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Prospective elemantary science teachers' epistemological beliefs

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Abstract

This research study examined "prospective elementary science teachers' epistemological beliefs". Forty-nine prospective elementary science teachers participated into research. The research was designed in both quantitative and qualitative manner, within the context of "*Special Methods in Science Teaching I*" course. Participants' epistemological beliefs were determined by administering "Scientific Epistemological Beliefs Scale" of Pomeroy (1993). Observation of in-class discussions, interview with students and document analysis were the three sources of data used in data triangulation part of the qualitative piece of the study. Data analysis indicated that prospective elementary science teachers were "traditional" according to the epistemological beliefs they hold.

Keywords: Epistemological beliefs; prospective elementary science teachers; teacher education; science methods course; teachers' beliefs

1. Introduction

Epistemology is a term in Greek and means the science of knowledge. It deals with the problem of knowledge in philosophy, such as the nature, structure, sources, and validity and reliability of the knowledge (Pears, 2004; Denkel, 2003; Cucen, 2001; Yazici 1999). Epistemology is a theory which also deals with the concepts in philosophy like "existence, knowledge, ethics, science, art, politics, and religion". From Plato to the beginning of 20th century it was among the main subjects of traditional philosophy (Cucen,2001, p.25).

Existing literature about the beliefs includes several similar or different definitions of belief. When what Pajares (1992, pp.313-314) quotes from ('Dewey (1933), Rokeach (1968), Abelson (1979), Nisbett and Ross (1980), Brown and Cooney (1982), Brown and Cooney (1982), Sigel (1985), Harvey (1986)); and what Deryakulu (2004) quotes from 'Nespor (1987) were examined, belief would be defined as a mechanism works outside of the individual. It is the individual's cognitive coding which leads her attitudes, behaviors and intellectual experiences.

On the other hand, epistemological belief was defined by Perry (1981) as "someone's points of views on the definition and sources of knowledge, the degree of its certainty, and its limitations and criteria" (Brownlee, 2001). Deryakulu (2004) accepts epistemological beliefs as the areas of individual differences and describes them as beliefs

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specific to the individual which include the definition of knowledge and how people learn and know this knowledge (p.259). Beliefs about the nature of knowledge and how and in which situations people can reach that knowledge might be seen as a determining factor for the beliefs about learning. Schommer (1993) describes beliefs about the nature of knowledge and the nature of learning as epistemological beliefs. Jehng (1993) identifies epistemological beliefs as socially shared intuitions. Meta-cognition is based on individuals' knowledge about their own strategies to learn and to construct meaning. In contrast with meta-cognition, epistemological beliefs are basic assumptions about the limitations and criteria of knowing. Additionally, these beliefs include the sources and conditions of knowledge production (Bauer, 2004).

The number of educational research studies on learners' beliefs about the nature of learning and knowledge is increasing (Chan and Eliot, 2004). Definitions of learners' related beliefs and examinations of how these beliefs would reflect on individuals' interpretations about their own learning are the basic foundations in the related literature (Clarebout 2001, p.53). These research studies are not limited with learners. There are also some other research studies with teachers focused on the same kinds of beliefs. Isenberg (1990, p.322) describes three assumptions in which educational research studies with teachers are based on.

1. Teacher's practice is under the effect of her thoughts.
2. Thoughts, decisions and judgments lead teaching process.
3. Teaching is a decision making process at very high levels.

Based on these assumptions; one might conclude that teachers' epistemological beliefs effect their decision making and execution process. Therefore; in this research study, prospective elementary science teachers' epistemological beliefs were examined.

2. Method

2.1. Participants:

This research study is designed in a mixed-qualitative and quantitative- manner. 49 prospective elementary science teachers, who attend to science education methods course in a big teacher training institution in Istanbul, participated in this research. Throughout the course, researchers focused only on participants' current epistemological beliefs other than focusing on the change in their beliefs during the instruction. The research study took place in 2004-2005 academic years.

2.2. Data collection:

Scientific Epistemological Beliefs Scale: 30-item, likert type scale translated and adapted in Turkish from Pomeroy's (1993) work by Deryakulu and Bikmaz (2003). Validity and reliability study of the scale was also done by the same researchers. The scale basically displays both traditional and contemporary beliefs about science. There were 22 items to reflect traditional beliefs about science, coded (+), and 8 items to reflect contemporary beliefs about science, coded (-). High scores from the scale represent more traditional views about science and in contrast, low scores from the scale represent more contemporary views about science. Items like "Science aims to reach knowledge which constitutes objective explanations" represent traditional view whereas, "Intuition plays an important role in scientific discoveries" represent contemporary views about science. Scale also consists of some items addressing science process skills which prospective teachers need to know and apply.

"What is knowledge?"- Open-ended questionnaire: questionnaire contains 8 open-ended questions and 24 choice items developed by the researchers. "What is knowledge? What is the source of knowledge? Define the valid knowledge. How people reach the knowledge?" are among these open-ended questions. An example to choice items is as follows:

Knowledge is:

- Based on rationale
- Formed at the end of trial and error process
- Objective
- Formed from observations

- A result of reason-outcome interrelations.

