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The Investigation of Elementary Mathematics Teacher Candidates' Problem Solving Skills According to Various Variables

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Abstract

The aim was to determine elementary mathematics teacher candidates' problem solving skills and analyze problem solving skills according to various variables. The data were obtained from total 306 different grade teacher candidates receiving education in Department of Elementary Mathematics Education, Buca Faculty of Education, Dokuz Eylul University in the fall term of 2012-2013. As a result of analyses, there was not a significant difference between male and female candidates' perceptions of their problem solving skills. There was a significant difference on their problem solving skills and impulsive approach to problem solving according to grades. Additionally, there was not a significant difference between their problem solving skills and their level of family income, settlement and region where they were lived before coming to the university and leisure activities. It was suggested to give weight to achievement that will leave a positive lasting impact on students' attitudes like metacognitive skills, for the reason that students' impulsive approach to the problems.

Keywords: Problem solving skill, elementary mathematics education, teacher candidate.

Introduction

Problem solving skills is the leading of basic skills that somebody must have and use in many fields of everyday life. Hence, problem solving is a process, not a matter in hand. The target point with teaching this process is learning and using of problem solving

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skills (Republic of Turkey Ministry of National Education [RTMNE], 2005). Problem solving skills is in the basis of curriculum in many countries today (National Council of Teachers of Mathematics [NCTM], 1989; Cai & Nie, 2007). The present curriculum in Turkey is based on problem solving skills and problem solving is handled as a process rather than a subject. Problem solving enables that students both apply learned information and internalize their acquired achievements. For this reason, problem solving should be focal point of lessons learned at school especially mathematics (NCTM, 1980). Problem solving is an effective method used in teaching mathematics (Stigler & Hiebert, 1999) and it can be an important approach that will help to transcend traditional mathematics education which is transmission of facts (Lerman, 2000). Hence, the opinion that the development of problem solving skills should be among the precedence of education build consensus among math teachers (Karataş & Güven, 2004).

Problem solving skills should encourage students to think and use the information that they have. In other words, no matter what the subject or level, thinking should be turned into the most obvious form of an issue or problem solving activity (Yıldırım, 2004). According to Ulgen (2001), this transformation is described as that a person finds a solution that he can handle situations preventing to reach his goal. Similarly, Anderson (1980) defined problem solving as sequence of mental processes towards the target. Especially, most of the thinking processes are used in solving word problems (Soydan, 2001). According to Dewey, problem is described as everything that confuses the human mind, challenged him and obscures the belief (Baykul & Aşkar, 1987).

The main purpose of math teaching should be to take students competent problem solvers as a generally accepted idea (Schoenfeld, 1992). Problem solving requires separate solutions for each problems rather than a single path of thinking and solution (Baykul, 2006). Students who are academically successful are students who use effective strategies in problem solving and have acquired their perception (Garrett et. al, 2006). There are many stages of problem solving. These are basically collected in three phases such as understanding the problem, solving the problem and answering the problem (Charles et. al, 1994).

Decision-making competence in problem solving skills, which is a mental activity, is a result of the thinking process. For this reason, in the problem solving process, there are two types of thinking process including understanding and searching (Newell & Simon, 1972). Problem solving process is to research with controlled activities to achieve the aim that clearly designed but could not be achieved immediately (Altun, 2004). Besides, people who have advanced problem solving skills are not hard put to adapt to the environment and lead to the development of interdisciplinary relations. Solving of problems requires interdisciplinary knowledge, versatile thinking and creativity (Senemoğlu, 1997). Beyond these, the main idea is to teach more free and creative thinking in problem solving first of all (Umay, 1994). Web-based instructon model with the creative problem solving process help teachers to construct the theoretical framework easily in order to stimulate students to research the information and use them for the process of problem-solving (Liamthaisong et. al, 2011).

It is seen that the majority of students are hard put to solve similar problems. Here, it can be mentioned both operational and structural deficiency at the point of the transfer of knowledge to the application. That is to say, the characteristics that different problems have can lead to confusion. Hence, students have difficulty in making sense an experienced problem in given context to another context and thus have difficulty to solve it (Bransford et. al, 1999). Several methods, techniques and strategies have developed in terms of removing these and similar conditions or providing convenience

to individuals in problem solving. All these developments involve the steps for knowing inside out and using effectively of problem solving (Demirel, 2003) to raise a youth who solve problems not pose problems. These steps do not address the structure of single operational steps. These steps refer to find a result, as well as find a way; get rid of difficulty (Polya, 1957).

