International Journal of Assessment Tools in Education
2023, Vol. 10, No. 4, 723–740
https://doi.org/10.21449/ijate.1311600
Published at https://ijate.net/ https://dergipark.org.tr/en/pub/ijate *Research Article*

Development of self-regulation scale for middle school students: Validity and reliability study

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ARTICLE HISTORY

Received: June 08, 2023
Revised: July 28, 2023
Accepted: Oct. 18, 2023

Keywords:
Self-regulation,
Middle school students,
Scale development.

Abstract: This study was conducted to develop a valid and reliable measurement tool that can identify middle school students' self-regulation skills. Firstly, the literature was utilized in the development of the measurement tool. The form was finalized with the support of the opinions of different experts and a trial application. Then, the form was administered to 341 middle school students to determine its construct validity, and exploratory factor analysis (EFA) was performed on the collected data. Then, the form was administered to 341 middle school students to determine its construct validity, and exploratory factor analysis (EFA) was performed on the collected data. As a result of the study, it was determined that the scale consisted of 9 items and two sub-dimensions, namely "forethought" and "volitional control and self-reflection." In order to reveal the reliability of the scale, internal consistency, two-half test analyses, and composite reliability (CR) were used, and it was determined that the values found were .74 and above. In order to reveal the accuracy of the obtained structure, data were collected from 218 middle school students in a different province, and confirmatory factor analysis (CFA) was performed with these data. As a result of the analysis, the two-factor structure of the scale was confirmed. When the findings are examined, it can be said that the scale is a reliable and valid tool that can be applied to determine the self-regulation skills of students studying at the middle school level.

1. INTRODUCTION

Self-regulation has become an important topic in educational research in recent years, and research has generally focused on self-regulated learning (SRL) (Dever et al., 2023; Pijeira-Díaz, 2023). Therefore, SRL has been significantly examined in educational research. Although research on SRL has made a significant contribution to educational research, research on the process of self-regulation has remained limited (Öztürk, 2020). Research on the self-regulation process is important in evaluating the quality of student's own learning and the process of performing a task (Sökmen et al., 2023). In this context, it can be said that it is necessary to conduct research to examine the self-regulation process. The literature shows that the studies on self-regulation were mostly qualitative, and quantitative studies, including experimental and relational studies were insufficient in number (Öztürk, 2020). The reason for the low number

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e-ISSN: 2148-7456 /

of quantitative studies may be the lack of a scale that can determine students' self-regulation skills. This study was conducted to develop a valid and reliable scale to determine the self-regulation skills of middle school students. The research is expected to encourage the conduct of quantitative research on self-regulation skills.

1.1. Theoretical Framework

1.1.1. *Social cognitive theory*

In the literature, self-regulation is based on many different theories. Among these theories, the most accepted one for self-regulation is the social cognitive theory (Zimmerman, 2000). According to the social cognitive theory, the learner is at the center of learning (Zimmerman, 2000). According to this theory, learning takes place through the interaction of cognitive, environmental, and behavioral factors (Bandura, 1986). In other words, the events that the individual sees around him/her in the learning process, his/her own experiences, and his/her cognitive characteristics are effective (Bandura, 1986). Self-efficacy, self-regulation, and motivation are important concepts in social cognitive theory. This study focuses on the concept of self-regulation.

1.1.2. *Self-regulation*

The concept of self-regulation was first defined by Albert Bandura as an individual's setting goals, using resources to achieve them, and making the necessary effort (Bandura, 2002). Zimmerman (2000), who based self-regulation on social cognitive theory, defined self-regulation as planned and cyclical thoughts, feelings, and behaviors developed by the individual to achieve personal goals. Based on this definition, Zimmerman (2000) considered the self-regulation model in three dimensions: forethought, volitional control and self-reflection.

Forethought refers to the actions to be taken toward the task before starting a task (Sakız & Yetkin-Özdemir, 2014). In the forethought phase, the students analyze what is expected of them. Goal setting and strategic planning have a critical role in this phase (Zimmerman, 2000). In goal setting, the individual plans by deciding how to perform and the expectations at the end of the performance (Sakız & Yetkin-Özdemir, 2014). In this phase, the individual determines the strategies to be used in the process of performing the task before starting the task (Flower & Hayes, 1981; Pintrich, 2000; Wong et al., 2021; Zimmerman, 2000; Zimmerman & Risemberg, 1997). In strategic planning, the individual decides on the strategy necessary for the best performance. At this stage, the student can create and maintain the plan (Sakız & Yetkin-Özdemir, 2014).

Volitional control refers to the actions to be taken towards the task in the process of performing a task (Sakız & Yetkin-Özdemir, 2014). In the volitional control phase, the students can focus their attention to perform the task expected of them, take actions that will help him/her complete the task, and make the necessary changes in their plan (Zimmerman, 2000). In this stage, the individuals can keep distractions under control by focusing their attention on the subject of study. Thus, they can focus on the task (Sakız & Yetkin-Özdemir, 2014). In addition, individuals can control their time in the process and can make some changes if necessary (Öztürk & Ada, 2023). In the volitional control phase, students can control the strategies they have determined in the forethought phase and re-determine strategies if necessary (Sakız & Yetkin-Özdemir, 2014).

