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A MATHEMATICAL PROBLEM-SOLVING PERCEPTION SCALE FOR SECONDARY SCHOOL STUDENTS: A VALIDITY AND RELIABILITY STUDY

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Abstract

Determining students' perceptions of problem-solving is an important step to improve their mathematical problem-solving skills. For this reason, the aim of this study was to develop a scale to determine secondary school students' perceptions of mathematical problem solving. In the study conducted in a basic research model, a scale application, one of the quantitative research methods, was used. The sample of the study consisted of 325 secondary school students. Validity and reliability analyses were made with the data obtained on the sample. Five sub-dimensions of the scale were determined through exploratory factor analysis. Confirmatory factor analyses were performed for these 5 sub-dimensions, and the fit indices were found to range from acceptable to excellent. The explained variance of the "Mathematical Problem-Solving Perception Scale" was 66.15%, and the Cronbach alpha value for the whole scale was .93. It was concluded that the scale would reveal the perception levels of secondary school students towards mathematical problem solving in a valid and reliable way.
Keywords: *mathematics, perception, problem solving, scale development, secondary school students*

Introduction

Besides the ability to acquire and learn mathematical knowledge, it is of great importance for the individual to be able to use this mathematical knowledge in solving various problems he/she encounters. In the 21st century, with the development of technologies for accessing information, it has become easier to obtain information and the need for information to be readily available to the individual has decreased. Instead, the importance of determining solutions for problems that are encountered and of putting these solutions into practice has increased. In addition, nowadays, in accordance with the philosophy of progressive education (Dewey, 1997) arising from the philosophical movement of pragmatism, which affects education systems, the view is widespread that the individual's possession of information that he/she will rarely or never use throughout his/her life will not provide him/her with any benefit. According to this view, it is considered important to develop the ability to cope with situations and problems that an individual may encounter throughout his/her life. Therefore, it is of great importance that individuals are equipped with problem-posing and problem-solving skills in the education process.

Rather than raising individuals who accept ready-made knowledge by memorizing it, knowledge societies aim to raise individuals who know how to put learning into practice, what and how to learn and where to use this learning, and who can produce new knowledge based on this information (Güven & Kürüm, 2008). Accordingly, in today's knowledge societies, problem-solving skills are among the most important skills that individuals need to acquire in

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their educational life. Problem-solving skills have an important place not only for the education lives of individuals, but also for their whole lives. By using problem-solving skills, individuals can overcome all kinds of problems that they may encounter during their lives.

A problem is the conflict that an individual experiences when he/she is prevented from achieving a goal (Morgan, 1995). Olkun and Toluk (2004) define problems as situations which awaken the desire in a person to solve them, but which, because the solution procedure is not ready, the person can solve by using his/her knowledge and experience. For an individual to solve a problem that he/she encounters, he/she should be able to use basic problem-solving skills such as the ability to establish relationships and differences between concepts, to think algorithmically, and to analyse and approach the problem from different perspectives. These skills constitute the individual’s problem-solving skills as a whole. Therefore, one of the main goals of education and training programmes is to raise individuals who can keep pace with the age they live in and solve the problems they encounter in a beneficial way. Accordingly, it can be said that organising curriculum development efforts in a way that focuses on the objectives for problem-solving skills will contribute to the development of the individual and society.

The general trend in mathematics teaching in Türkiye in recent years has been to give weight to problem-solving and problem-posing activities, and to frequently use problem-based instruction and cooperative teaching approaches (Ministry of National Education [MoNE], 2022). Therefore, it can be said that problem posing is not the next step after problem solving, but that there is a spiral relationship between them rather than a hierarchical one. The implementation of problem-solving and problem-posing activities in mathematics teaching within the framework of this spirality can make the process more efficient and effective.

