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Research Article

Self-Regulation Scale in Mathematics: short form development and validity-reliability study[1]

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Abstract

Self-regulation in mathematics is the organization of the student in line with the mathematics course outcomes. Students' ability to organize the mathematics learning process in a healthy way can increase their mathematics achievement. Knowing students' self-regulation towards mathematics will contribute to providing the necessary education for mathematics achievement. The purpose of this study is to develop a valid and reliable short-form scale to measure middle school students' self-regulation skills towards mathematics. In this context, existing self- regulation scales were examined and an item pool of 56 items was created by utilizing the items in the literature and the statements developed by the researchers. In line with expert opinions, a preliminary form of 25 items consisting of positive statements was prepared and this form was applied to 342 middle school students. As a result of exploratory factor analysis, the number of items was reduced to 14 and the scale had a four-factor structure: Effort, Integrated, Review and Getting Support. Confirmatory factor analysis confirmed this structure. The overall Cronbach's alpha reliability coefficient of the scale was calculated as .78, and the coefficients related to the sub- dimensions were found to be acceptable. The developed Short Mathematics Self-Regulation Scale (S-MSRS) is recommended as a tool that can be applied in a short time, has understandable expressions and can be used at different grade levels.

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Introduction

In recent years, the focus of studies on academic achievement has been on the concept of self- regulation in which students play an active role in their own learning process (Ainley & Patrick, 2006). Self-regulation is an active and effective process in which an individual is aware of his/her own learning, can control himself/herself, set learning goals, adjust his/her metacognitive capacity and behaviors (Bandura, 1986).

Self-regulation is self-organization. It also includes cognitive strategies such as planning and reviewing one's learning. Self-effort and self-evaluation are also important for self-regulation. It has gained importance by emphasizing the ability of learners to take responsibility for their own learning, to monitor what, when and how much they learn, and to apply

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appropriate strategies (Schuitema et al., 2012). People with well-developed self-regulation have more self- regulation and effort in the problems they will face in their courses or throughout their lives. These individuals determine a strategy to achieve their goals and use this strategy and then monitor their efforts and achievements, and as a result, they arrive at an evaluation. They organize their learning processes and strategies according to the evaluation results (Çiltaş, 2011).

Today, measuring and developing self-regulation in various courses is gaining importance. However, the self-regulation of students in mathematics is the most emphasized in research. Because mathematics courses have a special importance in terms of providing an understanding of the world we live in, having interesting methods and relationships and being in a closer relationship with the mental activities of the individual (Üredi & Üredi, 2005). Self-regulation involves students' active learning processes. Likewise, the relationship between mathematics and self-regulation is important since it is of great importance for students to perform active learning in mathematics lessons. Mathematical self-regulation is the organization of the student in line with the mathematics course objectives. The student's organization of the mathematics learning process leads to an increase in mathematics achievement. For this reason, self-regulation skills are important for mathematics lessons

Many studies have shown that students with self-regulation in mathematics are more successful in mathematics (Clearly & Chen, 2009; Lee et al., 2010, Usta, 2014). Clearly and Chen (2009), in their research examining the differences in self-regulation, motivation, and mathematics achievement in middle school according to grade level and mathematics context, showed that students' use of regulatory strategies during mathematics learning was the primary motivational predictor and emphasized the importance of identifying changing student motivation and self- regulation in the early middle school years and the potential role that context may have in these processes. Students who can control their own learning processes make all the necessary efforts by using metacognitive processes such as planning, organizing, and evaluating in the learning process, in other words, self-regulation skills (Çiltaş, 2011).

Studies conducted at the primary and secondary school level reveal that students' self-regulation skills towards mathematics course can show significant differences according to various variables (Aktan, 2012; Erdoğan & Şengül, 2014; İpek, 2019). Aktan (2012) examined the effect of 5th grade students' self-regulatory learning strategies on academic achievement and stated that especially female students scored higher in elaboration, organization, metacognitive self-regulation, time management and help-seeking strategies. Similarly, Erdoğan and Şengül (2014), in their study with 6th, 7th and 8th grade students, found that there were significant differences in students' self-regulation and metacognitive skills according to grade level and gender variables, and that these differences were in favor of female students. İpek (2019) examined the relationships between mathematics anxiety, self-efficacy beliefs, and self- regulation skills of middle school students; stated that as students' self-regulation scores increased, their self-regulation skills towards mathematics courses also increased. He also emphasized that there were significant differences in the sub-dimensions of "openness" and "seeking" according to grade level; especially 5th grade students had higher scores in these sub- dimensions.

