The Effect of Project Based Laboratory Application on Pre-Service Teachers’ Understanding of Nature of Science

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SYNOPSIS

INTRODUCTION

Understanding nature of science is one of the most important aims of science education (Tao, 2003; Sadler, 2004; Bora, 2005). Nature of science and nature of scientific knowledge are two dimensions of scientific literacy (Meichtry, 1999). Scientific literate individuals use scientific knowledge and search for scientific thinking ways in order to cope with social and individual problems (Sadler, 2004). It is advocated that nature of science should be taught to increase scientific literacy (Hand & et. al., 1999). Researches display that both teachers and students have insufficient views about nature of science (Lederman, 1992; Gürses & et. al., 2005; Küçük, 2006; Tufan, 2007).

When science teachers have clear understanding about nature of science, they support their students’ scientific literacy during their teaching applications. According to Lederman (1999), for transferring teachers’ understanding about nature of science into classroom applications, science teacher education programs should be arranged for developing students’ conceptions about nature of science.

Abd-El Khalick (2001) arranges general approaches about nature of science as given below (Muğaloğlu, 2006):
1. Scientific knowledge is changeable.
2. Empiric knowledge is the basis of scientific explanations.
3. Observations, inferences and theories are different from each other.
4. Scientific theories and laws are different from each other.
5. Science requires for creativity and imagination.
6. Scientific knowledge is based on theories.
7. Science is coordinated with social and cultural components.
8. There are various scientific methods.
PURPOSE OF THE STUDY

The aims of the study are (i) determining students’ views of nature of science, (ii) the effect of laboratory application and project based laboratory application on first year pre-service teachers’ knowledge and understanding the nature of science and (iii) the effect of mentioned applications on preservice teachers’ attitudes towards chemistry.

METHODOLOGY

The study was conducted in the extent of general chemistry laboratory in 2006-2007 Fall semesters. At the beginning of the semester, the samples filled The Beliefs about Science and School Science Questionnaire (BASSSQ) and Views of Nature of Science Questionnaire (VNOS-C) and the Scale of Attitudes towards Chemistry (SAC) as pre test.

In addition to the common laboratory program, project based laboratory application has been conducted. One week preservice teachers have conducted an experiment in the laboratory and a week later they have worked on the project based laboratory application about a chemistry subject that they have chosen.

In the laboratory, at first stage the researchers have given short information about each experiment and discussed the aims and the stages of the experiment with the preservice teachers. Preservice teachers have worked in the laboratory individually. After they conducted their experiment they have prepared the experiment report.

At the second stage of the research, project based laboratory application has been conducted. Preservice teachers have worked in teams of 2-3 members at that stage. At the beginning of that stage, the teams have determined their project questions. After determining the project questions, they have prepared their schedules. The researchers have checked the work of the teams at the determined check points. Most of the teams have suggested an experiment in order to give an answer to their project question and they have conducted that experiment in the laboratory. At the end of the applications, the teams have presented their projects in the classroom. The measurement tools which administered as pre test prior to the applications have been administered as post test at the end of the semester.

a) Samples

First year physics (N=24) and biology (N=61) preservice teachers have been participated in the study.

b) Instruments

Beliefs about Science and School Science Questionnaire (BASSSQ): The questionnaire was developed by Chen and others (1998) to determine student’s beliefs about nature of science and science teaching. It has two dimensions. In the study, the first dimension of the scale called “Teacher’s views about nature of science” has been used. It is five point Likert type scale.

Views of nature of science questionnaire (VNOS-C): The questionnaire was developed by Lederman and others (2002). In the study Version C of the questionnaire has been used. The questionnaire is consisted of open ended questions which aim to determine student’s views of nature of science.
The Scale of Attitudes towards Chemistry (SAC): It was developed by Şimşek (2002) for determining students’ attitudes towards chemistry. It is consisted of 21 items and it is a five point Likert type scale. The alpha reliability of the scale is 0.82.

FINDINGS

The pre and post test results of the BASSSQ have been compared by paired samples t-test. It has been found that there was a significant difference between the post and the pre test (p<.05). As a result of the laboratory and project based laboratory applications, preservice teachers’ beliefs about nature of science significantly developed.

Students’ responses to VNOS-C evaluated as mentioned in the literature and classified as “good”, “average”, “weak” (Milwood & Sandoval, 2004; Thye & Kwen, 2003).

When preservice teachers’ responses to the first question in VNOS-C “What is science?”, “What is the difference between science (exp. Physics and biology) and other disciplines (exp. Religion and philosophy)?” has been evaluated, it has been determined that preservice teachers’ “weak” views about this subject developed.

As a result of the applications, the % of the preservice teachers’ who have been able to explain the difference between scientific laws and theories and give examples to the laws and theories has been increased.

In post test, the % of preservice teachers who can explain how researchers can be sure about the structure of atom and what kind of evidences they use to support their ideas has been increased.

The Scale of Attitudes towards Chemistry (SAC) has been administered as pre and post test before and after the applications to determine the effect of the applications on preservice teachers’ attitudes towards chemistry. The pre and post test results of the SAC compared by paired samples t-test. It has been found that preservice teachers’ attitudes towards chemistry have been increased as a result of the applications.

DISCUSSION

As a result of laboratory and project based laboratory application, preservice teachers’ knowledge related to the nature of science and their attitudes towards chemistry have been increased. The analysis of the data has displayed that students’ understanding of the science nature can be increased by using some special instructional methods like project based laboratory method.

When the pre test results of the scales have been examined, it has been seen that preservice teachers have insufficient understanding the nature of science. This finding stressed that the education programs prior to the university can not develop students’ understanding the nature of science and also the education at the university can not correct students’ misconceptions about nature of science. For this reason, the views of the preservice teachers’ about the nature of science should be determined and instruction should be planned to eliminate their misconceptions.

Laboratories are places in which students learn the practical usage of the theoretical knowledge and discover the scientific laws by using the evidences which they get through the experiments. Students learn how to convey a scientific research and inquiry in the laboratory. Therefore, laboratories are suitable places in which students develop their knowledge about nature of science and eliminate their misconceptions about the nature of science. Students follow the directions of the experiment like a cookbook in a traditional laboratory method is not suitable for developing their views and knowledge about the nature of science. Instead of traditional methods, when students conduct the experiments
by searching, thinking and reasoning, they will reach scientific knowledge and increase their understanding the nature of science.

SUGGESTIONS

When the teachers have sufficient information about nature of science, they will teach their students more effectively. Therefore, the teachers should be taught about the nature of science.

The applications which aim to develop student’s views about the nature of science should be used at all levels of education. Students’ misconceptions about the nature of science have been occurred at early stages of the education. Therefore, at early stages of science education, students should be taught about nature of science.

Students should have information about the nature of science and the importance of scientific knowledge for it’s’ usage in daily life. For this reason, the activities should be placed in curriculums to develop students’ beliefs and knowledge about the nature of science.
REFERENCES