In mathematics teaching, the individual’s analysis of events within the framework of logic, establishment of cause-effect relationships, and determination and implementation of the necessary process steps are among the learning outcomes of the mathematics curriculum (MoNE, 2022). Since these stated outcomes are directly addressed in problem-solving instruction, it can be said that it is important to include studies that focus on problem-solving skills in mathematics teaching in the literature. The goal of contemporary education systems should be to raise individuals with advanced problem-solving skills (Bayazit & Aksoy, 2010). Therefore, it is important for the individual to be trained in order to produce knowledge throughout his/her education life and to find solutions to problems he/she will encounter by producing new knowledge.

The skills of reasoning, estimation, analysis, synthesis, and evaluation, which are metacognitive skills, are target behaviours included in problem-solving and problem-posing instruction. It is possible to find a solution to a commonly encountered mathematical problem by associating it with a problem with previously known solutions. However, the individual’s ability to find a solution to a problem unlike any that he/she has encountered before can be achieved by applying the steps of separating the components of that problem, making a plan, implementing the plan appropriately and describing what he/she has achieved. It is possible to foster the metacognitive skills included in these steps by teaching mathematical problem solving and problem posing.

Students’ perceptions of problem solving have an active place in any kind of study to be made for developing students’ mathematical problem-solving skills. For this reason, it is important for studies to be made to determine the level of students’ perceptions towards problem solving. In the literature, there are measurement tools that measure students' attitudes towards mathematics (Eskici et al., 2017; Gülburnu & Yıldırım, 2021; Tezer & Özcan, 2015), their attitudes towards problem solving in mathematics lessons (Aydın, 2020), and their perceptions towards social problem solving (Hawkins et al., 2009). However, there is no scale in the literature that aims to determine students' problem-solving perceptions in mathematics lessons. Therefore, it can be said that the scale developed in this study has unique value for the literature. In addition, it can be said that the reason for the limited number of studies in the literature that investigate students' mathematical problem-solving perceptions (Ersoy, 2022) is due to the absence of a measurement tool that reveals secondary school students' perceptions of problem solving. In line with this need, the "Mathematical Problem-Solving Perception Scale" developed by the researchers aims to determine the mathematical problem-solving perceptions of secondary school students.

Research Methodology

Model

This study, whose aim was to develop a valid and reliable measurement tool that will determine secondary school students' perceptions of mathematical problem solving, was prepared in a basic research model. In the research, 5-point Likert-type scale development, validity and reliability studies were carried out.

Population and Sample

In order to ensure the construct validity of the perception scale consisting of 33 items, which was prepared by the researcher and whose content validity was ensured by obtaining expert opinion, a pilot study was conducted. A total of 2412 secondary school students studying in Antalya, Türkiye, made up the population of the study. Due to the COVID-19 measures, the pilot implementation was carried out in the online environment because the students could not be found in face-to-face education. In all, 325 secondary school students were included in the pilot study with the simple random sampling method. According to Balcı (2018), in the simple random sampling method, it is independently and equally likely that each sub-unit of the population with which the study is conducted will be the research sample. With the data obtained, exploratory factor analyses (EFA) and confirmatory factor analyses (CFA) were performed within the scope of the construct validity studies.

The sample consisted of 325 secondary school students who participated in the pilot implementation in the specified population of the study in the fall semester of 2021-2022. The demographic information of the secondary school students included in the sample is given in Table 1.

Table 1
Information on the Sample of the Pilot Implementation Study for the Mathematical Problem-Solving Perception Scale

		Number *(f)*	Percentage *(%)*
Gender	Female	180	55
	Male	145	45
Grade	5th Grade	50	16
	6th Grade	77	24
	7th Grade	99	30
	8th Grade	99	30
Type of Secondary School Attended	General Secondary School	291	89
	İmam Hatip Secondary School	11	4
	Regional Boarding Secondary School	3	1
	Private Secondary School	20	6

As seen in Table 1, among the secondary school students included in the research sample, 180 (55%) were girls and 145 (45%) were boys. Fifty (16%) of the students were in 5th grade, 77 (24%) were in 6th grade, 99 (30%) were in 7th grade, and 99 (30%) were in 8th grade. Among the types of schools they attended, 291 (89%) were general secondary schools, 11 (4%) were imam hatip secondary schools, 3 (1%) were regional boarding secondary schools, and 20 (6%) were private secondary schools.