Various scales have been developed to find out the level of students' self-regulation (Arslan & Gelişli, 2015; Çokçalışkan et al., 2015; Kadıoğlu et al., 2011; Pintrich et al., 1991). Arslan and Gelişli (2015) developed the Perceived Self-Regulation Scale. The study was conducted on 604 middle school students. The scale consists of 16 items and two factors (openness and seeking). The Self-Regulatory Learning Strategies Scale (MSLQ Motivated Strategies for Learning Questionnaire) developed by Pintrich et al. was adapted into Turkish by Aktan (2012). The scale consists of 40 items and 8 sub-dimensions. Kadıoğlu et al. (2011) developed the Self- Regulatory Learning Strategies Scale (SLSS) to evaluate the self-regulatory learning strategies of high school students. The scale consists of a total of 29 items and 8 sub-dimensions. Çokçalışkan et al. (2019) developed the Self-Regulated Learning Inventory (SLI) to assess the self-regulated learning skills of 4th grade primary school students. The inventory consists of 35 items and 3 sub-dimensions.

It is critical for students to take an active role in mathematics learning processes and to be able to plan and control their learning in order to increase learning retention and success. In this context, self-regulation skills include functions such as students' taking responsibility for their own learning, setting goals, using strategies, and evaluating their learning processes; and it stands out as an important variable that directly affects the quality of learning in areas that require cognitive effort such as mathematics. In the national and international literature, it is noteworthy that the number of scales developed to assess students' self-regulation levels in mathematics is limited and the existing scales are mostly either designed for a single level of education or have very general and lengthy statements. This situation may cause difficulties in the application process and may cause validity and reliability problems for students of different ages and developmental levels.

Based on this need, it was aimed to develop the Short Self-Regulation in Mathematics Scale (S-MSRS), which is shorter, simpler, clearer and adaptable to different educational levels. It is predicted that this scale to be developed will be a more practical and functional tool than the existing scales, especially in terms of the shortness of the application period, the use of age- appropriate language, and limiting the measurement scope to the mathematics-specific context. Thus, it will be possible to effectively monitor and support students' self-regulation skills in both educational research and teaching processes.

Method

Research model

This study was conducted within the framework of descriptive survey design, which is one of the quantitative research methods. Descriptive survey design is a research approach that aims to define an existing situation or a phenomenon as it exists and to express the opinions, characteristics or behaviors of individuals with numerical data (Karasar, 2012). Within the scope of this study, it was aimed to develop a short and valid scale to measure middle school students' self-regulation skills towards mathematics course.

In the research process, basic stages such as creating an item pool, obtaining expert opinions, conducting a pilot study, and then conducting validity and reliability analyses were followed. In analyzing the psychometric properties of the scale, construct validity and internal consistency reliability were evaluated using appropriate statistical techniques.

Study Group

The first study group, which was formed to test the construct validity of the scale with exploratory factor analysis (EFA), consisted of 342 middle school students studying in a public middle school in Kocaeli city center in the fall semester of the 2022-2023 academic year. During the pre-analysis process, forms with missing or incorrect data were eliminated and the analyses were conducted on 332 students. The grade levels of the participants were 5th, 6th, 7th and 8th grades, and convenience sampling method was used in sample selection. The second study group, which was formed to test the validity of the factor structure obtained as a result of EFA, consisted of 254 middle school students studying in different public schools in Kocaeli in the same academic year

Research Process and Data Collection

Data for the first application form were collected in October 2022 and data for the second application form were collected in November 2022. The data collection tool used in the study was started with an item pool consisting of original items developed by examining existing self- regulation scales and statements adapted from scales with proven validity in the literature. A pilot form was prepared in line with expert opinions and applied to the students. During the data collection process, the purpose of the study was explained to the students, it was stated that participation was voluntary, and the answers would be kept confidential. The application took an average of 20-25 minutes.

In the scale development process, firstly, valid and reliable self-regulation scales in the literature were examined and items that could be adapted to mathematics course were determined. In this context, the Perceived Self-Regulation Scale developed by Arslan and Gelişli (2015) consists of 16 items, and as a result of the exploratory factor analysis, it was determined that the items were grouped into two factors: "openness" and "seeking". Cronbach Alpha internal consistency coefficient for the whole scale was reported as 0.90. In addition, the Motivational Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1991) was adapted into Turkish by Aktan (2012) and applied to 5th grade students as the Self- Regulatory Learning Strategies Scale. This scale consists of 40 items and 8 sub-dimensions: elaboration, organization, metacognitive self-regulation, time management, effort regulation, seeking help, repetition, learning from peers. The overall Cronbach Alpha coefficient obtained as a result of confirmatory factor analysis was 0.95, indicating that the scale was highly reliable.

