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The Relationship Between Pre-Service Teachers' Critical Thinking Tendencies and Problem Solving Skills

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Abstract

The aim of this study is to determine the relationship between pre-service teachers' critical thinking tendencies and problem solving skills. Besides, the other problem of the study is whether problem solving skills show significant difference according to the critical thinking tendency level and according to the compound effect of critical thinking tendency level with gender, department and grade level respectively. The sample of the study consists of 224 1st and 2nd grade pre-service teachers studying at Afyon Kocatepe University Education Faculty. The California Critical Thinking Disposition Inventory, which was developed by Facione and Giancarlo (1998) and adapted into Turkish by Kökdemir (2003) and Problem Solving Inventory, which was developed by Heppner and Petersen (1982) and adapted into Turkish by Şahin, Şahin and Heppner (1993) are used as means of data collection in the study. According to the findings of the study, a significant and positive relationship between pre-service teachers' critical thinking tendencies and problem solving skills was found. According to the pre-service teachers' critical thinking tendency level (low, positively, high), problem solving skills and sub-dimensions show a significant difference. However problem solving skills show no significant differences according to the compound effect of critical thinking tendency level with gender, department and grade level.

Keywords: critical thinking tendency, problem solving skill, pre-service teacher.

The leading tool human beings use to make sense of the world is thinking. Thinking activity is behind the most of the characteristics human beings have. Talking, discussing, making choices and a lot of acts like that are all directed by thinking (Neville, 1981).

All human beings think by their nature. But if they don't possess effective thinking skills, they often think biased, deficient and not goal oriented (Doğanay and Ünal, 2006). On the other hand, knowledge society that we live in in this century demands individuals that can examine information he/she encounters, thinks independently and takes different approaches to events. To put it in a different way, at the present time human beings should generate an elimination system for the information he/she gains. At this point, the mental process which human beings need to use as a reasonable filter is critical thinking. (Thayer and Bacon, 2000). So critical thinking is an important mental process for human beings that accord with

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demands of the knowledge society.

Critical thinking is reasonable and reflective thinking focused on deciding what to believe or do (Ennis, 1991: 6). Critical thinking can be defined by the skill of taking the responsibility of his/her own ideas. For this purpose, individuals improve various criterion and standards to evaluate their thinkings and use this criterion and standards constantly in order to enhance the quality of their thoughts (Paul and Elder, 1994). Cücelođlu (2003: 216-217) defines critical thinking as “active, organised mental process that is aimed at understanding ourselves and everything around us by being conscious of our own thinking processes, by considering others’ opininons and by practicing our learnings”. Halpern (2002: 37) has described critical thinking as “. . .thinking that is purposeful, reasoned, and goal directed – the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and making decisions”.

Critical thinking, as a kind of thinking, is mostly defined with regard to using specific skills. But only possessing some skills is not enough to perform them. An individual’s tendency to use these skills is of the essence for critical thinking. Critical thinking tendency is the intrinsic motivation of thinking critically when someone faces a problem to solve, an idea to analyse or a situation to judge (Giancarlo, 2006). The approachment of an individual who has critical thinking tendency to specific issues, question and events can be characterized by these actions:

- clarity in stating the question or concern,
- orderliness in working with complexity,
- diligence in seeking relevant information,
- reasonableness in selecting and applying criteria,
- care in focusing attention on the concern at hand,
- persistence though difficulties are encountered,
- precision to the degree permitted by the subject and the circumstance (Facione, 1991).

According to John Dewey, problem is everything that confuses an individual, challenges his/her mind and makes the belief vague (Gelbal, 1991: 167-168). Bingham (2004: 24) defines problem as obstacles that inhibit the existing power of an human that is aimed at reaching a goal. In this regard, basically, problem solving is the process of overcoming the obstacles which are obviating to reach a goal (Morgan, 1999). From another angle, problem solving is moving beyond simply implementing the learned rules to solve problem and finding new ways for that purpose (Korkut, 2002).

Problem solving skill includes understanding and restricting a problem, choosing the proper method for its solution, using this method and analysing the results when faced with a problem. When an individual acquires this skill, he/she gets into the habit of using problem solving to explain the situations, circumstances and events around him/her. (Altun, 2002). At this point the first and the most important activity for solving a problem is thinking. Thinking activitvy starts when one intuits a problem and solving that problem becomes a target for that individual; as a result, this objective directs individual’s thinking. Thus, thinking activity that begins with intuiting problem consists of a process (Kalaycı, 2001). Within this period, an individual needs to use higher order thinking skills. An individual who aims to overcome different types of problems has to be a creative, reflective, critical and analytical thinker (Bilen, 1996).



