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A Study on the Awareness of the Teachers Working in Special Education Schools towards Mathematical Problem-Solving Process

Sedat TURGUT[a], Özlem DOĞAN TEMUR[b], Mahir UĞURLU[c*]

a Dr., Bartın University (http://orcid.org/0000-0002-6612-9320)

b Prof. Dr., Kütahya Dumlupınar University (http://orcid.org/0000-0002-1877-0973)

c*Res.Asst., Bartın University (http://orcid.org/0000-0003-4005-4882) *mahirugurlu34@hotmail.com

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ABSTRACT

This study aims to examine the awareness of teachers working in special education schools towards mathematical problem-solving process. The study was carried out in two stages. In the first stage of the study, a scale was developed for the awareness of problem-solving process. The draft scale form was administered to 215 teachers working in special education schools. In order to determine the structural integrity of the scale, exploratory factor analysis (EFA) was conducted for the data obtained. The findings of the EFA indicated that the scale, which contains twenty-nine items, has a three-factor structure. It was calculated that the three factors explained 52.40% of the total variance. The Cronbach's alpha value of the scale is .93. The three-factor structure revealed by EFA was tested with confirmatory factor analysis (CFA). As a result of CFA, it was calculated as SRMR=.06, RMSEA=.06, CFI=.90, IFI=.90. In the second stage of the study, the teachers' awareness of mathematical problem-solving process was examined in terms of several variables. For this purpose, the scale was administered to 181 teachers working in special education schools. As a result of the analysis of the obtained data, there is no statistically significant in teachers' awareness of mathematical problem-solving process in terms of their gender and professional seniority; however, there is a statistical significance in terms of the variables such as graduation, the school and the group taught. The results were interpreted based on the previous studies in the literature.

Keywords: Special needs education, mathematics instruction, problem-solving, awareness, scale

Özel Eğitim Okullarında Görev Yapan Öğretmenlerin Matematiksel Problem Çözme Sürecine Yönelik Farkındalıkları Üzerine Bir Araştırma

Öz

Bu araştırmada özel eğitim okullarında görev yapan öğretmenlerin matematiksel problem çözme sürecine yönelik farkındalıklarının incelenmesi amaçlanmıştır. Araştırma iki aşamada gerçekleştirilmiştir. Araştırmanın birinci aşamasında problem çözme süreci farkındalığına yönelik bir ölçek geliştirilmiştir. Hazırlanan taslak ölçek formu özel eğitim okullarında görev yapan 215 öğretmene uygulanmıştır. Ölçeğin yapısını belirlemek için uygulama sonucunda elde edilen verilerin açımlayıcı faktör analizi (AFA) yapılmıştır. AFA sonucunda ulaşılan bulgura göre yirmi dokuz madde içeren ölçek üç faktörlü bir yapıya sahiptir. Üç faktörün açıkladıkları toplam varyans oranı %52.40 olarak hesaplanmıştır. Ölçeğe ilişkin hesaplanan Cronbach Alfa değeri .93'tür. AFA ile ortaya çıkarılan üç faktörlü yapı doğrulayıcı faktör analizi (DFA) ile test edilmiştir. DFA sonucunda SRMR=.06, RMSEA=.06, CFI=.90, IFI=.90 olarak hesaplanmıştır. Araştırmanın ikinci aşamasında geliştirilen ölçek aracılığıyla öğretmenlerin matematiksel problem çözme sürecine yönelik farkındalıkları çeşitli değişkenler açısından incelenmiştir. Bu amaçla ölçek özel eğitim okullarında görev yapan 181 öğretmene uygulanmıştır. Elde edilen verilerin analizi sonucunda öğretmenlerin matematiksel problem çözme sürecine yönelik farkındalıklarının cinsiyet ve görev süresi değişkenlerine göre istatistiksel olarak anlamlı bir farklılık göstermediği; mezun olunan bölüm, görev yaptığı kurum ve öğretim yapılan grup değişkenlerine göre ise istatistiksel olarak anlamlı bir farklılık gösterdiği belirlenmiştir. Bulgular literatüre dayalı olarak yorumlanmıştır.

Anahtar kelimeler: Özel eğitim, matematik öğretimi, problem çözme, farkındalık, ölçek

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1 | Introduction

Special education is a kind of education designed by individualizing for the needs of learners with disabilities. This education includes preventive, remedial and compensatory interventions, and covers a systematic and intensive process which is planned by experts towards the purpose (Heward, 2012; Zigmond et al., 2009).

Every child demonstrates some different developmental characteristics in terms of their learning abilities. Since these differences are relatively smaller in children who grow typically, they benefit from general curricula. They need an individualized curriculum because children with special needs differ in a broader context in terms of learning characteristics. This situation causes the necessity of curriculum adaptation and in-class educational arrangements for children with special needs (Fuchs et al., 2010; Heward, 2012).

It can be said that one of the reasons for the difficulties of students with special needs in mathematics education is related to the content of the prepared instruction and the presentation of the content. Teaching content should be presented effectively in order to minimize these difficulties. At this point, the importance of mathematics knowledge of the teacher comes into effect. Shulman (1987) addresses the teacher knowledge which is necessary for effective teaching as general pedagogical knowledge, educational content knowledge, educational aims and values knowledge, recognition of student characteristics, field knowledge, curriculum knowledge, and pedagogical field knowledge. While the first four of these characteristics determine general aspects of teacher knowledge, Shulman concentrates fundamentally on the last three characteristics which constitute the content dimension of teacher knowledge (Ball et al., 2008).