The items deemed appropriate from these two scales were revised to assess students' self- regulation levels in mathematics courses and combined with the original statements developed by the researchers to form an item pool of 56 items in total. This pool was submitted to expert opinion in order to support the content validity of the scale to be developed, and the first application form (pilot) was created with 25 items, all of which were positive. A five-point Likert-type rating (1- Strongly Disagree, 2-Disagree, 3-Somewhat Agree, 4-Agree, 5-Strongly Agree) was used for each item

Data analysis

SPSS 16.0 and SmartPLS 4 programs were used to analyze the data obtained from the scale items. Scale items were scored as 1-2-3-4-5 in the SPSS 16.0 package program. Thus, self- regulation scores in mathematics were obtained from each scale applied. A high score indicates that students' self-regulation in mathematics is high, while a low score indicates that their self- regulation in mathematics is negative. Before testing whether the scale was unidimensional or multidimensional, and if multidimensional, which items were grouped under which dimension, the item-total correlation was examined with the SPSS 16.0 package program and it was concluded that 14 items had correlation values that could remain in the scale. The 14-item scale was subjected to factor analysis. Factor analysis was used to prove the construct validity of the scale. In order to apply exploratory factor analysis, the data file must be suitable for analysis. This suitability was determined through Kaiser-Meyer-Olkin (KMO) test and Bartlett Sphericity. As a result of the exploratory factor analysis, 3 items with factor loading values less than 30 and the difference between factor loading values in two or more factors was less than10 were removed from the scale. After this revision, the resulting 22-item form was administered to a group of middle school students. In the preliminary analyses, a total of 8 items with low factor loadings or high loadings on more than one factor according to item-total correlations and exploratory factor analysis were removed from the scale. Thus, a four-factor structure (Effort, Integrated, Review, Support) consisting of a total of 14 items was obtained. This structure was tested with EFA and CFA and the construct validity of the scale was supported.

Evidence regarding the reliability of the final scale formed as a result of the analysis was presented. The evidence for the reliability of the scale was presented by calculating the internal consistency coefficient. In addition, the relationship between the factors forming the scale based on the items under the factors was tested by correlation analysis method. As a result, exploratory factor analysis and confirmatory factor analysis were used for the validity study of the scale. For the reliability study, Cronbach Alpha was used. The lowest score that can be obtained from the scale is 14 and the highest score is 70. When interpreting the mean scores obtained from the scale: 1.00-1.80 is considered as "very low", 1.81-2.60 as "low", 2.61-3.40 as "medium", 3.41-4.20 as "high" and 4.21-5.00 as "very high".

Ethics

This study was conducted with the approval of Kocaeli University Social and Human Sciences Ethics Committee dated 20.09.2022 and numbered E-90104632-19.

Findings

Exploratory Factor Analysis (EFA)

In order to determine whether the scale items were divided into meaningful factors independent of each other, varimax-rotaied principal component analysis was used. At the end of this process and item-total correlation, 8 items were removed from the scale, leaving a total of 14 items related to the four factors identified in the scale.

Table 1. Findings related to factor load distributions of items as a result of factor analysis

Articles	Factor 1 (Effort)	Factor 2 (Integrated)	Factor 3 (Review)	Factor 4 (Receiving Support)
Item8	,757			
Item5	,750			
Item10	,748			
Item1	,598			
Itemm14	,592			
Item13		,702		
Item9		,680		
Item6		,632		
Itemm2		,578		
Item4			,741	
Itemm7			,719	
Itemm11			,516	
Item12				,878
Item3				,874
14 items	**5 items**	**4 items**	**3 items**	**2 items**

KMO: 0.792 BARTLETT:0.001

Table 1 shows the factor load distributions of the items in the scale as a result of the factor analysis. During the factor analysis, if the loading of an item in the scale was above 0.40, the item was counted in that factor. As seen in Table 1, the factor loadings for 14 items ranged between 0.516 and 0.878. Factor 1: 5 items explained 29.40%, Factor 2: 4 items explained 12.59%, Factor 3: 3 items explained 8.18%, Factor 4: 2 items explained 7.35%. The total variance explained in its final form is 57.52%. According to the factor analysis, 5 items were grouped under factor 1, 4 items under factor 2, 3 items under factor 3 and 2 items under factor. Accordingly, factor 1 is categorized under the title of "Effort", factor 2 under the title of "Integration", factor 3 under the title of "Review", and factor 4 under the title of "Getting Support". As a result, the developed scale consisted of a total of 14 self-regulation sentences, all of which were positive.

