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Perceived problem solving skills: As a predictor of prospective teachers' scientific epistemological beliefs

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Abstract

This study aims to determine the level of perceived problem solving skills of prospective teachers and the relations between these skills and their scientific epistemological beliefs. The study was conducted in the fall semester of 2015-2016 academic year. Prospective teachers were applied Problem Solving Inventory which was developed by Heppner and Petersen (1982) and adapted into Turkish by Savasır and Sahin (1997) to determine their level of perceived problem solving skills. Also their epistemological beliefs were determined by using The Scientific Epistemological Beliefs Survey which was developed by Pomeroy (1993) and adapted into Turkish by Deryakulu and Hazır Bıkmaz (2003). The correlational model was used in this study. Obtained data were analyzed by regression analyses and results were discussed.

Keywords: Perceived problem solving skill, problem solving, science education, scientific epistemological beliefs

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1. Introduction

The curriculum of science education course aims to raise individuals who research, who inquire, who can make effective decisions, who can solve problems, who have self-confidence, who are open to cooperation, who can communicate effectively, who learn lifelong, who have the knowledge in, positive attitudes towards and have positive perceptions and values for science studies, who can understand how scientists have created scientific knowledge as well as the processes that the created knowledge has undergone and can understand how this knowledge is used in. new research, who can understand that knowledge may change over time, and who internalise the approach of scientific research and thus can produce solutions to problems (MEB, 2013). Individuals' problem solving skills and their epistemological beliefs are important in attaining these goals. Problem solving is the process of individuals' challenging the obstacles they encounter (Temel & Morgil, 2012). According to Hepner (1982), it means coping with problems. Altun and Arslan (2006), on the other hand, defines problem solving as a way of thinking which is to be useful in eliminating any kind of difficulty and as a learning approach to raise quality in teaching. The reason for this is that individuals cope with their environment and their problems within the framework of their power. Individuals' self-evaluation in terms of coping effectively with their problems is extremely important in this. People with positive self-perception in problem solving are likely to be much more successful in the skill of real problem solving because the approach of individuals who have such thoughts as "I can cope with my problems, these problems are not too frightening to cope with, coping with these problems depends on me to a large extent" and who focus on the problems in such a perspective can assure healthy thoughts and effective solutions (Guclu, 2003). According to Gagne (1970), problem solving is the highest level of learning, and problem solving skill is a life skill difficult to avoid. Individuals having good problem solving skills have positive personality traits such as patience, independence, and curiosity. Good problem solvers usually have self-respect, they have capability and common sense in making decisions. They have such problem solving qualities as flexibility, broadmindedness and tolerance; and they are also creative (Arenofsky, 2001). All these properties are closely related with individuals' epistemological beliefs; because problem solving is an educational process requiring individuals to think about the accuracy of multiple perspectives and thoughts while analysing the problems and solutions (Aksan & Sozer, 2007). As Shommer-Aikins and Hutter (2002) point out, people who believe less that knowledge has a simple structure adopt different perspectives, think flexibly and deeply; but those who believe less in the precision of knowledge think that knowledge is changeable, and they think more about the nature of knowledge. Epistemological beliefs are individuals' beliefs about the nature of knowledge and the process of knowing (Hofer & Pintrich, 1997). As researchers such as Kitchener (1986), Schoenfeld (1988), Spiro, Vispoel, Schmitz, Samarapungavan, and Boerger (1987) point out, epictemological beliefs are individuals' beliefs about the precision of knowledge, organisation of knowledge, and controlling the process of obtaining knowledge. A review of the literature makes it clear that differing approaches have been put forward in terms of epistemological beliefs. Some of the approaches put forward are as in the following: Perry (1970; as cited in Hofer & Pintrich, 1997) labelled university students' epistemological development as dualism, multiplism, relativism, and commitment; and thus explained it at 4 developmental levels. Belenky, Linchy, Goldberger, and Tarule (1986; as cited in Browlee, Boulton-Lewis & Purdie, 2002) studied women's epistemological development and divided the development into 5 phases. The phases are silence, received knowledge, subjective knowledge, procedural knowledge, and constructed knowledge. Shommer (1990), however, claimed that models put forward in the above mentioned studies considered epistemological beliefs as dimensional structures; but that they had multidimensional structures. While exhibiting the 4-dimensional structure of the epistemological model, Shommer made use of the findings obtained by Perry (1970), Dweck and Leggett (1988), Schoenfeld (1983) (as cited in Deryakulu, 2006). Shommer (1990) suggested that epistemological beliefs had four dimensions: 1) simple knowledge, 2) certain knowledge, 3) quick learning, 4) innate ability. Hofer and Pintrich (1997), on the other hand, distinguished such dimensions of epistemological beliefs as certain knowledge (for instance, knowledge is certain or uncertain), simple knowledge (for instance,

knowledge is absolute or relative), the source of knowledge (for instance, knowledge is obtained by the authority or can be challenged), and proof of knowledge (for instance the way of proving knowledge). It was claimed that the first two dimensions were related with the nature of knowledge but that the final two were related with the nature of knowing.