Field knowledge includes information on the subject and the organization of information. It requires to go beyond knowledge of the realities or concepts of a field (Shulman, 1986). Therefore, it can be stated that not only knowledge is sufficient to understand a subject, but also the structure of knowledge should be understood. Curriculum knowledge includes curricula designed to teach the subject at a special level and current teaching materials related to curricula (Shulman, 1986). In other words, it includes the curricula adapted for the application of the instruction, the textbooks to be used and various educational materials. Pedagogical field knowledge involves the subject knowledge dimension for teaching related to the teacher's field (Shulman, 1986). More specifically, it includes the teacher's teaching strategies, context-focused presentations, examples, and numerous practices that the teacher uses to make the subject more comprehensible. Based on this knowledge, it can be said that for effective mathematics teaching, the teacher should have the necessary equipment in terms of field knowledge, curriculum knowledge, and pedagogical field knowledge.

Fennema and Franke (1992) developed the framework drawn by Shulman and suggested a teacher knowledge model that includes four components: field knowledge, pedagogical knowledge, students' cognitive knowledge, and teachers' beliefs. According to this model, the teacher's field knowledge is related to pedagogy knowledge and student cognition. Pedagogical knowledge and student cognition are combined with beliefs to create a set of knowledge that determines teacher's classroom practices and behaviors. Knowledge has a dynamic formation and teaching is a process in which teachers can adapt their current knowledge and generate new knowledge (Petrou & Goulding, 2011).

Field knowledge encompasses the concepts related to the field, relationships among the concepts, procedures, problem-solving processes, the use of concepts and procedures in the problem-solving process. Pedagogical knowledge indicates the elements of teaching such as effective approaches in planning teaching, classroom procedures, behavior management, and motivation techniques. Student cognition expresses knowing how students think and learn during the learning process and the difficulties that may occur (Fennema & Franke, 1992). Therefore, it can be stated that the knowledge required for effective mathematics education consists of more than one component. Strong field knowledge is necessary among mathematics teachers, and this necessity shows a significant importance in Turkey.

In Turkey; to be able to use mathematical skills in everyday life by associating them with each other, solve problems based on the relationships between numbers, and solve mathematical problems encountered in everyday life by using these processes are among the aims of mathematics curricula followed in schools where the students with special needs are taught (Ministery of National Education-MNE, 2018, 2018b, 2018c). At this point, the role of problem-solving skills appears. It can be said that problem-solving technique is an inseparable part of mathematics teaching. The National Council of Teachers of Mathematics (NCTM) (2000) stated that all students should have access to new mathematical knowledge with the help of problem-solving and develop and apply suitable strategies to solve problems. Problem-solving is additionally a means of improving mathematical knowledge. Through problem-solving, students can explore and strengthen their knowledge of numbers. Students' operational fluency and conceptual understanding abilities also develop (NCTM, 2000).

Problem solving has a place in all parts of mathematics taught at schools. Students have the chance to use mathematical concepts and procedures by means of problem-solving. Teachers should motivate students to use different strategies with the problems which they choose so that students can discover new strategies, reach generalizations and comprehend mathematical relationships. In this way, it will be helpful for the development of mathematical ideas in students and they will be able to perceive mathematical concepts. During the problem-solving process, students can develop their high-level thinking skills. To this end, students should be asked to clarify and confirm their answers. Students' self-confidence will also increase in learning environments where they can discuss solution strategies. Moreover, students will be able to realize the strengths and weaknesses of different strategies and develop alternative solution strategies. Therefore, students 'tendencies towards solving mathematical problems will be formed by the teachers' decisions and teaching practices.

Students with special needs may have difficulties in problem-solving process just as much as their typically developing peers. These difficulties especially appear in their abilities such as abstract thinking and transferring knowledge. It is important to teach students with special needs what to do when solving problems. In this process, there is a necessity to develop suitable strategies for planning and solving problems for students with special needs. Teachers working in the field of special education have serious responsibilities in this regard, and teachers' awareness of the problem-solving process plays a determining role in planning and developing appropriate strategies (Goldman, 1989; Jitendra & Hoff, 1996). Awareness is related to teacher knowledge and has a critical role for a teacher to realize, express, interpret and make immediate decisions about the characteristics of classroom practice (Potari, 2013). In the process of problem-solving, it will be effective for teachers to determine the required strategies, methods and approaches by having awareness about this process in achieving competence for students with special needs (Friend & Bursick, 2011; Stein et al., 2006; Woodward et al., 2012).

In the learning process, students with special needs may not develop at the same level as their peers in general education since these students have difficulty in abstract thinking. They should, therefore, be encouraged to express their thoughts in concrete ways. Concrete experiences in the problem-solving process may enable them to set relationships between concepts and reach generalizations. These students should be provided with the opportunity to solve problems in different ways. Being aware of how they solve problems reveals teachers how to lead students to the next step (Bahr & de Garcia, 2010). Therefore, it can be said that teachers' awareness of the mathematical problem-solving process is one of the requirements of effective teaching. This study aims to investigate the awareness of teachers working in special education schools of the mathematical problem-solving process. The study was conducted in two stages. In the first stage, a scale for awareness of problem-solving process was developed. In the second stage, the awareness of teachers of the mathematical problem-solving process was investigated in terms of various variables by means of the developed scale.

