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ANALYZING SECONDARY SCHOOL STUDENTS' MATHEMATICAL PROBLEM-SOLVING ATTITUDES IN TERMS OF CERTAIN VARIABLES

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ABSTRACT

This research study aims to examine secondary school students' mathematical problem-solving attitudes in terms of certain variables. The study was carried out to determine whether the students' mathematical problem-solving attitudes differ or not in terms of the variables of gender, grade, attending nursery school, parents' education level and mathematical achievement. The research sample consists of the students enrolled in the different gradesof randomly chosen secondary schools in the European side of Istanbul during 2013-2014 academic year.The research data were obtained using the "Mathematical Problem Solving Attitude Scale" developed by Canakciand Özdemir (2011) and a personal information form. The statistical analyses of the research data were performed with the package program of SPSS 19.0. The research findings are expected to contribute not only to the literature but also to the planning of teaching process taking into account the students' mathematical problem-solving attitudes. The findings were discussed for further research and researchers in accordance with the relevant literature.

Key Words: Mathematics, Maths Problem, Matematical Problem-Solving Attidue, Secondary School.

INTRODUCTION

Upbringing individuals who produce, explore and question has come into prominence in today's world, which is changing and advancing rapidly with technological growth.Therefore, a high-quality education plan is expected to be the one which enables individuals to develop their reasoning and problem-solving skills. In this context, problem-solving processes which take into account individual differences at every stage of education should be shaped with education plans because individuals need to solve everyday problems in order to adapt to life effectively. In a sense, to live means to solve problems, and there might be several types of problems: social, emotional, physical, mathematical etc. There might be small differences in these problems; nevertheless, the method to follow in any problem-solving situationis similar.

Since education and schools aim at upbringing active, efficient and therefore happy individuals, the ultimate aim of the curriculum is to help individuals solve some problems in order to build a better world and lead a happy life. However, problem-solving skills cannot be earned in a didactic way. This process needs to be carried out actively in an educational environment. One of the most effective ways of earning problem-solving skills is to work on mathematical problems because thinking strategies used in mathematical problem-solving would also influence an individual's life perspective.

As is known, problem-solving process plays an active role in understanding mathematical knowledge and establishing a connection between the pieces of mathematical knowledge. Therefore, mathematics teachers

are in agreement that students' problem-solving skills should be developed (Karataş and Güven, 2003). Recent studies in primary mathematics programs and assessment standards pay a special attention to developing the skills of mathematical problem-solving and reasoning, and they emphasize the importance of using these skills to solve problems we face in real life (Arslan and Altun, 2007).

Problem is any situation that requires a solution and for which there is no immediate solution in daily life (Polya, 1997). In terms of mathematics, problem is defined as a matter that needs to be found and shown, but the way to find and show it is not obvious with available information at first sight (Kayan and Çakıroğlu, 2008). Mathematical processings require divergent thinking skills. Mathematical problems are those that are encountered for the first time and for which there is no immediate solution. Therefore, they are a sum of processings that require using divergent thinking strategies to solve.

Students are observed to have difficulty with understanding mathematical terms or grasping what has been asked in a question, reading and telling a problem accurately, focusing on a problem, describing a problem, and checking a solution due to limited skills and insufficient time (Shermen and et al., 2005).For this reason, problem-solving, which is known as a process, has a role in forming both positive and negative attitudes. As long as there is no change in students' wrong beliefs and negative attitudes towards mathematics and mathematical problem-solving, students will not be a good problem solver. The concept of attitude, which is an acquired internal state that influences an individual's choice in their acts towards a set of things, individuals, events and various settings, becomes prominent (Senemoğlu, 2001).

Attitude is defined as a learned tendency to respond to a particular object in a positive or negative manner (Fishbein&Ajzen, 1975). Attitude is "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon an individual's response to all objects and situations with which it is related" (Allport, 1935). Attitude, as a tendency to develop a way of possible conduct and behaviourin response to any event or situation, forms the root of every human act (Çelik, 2005, cited in Çanakçı and Özdemir, 2011). It is of essence to know students' problem-solving attitudes in a problem-solving process because it will be infuential to determine the teacher's methods and approaches in a problem-solving process and teaching of it. As knowing about students' attitudes and knowing how to measure their attitudes could be a major factor in increasing the quality of education, research studies conducted with the aim of measuring students' problem-solving attitudes towards certain subject matters are essential (Duatepe and Çilesiz, 1999). For this reason, it is necessary to develop valid and reliable measuring instruments that will measure students' problem-solving attitudes and to plan the teaching process taking into account students' attitudes for athematical achievement (Çanakçı and Özdemir, 2011).