There are a large number of concepts on problem-solving skills in the literature. For example, such as creativities, discrimination and defining of problem, producing solutions, cognizance the salient features of problem, making an effort for solution and performing an application, reaching conclusion, giving a decision, mental processes, imagination, imagining based on experiences are dealt with problem solving. Individuals experience with many concepts in daily life and have to cast about the problem. This process is a complicated process involving cognitive, affective and behavioral activities (Taylan, 1990), as well as it affects individual's problem solving performance and the process of coping with problems (Bonner & Rich, 1988).

Enhancing the quality of teaching relate to the degree of demonstrating of students' acquired skills. Hence, students' potential problem solving skills should be determined besides that problem solving skills should be gained to students. Because, the evaluation of students' problem solving skills provide both having information about students' knowledge of mathematics and the obtainment of information having the characteristics of clue that may guide education programs (Karataş, 2002). Problem solving skills learned and developed ever since pre-school period is gained from childhood and developed in school years (Miller & Nunn, 2001). When education is considered as a problem-solving process, students are expected to be a good problem solver in primary school years (Serin & Derin, 2008). According to Demirel (1999), problem solving methods should be in all levels of education from primary school to university (cited in Bayraktar et al., 2011). Bruner, reading students as individuals who solve actively problems, handles the teaching-learning process as a period helping students to discover problems that can be managed or solved (Balay, 2004).

So that students are successful at web-based education applications, they should have advanced problem solving skills. Students with advanced problem solving skills successfully navigate their learnings through highly complex Web-based environments (Kauffman et al., 2008). Providing learners with manipulative function in multimedia learning improves their problem solving (Zheng et al., 2009).

In this study, it is tried to determine primary mathematics teacher candidates' problem solving skills and whether their problem solving skills change according to various of variables as class, gender, the region and settlement lived before coming to the university, level of family income and leisure activities.

Method

Research model

Progressive methods of descriptive research method were used in this study. This kind of research study is used to explore the onset, direction, growth rate, pattern, indication of decline in development and interaction between factors affecting the development (Uysal, 1974). This model intends to reveal how the investigated fact, case or subject changes or develops in a specific period of time (Cohen et. al, 2007). Addition, rather than to follow the same sample in the cross-sectional studies, the research can be completed as soon as possible by working with the samples used in different years and may be equivalent (Çepni, 2010).

Research group

The research group was composed of 306 students studying in different class levels in Department of Elementary Mathematics Education, Buca Faculty of Education, Dokuz Eylul University, in the fall semester of 2012-2013 academic years, as showed in Table 1.

Table 1. *Distribution of the sample of the research according to class and gender variables*

Variables	*Subcategory*	*N*	*%*	*Total*
Class	1	71	23.20	306
	2	86	28.11	
	3	84	27.45	
	4	65	21.24	
Gender	Female	221	72.22	306
	Male	85	27.78	

Data Collection Tools

The Problem Solving Inventory (PSI) developed by Heppner and Petersen (1982) and adjusted Turkish was used as a data collection tool in the research. The part composed of personal information of the students participated in the study which was chosen to determine students' class, gender, the region and settlement lived before coming to the university, level of family income and leisure activities was added to the PSI. The PSI was implemented to volunteer students. The implementation lasted twenty minutes for each group.

Problem Solving Inventory (PSI). The Problem Solving Inventory (Form A (PSI); Heppner, 1988; Heppner & Petersen, 1982) is a tool containing 32 items like Likert which was constructed in order to determine the people's problem solving skills and their perceptions related to problem solving strategies (Heppner, 1988). The inventory in fact contains 35 items but 9th, 22nd and 29th items were not included in scoring. The answers which can be given to the items change as 1 (absolutely agree), 2 (usually behave like that), 3 (often behave like that), 4 (sometimes behave like that), 5 (rarely behave like that) and 6 (absolutely not agree). The scores which can be obtained from the inventory show variance between 32 and 192; (32-80 the highest level, 81-192 the lowest level). The low score which is gathered from the inventory means that the individual has perceived his problem solving skill positive and the high score means that the individual has perceived himself negative about his problem solving skill. When the scores gathered from sub-items which survey the attitudes to problem solving manners which can be indicated as positive in grading the sub-items, have been decreasing it is perceived as related manners used much more. When the grades gathered from sub-items which survey the problem solving attitudes (hasty attitude-avoider attitude) indicated as negative-ineffective have been decreasing it is thought that the desired attitudes are used much less (Ferah, 2000).