2 | METHOD (STAGE I)

At this stage of the study, a scale was developed to examine the awareness of teachers working in special education schools towards mathematical problem-solving process. For this purpose, exploratory factor analysis (EFA) was conducted using the data obtained from the draft form of the scale and the structure of the scale was determined. Afterwards, this determined structure was tested with confirmatory factor analysis (CFA).

STUDY GROUP

The study group was selected by the convenience sampling method. It is thought that the size of the study group should be at least five times the number of observed variables in order to estimate the relationships reliably while developing a scale (Büyüköztürk, 2002). In this context, the study group for EFA consists of 215 teachers who work at special education schools in Istanbul and took part in the research voluntarily. 152 (70.7%) of these teachers are female and 63 (29.3%) of them are male. 57 (26.5%) of the teachers have an associate's degree, 153 (71.2%) of them have bachelor, and 5 (2.3%) of them have a master's degree. 73 (34%) of the teachers graduated from special education, 25 (11.6%) of them graduated from primary education, 57 (26.5%) of them graduated from child development, and 60 (27.9%) of them graduated from various departments in the faculties of education (for example; Turkish teaching, preschool teaching, science teaching, psychological counseling and guidance). 112 (52.1%) of the teachers have professional seniority of 1-5 years, 57 (26.5%) have professional seniority of 6-10 years, 32 (14.9%) have professional seniority of 11-15 years, and 14 (6.5%) have a professional seniority 16 years and more. 189 (87.9%) of the teachers work in public schools and 26 (12.1%) of them work in private schools. 67 (31.2%) of the teachers teach the students with mild mental disabilities, 69 (32.1%) teach the students with moderate mental disabilities, 68 (31.6) teach the students with severe mental disabilities and 11 (5.1%) teach the students with autism.

The study group for CFA consists of 216 teachers who work at special education schools in Istanbul and took part in the research voluntarily. 152 (70.4%) of these teachers are female and 64 (29.6%) of them are male. 55 (25.5%) of the teachers have an associate's degree, 154 (71.3%) of them have bachelor, and 7 (3.2%) of them have a master's degree. 70 (32.4%) of the teachers graduated from special education, 29 (13.4%) of them graduated from primary education, 31 (14.4%) of them graduated from child development, and 86 (39.8%) of them graduated from various departments in the faculties of education (for example; Turkish teaching, preschool teaching, science teaching, psychological counseling and guidance). 116 (53.7%) of the teachers have professional seniority of 1-5 years, 51 (23.6%) have professional seniority of 6-10 years, 33 (15.3%) have professional seniority of 11-15 years, and 16 (7.4%) have a professional seniority 16 years and more. 183 (84.7%) of the teachers work in public schools and 33 (15.3%) of them work in private schools. 73 (33.8%) of the teachers teach the students with mild mental disabilities, 69 (31.9%) teach the students with moderate mental disabilities, 66 (30.6) teach the students with severe mental disabilities and 8 (3.7%) teach the students with autism.

STRUCTURE OF THE SCALE

After examining the scientific studies on the problem-solving process in detail, a draft form containing twenty-nine items was prepared. The opinions of six academicians and two special education teachers were asked to determine the validity and comprehensibility of the items in terms of content validity, language, and expression. According to expert opinions, items that may have the same meaning and contain expression disorders have been corrected. The Likert-type five-point rating was used to determine the agreement in the item expressions in the scale as "5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 absolutely disagree". There are no items scored reversely among the scale items.

Data Collection

The draft scale form consisting of twenty-nine items was administered to 215 teachers working in special education schools in the second term of the 2018-2019 academic year for EFA. The scale was administered to 216 teachers for CFA. Before applying the scale, the teachers were informed about the purpose of the scale. The scale was voluntarily filled out by the teachers in their institutions in a way that would not interfere with their teaching process.

Data Analysis

EFA was applied to determine the construct validity of the scale. Factor analysis reduces a large number of variables observed to a smaller number of factors (Tabachnick & Fidell, 2014). It also determines the number and quality of factors (Brown, 2015). EFA is a statistical tool that allows examining the basic structure of data. It examines all the relationships between the items in the scale and tries to reveal the hidden factors from the measured variables (Osborne & Banjanovic, 2016). In other words, it enables researchers to define and summarize the data by grouping the related variables together (Tabachnick & Fidell, 2014). Thus, independent variables that measure the same property are brought together as factors.

Item-total correlations of items in the scale were examined before applying the EFA. It is accepted that if the item-total score correlation value is .30 and above, it has a good level of item discrimination; if it is between .20 and .30, it should be corrected; and if it is below .20, it should be removed from the scale (Büyüköztürk, 2012).