In the light of these data, this study aims to analyse prospective teachers' levels of perceived problem skills and to determine the correlations between their levels of perceived problem solving skills and their scientific epistemological beliefs based on the importance of their problem solving skills and epistemological beliefs in attaining the goals of science education. Studies are available in the literature examining the correlations between epistemological beliefs and academic achievement (Cano, 2005); motivation (Liang & Tsai, 2010; Paulsen & Feldman, 1999, 2005; Yılmaz, & Sen, 2012); the choice of learning approaches (Phan, 2008); comprehending learning (Chan, 2004); motivation and learning strategies (Sen, Yılmaz & Yurdugul, 2014). There are also studies examining problem solving skills (Altındag, Goksel, Koray & Koray, 2012; Aksan & Sozer, 2007; Duzakın, 2004; Otacıoglu, 2008; Buluc, Kuru & Taneri, 2010; İnel, Evrekli & Turkmen, 2011; Polat & Tumkaya, 2010; Vural, 2010; Yavuz, Arslan & Gulten 2010) in the literature. In this current study, however, determining the correlations between problem solving skills and traditional as well as nontraditional scientific epistemological beliefs is important in terms of seeing the differences.

1.1. Purpose of the study

The purpose of the study was to analyze prospective teachers' levels of perceived problem skills and to determine the correlations between their levels of perceived problem solving skills and their scientific epistemological beliefs based on the importance of their problem solving skills and epistemological beliefs in attaining the goals of science education.

Answers to the following questions were sought for our purposes:

1. What is the level of prospective teachers' perceived problem solving skills?

2. Are there any statistically significant differences between prospective teachers' levels of perceived problem solving skills and their scientific epistemological beliefs?

2. Method

Correlational model was used in this study. Correlational model is a research model aiming to determine the existence and/or the extent of changes between two or more variables (Karasar, 2014).

2.1. Study Group

60 prospective teachers attending a state university took part in the research. Purposeful sampling method was employed in collecting the sample. Purposeful sampling is an approach of non-random sampling which enables researchers to research in depth the cases rich in knowledge depending on the research purpose (Buyukozturk et al., 2013).

2.2. Data Collection Tool

Problem solving skills inventory (PSSI), which is used for measuring one's perceived problem solving skills. The inventory was developed by Heppner and Petersen (1982) and was adapted into Turkish by Savasır and Sahin (1997). It is a 35-item scale of 6-pointed Likert type. Savasır and Sahin (1997) found that the PSSI was composed of three factors: "Reliance on problem solving skills (RPSS)" (alpha coefficient = .85), "Approaching-Avoidance (AA)" (alpha coefficient = .84), and "Personal Control (PC)" (alpha coefficient = .72). High scores received from the scale represent failure to find effective solutions to problems – that is to say, low level of perceived problem solving skills (Taylan, 1990).

Scientific epistemological beliefs survey (SEBS), which was developed by Pomeroy (1993) so as to determine individuals' epistemological beliefs. It was translated and adapted into Turkish by Deryakulu and Hızır Bıkmaz (2003). It was found following the analyses that the scale had one-factor structure and that it had 30 items. Of the 30item, 5-pointed Likert type scale, 22 items reflecting traditional science conception were encoded positively and 8 items reflecting non-traditional science conception were encoded negatively. Internal cronbach alpha coefficient was found to be .91. The scale basically has a two-ended structure reflecting individuals' conception of science. High scores received from the scale represent beliefs in traditional conception of science whereas low scores represent beliefs in non-traditional conception of science.

3. Findings

Firstly, the data obtained from the PSSI which was applied so as to determine prospective teachers' perceived problem skills were analyzed in this study. As in the study conducted by Guclu (2003), mean scores and standard deviations for all of the items in the factors of RPSS, AA, and PC were calculated. Descriptive statistics concerning prospective teachers for the items in all three factors are shown in Table 1.

Table 1. Means and standard deviations for prospective teachers in terms of the items in the factors of RPSS, AA, and PC

Groups	N	Mean	Std. Deviation
RPSS	60	2,51	,98
AA	60	3,07	,56
PC	60	3.33	,72

An examination of Table 1, makes it apparent that the mean scores for prospective teachers in terms of the items in the factors of RPSS, AA and PC are 2,51, 3,07, and 3,33; respectively.