Heppner (1988) determined three factors in the result of the factor analysis which he carried out in his research. These were "problem-solving confidence" which states the individual's confidence in solving new problems; "approach-avoidance style" which states the effective research in order to revise their first problem solving effort and "personal control" which states the skill of maintains self-control in problematic situations (Bayraktar et. al, 2011). Taylan's (1990) who tried to adapt the inventory to

Turkish obtained factors in the results of his research are the same factors. However, 6 factors were encountered as a result of factor analyzes of the study of adaptation to Turkish by Şahin et al. (1993). The reliability of these six factors were indicated as: the reliability of the items in impulsive style (13,14,15,17, 21, 25, 26, 30, 32) was *r* = .78, the reliability of the items in reflective style (18, 20, 31, 33, 35) was *r* = .76, the reliability of the items in problem-solving confidence (5, 11, 23, 24, 27, 28, 34) was *r* = .74, the reliability of the items in avoidant style (1, 2, 3, 4) was r=.69, the reliability of the items in monitoring (6, 7, 8) was *r* = .64 and the reliability of the items in planfulness (10, 12, 16, 19) was *r* = .59.

In addition to this, the reliability and validity results about Problem Solving Inventory in Şahin et al. (1993)'s research are like that: Cronbach Alpha reliability correlation of the scale was found as *r* = .88 and split-half reliability was *r* = .81 found via split-half technique by dividing odd and even numbers. Criterion-related validity; the total correlation coefficiency between the total score of the scale and Beck Depression Inventory was found as .33 and the correlation coefficiency with STAI-T total score as .45.

Construct validity; the end groups which were constructed according to the scores obtained from Beck Depression Inventory and STAI-T were indicated to be separated meaningfully. As a result of discriminant analysis results, the scale was found dysphoric and without dysphoric groups to be graded into their own groups with 94% and 55% proportions respectively; anxiety and without anxiety groups to be graded into their own groups with 90% and 80% proportions respectively (Savaşır & Şahin, 1997: 80).

The reliability coefficiency (cronbach-alpha) of the problem solving inventory which was conducted with 306 students was found as .90. The reliability results of 6 factors were like: the reliability of the items in impulsive style was *r* = .75, the reliability of the items in reflective style was *r* = .74, the reliability of the items in problem-solving confidence was *r* = .72, reliability of the items in avoidant style was *r* = .67, the reliability of the items in monitoring was *r* = .55 and the reliability of the items in planfulness was *r* = .64. The obtained reliability coefficiency scores are perceived as the reliable ones.

Data Analysis

SPSS 15 program, independent samples t-test and one-way analysis of variance (ANOVA) were used in data analysis. Mean, standard deviation, independent samples t-test for the comparison of binary groups and one-way analysis of variance (ANOVA) for the comparisons of more than binary groups were used in data analysis. Assumptions for t-test and ANOVA were controlled and it was seen that the scores had normal disturbance and assumptions of the homogeneity of variances were provided. The significance level for all statistical calculations was determined as 0.05.

Findings

Means and standard deviations belonging to elementary mathematics teacher candidates' problem solving skills are given in Table 2.

Table 2. *The Results of Descriptive Statistics of Primary Mathematics Teacher Candidates' Problem Solving Skills and Problem Solving Subcategories*

Problem Solving Skills and Subcategories	*N*	$\bar{x}$	*SD*
Impulsive Style	306	27.91	6.72
Reflective Style	306	12.55	3.84

Table 2 (Cont). *The Results of Descriptive Statistics of Primary Mathematics Teacher Candidates' Problem Solving Skills and Problem Solving Subcategories*

Problem-Solving Confidence	306	18.43	4.96
Avoidant Style	306	10.79	3.58
Monitoring	306	7.70	2.55
Planfulness	306	10.15	3.08
Total Score	306	87.55	18.60

Whether primary mathematics teacher candidates differently perceive the problem solving skills based on their gender was analyzed via independent samples t-test. The data about analysis results were given in Table 3. According to the result, problem solving skills did not show difference in impulsive style [t_{304} = 1.778, p > .05], reflective style [t_{304} = -.140, p > .05], problem-solving confidence [t_{304} = -281, p > .05], avoidant style [t_{304}=.918, p > .05], monitoring [t_{304} = 1.682, p >.05], planfulness [t_{304} = -.847, p > .05], and total score [t_{304}=.800, p > .05] according to gender.

Table 3. *t-Test Results of The Comparison of Means of Elementary Mathematics Teacher Candidates' PSI Subcategory and Total Scores According to Gender*

	Gender	*N*	$\bar{x}$	*SD*	*sd*	*t*	*p*
Impulsive Style	Female	221	27.49	6.44	304	1.778	.076
	Male	85	29.01	7.31			
Reflective Style	Female	221	12.57	3.72	304	-.140	.889
	Male	85	12.51	4.15			
Problem-Solving Confidence	Female	221	18.48	4.67	304	-281	.779
	Male	85	18.31	5.68			
Avoidant Style	Female	221	10.67	3.41	304	.918	.359
	Male	85	11.09	3.99			
Monitoring	Female	221	7.55	2.59	304	1.682	.094
	Male	85	8.09	2.44			
Planfulness	Female	221	10.24	3.05	304	-.847	.397
	Male	85	9.91	3.19			
Total Score	Female	221	87.02	17.79	304	.800	.425
	Male	85	88.92	20.63			

Descriptive statistics of primary mathematics teacher candidates' perception of their problem solving skills according to grade variable take place in Table 4. One-way analysis of variance (ANOVA) was used in order to determine whether primary mathematics teacher candidates' perception of their problem solving skills changes according to their grades.

