The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2016

Volume 4, Pages 352-356

ICEMST 2016: International Conference on Education in Mathematics, Science & Technology

EFFECT OF NATURE OF SCIENCE ACTIVITIES ON NATURE OF SCIENCE AND SCIENTIFIC EPISTEMOLOGICAL BELIEFS OF PRE-SERVICE PRESCHOOL TEACHERS

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ABSTRACT: The objective of the present study is to research the effect of nature of science instruction based on direct reflective approach on the views of pre-service preschool teachers on nature of science and their scientific epistemological beliefs. The study was conducted with 38 Fırat University, Faculty of Education Preschool Teaching Department senior students. The study was conducted with seven activities that were used in previous studies. Views of Nature of Science Questionnaire (VNOS) and Scientific Epistemological Beliefs Scale were utilized as data collection tools. Data was collected by applying the scales before and after the activities. Data collected via the Views of Nature of Science Questionnaire were digitized by assigning 3.5 points for scientifically adequate explanations, 1 point for partially adequate scientific explanations, and 0 point for non-scientific explanations and then assessed based on these scores. SPSS software package was used to analyze quantitative data and required analyses were conducted. It was determined that pre-service teachers had a poor understanding on the nature of science before the applications were conducted. Based on study results, it was determined that most of the illusions of the pre-service teachers on the nature of science were eliminated at the end of the application that entailed direct reflective approach activities. It was also found that beliefs of pre-service teachers on epistemological structure of science improved after the application.

Keywords: Science education, pre-school science education, epistemological belief, nature of science, direct reflectors.

INTRODUCTION

The objective of the science curriculum implemented in Turkey is to educate students as science literate individuals independent of their individual differences (MEB,2013). Schwartz, Lederman and Lederman (2008) indicated that individuals should comprehend conceptual scientific knowledge and the nature of science and scientific research to become science literate. Northcutt and Schwartz (2013), on the other hand, stated that individuals should understand scientific concepts, processes and nature.

Pre-school period is the basis of life. Education received in that period would affect the achievements of students in the following levels of education. The aim of the pre-school science education is the individual to observe, interpret the events around the individual, understand the relationships between these events and generally to achieve basic scientific process skills (Hamurcu, 2003). The aforementioned achievements are related to the nature of science (Ayvacı and Özbek, 2014). Thus, it is proposed that children who encounter scientific subjects for the first time should primarily comprehend the elements of the nature of science (Küçük, 2006; Ayvacı, 2007; Akerson, et al., 2011). In this context, pre-school teachers should pay attention to the the elements of the nature of science while planning scientific activities.

Although science and nature of science instruction is significant in educational process, in several studies, it was found that teachers have various misconceptions on the subject (Abd-El Khalick, 2002; Dickinson, Abd-El Khalick & Lederman, 2000; Wahbeh, 2009). Schwartz (2007) considered the lack of education on the nature of science among the reasons of these inaccurate beliefs on the nature of science.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

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Positive results obtained from studies conducted on the subject demonstrated that nature of science instruction should be conducted with the execution of a process particularly planned for this purpose (Lederman & Abd-El Khalick, 1998; Abd-El Khalick & Lederman, 2000; Bell, Blair, Crawford & Lederman, 2003; Khishfe, 2004). Epistemological beliefs include theories related to the nature of learning such as knowledge, nature of knowledge and the process of knowledge acquisition (Hofer and Pintrich, 1997; Schommer, 1990). It is quite important to research these beliefs, since scientific epistemological beliefs of teachers could affect the quality of science education in different ways (Chan, 2004; Hashweh, 1996; Luft and Roehrig, 2007).

The objective of the present study is to investigate the effect of reflective approach based nature of science instruction on pre-service pre-school teachers' nature of science and scientific epistemological beliefs under the light shed by the aforementioned study results. It was considered that the present study would contribute to literature, since there are no previous studies on pre-service pre-school teachers' nature of science and epistemological beliefs.

Objective of the Study

The objective of the present study is to research the effect of reflective approach based nature of science instruction on pre-service pre-school teachers' nature of science and scientific epistemological beliefs.

Research Questions

1. What is the effect of direct reflective approach based nature of science instruction on the views of pre-service pre-school teachers on the nature of science?
2. What is the effect of direct reflective approach based nature of science instruction on scientific epistemological views of pre-service pre-school teachers?

METHODS

To develop the views on the nature of science, activities named Exchange of Cards, Are the Limits of the Science Scientific?, Isn't it so?, What is in the Black box, tangram and the tube?, Footprints, Mysterious Cubes, Black Box, Fosils, Ordering the Events and Young-Old were applied using direct reflective approach (Doğan, Çakıroğlu, Bilican ve Çavuş, 2009). After the activities, characteristics of the nature of science themes were discussed by pre-service teachers, enabling them to reflect their opinion.