Self-reflection refers to the actions to be taken toward the task after performing a task (Sakız & Yetkin-Özdemir, 2014). In the self-reflection phase, the students complete the task and evaluate their performance on the completed task (Zimmerman, 2000). In this phase, the individual can check whether he/she has achieved the goals he/she has set, evaluate his/her performance in the process of performing the task, and identify his/her deficiencies (Zimmerman, 2000). In the self-reflection phase, individuals can perform the task by checking the strategies they

determined in the forethought phase and, if necessary, by determining a new strategy (Öztürk & Ada, 2023).

In this study, Zimmerman's (2000) cyclical model of self-regulation was used. Although the model consists of three stages, it is very difficult to distinguish between skills that occur during the task process and skills that occur after the task. For example, controlling the student's goal is an action that occurs both in the process and in the outcome. Similarly, motivation is both a process and an outcome action. Therefore, in this study, a two-dimensional model was designed by considering volitional control and self-reflection together.

1.1.3. *The present study*

The literature review shows that different scales related to self-regulation have been developed. Eryılmaz and Mammadov (2017) developed a 47-item SRL scale based on Zimmerman's model as a result of their research with high school students aged 14-19. Another 16-item measurement tool is the perceived self-regulation scale (Arslan & Gelişli, 2015). Kröner et al. (2017) conducted a German adaptation study of the academic self-regulation questionnaire. The adaptation study of the 28-item scale developed by Steinbach and Stoeger (2018) to reveal teachers' attitudes toward SRL was carried out by Sarikaya and Sökmen (2021). Upon examination of these scales, it becomes evident that some of them are not suitable for middle school students due to the differences in the age groups of the sample in which they were developed, and some of them have weak usefulness due to the excessive number of items, and there are some points that do not match with the theoretical ground. It can be seen that the behaviors emphasized in some items in the scales are not related to self-regulation skills and that the items are not similar to the self-regulation behaviors mentioned in the existing theories. Since there is no general self-regulation scale developed directly for middle school students and the existing scales are not suitable in terms of item and structure, it was necessary to develop this scale. The current study aims to provide the literature with a measurement tool that is theoretically based on solid ground, can reveal self-regulation skills in middle school students in a valid and reliable way, and has high usability.

2. METHOD

In this section, information about the methodology of the study, such as the research model, the study group, the preparation of the trial form of the scale, the process, and data analysis are included.

2.1. Research Method

This study is a scale development study conducted in accordance with the survey model. The survey model is a type of research that is used to collect information on characteristics such as attitudes and behaviors from a large sample group. In this model, a general situation is presented (Fraenkel et al., 2015; McMillan & Schumacher, 2014). In this study, the steps of developing a Likert-type measurement tool were followed in order to determine the general self-regulation skills of middle school students. The study includes two main stages. In the first part, EFA was conducted to determine the structure of the scale; in the second part, CFA was conducted to verify the existing structure. Thus, the validity and reliability studies of the developed scale were reported in a phased manner.

2.2. Study Group

The participants for this study were selected using the cluster random sampling, which is a probability sampling technique. This sampling method involves selecting the sampling unit or units deemed necessary in the research and randomly obtaining participants from this group (Akarsu, 2015). This method is the best way designed to obtain a representative sample of the population of interest (Fraenkel et al., 2015). In this study, the simple random sampling method

was used in order to increase the representative capacity of the population. The data of the study were obtained from two different provinces, one in Eastern Anatolia and the other in the Eastern Black Sea Region. First of all, five of the middle schools in the province were selected by random method. Then, the scale was applied to groups of voluntary participants.

The study was based on voluntary participation. The participants of the first phase of the study EFA consisted of 352 middle school students studying in the central district of a province in the Eastern Anatolia Region. All participants were Turkish and enrolled in public middle schools. The scale form belonging to six students, most of whom were found to be left blank in the pre-analysis checks, was excluded from the study; the analyses were carried out on 346 student data. In order to ensure representativeness in the study, an equal or close number of data were collected from all grade levels. Among the participants of the first phase, 85 were 5th-grade students, 86 were 6th-grade students, 86 were 7th-grade students, and 89 were 8th-grade students. Of the participants, 180 were girls (52%), and 166 were boys (48%).

The participants of the second stage of the study CFA consisted of 218 middle school students studying in the central district of a province located in the Eastern Black Sea Region. All participants were Turkish and enrolled in public middle schools. In the second phase of the study, an equal or similar number of students from each grade level were included in the study. Among the participants, 54 were 5th-grade students, 56 were 6th-grade students, 55 were 7th-grade students, and 53 were 8th-grade students. Of the participants, 111 were female (51%), and 107 were male (49%). Field (2013) states that in factor analysis studies, 100 people are considered poor, 200 people are considered average, 300 people are considered good, 500 people are considered very good, and 1000 people are considered excellent in terms of sample size. Considering the number of participants in the study, it can be concluded that the sample sizes are good and average in terms of meeting the requirements for factor analysis.