As is known, it is expected to earn students basic mathematical skills such as problem solving, communication, association, and reasoning in every stage of education, from primary school to university (Cantürk-Günhan and Başer, 2007). Problem-solving takes place among the purposes of mathematics and all other subjects (Soylu and Soylu, 2006). It is obvious that mathematics and its education can only develop in relation with other sciences. Within this context, problem-solving education rises in importance as students learn how to learn and solve problems they face in their daily lives with a more rational and analytical way of thinking (Soytürk, 2011). In the light of this information, the problem of this research study is to examine secondary school students' mathematical problem-solving attitudes.

Aim of Research

This research study aims to examine secondary school students' mathematical problem-solving attitudes in terms of certain variables. The study was carried out to determine whether the students' mathematical problem-solving attitudes differ or not in terms of the variables of gender, grade, attending nursery school, parents' education level and mathematical achievement.

METHOD

This research study is designed in descriptive survey model. The survey model aims to describe the existing situation as it stands in the past or currently (Karasar, 2005).

Research Group

This research study, which was carried out in the city of İstanbul during 2013-2014 academic year, consists of 160 randomly chosen students enrolled in the fifth and sixth grades of a secondary school.The research group was determined using the easily accessible method of sampling. The sampling method provides pace and convenience for the research because the researcher chooses an easily accessible case with this method. (Yıldırım and Şimşek, 2006).

Data Collection and Data Analysis

The data were collected using the "Mathematical Problem-Solving Attitude Scale" developed by Canakci and Özdemir (2011) and a personal information form. Depending on the variables, the parametric tests of independent group t test and ANOVA were used for the analysis of the data which show homogeneous distribution. As a result of the ANOVA, complementary Post-Hoc analysis techniques were carried out when significant differences were obtained.

Mathematical Problem-Solving Attitude Scale: Mathematical Problem-Solving Attitude Scale (MPSAS) was developed by Çanakçı and Özdemir (2011) due to the absence of a scale that measures mathematical problem-solving attitudes of the second grade primary students in Turkey. The two-dimensional Likert-type MPSAS,which measures second grade primary students' mathematical problem-solving attitudes, is composed of 19 items, and is valid and reliable. The first factor, which consists of 10 items, is titled "Enjoyment Scale" since the items in this factor reflect the attitudes about whether or not students like solving problems, they get bored of solving problems,or they have difficulty in solving problems. The second factor, which consists of 9 items, is titled "Teaching Dimension" since the items in this factor reflect students' attitudes towards the teaching process of problem-solving. The internal consistency coefficient is 0.848 for the whole scale. It was found to be 0.638 in this study.

FINDINGS

Table1: Students' Frequency and Percentage Values For the Variable of Gender

Gender	*F*	%
Girl	83	51,9
Boy	77	48,1
Total	160	100

The research sample group consists of 160 secondary school students, 83 (51,9%) of which are female, and 77 (48,1%) of which are male.

Table 2: Students' Frequency and Percentage Values For the Variable of Grade

Grade	*F*	%
5th Grade	78	48,8
6th Grade	82	51,2
Total	160	100

The research sample group consists of 160 secondary school students, 78 (48,8%) of which are from the fifth grade, and 82 (51,2%) of which are from the sixth grade.

Table 3: Students' Frequency and Percentage Values for the Variable of Parents' Education Level

	Mother's Educational Level		Father's Educational Level	
	f	%	*f*	%
Illiterate	5	3,1	6	3,8
Primary School	55	34,4	38	23,8
Secondary School	57	35,6	52	32,5
High School	38	23,8	45	28,1
University	5	3,1	19	11,9
Total	160	100	100	100

Of all the secondary school students in the research sample group, 5 (3,1%) students stated that their mothers were illiterate; 55 (34,4%) students stated that their mothers were primary school graduates, 57 (35, 6%) stated that their mothers were secondary school graduates; 38 (23,8%) stated that their mothers were high school graduates, and 5 (3,1%) students stated that their mothers were university graduates. On the other hand, 6 (3,8%) students stated that their fathers were illiterate; 38 students (23,8%) stated that their fathers were primary school graduates; 52 (32,5%) students stated that their fathers were secondary school graduates; 45 (28,1%) students stated that their fathers were high school graduates; 19 (11,9%) students stated that their fathers were university graduates.