CFA is used to validate a developed scale or model with obtained data (Gürbüz, 2019). For this purpose, goodness-of-fit indices are evaluated. There is no consensus on which goodness-of-fit indices to use. However, it is recommended that the χ^2/df value be below 5 and the CFI, NFI, TLI values above .90 (Byrne, 2016; Kline, 2016). IBM SPSS AMOS 24 and IBM SPSS Statistics 25 programs were used in the analysis.

Research ethics

All ethical procedures were performed in this study. Ethical permission of the research was approved by Bartın University Social and Human Sciences Ethics Committee. Ethics committee document number is 2021-SBB-0240.

3 | Findings

Findings related to EFA.

The item total score correlation values of the items in the scale are presented in Table 1.

Table 1. Item Total Score Correlations for Scale Items

Item Number	Item Total Score Correlation	Item Number	Item Total Score Correlation	Item Number	Item Total Score Correlation
1	.46	11	.53	21	.73
2	.32	12	.54	22	.76
3	.72	13	.41	23	.81
4	.30	14	.46	24	.53
5	.56	15	.54	25	.69
6	.62	16	.68	26	.70
7	.63	17	.62	27	.38
8	.61	18	.34	28	.67
9	.31	19	.33	29	.49
10	.71	20	.62		

When Table 1 is examined, it is seen that item total score correlations between items ranged between .30 and .81. Based on this finding, it can be stated that the item discrimination is suitable.

Kaiser-Meyer-Olkin (KMO) value and Bartlett Sphericity Test results were examined in order to determine the suitability of scale items for factorization according to the data obtained from the scale. The calculated KMO value of .60 and above shows that the data are suitable for factorization. The chi-square value calculated as a result of the Bartlett Sphericity Test indicates that the data matrix is suitable for factorization (Büyüköztürk, 2012; Tavşancıl, 2005). KMO value was calculated as .88 in the result of the analysis. The Bartlett Sphericity Test value (χ^2 = 3715.18; p =.00) is significant. Based on these findings, it can be concluded that the data are appropriate in terms of EFA.

Eigenvalue graphic was used to determine the number of factors in EFA. Factors with an eigenvalue of 1 or more are considered as important (Büyüköztürk, 2012). The eigenvalue graph of the scale obtained as a result of the analysis is presented in Figure 1.

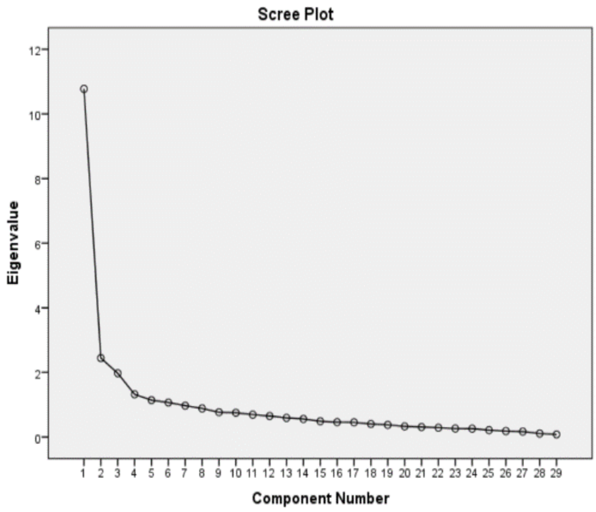


Figure 1. *Eigenvalue Graphic of the Scale*

When Figure 1 is examined, it can be said that the scale has a three-factor structure whose eigenvalue bigger than 1. The variance explained by these factors for the scale is 29.08% for the first factor, 12.21% for the second factor, 11.10% for the third factor, and 52.08% in total. It can be said that 40-60% of the total variance was explained is satisfactory (Tavşancıl, 2005).

Factor load values are taken into consideration in determining the items to be included in the factors as a result of EFA. It is stated that this value should be a minimum of .30 and if it is .45 and more, it is a good criterion (Büyüköztürk, 2012). In case the items in the scale have high load value in more than one factor, it is taken into consideration that the load difference is at least .10 (Büyüköztürk, 2012). As a result of the analysis, it was determined that there are no overlapped items in the factors. Factor load value, mean and standard deviation values of the items in the scale are presented in Table 2.

Table 2. Factor Load Value, Mean and Standard Deviation Values of Scale Items

Factor	Item Numbers	Rotated Factor Loads	Mean	Standard Deviation
Factor 1	23	.81	3.92	.91
	21	.79	3.70	1.00
	10	.78	3.97	.98
	26	.77	4.13	.84
	25	.75	3.64	.98
	22	.74	3.89	.97
	17	.74	3.79	.99
	28	.73	3.76	1.01

	3	.66	3.92	1.06
	15	.65	3.67	1.07
	20	.57	4.07	.75
	5	.57	3.65	1.10
	7	.54	4.01	.92
	29	.50	3.62	.98
	24	.40	4.22	.69
Factor 2	4	.70	4.03	.98
	2	.70	4.49	.60
	16	.63	3.94	.95
	18	.58	4.43	.65
	8	.58	4.18	.84
	6	.58	3.68	.96
	9	.55	4.69	.54
	12	.45	3.75	.92
	11	.37	4.04	.89
Factor 3	19	.71	4.51	.64
	1	.64	4.20	.80
	27	.63	4.39	.67
	14	.53	4.28	.65
	13	.49	4.33	.81

When Table 2 is examined, it is seen that the rotated factor load values of the scale items range from .37 and .81. Twenty-nine items in the scale were divided into 15 items in the first factor, nine items in the second factor and five items in the third factor.