2.3. Preparation of the Trial Form of the Scale and Process

Firstly, ethics committee permissions and application permissions required for the study were obtained. In order to develop a measurement tool to determine the general self-regulation skills of middle school students, a trial form of the scale was first developed. The process of preparing the trial form involved several stages recommended in the literature, including item writing, seeking expert opinions, and conducting a pre-test (Tavşancıl, 2014). In order to write the scale items, firstly, a literature review was conducted, and the scales and studies in the literature were utilized (Arslan & Gelişli, 2015; Bandura, 1991, 2002; Diehl et al., 2006; Eryılmaz & Mammadov, 2017; Graham et al., 2005; Kröner et al., 2017; Pintrich & De Groot, 1990; Sarikaya & Sökmen, 2021; Sarikaya & Yılar, 2021; Schunk, 2005; Schunk & Zimmerman, 1994; Zimmerman, 2000, 2002). Accordingly, a trial form consisting of 32 items was developed.

It is recommended to consult expert opinion to ensure content and face validity before the pilot study (Kline, 1994). For this reason, the items were presented to three expert lecturers working on self-regulation, one expert lecturer in the field of measurement and evaluation, and two expert lecturers in the field of mother tongue education for comprehensibility. A form with options of "appropriate" and "inappropriate" was designed for each item to collect the experts' opinions on item suitability. The items were evaluated according to their ability to measure self-regulation skills, comprehensibility of the item, and language appropriateness. There was also a section in the form for the items that the experts wanted to add. As Veneziano and Hooper (1997) emphasized content validity was calculated as the ratio of the number of experts who expressed an appropriate opinion for the items to the total number of experts minus one. Items with content validity values below .80 were removed from the scale form; three new items were added to the form in line with the suggestions of the experts. Necessary revisions were made in terms of content and appearance, and the new items were presented to the experts for further

evaluation, finalizing the scale. Through these processes, seven items were removed from the form, and resulting in a 28-item form for item analysis. In the final form, there are 25 positive and three negative items in the scale form to assess agreement with the items, a Likert-type five-point rating response category of "never (1)", "rarely (2)", "sometimes (3)", "usually (4)" and "always (5)" was used. In this form, the scale was tested for comprehensibility by applying it to 20 middle school students, and in line with the suggestions, minor changes were made on three items, and it was submitted to the experts again. As a result of the corrections, the form consisting of 28 items was finalized.

After these stages, validity and reliability studies of the revised form were conducted. First, the trial form was applied, and EFA was conducted. In addition, criterion-related validity was used within the scope of validity processes. In this context, the perceived self-regulation scale developed by Arslan and Gelişli (2015) was chosen as a criterion. Then, the revised form was applied, and CFA was conducted. It took approximately 10 minutes to complete the measurement tool.

2.4. Data Analysis

Before conducting the EFA, data preprocessing steps were implemented to ensure data quality. Extreme values, missing data, and incorrect values were addressed. To begin with, it is recommended that the number of cells left blank in the dataset should not exceed 2% of the total dataset. In this study, six participants' data were removed from the dataset as they contained extreme values or incorrect entries (Kalton & Kaspyzyk, 1986). The remaining missing data were examined, and it was observed that the number of cells left blank did not exceed 2% in the total data set; a total of seven cells were left blank in the entire data set. The missing data were filled with FIML method (Enders & Bandalos, 2001). For each student data set, kurtosis and skewness values and box-and-whisker plots were also analyzed. Then, the data set was analyzed in terms of multivariate outliers with the help of Mahalanobis distance. Five individuals who were significant at the $\alpha = 0.001$ level were excluded from the data set. All analyses were conducted with 341 student data. TV, VIF and CI index values were analyzed to determine whether there is a multicollinearity problem. As a result of the process, it was seen that there was no multicollinearity problem in the data set. Mardia's (1970) skewness value was used to determine whether the obtained data set meets the multivariate normal distribution. Uysal and Kılıç (2022) suggest the use of Mardia's skewness coefficient as a multivariate normality determination technique in terms of both power and type 1 error. Accordingly, it was determined that the data set did not exhibit a multivariate normal distribution (Mardia's skewness coefficient=109.01, $p<0.05$). It was also found that the skewness coefficients of the variables ranged from 0.100 (item 28) to -1.136 (item 27) and the kurtosis coefficient ranged from 0.004 (item 8) to -1.553 (item 28). Since the data set does not show a multivariate normal distribution, unweighted least squares (ULS), which is robust to violating this assumption of the analysis, was used as a factor extraction method (Brown & Moore, 2012).

