicarious experience)
- Seeing kids do better than me in math pushes me to do better. (Vicarious experience)
- My math teachers have told that I am good at learning math. (Social persuasions)
- People have told me that I have a talent for math. (Social persuasions)
- Just being in math class makes feel stressed and nervous. (Physiological state)
- I start to feel stressed-out as soon as I begin my math work. (Physiological state)