After the self-regulation scale in mathematics was finalized with 14 items and 4 factors, Cronbach alpha internal consistency coefficients for each dimension and the overall test were calculated for the reliability of the scale. Since this coefficient is calculated by taking into account all items in the scale, it is the coefficient that best reflects the overall reliability structure of the test compared to other coefficients (Özdamar, 2004). The alpha reliability of the final version of the scale was calculated as 0.78. Accordingly, it can be said that the reliability of the scale is high. The alpha reliabilities obtained from the sub-factors are 0.78 for "Effort" (item number 5), 0.64 for "Integrated" (item number 4), 0.58 for "Review" (item number 3), and 0.77 for "Getting Support" (item number 2). The calculated reliability coefficients reveal that the scale has an acceptable level of internal consistency for the overall scale and for each factor.

Confirmatory Factor Analysis (CFA)

Cronbach Alpha internal consistency coefficients were calculated for the reliability of the self- regulation scale in mathematics. Since this coefficient is calculated by considering all items in the scale, it is the coefficient that best reflects the overall reliability structure of the test compared to other coefficients (Özdamar, 2004). The alpha reliability of the final version of the scale was calculated as 0.78. The calculated reliability coefficients reveal that the scale has an acceptable level of internal consistency in general and for each factor.

Table 2. Validity and reliability values related to the K-PBSS

Latent Variable	Indicators	Loads	VIF	Composite Reliability (CR)	Cronbach Alpha	AVE
Effort	E1	0,791	1,691	0,853	0,784	0,538
	E2	0,694	1,395			
	E3	0,625	1,298			
	E4	0,769	1,611			
	E5	0,776	1,524			
Integrated	I1	0,677	1,226	0,787	0,640	0,482
	I2	0,723	1,253			
	I3	0,617	1,137			
	I4	0,753	1,309			
Review	R1	0,724	1,150	0,783	0,586	0,547
	R2	0,738	1,231			
	R3	0,756	1,195			
Getting Support	S1	0,657	1,660	0,828	0,773	0,715
	S2	0,999	1,660			

When the alpha values in Table 2 are analyzed, it is seen that all values except the review factor are above 0.60. The second value used for internal consistency in PLS analyses is the composite reliability (CR) coefficient (Hair et al. 2017; Gaskin, statwiki.com). When the results are analyzed, it is seen that the composite reliability coefficients are above 0.70. According to these results, it can be said that the variables considered are at the desired level in terms of internal consistency. When the AVE values are analyzed, it is seen that all values except the *integrated* factor are above the accepted values.(Hair et al. 2017), which is above the lower limit of 0.50. Some sources suggest that AVE values can be as low as 0.40 in scale development or adaptation studies (Fornell & Larcker, 1981). It is also stated that AVE > .50; CR > .70 and CR > AVE is a prerequisite for convergent validity; AVE values less than .50 will not be a problem if the CR value is greater than .70 (Fornell & Larcker, 1981). When VIF values are examined, it is desired that the coefficients should be below 5 in factor analysis (Hair et al., 2017). When the VIF values table is examined, it is seen that the coefficients are at an acceptable level.

Table 3. Discriminant validity coefficients of the subscales of the scale

Fornell-Larcker Criteria					**Heterotrait-Monotrait Ratio**				
Subscales of the Scale	**Effort**	**Getting Support**	**Integrated**	**Review**	**Subscales of the Scale**	**Effort**	**Getting Support**	**Integrated**	**Review**
Effort	**0.734**				**Effort**				
Getting Support	-0.024	**0.846**			**Getting Support**	0.064			
Integrated	0.465	0.133	**0.694**		**Integrated**	0.649	0.211		
Review	0.501	0.156	0.417	**0.739**	**Review**	0.725	0.211	0.682	

The discriminant validity findings in Table 3 were evaluated by considering Fornell-Larcker criteria and Heterotrait-Monotrait (HTMT) ratios. In the discriminant validity test proposed by Fornell and Larcker (1981), the root AVE (average variance explained) value of a construct should be greater than its correlations with other constructs. This criterion indicates that measures of similar constructions can be distinguished from each other. In this study, the Fornell-Larcker values ranged from 0.694 to 0.846 and were higher than the correlation values of each construct with other constructs. In addition, the HTMT ratios remained below .85, indicating that the discriminant validity was achieved in accordance with the criteria suggested by Henseler et al. (2015). These findings reveal that the measurement model has significant discrimination between constructions. In conclusion, it can be said that the four-factor structure of the Short Mathematics Self-Regulation Scale (B-MSRS) developed in line with the obtained analyses is valid and reliable and statistically supported in terms of both composite validity and discriminant validity. The scale showed structural consistency in samples of middle school students.