Item correlation matrix, R-matrix determinant coefficients, and anti-image values were also examined for the suitability of the data set. Item correlation values are expected to be no lower than .30 and no higher than .90 (Field, 2013). It was determined that each item in the data set met this condition. Although the multicollinearity problem is not a major problem, it can be perceived as a problem in the case of extremely highly correlated items. In this case, the R-matrix determinant coefficient should be checked, and this value should be greater than 0.00001 (Field, 2013). In the study, it was observed that the values examined were greater than 0.00001. The values in the anti-image table are recommended to be greater than .50 (Field, 2013). The values obtained for the study data were found between .57 and .82. These findings show that the data are suitable for analysis. In addition, Kaiser-Mayer Olkin (KMO) value was examined for the adequacy of the sample size. The KMO value was calculated as .830. According to

Pallant (2001), a KMO value of 0.60 and above is considered sufficient. In addition, Bartlett's test of sphericity was significant ($X^2_{(36)}$=697,687; p=0.00). So, data driven correlation matrix is statistically significantly differ from identity matrix. In this direction, it can be said that the data obtained with the trial form are suitable for factor analysis. The distribution of items across factors and the loading values of items were analyzed. It is recommended that the difference between two loading values should be at least 0.10 to avoid overlapping items (Büyüköztürk, 2007). Overall, based on these analyses, the data were found to be suitable for further factor analysis, and overlapping items were identified and addressed. The relationship between the scale developed within the scope of this study and the perceived self-regulation scale (Arslan & Gelişli, 2015) selected as a criterion was examined with the Pearson correlation coefficient.

In order to determine the construct validity of the scale, factor analysis was performed with Direct Oblimin rotation. Because in cases where there is a relationship between sub-dimensions, it is recommended to use oblique methods (Kılıç, 2022). Scree Plot, optimal parallel analysis (Patil et al., 2017), was used to determine the number of factors. HULL analysis was not used to determine the number of factors. Because Kılıç (2022) states that as the correlation between dimensions increases, the success of HULL analysis in estimating the number of dimensions decreases. For item validity, corrected item-total correlations were checked and item factor loadings and common factor variance were taken into consideration. Internal consistency reliability was assessed using Cronbach's alpha coefficient and Mcdonald's omega coefficient. This coefficient measures the consistency or reliability of the scale as a whole and its sub-dimensions. Furthermore, CR were examined to assess the reliability of the scale. All of these analyses were performed using the SPSS 24.0 software package. CR calculated with Excel. Mardia'skewness coefficient was calculate with Past Istatistic 4.12.

Then, CFA was conducted to determine the model fit of the scale. Data set was analyzed in terms of multivariate outliers with the help of Mahalanobis distance. As a result of the analysis, no multivariate outliers were observed. TV, VIF and CI index values were analyzed to determine whether there is a multicollinearity problem. As a result of the process, it was seen that there was no multicollinearity problem in the data set. As a result of the analysis, it was seen that the data set met the assumption of multivariate normal distribution. For construct fit, X^2/df, RMSEA, SRMR, RMR, CFI, RFI, NNFI, NFI, and IFI fit indices were checked. In addition, R^2 values for each item were reported. The analyses were conducted with LISREL 8.80 package program.

3. FINDINGS

3.1. EFA Findings

In the first step of the analysis, the item-total correlation values were examined, and the items that were found to be insufficient were removed from the analysis in order (Items 28, 7, 17, 14, 10, 27, 26, 8, 11). The analysis was repeated after each item's removal.

According to the results of the factor analysis conducted with 19 items, a four-factor structure with eigenvalues above 1, at least two items, variance explained by more than 5%, and 48.72% of the total variance was obtained. The ratios of each item explaining the variance in a common factor together were examined, and it was observed that these values ranged between .31 and .60. Kalaycı (2009) stated that removing the items with low factor loadings from the analysis will increase the total variance explained. Accordingly, items 2, 12, and 20 in the trial form with a common variance value of less than .40 were removed from the analysis, and the factor analysis was conducted again. As a result of the analysis with 16 items, a three-factor structure explaining 46.88% of the total variance was reached. The result of the analysis showed that the factor loadings of some items was less than .40. For this reason, Items 23, 16, and 15 were removed from the analysis, respectively. The analysis was repeated after each item's

removal. In the final analysis with 13 items, a three-factor structure explaining 51.33 of the total variances emerged. In this model, the factor variances of the items are between .40 and .59.

EFA was conducted on the new scale form obtained. Two items that were found to be overlapping items were removed from the form. After the items were removed, the explained variance decreased to 47%. The analysis was repeated and it was determined that the common variance value of one item decreased to .29. For this reason, the related item was removed from the analysis. The analysis was repeated and it was seen that the common factor variance value of one item was .35. Therefore, the related item was removed from the analysis. As a result of this process, nine items remained on the scale. All of the remaining items are positive.

For the nine-item version of the form, the item correlation matrix, R-matrix determinant coefficients, and anti-image values were re-examined before EFA. As a result of this process, it was observed that the relevant values were within the ideal range. It was observed that the correlation values were moderate, determinant coefficients were greater than 0.01, anti-image covariance values were between .57 and .77, and anti-image correlation values were between .80 and .89.