Measurement Tool

In this study, a “Mathematical Problem-Solving Perception Scale” was developed for secondary school students. In the study, the process of seeking answers to the question “What are secondary school students’ perceptions about learning problem-solving skills in mathematics?” was begun with a literature review. As a result of the literature review, the item pool was discussed within the scope of the following sub-dimensions: Students’ perceptions of willingness and voluntariness, perceptions of fear and hesitation, and perceptions of importance and value related to mathematical problem-solving skills.

In the sub-dimensions stated above, the scale items were created for the feeling of happiness, the feeling of fun and pleasure, the feeling of insistence and determination for success, the feeling of sadness and distress, the feeling of interest, the feeling of fear and hesitation (avoidance), the feeling of giving up, and the feeling of pride. Opinions were obtained about the appropriateness of the prepared items by two experts from the department of curricula and instruction and by one expert from the department of measurement and evaluation in education. In line with these opinions, the scale items were finalised. The “Mathematical Problem-Solving Perception Scale” includes statements graded on a 5-point Likert-type scale in the form of (1) “Strongly disagree”, (2) “Disagree”, (3) “Undecided”, (4) “Agree”, and (5) “Strongly Agree”.

Data Collection Tool

The pilot implementation of the “Mathematical Problem-Solving Perception Scale” was made online via a website opened by the researcher. After obtaining the necessary permission from the Antalya Provincial Directorate of National Education, students who volunteered to respond to the scale were enabled to complete the scale online via the specified website.

Data Analysis

For data reliability, the results of the Cronbach alpha test, and for EFA, the results of the Bartlett test and Kaiser-Meyer-Olkin (KMO) test were examined. In the EFA, items with overlapping factor loadings were removed and Varimax rotation analyses were repeated. CFA was performed on 24 items and 5 sub-dimensions obtained as a result of the EFA and fitted t-values were obtained. These analyses were carried out with the SPSS 23.0 and LISREL 8.8 software programs.

Research Results

Model

Exploratory factor analysis (EFA): Prior to the EFA, which was carried out to ensure the construct validity of the problem-solving perception scale, the Bartlett test of sphericity was performed, and the KMO value was found to determine the suitability of the data obtained from the sample. As a result of the analysis, it was determined that the KMO value (0.905) was greater

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than 0.60, and it was concluded that the data were suitable for factorisation (Büyüköztürk, 2018).

When the factor loadings obtained with the varimax rotation technique were examined, it was determined that the factor loadings were above 0.40, and that there were 7 items with high loading values in more than one factor and the difference between these values was below 0.1. After assessing whether these items would cause a significant loss in terms of content validity of the scale, the items, which were determined to be overlapping, were removed from the scale. After the determined items were removed from the scale, EFA was repeated on the remaining 24 items. As a result of the analysis, a five-factor structure with an eigenvalue greater than 1 and representing the theoretical structure was obtained. The data obtained as a result of the factor rotation are given in Table 2.

Table 2
Final Factor Rotation Results

Items	Factor-1	Factor-2	Factor-3	Factor-4	Factor-5
Item-19	.831				
Item-28	.830				
Item-31	.799				
Item-33	.762				
Item-8	.745				
Item-18	.741				
Item-15	.721				
Item-27	.706				
Item-23	.650				
Item-24		.743			
Item-20		.701			
Item-22		.675			
Item-25		.658			
Item-16		.604			
Item-21			.752		
Item-10			.723		
Item-12			.713		
Item-11			.685		
Item-1				.827	
Item-2				.820	
Item-6				.621	
Item-3				.591	
Item-26					.827
Item-13					.757