Table 4: Students' Frequency and Percentage Values For the Variable of Their Math Grades

Math Grades	*f*	%
1	12	7,5
2	15	9,4
3	47	29,4
4	40	25,0
5	46	28,8
Total	160	100

Of all the students in the research sample group, 12 (7,5%) students got 1; 15 (9,4%) students got 2; 47 (29,4%) students got 3; 40 (25%) students got 4; and 46 (28,8%) students got 5 in mathematics.

Table 5: Results of the Independent Group t Test Performed to Determine Whether Secondary School Students'Mathematical Problem-Solving Attitude Scale (MPSAS) Scores Differ or Not in Terms of "Gender"

Scores	**Groups**	**N**	**Mean Rank**	**Std. Deviation**	**Std. Error Mean**	t	df	Sig.
MPÇTÖ Total	Girl	83	3,71	0,58	0,06	2,985	158	0,003
	Boy	77	3,44	0,57	0,06			
MPÇTÖ Enjoyment	Girl	83	3,82	0,85	0,09	2,135	158	0,034
	Boy	77	3,54	0,80	0,09			
MPÇTÖ Teaching	Girl	83	3,59	0,51	0,05	3,183	158	0,002
	Boy	77	3,33	0,53	0,06			

As shown in Table 5, as a result of the independent group t test performed to determine whether secondary school students' MPSAS scores differ or not in terms of the variable of "gender", significant difference was found among the groups in favor of female students (t=2,985; p<.05). When the other scale sub-dimensions are examined, significant difference was found between the sub-dimensions of Enjoyment (t= 2,135;p<.05) and Teaching (t=5,084;p<.05) in favor of female students. According to this finding, it can be concluded that

mathematical problem-solving attitudes differ in terms of gender, and female students have a more favourable attitude in comparison to male students.

Table 6: Results of the Independent Group t Test Performed to Determine Whether Secondary School Students'Mathematical Problem-Solving Attitude Scale (MPSAS) Scores Differ or Not in Terms of "Grade"

Scores	Groups	N	Mean Rank	Std. Deviation	Std. Error Mean	t testi		
						t	df	Sig.
MPÇTÖ Total	5th Grade	78	3,67	0,62	0,70	1,941	158	0,054
	6th Grade	82	3,49	0,55	0,06			
MPÇTÖ Enjoyment	5th Grade	78	3,80	0,88	0,10	1,642	158	0,103
	6th Grade	82	3,58	0,78	0,08			
MPÇTÖ Teaching	5th Grade	78	3,53	0,53	0,06	1,638	158	0,103
	6th Grade	82	3,40	0,53	0,05			

As shown in Table 6, as a result of the independent group t test performed to determine whether secondary school students' MPSAS scores differ or not in terms of the variable of "grade", no significant difference was found among the groups (t= 1,941;p>.05). When the other scale sub-dimensions are examined, no significant difference was found between the sub-dimensions of Enjoyment (t= 1,642;p>.05) and Teaching (t=1,638;p>.05). According to this finding, mathematical problem-solving attitudes can be said not to differ in terms of grade.However, when table 6 is examined, it can be observed that fifth grade students have higher mean scores in spite of the lack of significant difference. In this context, it can be concluded that as grade level increases, students' mathematical problem-solving attitudes decrease.

Table 7: Results of the Independent Group t Test Performed to Determine Whether Secondary School Students'Mathematical Problem-Solving Attitude Scale (MPSAS) Scores Differ or Not in Terms of "Attending Nursery School"

Scores	Groups	N	Mean Rank	Std. Deviation	Std. Error Mean	t testi		
						T	df	Sig.
MPÇTÖ Total	Yes	75	3,58	0,58	0,06	-0,039	158	0,969
	No	85	3,58	0,59	0,06			
MPÇTÖ Enjoyment	Yes	75	3,69	0,85	0,09	0,049	158	0,961
	No	85	3,68	0,83	0,09			
MPÇTÖ Teaching	Yes	75	3,46	0,51	0,05	-0,176	158	0,860
	No	85	3,47	0,56	0,06			

As shown in Table 7, as a result of the independent group t test performed to determine whether secondary school students' MPSAS scores differ or not in terms of the variable of "attending nursery school", no significant difference was found among the groups (t= -0,039;p>.05). When the other scale sub-dimensions are examined, it was observed that there was no significant difference between the sub-dimensions of Enjoyment (t= 0,049;p>.05) and Teaching (t=-0,176;p>.05). According to this finding, it can be stated that the variable of attending nursery school is not influential in mathematical problem-solving attitudes.