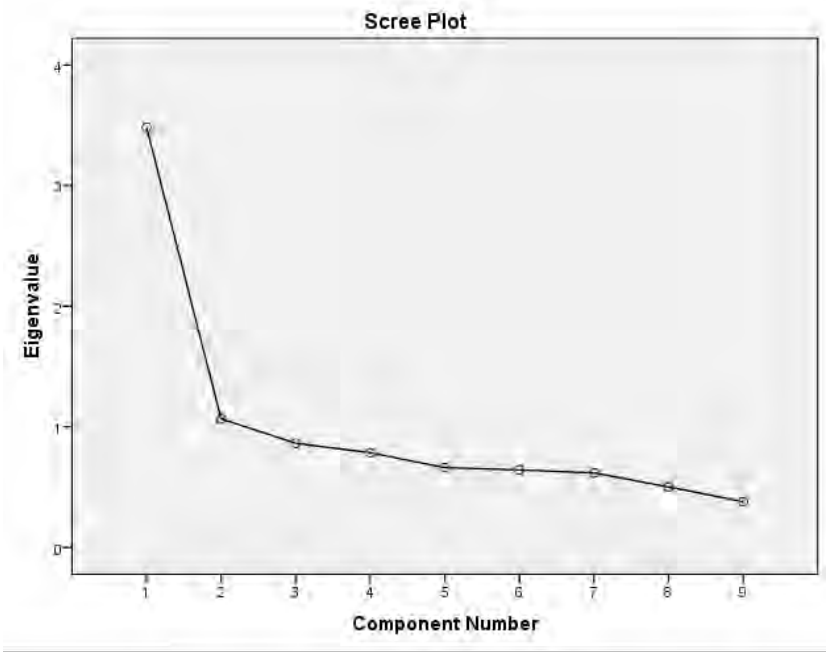
EFA was conducted again with the remaining nine items in the trial form, and the factor properties obtained are presented in Table 1.

Table 1. *Characteristics of the factors.*

Factor	Eigenvalue	Variance (%)	Total Variance (%)
1. Forethought	3.48	38.70	38.70
2. Volitional control and self-reflection	1.07	11.85	50.55

As seen in Table 1, according to the EFA results, a two-dimensional structure explaining 50.55% of the total variance, having at least 1% eigenvalue, at least four items, and at least 12% variance, was obtained. The Scree Plot showing the number of factors is shown in Figure 1.

Figure 1. *Scree plot.*



The Scree Plot shown in Figure 1 reveals a two-factor structure. To determine factor number optimal parallel analysis was used. Optimal parallel analysis findings reveal that Optimal parallel analysis findings reveal that it is a one-factor structure (3.48>1.417 for one factor; but

1.07<1.33). In this case, it is recommended to consult expert opinions. In order to determine the number of factors, the opinions of two faculty members who have international competence in the field of self-regulation and who also have self-regulation theory were consulted. Both experts who examined the items and factors approved the two-factor structure of the scale. One of the experts even presented the fact that the first four items targeted cognitive and the last five items targeted affective features as evidence. Therefore, the two-factor structure of the scale was analyzed. The results of the rotated component analysis (item number, item content, common factor variance of the items, factors, and factor loadings of the items under the factors) are presented in Table 2.

Table 2. *Rotated factor analysis results.*

Factor Name	Item	Common Factor Variance (Extraction)	Factor 1	Factor 2
Forethought	1	.57	.76	
	2	.45	.67	
	3	.62	.82	
	4	.42	.49	
Volitional control and self-reflection	5	.48		.64
	6	.53		.57
	7	.50		.64
	8	.49		.74
	9	.49		.74

Table 2 show that the ratios of each item explaining the variance in a common factor together were examined, and it was observed that these values ranged between .45 and .62. In the two-factor structure obtained, the first factor is the "forethought" sub-dimension consisting of Items 1-4. The second one is the "volitional control and self-reflection" sub-dimension consisting of Items 5-9. While naming the dimensions, the structure that the items aimed to measure was taken into consideration, and expert opinions were consulted. The loading values of the items in the "forethought" factor ranged between .49 and .82; the loading values of the items in the "volitional control and self-reflection" factor ranged between .57 and .74.

To determine the relationship between the factors of the scale, an analysis of the correlation between the factors was conducted. The resulting data are presented in Table 3.

Table 3. *Correlation between factors.*

Factors	r
1. Forethought	1.00
2. Volitional control and self-reflection	.533**

***p*<.01

Table 3 shows the correlation between sub-dimensions. The analysis indicates a positive, and significant relationship between them (r=.533, *p*=.000). This finding shows that there is no multicollinearity problem between the sub-dimensions of the scale and that they measure a separate characteristic. It was determined that there is a positive, high and significant relationship between the perceived self-regulation scale developed by Arslan and Gelişli (2015) for criterion-related validity and the scale developed within the scope of the study (r=.724, *p*=.000). Internal consistency Cronbach's Alpha and Mcdonald Omega reliabilities for the whole scale and for its sub-dimensions CR were calculated on the same sample. The coefficients are shown in Table 4.

Table 4. *Reliability coefficients.*

	Cronbach's Alpha	Mcdonald Omega	CR
Forethought	.78	.70	.77
Volitional control and self-reflection	.83	.73	.80
Overall Scale	.90	.79	

The Cronbach Alpha internal consistency coefficient of the overall scale was calculated as .90, Mcdonald Omega as .79. Considering these values, it can be considered that the scale has the necessary reliability. The fact that the reliability coefficients of the sub-dimensions are above .70 provides evidence that the scale will provide reliable measurements. Table 4 shows that CR values for all factors are higher than .70.