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When the factor rotation results given in Table 2 are examined, it can be seen that items 19, 28, 31, 33, 8, 18, 15, 27 and 23 are in the 1st factor, items 24, 20, 22, 25 and 16 are in the 2nd factor, items 21, 10, 12 and 11 are in the 3rd factor, items 1, 2, 6 and 3 are in the 4th factor, and items 26 and 13 are in the 5th factor. In the literature, there is a common view that the number of items in the dimensions should be at least two (Çokluk et al., 2012). Therefore, it was determined that the number of items in the factors included in the scale was appropriate. Among the items divided into sub-dimensions as a result of the EFA, items 8, 13, 15, 18, 19, 23, 26, 27, 28, 31 and 33 contain statements expressing negative perceptions. The other scale items refer to positive perceptions.

The sub-dimensions of the scale are named: (1) Fear and hesitation towards problem solving, and becoming distressed in problem-solving activities, (2) Showing interest in problem solving in class and feeling proud because of this, (3) Interest in problem-solving activities outside of class and feeling happy because of this, (4) Willingness for problem-solving activities in class and feeling happy because of this, and (5) Giving importance to problem-solving activities.

Confirmatory factor analysis (CFA): CFA were conducted to check the construct validity of the 5 sub-factors obtained as a result of the EFA of the problem-solving perception scale. CFA is a type of analysis that should be used in the scale development process to examine the latent structure of a measurement tool (Brown, 2006).

Using the data collected from the study group, first-order CFA was performed to test whether the structure consisting of 24 items and five factors obtained from the EFA was confirmed. Regarding the obtained fit indices, the generally accepted "excellent fit criteria" and "acceptable fit criteria" regarding goodness-of-fit in the literature (Kline, 2011; Schumacker & Lomax, 2010; Tanaka & Huba, 1985) were taken into account. The fit index values obtained from the CFA and the results that emerged in this direction are given comparatively in Table 3.

Table 3
Fit Indices Obtained from CFA

Fit Index	Excellent Fit Measures	Acceptable Fit Measures	Measure	Result
$\chi2/df$	$0 \leq \chi2/df \leq 2$	$2 \leq \chi2/df \leq 5$	3.12	Acceptable
GFI	.95 ≤ GFI ≤ 1.00	.85 ≤ GFI ≤ 95	.85	Acceptable
CFI	.97 ≤ CFI ≤ 1.00	.95 ≤ CFI ≤ .97	.95	Acceptable
NFI	.95 ≤ NFI ≤ 1.00	.90 ≤ NFI ≤ .95	.93	Acceptable
NNFI	.97 ≤ NNFI ≤1.00	.95 ≤ NNFI ≤ .97	.95	Acceptable
IFI	.95 ≤ IFI ≤ 1.00	.90 ≤ IFI ≤ .95	.95	Excellent
RMSEA	.00 ≤ RMSEA ≤ .05	.05 ≤ RMSEA ≤ .10	.081	Acceptable
SRMR	.00 ≤ SRMR ≤ .05	.05 ≤ SRMR ≤ .10	.065	Acceptable
AGFI	.95 ≤ AGFI ≤ 1.00	.50 ≤ AGFI ≤ .95	.68	Acceptable

When the fit indices obtained as a result of the CFA in the study are examined, it can be seen that they are: $\chi2/df$ = 3.12 ($2 \leq \chi2/df \leq 5$) "Acceptable", GFI = .85 (.85 ≤ GFI ≤ .95) "Acceptable", CFI = .95 (.95 ≤ CFI ≤ .97) "Acceptable", NFI = .93 (.90 ≤ NFI ≤ .95) "Acceptable", NNFI = .95 (.95 ≤ NNFI ≤ .97) "Acceptable", IFI = .95 (.90 ≤ IFI ≤ .95) "Excellent", RMSEA = .081 (.05 ≤ RMSEA ≤ .10) "Acceptable", SRMR = .065 (.05 ≤ SRMR ≤ .10) "Acceptable", and AGFI = .68 (.50 ≤ PGFI ≤ .95) "Acceptable". One of the fit criteria not included in the table is the "critical N" value, in which the adequacy of the research sample is

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evaluated. In SEM, a sample size of 200 or more is accepted as an indicator of adequate model fit in terms of the critical N statistic (Bollen, 1989). Therefore, it can be said that the sample size of 325 used in the research was adequate (Çelik & Yılmaz, 2016).