According to results of the test (as seen in Table 5), primary mathematics teacher candidates' perceptions of problem solving skills did not show any difference in reflective style [F(3,302) = 2.384, p > .05], problem-solving confidence [F(3,302) = 1.465, p > .05], avoidant style [F(3,302) = .315, p > .05], monitoring [F(3,302) = 1.570, p > .05] and planfulness [F(3,302) = 1.880, p > .05]. However, a significant difference was seen in impulsive style [F(3,302) = 5.947, p < .05] and total score [F(3,302) = 2.949, p < .05] according to the students' grade levels. According to Scheffe test results which were examined to determine why the difference occurs, the first (= 29.76) and third (= 29.21) graders have higher problem solving scores in impulsive style than the second (= 26.42) and fourth (= 26.20) graders. According to this situation, the first and third graders have been thought to use Impulsive Style in problem solving than the second and fourth graders. According to Scheffe test results

which were examined to determine why the difference occurs in total scores, the third (= 91.13) graders have higher problem solving scores in total scores than the second (= 83.72) graders. According to this situation, the third graders have lower perception of problem solving skills than the second graders.

Table 4. *Primary Mathematics Teachers' Problem Solving Skills According to Grade*

	First grade		Second grade		Third grade		Fourth grade	
	$\bar{x}$	***SD***	$\bar{x}$	***SD***	$\bar{x}$	***SD***	$\bar{x}$	***SD***
Impulsive Style	29.76	7.19	26.42	6.25	29.21	7.05	26.20	5.49
Reflective Style	12.39	3.86	11.79	3.56	13.32	3.93	12.75	3.93
Problem-Solving Confidence	18.77	5.16	17.51	4.48	18.98	4.71	18.58	5.56
Avoidant Style	11.03	3.66	10.89	3.84	10.74	3.44	10.46	3.37
Monitoring	7.52	2.63	7.39	2.38	8.19	2.51	7.66	2.70
Planfulness	10.37	3.04	9.71	3.15	10.69	2.71	9.78	3.42
Total Score	89.86	19.15	83.72	17.04	91.13	18.11	85.45	19.75

(N First grade = 71, N Second grade = 86, N Third grade = 84, N Fourth grade = 65)

Table 5. *ANOVA Results of Primary Mathematics Candidates' PSI Scores According to Their Grades*

	Source of variance	Total of squares	sd	Mean of squares	*F*	*p*	Meaningful Difference
Impulsive Style	Among groups	767.388	3	255.796	5.947	.001	1-2, 1-4
	In groups	12990.403	302	43.015			3-2,3-4
	Total	13757.791	305				
Reflective Style	Among groups	103.982	3	34.661	2.384	.069	Not
	In groups	4391.573	302	14.542			
	Total	4495.556	305				
Problem-Solving Confidence	Among groups	107.573	3	35.858	1.465	.224	Not
	In groups	7391.620	302	24.476			
	Total	7499.193	305				
Avoidant Style	Among groups	12.221	3	4.074	.315	.814	Not
	In groups	3900.394	302	10.186			
	Total	3912.614	305				
Monitoring	Among groups	30.557	3	10.186	1.570	.197	Not
	In groups	1959.783	302	6.489			
	Total	1990.340	305				
Planfulness	Among groups	53.234	3	17.745	1.880	.133	Not
	In groups	2851.148	302	9.441			
	Total	2904.382	305				
Total score	Among groups	3004.345	3	1001.448	2.949	.033	2-3
	In groups	102555.515	302	339.588			
	Total	105559.859	305				

Table 6. *Descriptive Statistics of Primary Mathematics Teacher Candidates' Perceptions of Their Problem Solving Skills According to Their Region Which They Lived Before They Started The University*