The factors that developed as a result of EFA were named according to the meaning relationship between the items they contain. Factor names and item expressions related to factors are presented in Table 3.

Table 3. Scale Factors and Item Expressions Related to Factors

Factors	Items	Expressions
Understanding and Solving the Problem	23	When she/he can't solve a problem, I ask the student to identify the points she/he has difficulty with.
	21	I ask the student to stop and examine the ways of solving problems while solving problems.
	10	I ask the student to explain the necessary procedures for solving a problem.
	26	I ask the student to re-read the problem when she/he has difficulty in solving it.
	25	I ask the student what she/he thinks about whether he comes to the solution.
	22	After solving a problem, I ask the student to check the correctness of her/his strategies and operations.
	17	I ask the student to make explanations about a problem and its solution at every step.
	28	I ask the student if she/he comes across a similar problem.
	3	I ask the student to make explanations (predictions) for the solution to the problem.
	15	I find the clues about the solution and let the student reach the solution.
	20	I ask the student to use the strategies she/he knows to solve the problem.
	5	In the process of problem-solving, I firstly ask the student read the problem.
	7	After the solution, I let the student check the answer, shapes and diagrams, and the calculations made.
	29	I ask the student how much time she/he needs to solve the problem.
	24	I suggest different solutions for problem-solving.

Teaching Problem Solving	4	I draw / use shapes or schemes in problem-solving process.
	2	I pay attention to using a clear and understandable language in problem-solving process.
	16	I do studies for the student to be able to determine the important numbers and words necessary for the solution of the problem.
	18	I use tools for concretization in problem-solving process.
	8	I do studies for the student to recognize and use mathematical words and concepts (equal, equality, add, part, whole, etc.) while solving-problems.
	6	I do studies for the student to write an equality for the solution of the problem.
	9	When choosing a problem, I make sure that the language of the problem is understandable.
	12	In the process of problem-solving, I ask the student to draw a figure or schema.
	11	I make the student do exercises to internalize the strategies he will use in problem-solving process.
Role of Teacher in Problem Solving Process	19	My role in the problem-solving process is to be a guide and facilitator.
	1	I feel enough in problem-solving.
	27	I remind the student that she/he may ask for help in the problem-solving process.
	14	I get prepared for problem-solving.
	13	I encourage the students to solve problems.

When Table 3 is examined, it can be seen that the items in the first factor are named as "Understanding and Solving the Problem" since it usually included expressions for understanding and solving the problem. The second factor is named as "Teaching Problem-Solving" because it includes items mostly related to the teaching process of problem-solving. As the items in the third factor usually included expressions about the tasks of the teacher in the problem-solving process, it is named as "The Role of the Teacher in the Problem-Solving Process".

Pearson correlation coefficients (r) were calculated to determine the relationship between the factors appeared in the results of the EFA. If Pearson value is .00-.29, it is interpreted as low-level relationship; if it is between .30-.69, it is interpreted as medium-level relationship; and if it is between .70-1.00; it is interpreted as high-level relationship (Büyüköztürk, 2012). Table 4 shows the Pearson correlation coefficient values.

Table 4. Pearson Correlation Coefficients Calculated for the Relationship Between Scale Factors

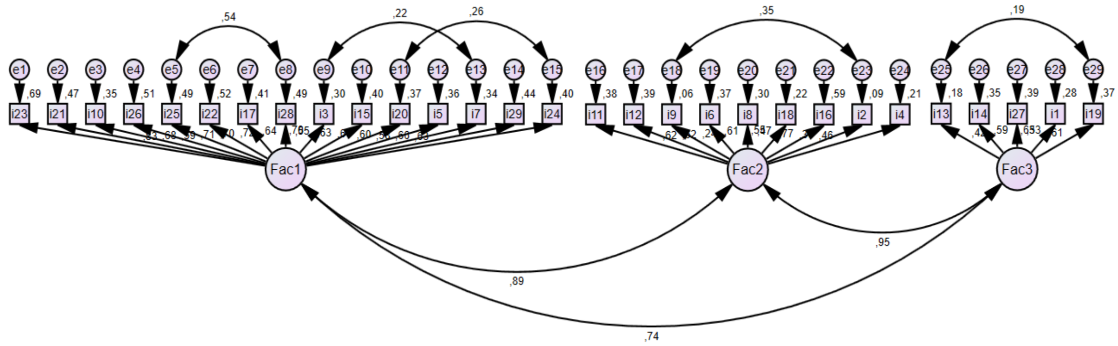
	Factor 1	Factor 2	Factor 3
Factor 1	-		
Factor 2	.72*	-	
Factor 3	.55*	.66*	-
Total	.96*	.87*	.71*

When Table 4 is examined, it is seen that the Pearson correlation coefficients calculated for the relationship between the factors vary between .55 and .72, the relationships between the factors are moderate, positive and significant in the level of "p<.01" (p=.00).