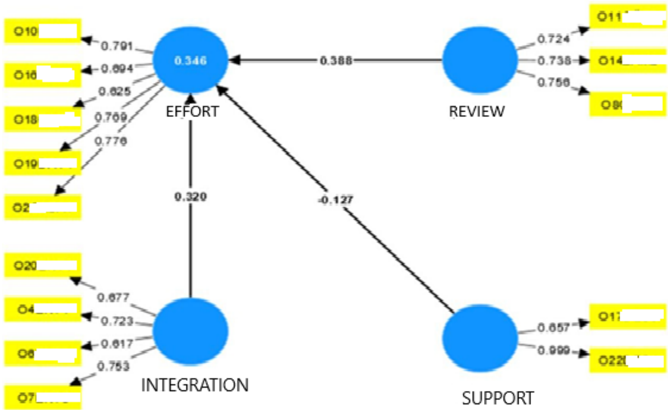

Figure 1. Diagram of SmartPLS4 Confirmatory Factor Analysis of the K-SCAS

When Figure 1 is examined, it is seen that the four-factor structure of the Short Mathematics Self-Regulation Scale (SMRS) was preserved as a result of the confirmatory factor analysis and each item had significant loading values under the factor to which it belonged. The path coefficients between the factors in the model and the observed variables ranged between 0.61 and 0.99, and these values are above the recommended minimum threshold value of 0.50 (Hair et al., 2017). The high correlation of all items with the relevant dimensions supports the construct validity of the scale. In addition, the presence of low-level cross-correlations between the factors in the diagram shows that the scale maintains its discriminant validity.

Conclusion

In this study, it was aimed to develop a valid and reliable short scale to measure middle school students' self-regulation skills towards mathematics course. For this purpose, the literature was reviewed, an item pool of 56 items was created, content validity was ensured with expert opinions, and a preliminary form of 25 items was applied. As a result of the exploratory factor analysis, the items with low loading values were eliminated and the scale was formed with 14 items and four factors: Effort, Integrated, Review, and Getting Support. The findings of confirmatory factor analysis showed that this structure was highly compatible with the data. The overall reliability of the scale and the Cronbach Alpha values of the sub-dimensions were at acceptable levels, indicating that the scale exhibited a consistent structure.

Although the overall validity and reliability results of the scale are sufficient, the “Getting Support” subscale contains only two items, which may limit the structural consistency of this factor. Therefore, it is recommended that this subscale be reconsidered and expanded in future studies based on qualitative data.

The composite reliability (CR) and average variance explained (AVE) values revealed that convergent validity was achieved. Moreover, the analyses using Fornell-Larcker criteria and HTMT ratios show that discriminant validity is also achieved. This suggests that the scale is not only valid and reliable but also structurally stable.

These findings are consistent with the theoretical context established between self-regulation and academic achievement (Bandura, 1986; Pintrich et al., 1991; Cleary & Chen, 2009). Self- regulation enables students to effectively use metacognitive processes such as planning, monitoring and evaluating learning processes. This is a factor that directly affects success, especially in an abstract and process-oriented field such as mathematics (Lee et al., 2010; Çiltaş, 2011). Therefore, the developed scale has the potential to be an important tool for educators and researchers. We recommended are for further studies and applicaitons;

- Age-related validity analyses can be conducted on different age groups (e.g., high school and university level).
- The scale can be evaluated in terms of cultural validity by testing it on students from various socioeconomic levels.
- With the digitalization of the scale, it can be used as an assessment tool for monitoring students' self-regulation

levels in online teaching processes.

- Deeper analyses can be conducted with path analyses or structural equation modeling to reveal the effect of self-regulation skills on mathematics achievement.

References

Ainley, M., & Patrick, L. (2006). Measuring self-regulated learning processes through tracking patterns of student interaction with achievement activities. *Educational Psychology Review, 18*(3), 267-286.

Aktan, O. (2012). The relationship between self-regulatory learning strategies and academic achievement of fifth grade elementary school students. *Education and Science*, 37(164), 179-190.