Secondly, the data obtained from the PSSI and the SEBS were analyzed separately so as to determine the correlations between prospective teachers' levels of perceived problem solving skills and their levels of traditional and non-traditional scientific epistemological beliefs. The results are shown in Tables 2 and 3.

Table 2. Findings concerning multiple regression analysis for predicting prospective teachers' traditional epistemological beliefs

Model	Unstandardized Coefficients		Standardized Coefficients			Correlations	
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial
(Constant)	4,978	,358		13,891	,000		
RPSS	-,088	,067	-,178	-1,314	,194	-,283	-,173
AA	-,100	,124	-,117	-,805	,424	-,290	-,107
PC	-,151	,091	-,227	-1,669	,101	-,321	-,218

Table 3. Findings concerning multiple regression analysis for predicting prospective teachers' non-traditional epistemological beliefs

Model	Unstandardized Coefficients		Standardized Coefficients			Correlations	
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial
(Constant)	2,298	,404		5,690	,000		
RPSS	,096	,075	,181	1,273	,208	,161	,168
AA	,085	,140	,092	,605	,548	,063	,081
PC	-,174	,102	-,244	-1,710	,093	-,161	-,223

According to Table 2, the variables of RPSS, AA and PC together yield a medium level significant correlation with prospective teachers traditional epistemological belief scores (R=,397, R2=,158, F(3.56): 3,490, Sig: ,021). The three factors altogether explain 15.8% of the total variances of traditional scientific epistemological beliefs. According to standardized regression coefficient (Beta), the order of importance of predictive variables for scientific epistemological belief is: PC, AA and RPSS. On examining the t-test results for the significance of regression coefficients, it was found that none of the three variables were a significant predictor of traditional scientific epistemological beliefs. According to Table 3, the variables of RPSS, AA and PC together do not yield any significant correlations with prospective teachers non-traditional epistemological belief scores (R=,272, R2=,074, F(3.56): 1,495, Sig: ,226).

4. Conclusion and Discussion

First, the data obtained from the PSSI which was applied so as to determine prospective teachers' perceived problem skills were analyzed in this study. The average scores for prospective teachers in terms of the items in the factors of RPSS, AA and PC were 2,51, 3,07, and 3,33; respectively. Later, these mean scores were analyzed one by one. The general mean score calculated for prospective teachers' perceptions in terms of the items in the factor of RPSS shows that prospective teachers rely on their problem solving skills. It is evident that the general mean score calculated for prospective teachers' perceptions in terms of the items in the factor of AA – representing revision of their initial problem solving efforts to consult later- is low. And the general mean score calculated for prospective teachers' perceptions in terms of the items in the factor of PC shows that prospective teachers' cannot sustain their personal control in solving problems.

Then multiple regression analysis was performed so as to determine the correlations between prospective teachers' levels of perceived problem solving skills and their levels of traditional and non-traditional scientific epistemological beliefs. The variables of RPSS, AA and PC together yielded a medium level significant correlation with prospective teachers traditional epistemological belief scores (R=,397, R2=,158, F(3.56): 3,490, Sig: ,021). The three factors altogether explained 15.8% of the total variances of traditional scientific epistemological beliefs. It was found that the variables of RPSS, AA and PC together did not yield any significant correlations with prospective teachers' non-traditional epistemological belief scores (R=,272, R2=,074, F(3.56): 1,495, Sig: ,226). A general evaluation of the results obtained demonstrates that prospective teachers' levels of perceived problem solving skills are low in general. It was remarkable that prospective teachers' levels of perceived problem solving skills yielded a significant correlation with the variable of traditional scientific epistemological beliefs while their levels of perceived problem solving skills did not yield a significant correlation with non-traditional scientific epistemological beliefs. Since the variable of perceived problem solving skills influences individuals' achievement in actual problem solving, low values for this variable restrict diverse perspectives displayed by individuals in the process of problem solving, their different ways of thinking, their flexibility in the process, their thoughts for reaching solution through different ways, and their belief that knowledge can be obtained in different ways. All these are closely related with non-traditional scientific epistemological beliefs. The findings obtained from research into epistemological beliefs suggest that individuals' beliefs in the nature of knowledge and of learning are related with their understanding, interpretation of knowledge and their patience in working with difficult academic tasks (Schommer, 1990; Schommer, Crouse & Rhodes, 1992; Spiro, Coulson, Feltovich, & Anderson, 1988). The availability of low score means in items especially in the AA factor shows low levels of efforts and patience in cases of problems; which is supportive of these findings.

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