Table 8: Results of the One-way Analysis of Variance (ANOVA) Performed to Determine Whether Secondary School Students'Mathematical Problem-Solving Attitude Scale (MPSAS) Scores Differ or Not in Terms of "Mother's Education Level"

Source of Variance			Sum of Squares	df	Mean Square	F	P
Mother's Educational Level	MPÇTÖ Total	Between Groups	1,522	4	0,381	1,089	0,364
		Within Groups	54,178	155	0,350		
		Total	55,700	159			
	MPÇTÖ Enjoyment	Between Groups	4,565	4	1,141	1,640	0,167
		Within Groups	107,886	155	0,696		
		Total	112,451	159			
	MPÇTÖ Teaching	Between Groups	0,276	4	0,069	0,233	0,919
		Within Groups	45,864	155	0,296		
		Total	46,140	159			

As shown in Table 8, as a result of the one-way analysis of variance (ANOVA) performed to determine whether secondary school students' MPSAS arithmetic mean scores differ or not in terms of the variable of "Mother's Education Level", the difference among their arithmetic mean scores was not found statically significant [$F_{(4-159)}$=1,089; *p*>.05]. As a result of the ANOVA test performed in relation to the other scale sub-dimensions, no significant difference was found in the sub-dimensions of Enjoyment[$F_{(4-159)}$=1,640; *p*>.05] and Teaching [$F_{(4-159)}$=0,233; *p*>.05]. Accordingly, it can be stated that mathematical problem-solving attitudes are not influenced by mother's education level.

Table 9: Results of the One-way Analysis of Variance (ANOVA) Performed to Determine Whether Secondary School Students'Mathematical Problem-Solving Attitude Scale (MPSAS) Scores Differ or Not in Terms of "Father's Education Level"

Source of Variance			Sum of Squares	df	Mean Square	F	P
Father's Educational Status	MPÇTÖ Total	Between Groups	1,199	4	0,300	0,853	0,494
		Within Groups	54,501	155	0,352		
		Total	55,700	159			
	MPÇTÖ Enjoyment	Between Groups	4,580	4	1,145	1,645	0,166
		Within Groups	107,871	155	0,696		
		Total	112,451	159			
	MPÇTÖ Teaching	Between Groups	0,687	4	0,172	0,586	0,673
		Within Groups	45,453	155	0,293		
		Total	46,140	159			

As shown in Table 9, as a result of the one-way analysis of variance (ANOVA) performed to determine whether secondary school students' MPSAS arithmetic mean scores differ or not in terms of the variable of "Father's Education Level", the difference among their arithmetic mean scores was not found statically significant [$F_{(4-159)}$=0,853; *p*>.05].As a result of the ANOVA test performed in relation to the other scale sub-dimensions, no significant difference was found in the sub-dimensions of Enjoyment[$F_{(4-159)}$=1,645; *p*>.05] and Teaching [$F_{(4-159)}$=0,586; *p*>.05]. Accordingly, it can be stated that mathematical problem-solving attitudes are not influenced by father's education level.

Table 10: Results of the One-way Analysis of Variance (ANOVA) Performed to Determine Whether Secondary School Students'Mathematical Problem-Solving Attitude Scale (MPSAS) Scores Differ or Not in Terms of "Mathematics Achievement Score"

Source of Variance			Sum of Squares	df	Mean Square	F	P
Mathematics Achievement Score	MPÇTÖ Total	Between Groups	10,441	4	2,610	8,940	0,000
		Within Groups	45,259	155	0,292		
		Total	55,700	159			
	MPÇTÖ Enjoyment	Between Groups	16,847	4	4,212	6,828	0,000
		Within Groups	95,604	155	0,617		
		Total	112,451	159			
	MPÇTÖ Teaching	Between Groups	5,770	4	1,443	5,539	0,000
		Within Groups	40,370	155	0,260		
		Total	46,140	159			

As shown in Table 10, as a result of the one-way analysis of variance (ANOVA) performed to determine whether secondary school students' MPSAS arithmetic mean scores differ or not in terms of the variable of "mathematics achievement score", the difference among the arithmetic mean scores was found statistically significant [$F_{(4-159)}$=8,940; p<.05]. As a result of the ANOVA test performed in relation to the other scale sub-dimensions, there was also a significant difference in the sub-dimensions of Enjoyment[$F_{(4-159)}$=6,828; p<.05] and Teaching [$F_{(4-159)}$=5,539; p<.05].