The internal consistency reliability coefficient of Cronbach's alpha, which was calculated to determine the internal reliability of the scale, is .93. When Cronbach's alpha value is .70 and more, it means that the scale is interpreted as reliable (Büyüköztürk, 2012). The Cronbach's alpha value of the first factor is .93, the Cronbach's alpha value of the second factor is .76, and the Cronbach's alpha value of the third factor is.63. Based on these findings, it can be said that the reliability of the scale is satisfying.

FINDINGS RELATED TO CFA.

Path diagram of the scale obtained as a result of the analysis is presented in Figure 2.



i=Item, Fac= Factor

Figure 2. *Path Diagram of the Scale*

As a result of the analysis, fit indices calculated as χ^2 = 735.357, *df*=369, χ^2/df=1.99, *p*<.001, SRMR=.06, RMSEA=.06, CFI=.90, IFI=.90. Based on this, it can be said that the scale has acceptable goodness-of-fit indices and has been validated.

4 | METHOD (STAGE II)

In the second stage of the study, the aim was to examine the awareness of teachers working at special education schools towards mathematical problem-solving process in terms of various variables. In this respect, it can be said that the study was conducted in the descriptive survey model. In descriptive survey studies, specific characteristics can be identified for a group (Büyüköztürk et al., 2012). While examining a situation in detail, the aim is giving detailed information about the situation without interruption (Karasar, 2012).

STUDY GROUP

The study group consists of 181 teachers working at special education schools in Istanbul. 118 (65.2%) of these teachers are female and 63 (34.8%) of them are male. 33 (18.2%) of the teachers have an associate's degree, 143 (79%) of them are bachelor and 5 (2.8%) have a master's degree. 73 (40.3%) of the teachers graduated from special education, 25 (13.8%) are primary teachers, 16 (8.8%) of them graduated from children development and 67 (37%) of them graduated from various departments of the faculties (e.g. Turkish teaching, preschool teaching, science teaching, psychological counselling and guidance). 82 (45.3%) of the teachers have professional seniority of 1-5 years, 53 (29.3%) of them have professional seniority of 6-10 years, 32 (17.7%) of them have professional seniority of 11-15 years and 14 (7.7%) of them have professional seniority of office is 16 years or more. 155 (85.6%) of the teachers work in public schools and 26 (14.4%) of them work in private schools. 62 (34.3%) of the teachers teach the students with mild mental disabilities, 60 (33.1%) teach the students with moderate mental disabilities, 48 (26.5%) teach the students with severe mental disabilities and 11 (6.1%) teach the students with autism.

DATA COLLECTION

Data were obtained by using the "Problem-Solving Process Awareness Scale" developed by the researchers in order to determine the awareness of teachers working in special education schools of mathematical problem-solving process. Before applying the scale, the teachers were informed about the study. Volunteer participation and time periods according to the teaching schedules of teachers were taken into consideration while collecting the data. The scale was administered to 181 teachers working at special education schools in the second term of 2018-2019 academic year.

Data Analysis

In the analysis of the data, the total scores of teachers from the scale were used. The normality test (Kolmogorov-Smirnov), measures of central tendency (mean, median, mode) and the ratio of skewness-kurtosis coefficients to standard error (Can, 2013) were examined in determining normality distribution of data. As a result of this analysis, it was determined that the data were not distributed normally and Mann-Whitney U test among nonparametric tests was used for comparing the averages of two groups and Kruskal-Wallis H test was used for comparing the averages of more than two groups.

5 | Findings

The mean (*M*), standard deviation (*SD*) and median (*Mdn*) values of the total scores of the teachers are presented in Table 5.

Table 5. Mean, Standard Deviation and Median Values of Scale Total Scores

Variable		*M*	*SD*	*Mdn*
Gender	Female	117.60	15.75	121
	Male	113.20	14.50	118
Graduation field	Special Education	110.60	15.78	115
	Primary Education	118.04	14.72	119
	Child Development	125.62	12.84	128
	Other	119.01	14.00	122
Professional seniority	1-5 years	117.04	15.20	119
	6-10 years	116.54	13.11	118
	11-15 years	112.28	19.46	117
	16 years and more	117.21	14.89	120
School	Public school	118.62	13.59	120
	Private school	100.84	17.18	97
Group taught	Students with Mild Mental Disabilities	108.04	17.61	113
	Students with Moderate Mental Disabilities	118.26	14.45	122
	Students with Severe Mental Disabilities	121.68	8.88	123
	Students with Autism	124.81	11.24	118
Total		116.07	15.43	119

When Table 5 is examined, it is seen that mean and median values of independent variables do not have similar values in each case. This indicates that there is a deviation from the normal distribution. Also, the Kolmogorov-Smirnov value is significant ($p<.01$) and skewness-kurtosis coefficients as a result of the ratio of standard error are not all within the limits of ±1.96 shows that the data are not normally distributed.

Table 6 presents the test results to determine the statistical significance of teachers' awareness of mathematical problem-solving process in terms of gender variable.

Table 6. Mann-Whitney U Test in terms of Gender Variable

Group	*N*	Range Mean	Total Range	*U*	*p*
Female	118	96.03	11331	3124	.07
Male	63	81.59	5140		

Table 6 shows that there is no statistically significance between the groups in terms of gender (U=3124; p>.05). According to this finding, it can be stated that teachers' awareness of mathematical problem-solving process does not differ in terms of their gender.