In the light of this information, critical thinking plays a significant role in problem solving process. Because in today's world, an individual who encounters many problems has to think critically for choosing proper knowledge and organise that knowledge which is obtained while realising the problem, characterising the problem and finding a solution to the problem phases. In this way, the individual can obtain proper data set for the problem, examine the reliability of this data set, classify it according to proper criterion, make logical deductions out of this data set and take responsibility for the judgements which were made in thinking process.

In the literature there are some studies that investigate the relationship between critical thinking tendencies and problem solving skills. Some of these studies are on pre-service teachers (Özcan, 2007; Gürleyük, 2008; Şara, 2012; Kasımoğlu, 2013; Berkant and Eren, 2013), and some others are on undergraduate students that study at different faculties (Hanley, 1995; Kökdemir, 2003; Tümkaya, Aybek and Aldağ, 2009). Besides, some researchers researched teachers (Turan, 2010) and students from different levels (Enright and Beattie, 1992); in addition some researchers handle this subject theoretically (Mumford, Mederious and Partlow, 2012; Leighton and Sternberg, 2013).

The problems of this study stated below;

- 1. Is there a significant relationship between the critical thinking tendencies and the problem solving skills of pre-service teachers?
- 2. Is there a significant difference between the problem solving skills and the sub-dimensions of Problem Solving Inventory of pre-service teachers according to the critical thinking tendency level (low, positively, high)?
- 3. Is there a significant difference between the problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and
 - a) gender,
 - b) department,
 - c) grade level?

Method

In this study the descriptive research model was chosen to respond the main problem and sub-problems of the study. The study was structured as a relational screening model to explore the relationship between critical thinking tendencies and problem solving skills. Relational screening is a research model which aims to determine the existence and/or degree of joint variation between two or more variants (Karasar, 2008: 79).

Participants

The population of the study consists of 1200 students who study at Afyon Kocatepe University Education Faculty 1st and 2nd class. The sample of the study was 224 students chosen out of the population by the stratified sampling method. Stratified sampling is a probability sampling technique wherein the researcher divides the entire population into different subgroups or strata and randomly selects the final subjects proportionally from the different strata (Yıldırım and Şimşek, 2005: 105). Below in Table 1 the distribution of sample according to the variables is given.

Table 1. Sample Distribution

Variable	f	%	
Gender	Female	167	74.6
	Male	57	25.4
	Total	224	100
Department	Preschool Teaching	65	29
	Primary School Teaching	46	20.5
	Social Sciences Teaching	43	19.2
	Science Teaching	37	16.5
	Turkish Teaching	33	14.7
	Total	224	100
Grade Level	1st Grade	110	49.1
	2nd Grade	114	50.9
	Total	224	100

Instruments

The first instrument used in this study is *California Critical Thinking Disposition Inventory (CCTDI-T)*. CCTDI-T¹, developed by Facione and Giancarlo (1998) and adapted into Turkish by Kkdemir (2003). The original form of the inventory includes 75 items. The Turkish version of the original scale contains 51 items and has 6 subscales which are Analyticity, Open-mindedness, Inquisitiveness, Self-confidence, Truth-seeking, Systematicity. A score of 40 and below on any of the six subscales indicates consistent opposition or weakness to that given disposition while a score of 50 or higher represents a positive impact of that attribute. A total score above 240 reflects a positive overall disposition toward critical thinking (Kkdemir, 2003). In this study none of pre-service teachers have high critical thinking tendency. Hence the study has been conducted on two levels of critical thinking tendency (low, positively). Cronbach alpha reliability coefficient of The California Critical Thinking Disposition was found as .84 and according to this result, inventory has a high level of reliability (Tavşancıl, 2006: 29).

The second instrument used in the study is Problem Solving Inventory. PSI² developed by Heppner and Petersen (1982) and adapted into Turkish by Şahin, Şahin and Heppner (1993). PSI contains 35 items and 6 subscales which are Impulsive Style, Reflective Style, Avoidant Style, Monitoring, Problem-Solving Confidence, Planfulness. Cronbach alpha reliability coefficient of the total inventory and of each sub-scales which were found in the original study, in other studies and in this study are given in Table 2.

Table 2. Cronbach alpha reliability coefficient of original inventory, of other studies and of this study

¹ In this study to use the inventory adapted by Kkdemir (2003), permission has been taken from the researcher.