After the ANOVA test, complementary Post-Hoc analysis techniques were performed to determine between which math grades the significant difference resulted from. In order todecide which post-hoc multiple comparison technique to be used, the Levene's test was performed to verify the homogeneity of group distribution variances, and it was found that the variances were homogeneous. Then, Tukey's multiple comparison tecnique was preferred since the variances were homogeneous. As a result of the Tukey'smultiple comparison analysis, it was found that MPSAS scores of the students with the Mathematics Achievement Score of 5 differed significantly when compared to the students with the Mathematics Achievement Score of 3, 2, and 1; MPSAS scores of the students with the Mathematics Achievement Score of 4 differed significantly when compared to the students with the Mathematics Achievement Score of 3 and 2 in terms of total scale scores. It was also found that MPSAS scores of the students with the Mathematics Achievement Score of 5 differed significantly when compared to the students with the Mathematics Achievement Score of 3 and 2; MPSAS scores of the students with the Mathematics Achievement Score of 4 differed significantly when compared to the students with the Mathematics Achievement Score of 3 in the dimension of Enjoyment; and MPSAS scores of the students with the Mathematics Achievement Score of 5 differed significantly when compared to the students with the Mathematics Achievement Score of 3 and 2; MPSAS scores of the students with the Mathematics Achievement Score of 4 differed significantly when compared to the students with the Mathematics Achievement Score of 2 in the dimension of Teaching.According to this research finding, it can be concluded that mathematical problem-solving attitudes of the students with higher mathematics achievement scores were more favourable when compared to those with lower mathematics achievement scores.

CONCLUSION AND DISCUSSION

According to the research findings, it can be concluded that mathematical problem-solving attitudes differ in terms of gender and female students have a more favourable attitude in comparison to male students. When the literature is examined, as also suggested by Gülten and Soytürk (2012), it is seen that there are different results regarding the way female and male students' problem-solving skills are perceived (Polat and Tümkaya, 2010),and whether problem-solving skills differ or not in terms of gender depends on the research sample group (Arlı, Altunay, Yalçınkaya, 2011). On the other hand, gender difference in mathematics draws attention of researchers and educators in many different countries of the world, and this brings about studies on gender difference (Duru and Savaş, 2005). In this context, it is considered important to investigate mathematical problem-solving attitudes in terms of gender and identify the situation.

It can be stated that mathematical problem-solving attitudes do not differ in terms of grade levels. In spite of the lack of sigificant difference, when table 6 is examined, it is observed that fifth grade students have higher mean scores. In this context, it can be concluded that as grade level increases, students' mathematical problem-solving attitudes decrease. Another finding is that no difference was observed in the mathematical problem-solving attitudes of students in the research group in terms of "Attending Nursery School" and "Parents' Education Level".As suggested in a research study conducted by Berkant and Eren (2013), although students' problem-solving skills are expected to increase relatively as their grade levels, mean scores, parents' income and education levels increase, it was observed that the results obtained were not parallel with this expectation.In addition to these findings, this study shows that attending nursery school is expected to influence problem-solving, but no difference was found. On the other hand, since the research sample is small, it might be impossible to make definite judgements.

The last finding is that secondary school students' arithmetic means of MPSAS scores differed significantly in terms of the variable of "Mathematics Achievement Score". Thus, it can be stated that students with high mathematics achievement scores have more favourable attitudes of mathematical problem-solving. Students who are successful at solving problems are actually expected to be successful in mathematics. It was observed that there was a significant and positive relationship between problem-solving skills and achievement in mathematics. Students who were not good at mathematics were also observed not to be good at problem-solving (Özsoy, 2005). The research studies conducted by Özsoy (2005) and Yılmaz (2009) support this study in terms of the relationship between mathematical achievement and problem-solving.

In line with the research findings, the following suggestions can be provided for further research:
- Similar research studies can be conducted with student groups from different grades in order to examine mathematical problem-solving attitudes in terms of the variable of gender.
- In addition to the variables used in this study, other variables that would influence mathematical problem-solving attitudescan be identified and more extensive qualitative and quantitative research studies can be conducted.
-Research sample groups whose mathematical problem-solving attitude levels are low can be identified and relevant solutions can be found after detecting the reasons with qualitative research studies.
- With the help of experimental studies, different methods and techniques of teaching can be used to obtain approaches that would positively influence mathematical problem-solving attitudes.

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