When the RMSEA descriptive fit index, which is based on the difference between the estimated covariance matrix for the model and the sample covariance matrix, was evaluated, it was determined that the model showed an acceptable fit. When the other fit criteria are considered, it is seen that the model is significant as a whole. The factors of the CFA model, the factor loads, and the t-values of the items are given in Table 4.

Table 4
Factors, Factor Loads, and t-values of Items in the CFA Model

	Factor-1	Factor-2	Factor-3	Factor-4	Factor-5	
Item	CFA	CFA	CFA	CFA	CFA	*t*-value
8	1.08					14.50
15	1.06					15.40
18	1.04					14.53
19	1.18					16.84
23	1.01					13.89
27	1.04					14.69
28	1.13					17.33
31	1.18					16.71
33	1.18					16.16
16		.74				12.01
20		.83				11.66
22		.87				14.59
24		.80				12.51
25		.99				16.02
10			1.02			19.33
11			1.07			19.42
12			.81			18.36
21			.81			12.65
1				.99		20.35
2				1.00		20.27
3				.72		12.13
6				.59		10.51
13					1.13	8.70
26					.79	7.28

As can be seen in Table 4, “it is significant at the level of 0.05 if the t-value exceeds 1.96, and at the level of 0.01 if it exceeds 2.56” (Schumacker & Lomax, 2010). Meaningless ones should be removed from the scale.

Reliability

The item-total correlations of the items in the scale are calculated in Table 5.

Table 5
Item-Total Correlation Coefficients

Item	Item-Total Correlation	Item	Item-Total Correlation
Item-1	.629	Item-19	.647
Item-2	.603	Item-20	.516
Item-3	.629	Item-21	.574
Item-6	.306	Item-22	.665
Item-8	.479	Item-23	.415
Item-10	.693	Item-24	.451
Item-11	.664	Item-25	.692
Item-12	.571	Item-26	.618
Item-13	.678	Item-27	.590
Item-15	.595	Item-28	.570
Item-16	.419	Item-31	.462
Item-18	.601	Item-33	.516

As can be seen in Table 3, as a result of the item-total correlation analysis, it was determined that the item factor loadings of the scale were higher than the accepted cut-off value of .30 (Büyüköztürk, 2018).

Cronbach's alpha reliability test was used for the reliability analysis of the 5 sub-dimensions obtained as a result of the EFA. The results of the Cronbach's alpha reliability analysis of the total scale and its sub-dimensions are given in Table 6.

Table 6
Internal Consistency (Reliability) Coefficients of the Total Scale and its Sub-dimensions

Sub-Dimension (Factor)	Cronbach's Alpha
1st Factor	.920
2nd Factor	.817
3rd Factor	.857
4th Factor	.828
5th Factor	.610
Total Scale	.938

As can be seen in Table 6, the Cronbach's alpha coefficient, which shows the internal consistency of the scale, is .938 for all items, while according to the sub-dimensions, it takes values between .920 and .610. According to the obtained findings, it was determined that the measurements obtained for the total scale were highly reliable (Özdamar, 2004).

Correlation Values between Factors

The correlation values between the sub-dimensions of the problem-solving perception scale are given in Table 7.