	Central Anatolia		Aegean		Marmara		Eastern Anatolia		Southeastern Anatolia		Black Sea		Mediterranean	
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
Impulsive	29.68	5.64	28.40	6.95	27.39	6.43	26.33	6.18	26.50	4.20	29.00	6.46	25.95	6.54
Reflective	13.56	3.40	12.59	3.87	11.52	3.31	13.66	3.72	11.00	3.36	12.70	4.97	13.06	4.09
Problem-Solving Confidence	18.81	4.88	18.62	4.93	17.32	4.48	18.83	6.27	17.25	2.87	17.70	4.71	18.91	5.60
Avoidant	12.00	3.38	10.92	3.71	9.84	2.59	11.50	2.58	11.25	2.87	11.10	4.60	10.60	3.85
Monitoring	7.81	1.55	7.79	2.56	7.34	2.25	7.83	.75	5.75	1.25	8.20	2.82	7.68	3.18
Planfulness	10.25	2.54	10.39	3.23	9.26	2.76	11.00	3.46	9.50	1.73	9.40	3.20	10.13	2.92
Total score	92.19	18.19	88.73	18.84	82.69	14.59	89.17	18.75	81.25	2.75	88.10	20.3	86.35	21.5

Descriptive statistics of primary mathematics teacher candidates' perceptions of problem solving skills according to their region which they lived before they started the university was given in Table 6.

Table 7. *ANOVA Results of Primary Mathematics Candidates' PSI Scores According to Their Region Which They Lived Before They Started The University*

PSI and subcategories	Source of variance	Total of squares	sd	Mean of squares	*F*	*p*	Meaningful Difference
Impulsive Style	Among groups	313.923	6	52.321	1.164	.326	Not
	In groups	13443.868	299	44.963			
	Total	13757.791	305				
Reflective Style	Among groups	94.677	6	15.780	1.072	.379	Not
	In groups	4400.878	299	14.719			
	Total	4495.556	305				
Problem-Solving Confidence	Among groups	87.151	6	14.525	.586	.742	Not
	In groups	7412.042	299	24.789			
	Total	7499.193	305				
Avoidant Style	Among groups	73.825	6	12.304	.958	.454	Not
	In groups	3838.790	299	12.839			
	Total	3912.614	305				
Monitoring	Among groups	25.288	6	4.215	.641	.697	Not
	In groups	1965.052	299	6.572			
	Total	1990.340	305				
Planfulness	Among groups	59.075	6	9.846	1.035	.403	Not
	In groups	2845.308	299	9.516			
	Total	2904.382	305				
Total score	Among groups	1919.760	6	319.960	.923	.479	Not
	In groups	103640.100	299	346.622			
	Total	105559.859	305				

ANOVA was used in order to determine whether primary mathematics teacher candidates' perception of their problem solving skills changes according to their region which they lived before they started the university. According to ANOVA results (as seen in Table 7), there were not meaningful differences between primary mathematics teacher candidates' perceptions of problem solving skills and the region which they lived in before they started the university in impulsive style, reflective style, problem-

solving confidence, avoidant style, monitoring, planfulness and total score. [$F_{6\text{-}299}$ = 1.164, p > .05], [$F_{6\text{-}299}$ = 1.072, p > .05], [$F_{6\text{-}299}$ = .586, p > .05], [$F_{6\text{-}299}$ = .958, p > .05], [$F_{6\text{-}299}$ = .641, p > .05], [$F_{6\text{-}299}$ = 1.035, p > .05], [$F_{6\text{-}299}$ = .923, p > .05]. That is to say, candidates' region which they lived before they started the university do not have an effect on their problem solving skills and approaches to the problems.

Descriptive statistics of primary mathematics teacher candidates' perceptions of problem solving skills according to their settlement which they lived before they started the university was given in Table 8. ANOVA was used in order to determine whether primary mathematics teacher candidates' perception of their problem solving skills changes according to their settlement which they lived before they started the university.

Table 8. *Descriptive Statistics of Primary Mathematics Teacher Candidates' Perceptions of Their Problem Solving Skills According to Their Settlement Which They Lived Before They Started The University*

	Village			Town			District			Province		
	N	$\bar{x}$	*SD*	*N*	$\bar{x}$	*SD*	*N*	$\bar{x}$	*SD*	*N*	$\bar{x}$	*SD*
Impulsive Style	27	27.67	5.72	16	29.25	6.59	144	27.93	6.74	119	27.77	6.97
Reflective Style		13.74	3.32		12.12	3.81		12.35	3.88		12.59	3.89
Problem-Solving Confidence		19.22	4.68		17.94	4.74		18.42	5.18		18.33	4.81
Avoidant Style		11.44	3.10		10.69	2.47		10.93	3.79		10.49	3.55
Monitoring		8.04	2.81		7.62	2.19		7.67	2.52		7.67	2.60
Planfulness		10.89	2.66		10.37	3.03		9.98	2.98		10.15	3.31
Total score		91.00	15.17		88.00	16.52		87.28	19.17		87.02	18.99

According to ANOVA results (as seen in Table 9), there were not meaningful differences between primary mathematics teacher candidates' perceptions of problem solving skills and the settlement which they lived in before they started the university in impulsive style, reflective style, problem-solving confidence, avoidant style, monitoring, planfulness and total score [F(3,302) = .239, p > .05], [F(3,302) = 1.071, p > .05], [F(3,302) = .294, p > .05], [F(3,302) = .660, p > .05], [F(3,302) = .173, p > .05], [F(3,302) = .689, p > .05], [F(3,302) = .353, p > .05]. In other words, candidates' settlement which they lived before they started the university do not have an impact on their problem solving skills and approaches to the problems.