3.2. CFA Findings

CFA was conducted to evaluate the adequacy of the structure obtained from the EFA. As a result of CFA, it was determined that the chi-square fit index of the structure consisting of nine items and two factors was significant ($X^2_{(26)}$=44.20, p=.014). In this case, it is recommended to look at other fit indices (Table 5). R^2 values of the items are also presented in Table 5.

Table 5. *Fit index values.*

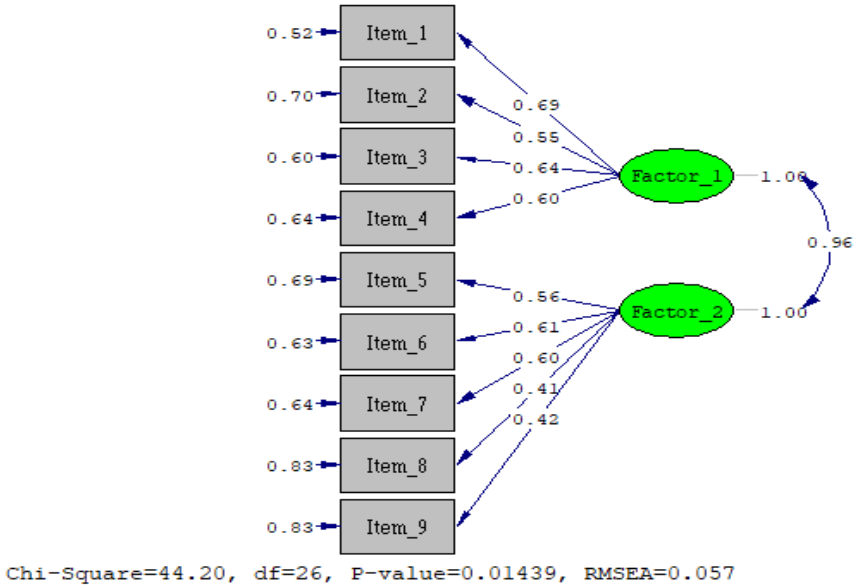
Indexes	Perfect Fit Criterion	Acceptable Fit Criterion*	Finding	Conclusion	Item	R^2
X^2 /df	0-2.5	2.5-3	1.7	Perfect	1	.48
SRMR	≤.05	≤.08	.045	Perfect	2	.30
IFI	≥.95	≥.90	.98	Perfect	3	.40
NNFI	≥.95	≥.90	.97	Perfect	4	.36
CFI	≥.95	≥.90	.97	Perfect	5	.31
RMSEA	≤.05	≤.08	.057	Acceptable	6	.37
RMR	≤.05	≤.08	.071	Acceptable	7	.36
RFI	≥.95	≥.90	.92	Acceptable	8	.17
NFI	≥.95	≥.90	.94	Acceptable	9	.17

*(Schumacker & Lomax, 2004)

Upon reviewing the fit index values presented in Table 5, it is observed that X^2 /df, SRMR, NNFI, CFI, and IFI values have excellent fitness levels; RMSEA, RMR, NFI, and RFI values have an acceptable fit level. Within the scope of the study, R^2 values for each item were also examined. It is seen that the R^2 values of the items are between .17 and .48. The R^2 values of the items are an indicator of the variance explanation rates of the items. In order to check the construct fit, the diagram containing the item-total correlation values and the t-value diagram were also examined. The path diagram for the first level CFA is shown in Figure 2.

Figure 2 depicts the item-total correlation values, which range between .41 and .69. These values indicate the correlation between each variable and the latent variable. A higher correlation coefficient suggests a greater degree of the variable's contribution in explaining the latent variable. Therefore, based on these findings, it can be inferred that the items in the scale are effective in distinguishing the trait to be measured and that they capture similar behaviors. Furthermore, a thorough examination was conducted to determine the significance of the analysis values for each item. It was found that the t-values ranged between 5.62 and 10.39. Importantly, all items reached significance at the p<.01 level. Thus, it can be confidently stated that the items within the scale are designed to measure distinct characteristics.

Figure 2. *Path diagram.*



4. DISCUSSION and CONCLUSION

The findings of this study, which aimed to develop a valid and reliable measurement tool that can measure the self-regulation skills of middle school students, supported the literature and provided some original results to the literature. The results of the study showed that the self-regulation scale consists of two dimensions: "forethought" and "volitional control and self-reflection". In this respect, it can be said that the research supports the literature. The unique result obtained in the study was that the items related to volitional control and self-reflection skills were collected in the same dimension. This may be due to the student's inability to fully distinguish between process and outcome self-regulation skills. In other words, students may not be able to distinguish between process and outcome evaluations. As a result of the research, a valid and reliable measurement tool was developed to measure the self-regulation skills of middle school students. English and Turkish versions of the scale form are presented in the Appendix.