Written Documents: Include student artifacts produced during in class activities and collected in their portfolio. Portfolio also includes participants' understandings about teaching, learning, science and scientist. These documents were used as secondary sources of data.

2.3. Data Analysis and Evaluation

Data corresponding scientific epistemological beliefs scale were analyzed in a statistical program, SPSS. Open-ended questions and written documents were analyzed by using open-coding technique (Yildirim, Simsek, 1999, p. 163; Punch, 2005, p. 199).

3. Findings

Findings from Scientific Epistemological Beliefs Scale: Table 1 displays participants' total scores from the scale.

Score interval	Frequency	Percentage (%)
70- 80	1	2.0
81-90	0	0
91-100	13	26.6
101-110	27	55.1
111-120	8	16.3
Total	**49**	**100**

Table 1. Participants total scores from Scientific Epistemological Beliefs Scale

As seen in table 1; 98% of the participants got high scores (between 91 and 120) from the scale. Although the highest score from the scale could be 150, it is found for the participants as 117. The lowest score for them was 71. 55% of the participants got scores between 101and 110. As high scores from the scale represents traditional views about science, it can be emphasized that prospective elementary science teachers participated in this research study have traditional views of science.

Findings from open-ended questionnaire: Data gathered from open-ended questions were coded in two groups: "definition of knowledge" and "sources of knowledge". Table 2 and table 3 display related codes consecutively. Related tables also display the frequency and percentage of codes. Frequency of codes might be more than number of participants. The reason of this difference in numbers is the multiple codes that learners' views would have.

Codes	Frequency of repetition	Percentage of total frequency (%)	Percentage of frequency of repetition (%)
Experience	15	30.61	25.00
Observation and experiment	11	22.45	18.33
Scientific research	8	16.33	13.33
Intellect-rationale	7	14.29	11.66
Objective reality	4	8.16	6.66
Profit approach	3	6.12	5.00
Truth	2	4.08	3.33
Others	5	10.20	8.33
Not know or not answered	5	10.20	8.33

Table 2. Codes for definitions of knowledge

Table 2 shows that codes from most participants (43.3%) display an empiricist approach to knowledge. Almost none of the participants, except the ones shown in the row of others (2 students), mentioned a contemporary view about science. Data show that participants' definitions of knowledge and valid knowledge refer only scientific

knowledge. In other words, data emphasize that prospective elementary science teachers only think about scientific knowledge when they are asked about valid and reliable knowledge.

Codes	Frequency of repetition	Percentage of total frequency (%)	Percentage of frequency of repetition (%)
Science/scientific research	10	20.41	13.16
Observation and experiment	9	18.37	11.84
Experience	8	16.33	10.53
Nature	8	16.33	10.53
Intellect-rationale	8	16.33	10.53
*religion	6	12.25	7.89
*intuition and imagination	6	12.25	7.89
Authority	5	10.20	6.58
Environment and everyday life	5	10.20	6.58
*society and culture	3	6.12	3.95
Curiosity	2	4.08	2.63
Other	6	12.25	7.89

Table 3. Codes for sources of knowledge

Table 3 shows parallel results with table 2. Participants mostly perceive the experiment and rationale as the sources of knowledge.

Student generated artefacts were used secondary sources of data to understand participants' epistemological beliefs in details. Data from these artefacts are consistent with data presented in the tables above. Participants were asked to define learning by writing an analogy about it. Table 4 displays these definitions and analogies.

Teacher	Student
Artist	Painting (2 times)
Flower	Bee
Baker	Dough
Miner	Gold
engineer	worker
Root	sapling
Coach	Succor
Hearth	Body
Fisherman	Someone trying to cross the sea
Archeologist	Work of history

Table 4. definitions and analogies of learning

Definitions and analogies presented in table 4 represent "behaviourist approach to learning" in participants' views. Only in the last two of the analogies guidance is emphasized as the role of a teacher.

4. Conclusion

Data displays that prospective elementary science teachers participated in this research study have traditional views in term of their epistemological beliefs. Research results are consistent with the research studies in other countries done by Odgers (2003), Tsai (2002), and Eick (2000). What most prospective science teachers understand from knowledge is scientific knowledge which can be proven and objective. Cucen (2001) argues that individuals, who count experiment as the basis of knowledge, believe the emptiness of human mind at birth. Those who count mind as the basis of knowledge believe uncertainty of senses in our experiences. Experiences and senses are subjective and change from person to person. Therefore, it makes hard to have something common. On the other hand; some believe both, experience and mind, as the basis of knowledge. They argue the necessity of both in forming a valid knowledge. In this research study it is seen that there is a consistency between prospective science teachers' epistemological beliefs and understandings about teaching and learning. They hold traditional views in both. In their research studies; Clark and Peterson (1986) and Doyle (1990) emphasized influence of teachers' beliefs on their thinking and influence of their thinking on their practice in teaching. Lederman (1992) and

Appleton and Asoko (1996) add some other research studies consistent with this argument, addressing the interaction between the beliefs about the nature of science and understandings about teaching and learning. The research study presented in this paper has also consistent results with the studies mentioned above.

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