Table 7
Correlation Coefficients Between Factors

Factors	Factor-1	Factor-2	Factor-3	Factor-4	Factor-5
1st factor	1	.301**	.422**	.328**	.349**
2nd factor	.301**	1	.647**	.647**	.094*
3rd factor	.422**	.647**	1	.612**	.096*
4th factor	.328**	.647**	.612**	1	.084
5th factor	.349**	.094*	.096*	.084	1

As can be seen in Table 7, the correlation coefficient between the 5th factor and the 2nd factor is $r = .094$ ($r < .30$), the correlation coefficient between the 5th factor and the 3rd factor is $r = .096$ ($r < .30$) and the correlation coefficient between the 5th factor and the 4th factor is $r = .084$ ($r < .30$), while the correlation values between the other factors vary in the range of $.30 < r < .80$. The fact that the correlation coefficient is between .30 and .80 indicates the expected level of correlation between the sub-dimensions of the scale (Büyüköztürk, 2018). On the other hand, since the correlation coefficient between the 5th factor and the 2nd, 3rd and 4th factors was not in the range of $.30 < r < .80$, and by considering that the reason for the low correlation between the 5th sub-dimension and the other sub-dimensions might be that the scale items were not fully understood by the sample, it was decided to conduct a second pilot study. The expressions included in the 13th and 26th items, which were thought to be the reason for the low correlation of the sub-dimension named "Giving importance to problem-solving activities" with the other sub-dimensions, were corrected. In the second pilot implementation of the perception scale, the 13th and 26th items were included as follows:

Item 13 (previous form): I do not mind whether a large number of problem-solving activities are included in the mathematics lesson.

Item 13 (latter form): I do not mind whether more or fewer problem-solving activities are included in the mathematics lesson.

Item 26 (previous form): I do not mind whether there are problem-solving questions in the exams I will take.

Item 26 (latter form): I do not mind whether there are a few or a lot of problem-solving questions in the exams I will take.

The sample of the second pilot implementation, which was determined by convenience sampling, consisted of 252 secondary school students studying at a secondary school in Antalya.

As a result of the second pilot implementation, the same factor structure was confirmed, and it was again verified that the scale was valid and reliable. Correlation analysis was also repeated to determine the levels of correlation between the sub-dimensions of the scale. The findings obtained as a result of the analysis are given in Table 8.

Table 8
Correlation Coefficients between the Sub-dimensions of the Scale According to the Second Pilot Study

Factors	Factor-1	Factor-2	Factor-3	Factor-4	Factor-5
1st factor	1	.380**	.495**	.453**	.636**
2nd factor	.380**	1	.655**	.658**	.523**
3rd factor	.495**	.655**	1	.594**	.549**
4th factor	.453**	.658**	.594**	1	.568**
5th factor	.636**	.523**	.549**	.568**	1

As can be seen in Table 8, it was determined that the correlation values between the sub-dimensions of the scale ranged between $.30 < r < .80$. Accordingly, it can be said that the correlations between the sub-dimensions of the scale are significant and acceptable (Büyüköztürk, 2018).

Discussion

In this study, a scale was developed to determine the perception levels of secondary school students towards mathematical problem solving. In the literature, numerous measurement tools have been developed to determine students’ attitudes towards mathematical problem solving and the effects of these attitudes on their academic achievement (Aydın, 2020; Russo & Minas, 2020). However, the great majority of these studies consists of achievement tests aimed at problem-solving (Fidan, 2008; Turhan, 2011). Students' attitudes towards problem-solving in different courses were also explored (Erdemir, 2009; Mason & Singh, 2016). In the Adesoji’s (2017) study, the effect of problem-solving strategies on students’ attitude toward chemistry was investigated. As a result of the study, it was suggested that teachers adopt problem solving strategies in their chemistry teaching. On the other hand, scales for determining students’ social problem-solving skills can also be found in the literature (Hawkins et al., 2009; Yaman & Dede, 2008). Ekici and Balım (2013) conducted a scale development study to determine the general problem-solving perceptions of secondary school students. The scale they developed differs from the scale in this study in that it aims to determine individuals’ perceptions about solving the problems they encounter in their lives.