Within the scope of the study, an item pool was first created. In order to write the scale items, a literature review was conducted, and the scales and studies in the literature were utilized (Arslan & Gelişli, 2015; Bandura, 1991, 2002; Diehl et al., 2006; Eryılmaz & Mammadov, 2017; Graham et al., 2005; Kröner et al., 2017; Pintrich & De Groot, 1990; Sarikaya & Sökmen, 2021; Sarikaya & Yılar, 2021; Schunk, 2005; Schunk & Zimmerman, 1994; Zimmerman, 2000, 2002). The items were then submitted to expert opinion in terms of content, language, and face validity. Then, the suitability of the data set for analysis was tested, and extreme data were removed from the data set. The scale was administered to 341 middle school students for EFA and 218 middle school students for CFA. Comrey and Lee (1992) and Field (2013) state that 100 is a poor sample size, 200 is a fair sample size, 300 is a good sample size, 500 is a very good sample size, and 1000 is an excellent sample size in factor analysis studies. Considering the number of participants in the study, it can be concluded that the sample sizes are good and average. Before EFA, the item correlation matrix, R-matrix determinant coefficients, and anti-image values were analyzed. Field (2013) states that item correlation values between .30 and .90 are a criterion for the suitability of the data set for analysis. The findings of the present study reveal that the item correlation values are within the aforementioned range. Field states that multicollinearity is not a major problem in scale development but suggests that this situation should be checked. For this reason, R-matrix determinant coefficients were checked, and it was

seen that these values were greater than 0.01. This shows that there is no multicollinearity among the items. In addition, the values in the anti-image table were found to be at the ideal level (>.50) (Durmuş et al., 2013). The KMO test result (.830), which shows the adequacy of the sample size, reveals that the data set is large enough for analysis. Pallant (2001) states that this value should be .60 and above. The result of Barlett's test of sphericity was also significant, indicating that the data set was suitable for factor analysis. Consequently, factor analysis was performed using direct oblimin rotation to assess the construct validity of the scale based on the obtained data.

In the EFA findings, the rates of each item explaining the variance in a factor loading together were examined. Kalaycı (2009) stated that removing variables with low factor loadings from the analysis will increase the overall explained variance. Accordingly, the items in the trial form with a factor loading less than .40 were removed from the analysis, and the factor analysis was conducted again. The extraction values of the items (.419-.622) indicate a satisfactory level. After this stage, the item factor loading values and the distribution of the items to the factors were analyzed. In item factor loading values, the common factor loading value is in favor of .30 and above; however, weights of .50 and above are considered quite good (Field, 2013; Kalaycı, 2009; Tavşancıl, 2014). In this direction, it was paid attention that the item factor loading value was .50 and above (.49-.82). Therefore, it can be concluded that the factor loading values of the scale items are highly satisfactory. Within the scope of the study, items that were found to be overlapping items were removed from the form. As a result of all these analyses, EFA was repeated, and a structure consisting of nine items and two sub-dimensions was obtained, explaining approximately 51% of the total variance. Kline (1994) emphasizes that the variance explained by the measurement tool should be at least 40%; Henson and Roberts (2006) emphasize that it should be 52%. Given these criteria, the variance explained in this study can be considered sufficient. A high, positive and significant relationship was found between the scale's perceived self-regulation scale (Arslan & Gelişli, 2015) used for criterion validity. This result provides evidence for the validity of the general self-regulation scale developed within the scope of the study.

The correlation value between the factors of the scale was analyzed (r=.533, *p*=000). A correlation coefficient of .90 and above between sub-dimensions is not recommended because it may indicate a multicollinearity problem (Field, 2013; Pallant, 2001). These data show that there are significant relationships between the sub-dimensions of the scale and that there is no multicollinearity problem. In addition, based on the findings, it can be said that each sub-factor measures a separate feature. The reliability analysis findings of the scale also provide evidence that the scale will provide reliable measurements (Fornell & Larcker, 1981).

The fit of the structure obtained from EFA was assessed using CFA. The chi-square fit index was found to be significant, indicating the need to examine other fit indices. The X^2/df value, which was calculated to assess model fit, was less than 2.5. According to Kline (2005), a value below 2.5 suggests excellent fit for the structure. Furthermore, Schumacker and Lomax (2004) and Kline suggested that the SRMR, NNFI, CFI, and IFI values demonstrate excellent fit, while the RMSEA, RMR, NFI, and RFI values indicate an acceptable fit. The R^2 values of the scale items provide insight into the contributions of each item to the model. Additionally, the item-total correlation values were found to be .40 or above. Büyüköztürk (2007) suggests that these values should be at least .30 or higher in order to effectively distinguish the feature being measured. Therefore, it can be concluded that the item-total correlation values indicate a good fit for the model. Similarly, the t values of the items confirm that each item aims to measure a distinct characteristic.

The scale has two sub-dimensions: "forethought" and "volitional control and self-reflection". While naming the sub-dimensions, the structure and characteristics of the items were taken into