Study Model

Empirical method was utilized in the present study. Qualitative method was used to determine the effect of direct reflective approach on the views of pre-service teachers about nature of science and quantitative method was used to determine the effect on their epistemological beliefs.

Study Group

The study was conducted with 38 junior students attending Fırat University, Faculty of Education, Pre-School Teaching Department.

Data Collection Tools

To determine the views of pre-service teachers on nature of science, views on nature of science scale (VNOS-C) was utilized. The scale was designed by Lederman and O'Malley and the scale obtained its final form (VNOS-C) of ten open ended questions after a revision by Abd-El Khalick. The survey was designed to identify the views on changeable nature of scientific knowledge, the empirical nature of scientific knowledge, objectivity of scientific knowledge, creative nature of scientific knowledge, observation-inference relationship in science, the effect of social and cultural structure in production of scientific knowledge, and themes on the nature of science that consists of scientific theories and laws.

To determine the epistemological beliefs of participating pre-service teachers, epistemological belief scale developed by Schommer (1990) and adapted to Turkish by Deryakulu and Büyüköztürk (2002) was utilized. The scale includes 35 items and Cronbach alpha coefficient of the scale was calculated as .71.

Data Analysis

Nature of Science questionnaire items were digitized using the scoring (0, 1, and 3.5 points) proposed by Vasquez-Alonso and Manassero-Mas (1999). Scientifically fit explanations provided by the participating pre-service teachers were scored 3.5 points, partially scientific explanations were scored 1 point, and non-scientific explanations received 0 (Cited by: Kaya, 2005).

Both views on nature of science and epistemological belief scales were applied in pretest posttest format, and the statistical relationship between the test results was investigated with paired sample t-test.

Due to the fact that views on nature of science questionnaire included open-ended questions, assessment of the scale was conducted by two researchers. Used to calculate the reliability of comparative agreement between the two researchers, Cohen kappa coefficient was calculated as 0.85. This value demonstrated that there was almost perfect agreement among the researchers.

FINDINGS

	N	X	Sd.	t	p
Pretest	38	0,89	1,48	-14,343	,00
Posttest	38	1,04	1,76		

It was determined that there was a significant difference between the analysis results of views on nature of science scale pretest and posttest scores ($p < 0.05$). Thus, it could be argued that application of direct reflective nature of science activities developed the views of pre-service teachers on nature of science.

	N	X	Sd.	t	p
Pretest	38	3,11	2,08	7,96	,00
Posttest	38	3,34	2,14		

It was determined that there was a significant difference between the results of the analyses of pretest and posttest data for epistemological beliefs survey ($p < 0.05$). The results of the analysis demonstrated that direct reflective nature of science activities improved the epistemological beliefs of pre-service pre-school teachers.

RESULT and DISCUSSION

In the present study, the effect of nature of science instruction based on direct reflective approach on the views of pre-service pre-school teachers on nature of science and their scientific epistemological beliefs.

Analysis of the data obtained before the application of nature of science activities demonstrated that pre-service teachers did not possess sufficient understanding for the dimensions of nature of science. This finding is consistent with the results of other studies conducted with teachers and pre-service teachers in other departments in literature (Abd-El-Khalick & Lederman, 2000; Abd-El-Khalick, 2005; Kenar,2008). Comparison of results of the pretest and posttest, which was conducted after the activities were implemented, demonstrated that there was a significant difference between the pretest and posttest data for nature of science views ($p < 0.05$). It could be argued that the application of the activities improved the views of pre-service pre-school teachers on nature of science.

Studies conducted about the views of of students and teachers on nature of science showed that direct reflective approach achieved successful outcomes in nature of science instruction (Abd-El-Khalick and Lederman, 2000; Khishfe and Abd-El-Khalick, 2002; Khishfe and Lederman, 2007; Seung, Bryan and Butler, 2009).

In the current study, analysis of the data obtained from pretest and posttest that was implemented after the instruction of direct reflective nature of science activities demonstrated that there was a significant difference between epistemological beliefs of pre-service teachers ($p < 0.05$).

In studies conducted to determine epistemological beliefs of primary school students, it was concluded that views of students on scientific knowledge were not developed (Khishfe and Khalick, 2002; Kang and Wallace, 2005; Sandoval, 2005; Küçük and Çepni, 2006; Küçük, 2006; Küçük and Bülbül, 2007; Özkal, 2007; Yalvaç et al., 2010; Uzun, 2011). Student beliefs on nature of science and their epistemological beliefs need to develop at early ages. This would be only possible through teachers who have complete knowledge on nature of science and with strong epistemological beliefs. Thus, during undergraduate education of pre-service teachers, their

epistemological beliefs should be improved via nature of science courses in order to attain the abovementioned goal (Yılmaz-Tüzün and Topçu, 2008).

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