² In this study to use the inventory adapted by Şahin, Şahin and Heppner (1993), permission has been taken from the researcher.

Sub-Scales	Number of Items	Original Inventory (α)	Berkant and Eren (2013). (α)	This study (α)
Impulsive Style	9	.78	.68	.71
Reflective Style	5	.76	.80	.77
Avoidant Style	4	.74	.77	.68
Monitoring	3	.69	.67	.70
Problem-Solving Confidence	6	.64	.69	.77
Planfulness	4	.59	.67	.68
Total	35	.88	.87	.86

As seen in Table 2, Cronbach alpha reliability coefficient of the total inventory was found as .86. Internal consistencies of sub-scales varied between .68 and .77. When Cronbach alpha reliability coefficient of the total inventory was compared with the other studies, it was seen that the values are close to the values found by Şahin, Şahin and Heppner (1993). These values indicate that inventory has a high level of reliability (Tavşancıl, 2006: 29).

Process and Analysis of Data

Data were obtained from pre-service teachers through the inventories and an information form; however, data from 7 participants were not evaluated since there was missing information in their forms. The inventories were analysed on a statistical programme. The relationship between critical thinking tendencies and problem solving skills of pre-service teachers was examined by bivariate correlation. The difference between problem solving skills and sub-dimensions of Problem Solving Inventory of pre-service teachers according to the critical thinking tendency level (low, positively, high) was examined by independent samples t-test according to normality test. The difference between the problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and gender, department and grade level respectively was examined by two-way Anova according to normality test.

Findings

1. Is there a significant relationship between the critical thinking tendencies and the problem solving skills of pre-service teachers?

The results of Pearson correlation analysis to examine whether there is a significant relationship between the critical thinking tendencies and the problem solving skills of pre-service teachers are shown in Table 3.

Table 3. Correlation Analysis between the critical thinking tendencies and the problem solving skills of pre-service teachers

		Critical Thinking Tendencies	Problem Solving Skills
Critical Thinking Tendencies	Pearson Correlation	1,00	,69*
	P		,00
	N	224	224
Problem Solving Skills	Pearson Correlation	,69*	1,00
	P	,00	
	N	224	224

As shown in Table 3, a significant and positive relationship was found between critical thinking tendencies and problem solving skills of pre-service teachers ($r=.69$; $p<.05$). For this reason, this suggests that when critical thinking tendencies of pre-service teachers increases, the problem solving skills of pre-service teachers increases, too.

2. Is there a significant difference between the problem solving skills and the sub-dimensions of Problem Solving Inventory of pre-service teachers according to the critical thinking tendency level (low, positively, high)?

The scores of pre-service teachers' which were taken from California Critical Thinking Disposition Inventory were classified as low and positively and to examine whether there is a significant difference between the problem solving skills and the sub-dimensions of Problem Solving Inventory of pre-service teachers according to the critical thinking tendency level (low, positively, high), independent samples t-test was conducted. The results are given in Table 4.

Table 4. Distribution of data related to problem solving skills of pre-service teachers according to the critical thinking tendency level

Dimension	Level	N	\bar{x}	SD	Df	t	p
Problem Solving Skill	Low	201	124,09	17,40	32,632	-10,69	*,00
	Positively	23	153,21	12,51			
Impulsive Style	Low	201	29,84	5,83	222	-3,953	*,00
	Positively	23	34,95	6,19			
Reflective Style	Low	201	21,57	4,31	35,696	-7,601	*,00
	Positively	23	26,52	2,76			
Avoidant Style	Low	201	14,49	3,19	222	-4,369	*,00
	Positively	23	17,56	3,23			
Monitoring	Low	201	13,19	2,84	43,896	-9,057	*,00
	Positively	23	16,52	1,47			
Problem-Solving Confidence	Low	201	24,63	4,74	32,149	-8,985	*,00
	Positively	23	31,82	3,48			
Planfulness	Low	201	17,28	3,23	42,380	-10,046	*,00
	Positively	23	21,56	1,72			

* $p<.05$

As shown in Table 4, there is a significant difference between the problem solving skills and the sub-dimensions of Problem Solving Inventory of pre-service teachers according to the



critical thinking tendency level (low, positively) ($p < .05$). Therefore when means were examined pre-service teachers' problem solving skills, who have positive critical thinking tendency, are significantly higher than pre-service teachers' who have low critical thinking tendency

3. Is there a significant difference between the problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and

- a) gender,
- b) department,
- c) grade level?