consideration as suggested by Kalaycı (2009). The first item of the "forethought" sub-dimension is related to goal setting. Many researchers emphasize that goal setting is a critical self-regulation skill and takes place in the forethought stage (Flower & Hayes, 1981; Pintrich, 2000; Wong et al., 2021; Zimmerman, 2000; Zimmerman & Risemberg, 1997). Schunk (1996, 2003) considers goal setting as an important factor that initiates self-regulation processes. The second item is related to strategizing. Wood and Bandura (1989) state that strategy development exists both at the beginning (forethought) and at the self-evaluation stage of the self-regulation process. There are researchers who state that strategy development is a critical self-regulation behavior (Bereiter & Scardamalia, 1983; De Smedt et al., 2018; Zimmerman, 2000). The third item involves creating a study plan. Planning skill is also related to strategy development skill. Researchers state that individuals with high levels of self-regulation skills plan frequently, check their plans, and revise their plans when necessary (Graham & Harris, 2005; Zimmerman & Kitsantas, 2007). Wong et al. (2021) report that planning is related to self-regulation skills and is an important factor in developing self-regulation skills. The last item of the forethought factor is related to the behavior of sticking to the plan. This is related to individuals' maintaining their motivation and self-efficacy beliefs (Graham et al., 1998; Raphael et al., 1988). The effect of motivation and self-efficacy beliefs on the self-regulation process is undeniable (Agustiani et al., 2016). As a matter of fact, Bandura (1993) and Schunk (2003) report that one of the most important sensory characteristics in the self-regulation process is self-efficacy belief. Malmivuori (2006) and Su et al. (2018) state that individuals with strong self-efficacy use self-regulation skills more actively. In this context, it can be stated that each of the scale items in the "forethought" sub-dimension requires self-regulation skills and are critical skills for determining general self-regulation skills. In this direction, it can be stated that the current study supports the literature.

When the items in the "volitional control and self-reflection" dimension are examined, it can be seen that there are items that include sensory characteristics such as motivation, attention, focus and time control. The first item is related to the willingness to learn. This item focuses on the individual's motivational processes. Researchers state that there is a strong relationship between self-regulation and motivation (Bandura, 1993; Op't Eynde et al., 2007; Li et al., 2022; Yu et al., 2022). The second item is about paying attention, and the third item is about focusing behaviors. Hanif et al. (2012) state that attention regulation includes self-regulation. Studies reveal the positive effect of attention and focus on self-regulation and report that individuals with high self-regulation are able to control attention and focus on their work (Berger et al., 2007; Koopmann et al., 2019; Posner & Rothbart, 2009; Sassenberg & Woltin, 2008; Turcotte et al., 2022). The last two items of the "volitional control and self-reflection" sub-dimension are related to time control and time rescheduling. Time control is a critical self-regulation behavior. Pajares and Johnson (1994) and Zimmerman and Risemberg (1997) state that effective management and planning of time is included in the personal processes sub-dimension of self-regulation. Indeed, individuals with high self-regulation who set goals and develop strategies are expected to be successful in time management (Sarikaya & Yılar, 2021). Harris and Graham (1996) also report that using time effectively and avoiding wasting time are self-regulation skills related to temporal factors. As can be seen, it is clear that each item that constitutes the dimension of "volitional control and self-reflection" is associated with self-regulation skills in the literature. In this direction, it can be stated that the findings support the literature.

4.1. Recommendations and Contributions to Education

As a result, it was determined that the scale developed was sufficiently reliable both on a general basis and on the basis of factors. It was concluded that the items of the scale could measure the trait that it aims to measure and can distinguish between individuals who have the trait targeted

to be measured and individuals who do not have it. The scale can be applied to all middle school students studying at different grade levels. The scale can be used in different studies to contribute to its validity and reliability. In addition, a primary school form of the scale can also be created based on the basic self-regulation skills included in the scale items. For this purpose, validity and reliability studies can be conducted again, and the compatibility between the two scales can be revealed.

Acknowledgments

This work was financially supported by the Scientific and Technological Research Council of Turkey (TÜBİTAK) under grant number 121K859.

Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors. **Ethics Committee Number**: Bayburt University, E-51694156-050.99-36868).

Authorship Contribution Statement

Ismail Sarikaya: Investigation, Resources, Visualization, Software, Formal Analysis, and Writing-original draft. **Mesut Ozturk**: Visualization, Software, Methodology, Supervision, and Validation. **Mustafa Ozgol:** Methodology, Supervision, and Validation.

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APPENDIX

Turkish and English versions of the scale

Self-Regulation Scale for Middle School Students

Items	Never ever	Rarely	Sometimes	Usually	Always
1. I set my goals before I start working.					
2. I strategize how I will learn before I start working.					
3. I create a work plan.					
4. I try to stick to my plan.					
5. I can make myself willing to learn.					
6. I focus my attention on the work.					
7. I focus on what I do.					
8. I check whether I have enough time.					
9. I can reschedule time according to the disruptions in the process.					

Ortaokul Öğrencileri İçin Öz-Düzenleme Ölçeği

Maddeler	Hiçbir zaman	Ara sıra	Bazen	Genellikle	Her zaman
1. Çalışmaya başlamadan önce hedeflerimi belirlerim.					
2. Çalışmaya başlamadan önce nasıl öğreneceğime ilişkin stratejiler oluştururum.					
3. Çalışma planı oluştururum.					
4. Planıma sadık kalmaya çalışırım.					
5. Kendimi öğrenmeye istekli hale getirebilirim.					
6. Dikkatimi çalışma konusuna veririm.					
7. Yaptığım işe odaklanırım.					
8. Yeterli zamanımın olup olmadığını kontrol ederim.					
9. Süreçte çıkan aksaklıklara göre zamanı yeniden planlayabilirim.					