Table 9. *ANOVA Results of Primary Mathematics Teacher Candidates' Problem Solving Skills According to The Settlement Which They Lived Before They Started The University*

PSI and subcategories	Source of variance	Total of squares	sd	Mean of Squares	*F*	*p*	Meaningful Difference
Impulsive Style	Among groups	32.611	3	10.870	.239	.869	Not
	In groups	13725.180	302	45.448			
	Total	13757.791	305				

Table 9 (Cont). *ANOVA Results of Primary Mathematics Teacher Candidates' Problem Solving Skills According to The Settlement Which They Lived Before They Started The University*

Reflective Style	Among groups	47.343	3	15.781	1.071	.361	Not
	In groups	4448.213	302	14.729			
	Total	4495.556	305				
Problem-Solving Confidence	Among groups	21.874	3	7.291	.294	.829	Not
	In groups	7477.319	302	24.759			
	Total	7499.193	305				
Avoidant Style	Among groups	25.474	3	8.491	.660	.577	Not
	In groups	3887.141	302	12.871			
	Total	3912.614	305				
Monitoring	Among groups	3.408	3	1.136	.173	.915	Not
	In groups	1986.931	302	6.579			
	Total	1990.340	305				
Planfulness	Among groups	19.751	3	6.584	.689	.559	Not
	In groups	2884.631	302	9.552			
	Total	2904.382	305				
Total score	Among groups	368.567	3	122.856	.353	.787	Not
	In groups	105191.293	302	348.316			
	Total	105559.859	305				

Descriptive statistics of the students' families' income are shown in Table 10. ANOVA was used in order to determine whether primary mathematics teacher candidates' perceptions of problem solving skills show meaningful differences according to their families' income.

Table 10. *Descriptive Statistics of Primary Mathematics Teacher Candidates' Perceptions of Their Problem Solving Skills According to Their Families' Incomes*

Income	500TL and under		500-1000TL		1000-1500TL		1500-2000TL		2000TL and above	
PSI and subcategories	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
Impulsive Style	27.14	5.61	28.68	6.73	27.88	6.55	27.58	6.39	27.88	7.62
Reflective Style	12.86	3.76	13.02	4.30	12.60	3.72	11.95	3.37	12.69	4.08
Problem-Solving Confidence	18.85	3.91	18.51	4.51	18.82	5.07	18.16	5.17	18.10	5.32
Avoidant Style	10.71	3.12	11.32	3.93	10.63	3.82	10.32	2.82	11.06	3.90
Monitoring	8.14	2.31	7.42	2.31	8.01	2.54	7.54	2.66	7.65	2.74
Planfulness	10.90	3.01	10.37	2.89	10.12	2.91	9.81	3.07	10.13	3.49
Total score	88.62	15.02	89.32	18.19	88.08	18.28	85.37	17.92	87.53	21.21

(N 500 and under=21, N 500-1000=62, N1000-1500=76, N 1500-200=79, N 2000 and above=68)(TL; Turkish Lira)

Table 11. *ANOVA Results of Primary Mathematics Teacher Candidates' Problem Solving Skills According to Their Family Incomes*

PSI and subcategories	Source of variance	Total of squares	sd	Mean of squares	*F*	*p*	Meaningful Difference
Impulsive Style	Among groups	57.463	4	14.366	.316	.867	Not
	In groups	13700.328	301	45.516			
	Total	13757.791	305				
Reflective Style	Among groups	45.530	4	11.383	.770	.545	Not
	In groups	4450.025	301	14.784			
	Total	4495.556	305				
Problem-Solving Confidence	Among groups	29.221	4	7.305	.294	.882	Not
	In groups	7469.972	301	24.817			
	Total	7499.193	305				
Avoidant Style	Among groups	42.243	4	10.561	.821	.512	Not
	In groups	3870.372	301	12.858			
	Total	3912.614	305				
Monitoring	Among groups	18.560	4	4.640	.708	.587	Not
	In groups	1971.779	301	6.551			
	Total	1990.340	305				
Planfulness	Among groups	24.210	4	6.053	.633	.640	Not
	In groups	2880.172	301	9.569			
	Total	2904.382	305				
Total score	Among groups	616.537	4	154.134	.442	.778	Not
	In groups	104943.323	301	348.649			
	Total	105559.859	305				