In this problem to examine whether there is a significant difference between the problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and gender, department and grade level respectively, two-way Anova was conducted. Results are given in Table 6a, 6b, 7a, 7b ve 8a, 8b.

Table 6a. Descriptive statistics related to problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and gender

	N	Low		Positively		Total			
		\bar{x}	SD	N	\bar{x}	SD	N	\bar{x}	SD
Female	105	124,31	17,75	17	155,11	12,24	167	127,44	19,61
Male	51	123,45	16,49	6	147,83	12,76	57	126,01	17,73

Table 6b. Results of two-way Anova related to problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and gender

Source of Variance	Sum of Squares	Df	Mean Square	F	p
Gender	263,61	1	263,61	,90	,34
Critical Thinking Tendency Level	12096,88	1	12096,88	41,73	,00
Gender*CTTL	163,81	1	163,81	,56	,45
Error	63769,49	220	289,86		
Corrected Total	81537,38	223			

As a result of two-way Anova, a significant difference between problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and gender was not found [$F(1,220)=,56$; ($p > .05$)]. In other words, problem solving skills of female pre-service teachers do not differentiate significantly from male pre service teachers' problem solving skills according to the critical thinking tendency. Pre-service teachers' problem solving skills do not show a significant difference according to the gender variable, too [$F(1,220)=,90$; ($p > .05$)]. In spite of this problem solving skills of pre-service teachers show a significant difference according to the critical thinking tendency [$F(1,220)=41,73$; ($p < .05$)].

Table 7a. Descriptive statistics related to problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and department

Department	N	Low		Positively		Total			
		\bar{x}	SD	N	\bar{x}	SD	N	\bar{x}	SD
Preschool Teaching	59	127,22	17,87	6	155,83	11,32	65	129,86	19,21
Primary School	43	120,83	16,32	3	150,33	4,50	46	122,76	17,43

Teaching									
Social Sciences Teaching	36	122,66	17,28	7	155,42	12,12	43	128,00	20,49
Science Teaching	34	126,41	14,52	3	152,00	19,67	37	128,48	16,28
Turkish Teaching	29	121,62	20,66	4	148,50	17,48	33	124,87	21,94

Table 7b. Results of two-way Anova related to problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and department

Source of Variance	Sum of Squares	Df	Mean Square	f	P
Department	473,39	4	118,34	,40	,80
Critical Thinking Tendency Level	15128,80	1	15128,80	51,90	,00
Department*CTTL	131,36	4	32,84	,11	,97
Error	62373,27	214	291,46		
Corrected Total	81537,38	223			

As a result of two-way Anova, a significant difference between the problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and department was not found [$F(4,214)=,11$; ($p>.05$)]. In other words, problem solving skills of pre-service teachers who study at different departments do not differentiate significantly according to the critical thinking tendency. Pre-service teachers' problem solving skills do not show a significant difference according to the department variable, too [$F(4,214)=,40$; ($p>.05$)]. In spite of this problem solving skills of pre-service teachers show a significant difference according to the critical thinking tendency [$F(1,214)=51,90$; ($p<.05$)].

Table 8a. Descriptive statistics related to problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and grade level

Grade Level	N	Low		Positively		Total			
		\bar{x}	SD	N	\bar{x}	SD	N	\bar{x}	SD
1st Grade	97	127,56	15,83	13	154,30	11,57	110	130,72	17,62
2nd Grade	104	120,85	18,23	10	151,80	14,16	114	123,57	19,91

Table 8b. Results of two-way Anova related to problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and grade level

Source of Variance	Sum of Squares	Df	Mean Square	f	p
Grade Level	431,74	1	431,74	1,53	,21
Critical Thinking Tendency Level	16904,17	1	16904,17	60,23	,00
Grade Level*CTTL	89,76	1	89,76	,32	,57
Error	61737,02	220	280,62		
Corrected Total	81537,38	223			

As a result of two-way Anova a significant difference between the problem solving skills of pre-service teachers according to the compound effect of critical thinking tendency level and grade level was not found [$F(1,220)=,32$; ($p>.05$)]. In other words, problem solving skills of pre-service teachers who study at 1st grade do not differentiate significantly from pre service teachers' problem solving skills who study at 2nd grade according to the critical thinking tendency. Pre-service teachers' problem solving skills do not show a significant difference according to the grade level variable, too [$F(1,220)=1,53$; ($p>.05$)]. In spite of this problem solving skills of pre-service teachers show a significant difference according to the critical thinking tendency [$F(1,220)=60,23$; ($p<.05$)].