Table 7 presents the test results to determine the statistical significance of teachers' awareness of mathematical problem-solving process in terms of the graduation variable.

Table 7. Kruskal-Wallis H Test in terms of Graduation Field Variable

Groups	*N*	Range Mean	*df*	χ^2	*p*	Significance
Special Education (1)	73	73.80	3	13.44	.00	1-2 1-3 1-4
Primary Education (2)	25	98.12				
Child Development (3)	16	105.16				
Other* (4)	67	103.70				

*Turkish Teaching, Preschool Teaching, Science Teaching, Psychological Counselling and Guidance

When Table 7 is reviewed, it is seen that there is a statistical significance between the groups in terms of the department graduated ($\chi^2_{(3)}$=13.44; p<.01). As a result of multiple comparisons, this significance was determined to be between special education and primary education, between special education and child development, and between special education and other groups. The scores of the teachers who graduated from primary education, child development and other groups are higher than those who graduated from special education department. According to this finding, it can be stated that teachers who graduated from primary education, child development and other groups have higher awareness of mathematical problem-solving process than teachers who have graduated from special education department.

Table 8 shows the test results to determine the statistical significance of the teachers' awareness of mathematical problem-solving process in terms of professional seniority variable.

Table 8. Kruskal-Wallis H Test in terms of Professional Seniority Variable

Groups	*N*	Range Mean	*df*	χ^2	*p*	Significance
1-5 years (1)	83	92.29	3	.50	.9	–
6-10 years (2)	53	90.75				
11-15 years (3)	32	85.84				
16 years and more (4)	13	96.50				

When Table 8 is examined, it is seen that there is no statistical significance between the groups in terms of professional seniority variable ($\chi^2_{(3)}$=.50; p>.05). According to this finding, it can be stated that teachers' awareness of mathematical problem-solving process does not differ in terms of professional seniority variable.

The results of the test conducted to determine the statistical significance of teachers' awareness of mathematical problem-solving process in terms of the school variable is presented in Table 9.

Table 9. Mann-Whitney U Test in terms of School Variable

Group	*N*	Range Mean	Total Range	*U*	*p*
Public School	155	98.66	15293	827	.00
Private School	26	45.31	1178		

When Table 9 is examined, it is seen that there is a statistical significance between the groups in terms of the institution variable (U=827; p<.01). The scores of teachers working in public schools are higher than those of teachers working in private schools. According to this finding, it can be stated that teachers working in public schools are more aware of mathematical problem-solving process than teachers working in private schools.

The results of the test conducted to determine the statistical significance of the teachers' awareness of mathematical problem-solving process according to the group taught variable are presented in Table 10.

Table 10. Kruskal-Wallis H Test in terms of the Group Taught Variable

Group	*N*	Range mean	*df*	χ^2	*p*	Significance
Students with Mild Mental Disabilities (1)	62	64.61	3	25.73	.00	1-2 1-3 1-4
Students with Moderate Mental Disabilities (2)	60	98.49				
Students with Severe Mental Disabilities (3)	48	110.25				
Students with Autism (4)	11	114.86				

When Table 10 is examined, it is seen that there is a statistical significance between the groups in terms of the group taught variable ($\chi^2_{(3)}$=25.73; p<.01). As a result of multiple comparisons, this significance was found to be between students with mild mental disabilities and students with moderate mental disabilities, between students with mild mental disabilities and students with severe mental disabilities and between students with mild mental disabilities and students with autism. The scores of the teachers who teach students with moderate mental disabilities, severe mental retardation, and autism groups are higher than the teachers who teach students with mild mental disabilities. According to this finding, it can be stated that the teachers who teach students with moderate mental disabilities, severe mental disabilities and autism are more aware of the mathematical problem-solving process than the teachers who teach students with mild mental disabilities.

6 | Discussion & Conclusion

This study aimed to investigate the awareness of teachers working at special education schools towards mathematical problem-solving process in two stages. In the first stage of the study, a scale was developed to determine teachers' awareness. The draft form of the scale consisting of twenty-nine items was administered to 215 teachers. EFA was done to determine the structure of the scale. As a result of the EFA, the scale was found to have a three-factor structure. The first factor was named as “Understanding and Solving the Problem”, the second factor was named as “Teaching Problem-Solving” and the third factor was named as “The Role of the Teacher in Problem-Solving Process”. The factor of the “Understanding and Solving the Problem” contains fifteen items with a factor load value ranging from .40 to .81. The first factor explains 29.08% of the total variance. The Cronbach's alpha reliability coefficient of the factor is .93. The factor of the “Teaching Problem-Solving” includes nine items with a factor load value ranging from .37 to .70. The second factor explains 12.21% of the total variance. The Cronbach's alpha reliability coefficient of the factor is .76. The factor of the “Role of the Teacher in the Problem-Solving Process” includes five items with a factor load value ranging from .49 to .71. The third factor explains 11.10% of the total variance. The Cronbach's alpha reliability coefficient of this factor is .63. The three factors in the scale explain 52.40% of the total variance.