Aktan, S. (2012). The relationship between students' academic achievement, self-regulation skills, motivation and teachers' teaching styles. Bayburt Education Faculty Journal, 14(28), 324-346. https://doi.org/10.35675/befdergi.487409.

Arslan, S., and Gelişli, Y. (2015). Development of perceived self-regulation scale: Validity and Reliability Study. *Sakarya University Journal of Education, 5*(3), 67- 74

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4*(3), 359-373

Çiltaş, A. (2011). A study on the importance of self-regulation teaching in education. Mehmet Akif Ersoy University *Journal of Institute of Social Sciences, 3*(5), 1-11.

Cleary, T. J., & Chen, P. P. (2009). Self-regulation, motivation, and math achievement in middle school: Variations across grade level and math context. *Journal of School Psychology*, 47(5), 291-314. https://doi.org/10.1016/j.jsp.2009.04.002

Çokçalışkan, H., Sakız, G., & Doğan, M.C. (2019). Development of self-regulated learning inventory for primary school fourth grade students: validity and reliability study.

Erdogan, F., & Sengul, S. (2014). A review of self-regulatory learning strategies for elementary school students in mathematics. *The Journal of Education and Training Researches*, *3*(3), 108-118.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18(1), 39-50.

Gaskin, J.,Validity and Realiability, http://statwiki.gaskination.com/index.php?title=CFA#Validity_and_Reliability.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM).* Sage Publication

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115-135.

İpek, H. (2019). *Investigation of middle school students' mathematics anxiety, mathematics self-efficacy beliefs and self-regulation skills towards mathematics course.* Doctoral dissertation, Marmara University, Istanbul, Turkiye.

Kadıoğlu, C., Uzuntiryaki, E., & Çapa Aydın, Y. (2011). Development of Self-regulated Learning Strategies Scale (SLLS). *Eğitim ve Bilim, 36*(160).

Koç, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: Inverse square root and gamma-exponential methods. *Journal of information systems, 28* (1), 227-261.

Lee, G., Lim, K., & Grabowski, B. (2010). Improving self-regulation, learning strategy use, and achievement with metacognitive feedback. *Educational Technology Research and Development, 58*(6), 629-648. https://doi.org/10.1007/s11423-010-9153-6.

Özdamar, K. (2004). *Statistical Data Analysis with Package Programs* I. Eskisehir: Kaan Bookstore.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).* University of Michigan.

Tavşancil, E., & Keser, H. (2002). Development of Likert Type Attitude Scale Towards Internet Use. *Journal of Educational Sciences and Applications, 1* (1).

Üredi, İ., & Üredi, L. (2005). The power of self-regulation strategies and motivational beliefs of 8th grade elementary school students to predict mathematics achievement. *Mersin University Faculty of Education Journal, 1*(2).

Usta, N. (2014). Factors that enable students to be successful in mathematics according to students participating in Bartın province inter-secondary mathematics competition. *Journal of Faculty of Education, 3*(2), 153-173.

Appendix 1. Mathematics Self-Regulation Scale-Short Form

Mathematics Self-Regulation Scale-Short Form						
1 Absolutely Disagree, 2 Disagree, 3 Partially Agree, 4 Agree, 5Strongly Agree						
		1	2	3	4	5
1	In math class, I strive to achieve my goals.					
2	I can use what I have learned in mathematics in daily life.					
3	I get help from my classmates in math lessons.					
4	I prepare a study plan for mathematics and stick to it.					
5	In math, I try to learn even the most difficult subjects.					
6	In mathematics, I try to find different ways to learn a topic.					
7	I organize my work in mathematics by looking at my notes.					
8	Even if I am not interested in mathematics, I manage to study until I finish the subject.					
9	I can use a topic I have already learned in mathematics in new subjects.					
10	I do not stop studying when subjects are difficult in mathematics					
11	In math class, I ask myself questions to make sure I understand the topic.					
12	In mathematics, when I do not understand a subject, I get help from my friends.					
13	I try to use what I have learned in mathematics in different courses.					
14	Even if I have difficulty in math lessons, I try to do it myself.					

Note: Items removed from the scale as a result of analysis
I don't get bored when I study math.
I get help from my teacher when I have difficulties in mathematics.
In math class, if something goes wrong, it doesn't demotivate me.
When studying mathematics, I can decide what I need to learn by thinking about the subject.
I use my time well when studying mathematics.
When I am studying math and I don't understand something, I go back and try to understand it.
If I don't understand something in math, I ask someone from my family.
I spend more time in math class.