Results and Discussion

When the results obtained from the study are examined, it is seen that a significant and positive relationship was found between the critical thinking tendencies and the problem solving skills of pre-service teachers ($r=,69$; $p<.05$). Today, individuals should have skills of distinguishing problems which they encounter, restricting these problems and using critical thinking in problem solving process in addition to many thinking skills, and also should have a tendency to use critical thinking in problem solving process. An individual can get information for solution and can come a long way for the solution of problem only by this way.

Similarly Kanbay, Aslan, Işık and Kılıç (2013) who studied on nursing undergraduate students, Tümkaya, Aybek and Aldağ (2009) on undergraduate students, Turan (2010) on primary school found a significant correlation between these two phenomena. Beside this, Enright and Beattie (1992) stated that critical thinking is an essential skill for problem solving in the conclusion part of their study. Leighton and Sternberg (2013) and Mumford, Mederious and Partlow (2012) pointed out in their theoretical study that critical and reflective thinking play an important role in increasing problem solving performance. Hanley (1995) concluded in the study that was carried out on undergraduate students that having critical thinking skills has a positive affect on approachments in problem solving process.

On the contrary Özcan (2007), stated in the study in which he examined the effect of the method of problem solving to pre-service teachers' critical thinking and achievement that problem solving method did not cause a difference in favor of experimental group's critical thinking. At the same time Gürleyük (2008) concluded that there is not a significant relationship between critical thinking tendency and problem solving skills in the study in which he studied on primary school pre-service teachers. The difference of the sample can be shown as a reason for the difference between conclusions.

Secondly a significant difference between the problem solving skills of pre-service teachers according to the critical thinking tendency level (low, positively) was found ($p<.05$). When means were examined, pre-service teachers' problem solving skills who have positive critical thinking tendency are higher significantly than pre-service teachers' who have low critical thinking tendency. Whereas a significant relationship between the critical thinking tendencies and the problem solving skills of pre-service teachers and a significant difference between the problem solving skills of pre-service teachers according to the critical thinking tendency level was found in this study, it can be said that these two results support each other. Similarly, Kökdemir (2003) stated that individuals who have high level of critical thinking tendency behave rationally in the process of making a decision, but however individuals who have low level of critical thinking tendency cut corners. Kökdemir (2003), in his study, indicated that individuals who have high level of critical thinking tendency make rational decisions not on all kinds of problems but especially on probability-based problems in comparison with individuals with low level of tendency.

In this study also a significant difference between the sub-dimensions of Problem Solving Inventory of pre-service teachers according to the critical thinking tendency level (low, positively) was found ($p<.05$). When means were examined pre-service teachers' scores of sub-dimensions of Problem Solving Inventory who have positive critical thinking tendency are higher significantly than pre-service teachers' who have low critical thinking tendency.

When findings of this study is examined, problem solving skills show no significant difference according to the compound effect of critical thinking tendency level with gender, department and grade level. Beside this, gender, department and grade level variables do not cause a significant difference on pre-service teachers' problem solving skills on their own, too.

Similarly Tmkaya, Aybek and Aldađ (2009) stated that gender and field of study were not significant variables related to critical thinking disposition or to perceived problem solving skills. In addition to that Berkant and Eren (2013) who worked on elementary mathematics teachers, Kasımođlu (2013) on pre-service teachers, Yenice, zden and Evren (2012) on science pre-service teachers, Kırılmazkaya (2010) on science and primary school pre-service teachers and Ulusoy et al. (2012) on undergraduate students indicated that, gender and grade level do not cause a significant difference on pre-service teachers' problem solving skills

In spite of this, řara (2012) who worked on primary school pre-service teachers found a significant difference related to the problem solving skills in favor of female pre-service teachers. Also, Grleyk (2008), who worked on primary school pre-service teachers, found a significant difference related to the problem solving skills in favor of male pre-service teachers. In addition to this, pre-service teachers who study at 4th grade have a higher level of problem solving skills than pre-service teachers who study at other grades. Tmkaya, Aybek and Aldađ (2009) found a significant difference related to the problem solving skills between first and 4th grader students in favor of 4th grader students. In this study to include first and second grade students and students from different departments at the same time could make a difference on the conclusions. Also Ocak and Eđmir (2014) found a significant difference in problem solving skill and impulsive and avoidant sub-dimensions according to the gender, in problem solving skill and reflective, monitoring, problem-solving confidence and planfulness sub-dimensions according to the grade level and in problem solving skill and impulsive sub-dimension according to the department.

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