According to the results (as seen in Table 11), meaningful difference has not been seen in impulsive style, reflective style, problem-solving confidence, avoidant style, monitoring, planfulness and total score according to primary mathematics teacher candidates' perception of problem solving skills [F(4,301)=.316, p>.05], [F(4,301)=.770, p>.05], [F(4,301)=.294, p>.05], [F(4,301)=.821, p>.05], [F(4,301)=.708, p>.05], [F(4,301)=.633, p>.05], [F(4,301)=.442, p>.05]. Namely, candidates' family incomes do not have an effect on their problem solving skills and approaches to the problems.

Descriptive statistics of the students' interested activities are shown in Table 12. ANOVA was used in order to determine whether there were meaningful differences between primary mathematics teacher candidates' perceptions of problem solving skills according to the activities which they are interested in.

Table 12. *Descriptive Statistics of Primary Mathematics Teacher Candidates' Perceptions of Their Problem Solving Skills According to Their Interested Activities*

PSI and subcategories	Sport		TV		Internet		Music art		Cultural		Other	
	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*	$\bar{x}$	*SD*
Impulsive Style	29.62	7.45	27.55	6.14	30.65	6.40	28.32	6.87	26.72	6.27	27.81	7.70
Reflective Style	12.80	4.08	12.98	3.73	13.73	4.51	11.72	3.84	12.13	12.13	14.05	3.87
Problem-Solving Confidence	17.95	5.91	18.43	3.97	18.96	4.78	18.73	4.28	18.02	5.07	20.57	5.38
Avoidant Style	10.64	3.74	10.93	3.40	11.54	3.33	10.72	3.56	10.51	3.62	11.71	3.87
Monitoring	7.73	2.36	7.66	2.57	8.38	2.61	7.41	2.22	7.66	2.75	7.71	2.45
Planfulness	9.98	3.13	10.11	2.71	10.81	4.09	10.11	2.95	10.00	3.07	10.71	2.88
Total score	88.73	20.88	87.68	16.03	94.08	19.74	87.02	16.67	85.04	18.35	92.57	21.38

Table 13. *ANOVA Results of Primary Mathematics Teacher Candidates' Problem Solving Skills According to Their Interested Activities*

PSI and subcategories	Source of variace	Total of squares	*sd*	Mean of squares	*F*	*p*	Meaningful Difference
Impulsive Style	Among groups	517.952	5	103.590	2.347	.041	Not
	In groups	13239.839	300	44.133			
	Total	13757.791	305				
Reflective Style	Among groups	148.049	5	29.610	2.043	.073	Not
	In groups	4347.507	300	14.492			
	Total	4495.556	305				
Problem-Solving	Among groups	138.585	5	27.717	1.130	.345	Not
Confidence	In groups	7360.608	300	24.535			
	Total	7499.193	305				
Avoidant Style	Among groups	44.443	5	8.889	.689	.632	Not
	In groups	3868.172	300	12.894			
	Total	3912.614	305				
Monitoring	Among groups	16.288	5	3.258	.495	.780	Not
	In groups	1974.052	300	6.580			
	Total	1990.340	305				
Planfulness	Among groups	22.192	5	4.438	.462	.804	Not
	In groups	2882.190	300	9.607			
	Total	2904.382	305				
Total score	Among groups	2494.748	5	498.950	1.452	.205	Not
	In groups	103065.111	300	343.550			
	Total	105559.859	305				

According to the results (as seen in Table 13), meaningful difference has not been seen in impulsive style, reflective style, problem-solving confidence, avoidant style, monitoring, planfulness and total score according to primary mathematics teacher candidates' perceptions of problem solving skills in terms of the activities they interested in [F(5,300)=2.347, p>.05], [F(5,300)=2.043, p>.05], [F(5,300)=1.130, p>.05], [F(5,300)=.689, p>.05], [F(5,300)=.495, p>.05], [F(5,300)=.462, p>.05], [F(5,300)=1.452, p>.05]. That is to say, the activities that candidates have an interest in do not affect their problem solving skills and approaches to the problems.