The sub-dimensions of the “Mathematical Problem-Solving Perception Scale”: Fear and hesitation towards problem solving, showing interest in problem solving in class, interest in problem-solving activities outside of class, willingness for problem-solving activities in class, and giving importance to problem-solving activities. In the fear and hesitation dimension, which is the first sub-dimension of the perception scale for mathematical problem solving, the perception of fear and hesitation that students feel during problem-solving activities in lessons, and the levels of distress associated with these, are measured. Indeed, in studies in the literature, it is reported that the subject of mathematics creates fear and anxiety in students (Alkan, 2011; Keklikçi & Yılmazer, 2013; Öztop & Toptaş, 2017). Ufuktepe (2009) stated that factors related to the subject were effective in the emergence of fear of mathematics in students, and that students' thinking processes were interrupted due to the stress they experienced especially in solving mathematical problems.

In the in-class interest dimension, which is the second sub-dimension of the scale, the students' perception levels of being interested in problem-solving activities in class and feeling proud of themselves due to their success in the activities, are measured. In studies investigating students' attitudes towards the subject of mathematics in the literature (Altuntaş & Erişen, 2021; Uygun, 2010), the subject of mathematics and the problem-solving process were considered together, and it was stated that students' perceptions of problem solving in mathematics lessons affected their interest in and enjoyment of the lessons.

In the dimension of extracurricular interest, which is the third sub-dimension of the scale, students' level of interest in studies outside the classroom, such as problem-solving homework and projects, is measured. Problem-solving skills are considered important in order to be successful in daily life as well as in mathematics class (Özcan, 2016). For this reason, directing students' problem-solving process towards extracurricular activities may be beneficial in terms of increasing students' achievement in class and problem-solving success in life. Similarly, students' perceptions of their extracurricular problem-solving responsibilities, as well as their perceptions of taking part in problem-solving activities in class, can play a decisive role in their success in the subject and in life. Studies revealing that students have positive attitudes towards solving mathematical problems (Özgen et al., 2017; Taşpınar, 2011) also report that students' encounters with mathematical problems in their daily lives and their beliefs in the benefit and necessity of problem solving are effective. For this reason, in the willingness and giving importance sub-dimensions of the scale, students' desire to participate willingly in in-class problem-solving activities and the level of importance they attach to problem-solving activities in the learning process are measured.

Conclusions

Determining students' perceptions of problem-solving is an important step to improve their mathematical problem-solving skills. For this reason, in this study, the "Mathematical Problem-Solving Perception Scale" was developed to determine secondary school students' perceptions of mathematical problem solving. The trial form of the 33-item scale was implemented with the participation of 325 secondary school students studying in the determined population. Following EFA and reliability analysis, 9 items were removed from the scale. CFA was also performed for 24 items and 5 sub-dimensions. The correlation between the sub-dimensions was examined, but the correlation of one sub-dimension with the other sub-dimensions was found to be low. For this reason, a second application was made in a different sample consisting of 252 secondary school students. In line with the analyses made, it was calculated that the "Mathematical Problem-Solving Perception Scale" consisted of five factors, the explained variance was 66.15%, and the Cronbach alpha value for the whole scale was .93. Consequently, it was concluded that the scale would reveal the perception levels of secondary school students towards mathematical problem solving in a valid and reliable way.

The study contains some limitations. Although the sample size is adequate, it was prepared only for secondary school students. Considering that mathematical problem solving is important for students studying at all levels, it can be recommended that similar scales suitable for different education levels be developed. Moreover, the study includes only quantitative data. It can be said that the findings obtained from this scale development study can be supported by studies based on the interview method, with the aim of determining students' perceptions about problem solving.

For the future studies, it can be recommended to develop the Mathematical Problem-Solving Perception Scale on different education levels. The scale can be used in descriptive studies to reveal students' current situation regarding mathematical problem-solving perceptions. Moreover, it can be suggested that the scale be used as a data collection tool in experimental research to improve students' mathematical problem-solving perceptions.

Note

This study was produced from the master's thesis of the first author.

Research and Publication Ethics Statement

The study was approved by "Akdeniz University Rectorate Social and Human Sciences Scientific Research and Publication Ethics Committee" (Date: 31.12.2020; Number: 138704). The authors declare no competing interest.

Declaration of Interest

The authors declare no competing interest.

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