The Cronbach Alpha internal consistency reliability coefficient of the scale is .93. According to the results of EFA, no items were removed from the scale. The structure of the scale determined by EFA was tested with CFA and validated. The last form of the scale contains twenty-nine items. Each of these items is scored as "5 strongly agree, 4 agree, 3 neutral, 2 disagree, 1 absolutely disagree". Total score can be obtained from each factor and the whole scale. The maximum point which can be rated from the entire scale is 145 and the minimum point which can be rated from the whole scale is 29. The scale presents an opportunity to examine the awareness of teachers working in special education schools of mathematical problem-solving process and to compare them in terms of different variables.

In the second stage of the study, the statistical significance of the teachers' awareness of mathematical problem-solving process in terms of gender, professional seniority, graduation department, institution and the group taught was examined. As a result of the study, there was no statistical significance between the awareness of teachers of mathematical problem-solving process in terms of gender and professional seniority variables. It was determined that there is a statistical significance in terms of the variables of department, institution and the group taught.

It was concluded that teachers who graduated from special education department were less aware of mathematical problem-solving process than primary teachers and the teachers who graduated from child development and other departments. This result can be explained by the fact that special education teachers have less mathematical problem-solving opportunity with their students. Because the students with special needs have limitations compared to their peers in terms of cognitive skills, special education teachers also implement basic functional skills and life skills teaching with their students; mathematical problem-solving is studied at a simple level when students reach the required readiness. Therefore, it can be said that special education teachers have lower awareness of mathematical problem-solving than teachers in other fields. Problem-solving is generally taught mechanically to students affected by disability and ineffective problem-solving strategies are used in the teaching process (Jones et al., 1997; Van Luit & Naglieri, 1999). Special education teachers should have strategies to help students who struggle with mathematics gain access to the general education curriculum (Gargiulo & Metcalf, 2013; Powell et al., 2013). Strategy education will be effective in supporting special education teachers' awareness of problem-solving process (Hott & Isbell, 2014). Special education teachers should also use the strategies such as FAST DRAW (Mercer & Miller, 1992), SOLVE IT (Montague et al., 2000), STAR (Gagnon & Maccini, 2001), TINS (Owen, 2003), RIDE (Mercer et al., 2011) and other strategies that help students learn mathematical concepts and procedures in problem-solving process. Therefore, special education teachers should be aware of problem-solving strategies.

It is concluded that the teachers working at public schools are more aware of mathematical problem-solving process than the teachers working in private schools. In public schools, teachers are able to design and develop curricula, lesson plans, and programs in line with the interests and abilities of their students. This situation suggests that special education teachers implement this action more often in their classrooms. The reason for this suggestion is that individual education is more prominent in special education and an Individualized Education Plan (IEP) is prepared for each student and the educational needs of the student are taken into consideration. However, teachers working at private schools implement the teaching module prepared for the student directly in the Guidance Research Centre (GRC) and try to provide the students with the targeted skills in the teaching module. Moreover, the teachers at public schools spend more time with their students and get to recognize them better than the teachers at private schools. This indicates that the teachers working at public schools have a more positive attitude towards their students than the teachers working at private schools. Positive attitudes contribute to teachers 'positive tendencies in teaching students with special educational needs (Sharma et al., 2008; Slinigner et al., 2000; Thaver & Lim, 2014), positive or negative attitudes affect teachers' teaching performance (Avramidis et al., 2000; Buell et al., 1999; Campbell et al., 2003; Park et al., 2010). Consequently, it can be said that positive attitudes of special education teachers will affect their awareness of problem-solving process positively. It was determined that teachers who teach the students with moderate and severe mental disabilities and the students with autism are more aware of mathematical problem-solving process than teachers who teach the students with mild mental disabilities. Children with mild mental disabilities are the closest group to the children growing typically in having cognitive skills. Children with moderate and severe mental disabilities and children with autism generally have more limitations in terms of cognitive skills. Therefore, it can be stated that teachers who teach the students with moderate and severe mental disabilities and the students with autism use different teaching techniques for teaching mathematical problem-solving skills, develop and use alternative strategies, and make more efforts for concrete, clear and understandable instruction. The students struggling with mathematics need explicit instruction to understand concepts and relationships between concepts (Fuchs, Fuchs, Hamlett, et al., 2002). Explicit instruction of mathematics is precise, distinct and complicated (Stein et al., 2006). Explicit instruction often includes mathematical practices and teacher demonstrations under the guidance and direction of the teacher (Miller et al., 2011) and is extremely effective in teaching the students struggling with mathematics (Baker et al., 2002; Kroesbergen & Van Luit, 2003). The use of concrete and representative models in mathematics teaching is useful to promote conceptual understanding (Butler et al., 2003; Gersten et al., 2009). Therefore, it can be stated that the teachers who teach the students with moderate and severe mental disabilities and the students with autism are more aware of mathematical problem-solving process than teachers who teach the students with mild mental disabilities.

STATEMENTS OF PUBLICATION ETHICS

Ethical permission of the research was approved by Bartın University Social and Human Sciences Ethics Committee. Ethics committee document number is 2021-SBB-0240.

RESEARCHERS' CONTRIBUTION RATE

All authors contributed equally rate to the research.

CONFLICT OF INTEREST

We confirm that there are no conflicts of interest associated with this study.

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