Result and Discussion

Male and female teacher candidates' problem solving skills have been seen to intensify in impulsive style whereas they have lesser intensity in monitoring in the research study which was carried out in aim of investigating primary mathematics teacher candidates' problem solving skills and whether they differ according to various variables. When problem solving skill subcategories were examined in terms of males have been seen to be in more hasty, avoidant and evaluative attitudes than females. Females have been seen to intensify more in other subcategories: Reflective style, problem-solving confidence and planfulness than males. When the gender variable was generally examined meaningful difference has not been seen between female and male teacher candidates' problem solving subcategories and total scores. In the same manner, Aslan and Uluçınar Sağır (2012) did not find a meaningful difference in among female and male teacher candidates' total scores of PSI in their study; however, they found a difference between female and male in impulsive style. On the other hand, D'Zurilla, Maydeu-Olivares and Kant (1998); Güven and Akyüz (2001); Gölgeleyen (2011); Özbulak et al. (2011); Gündoğdu (2010) stated that there was a meaningful difference in problem solving skills in terms of gender in their studies. Gold et al., (1984) and Graybill (1975) remarked that males were more successful than females in their studies whereas Sezen and Paliç (2011) stated that females had more positive perception on their own problem solving skills than males. However, Polat and Tümkaya (2010) researched primary school teacher candidates' problem solving skills in terms of thinking needs and they found a meaningful difference in problem solving skill in terms of the students' gender and grades. In the same manner; Saygılı (2000); Saraçoğlu et al. (2001); Taylan (1990); Gültekin (2006); Sarıbıyık et al. (2004); Çilingir (2006); Özkütük et al. (2003) found a meaningful difference between problem solving skills and the students' gender.

When primary mathematics teacher candidates' problem solving skills were examined in terms of grade levels there were meaningful difference in their impulsive style and total PSI scores, but there were not a meaningful difference in their reflective style, problem-solving confidence, avoidant style, monitoring and planfulness scores. In the same manner; Sezen and Paliç (2011); Gündoğdu (2010) found that candidates' grade levels do not have a meaningful effect on their perception of problem solving skills. On the other hand, Saraçoğlu et al. (2001) found that students' problem solving skills and their overall achievements changes meaningfully according to department. Polat and Tümkaya (2010) found that primary school teacher candidates' problem solving skills in terms of their grade level differs significantly in favor of fourth grades. Besides, Taylan (1990) and Ünüvar (2003), Yıldırım et al. (2011), Ferah (2000) and Doğan (2009) found that there were not a meaningful difference between students' problem solving skills according to their grade levels in their research carried out with college and high school students.

According to the analysis results, there were not a meaningful difference between primary mathematics teacher candidates' perceptions of problem solving skills and the regions which they lived in before they started the university in impulsive style,

reflective style, problem-solving confidence, avoidant style, monitoring, planfulness. Basmacı (1998) stated that the students' birth place does not have a significant effect on their perceptions of problem solving skills in her study named as the study of university students' perception of problem solving skills in terms of some variables.

Meaningful relationship between problem solving skills and family income has not been found in the study. Gölgeleyen (2011) did not found a relationship between family income level and problem solving skills. Çilingir (2006) and Türkçapar (2009) and Cengiz (2010) found that students' problem solving skills do not show a meaningful difference according to their families' incomes in parallel with the study results. Meaningful difference does not occur between parents' occupations and education level and problem solving skills levels (Barut & Genez, 2000:361). However, Kasap (1997) reached the conclusion that there was relationship between problem solving attitude and problem solving success in her study researched the problem solving attitude according to socio-economic status. Bilge and Aslan (1999) have put forward that university students' problem solving skills increase in parallel with their income level. Nacar and Tümkaya (2011) found that problem solving skills increase with income level.

Meaningful difference has not been seen between primary mathematics teacher candidates' perception of problem solving skills and the activities they are interested in. Türkçapar (2009) also indicated that there is not difference in problem solving skills in terms of the ways of recreation. Gölgeleyen (2011) found that industrial vocational high school students' problem solving skills do not have a meaningful difference in terms of participation to the social events. However, Yıldırım et al. (2011) researched the factors affecting the problem solving skills and found meaningful difference in terms of the students' gender, grades, fathers' education level and occupation, studying style, academic success, parents' attitude, feeling lonely, self-confident and consuming cigarette and alcohol.

Suggestions

- The suggestions below are recommended following the study carried out:
- Education programs should be developed and provided their continuity with reference to meaningful difference in the students' problem solving skills.
- Educational attainments like the ones having long time effect on the attitudes like metacognitive skills should be given importance because female and male students are generally in impulsive style in problem solving skills.
- Social skills which provide the students to feel strong in social and emotional perspectives should be supported in order to use their problem solving skills in the activities they interested in and in this manner, desired behaviors should be gained in the students.
- Education environment subjecting the teacher candidates' creativity in problem solving situations should be created in order to bring up teacher candidates who have internal locus of control and feel themselves competent in problem solving.
- Problem solving education should be given more places in teacher candidates. They should be provided to organize their own thoughts. They should develop more real-life thinking skills and construct more realistic thinking models. These are because teacher candidates take place less in monitoring.

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