



Changing Views of Nature of Science Following Explicit Instruction

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Abstract

The nature of science tends to be one of the most overlooked aspects of science literacy in classrooms across the United States (Bell, 2009). The purpose of this study is to examine the improvement of seven pre-service science teacher's views of nature of science over the course of a semester in which they received explicit instruction about the nature of science. The results of this study showed that all seven pre-service teachers improved their views of the nature of science which indicates that explicit instruction is an essential part of pre-service teachers gaining an understanding of the nature of science.

Introduction

One of the main goals of science education in the United States has been to produce a scientifically literate populous that has a well-rounded knowledge of science, is capable of making informed decisions of scientific claims, and can positively contribute to the economy and society in which we live (Lederman, 1998; NRC, 1997). In order to foster the development of a scientifically literate populous, educators have identified three central components of science literacy: scientific knowledge, methods of science, and nature of science (NOS) (Virginia Mathematics and Science Coalition, 2010). Scientific knowledge is the most well-known component and consists of scientific laws, theories, definitions, and other scientific concepts (Virginia Mathematics and Science Coalition, 2010). Methods/Practices of science refers to the many ways which scientists generate scientific knowledge, i.e. predicting, measuring, and experimenting (Virginia Mathematics and Science Coalition, 2010). While these two components of science literacy are commonly addressed in high schools across the United States, nature of science continues to remain the least understood aspect of science literacy (Bell, 2009). A debate remains, however, on how the nature of science can best be taught. Some hold to the view that nature of science can be taught implicitly through hands-on activities while others subscribe to the idea that the nature of science must be taught explicitly (Bell, 2009). According to research, the most effective method on changing students views of the nature of science seems to be an explicit approach (Bell et. al, 2003). The purpose of this study is to examine the effects that explicit NOS instruction has on changing pre-service science teachers views of nature of science.

Methods

- **Participants** in this study consisted of seven pre-service science teachers (PSTs) enrolled in CIED 4613 at the OSU College of Education (COE). All seven PSTs were undergraduate secondary science education majors in their junior year of the COE teacher education program. Four of the PSTs identified having a Biology emphasis, one had a Chemistry emphasis, one had a Physical Science emphasis, and one PST had an Earth and Space Science emphasis. Throughout the course, students received explicit instruction about the nature of science and had the opportunity to participate in activities designed to increase the student's views of the nature of science. Also, as part of the CIED 4613 curriculum, all seven students facilitated a BIOL 1114 Lab section. This consisted of students assisting lab TAs in helping Biology students generate hypotheses, design experiments, collect and analyze data, and formulate evidence-based explanations.
- **Rubric:** The pre-service science teacher's views of nature of science were assessed using the Views of Nature of Science (VNOS-D) instrument. The VNOS-D consists of eleven free-response questions aimed at gaining an understanding of the respondents views of ten aspects of nature of science. Using the newly developed VNOS-D rubric, PSTs responses were identified as either naïve, emerging, or informed. Scores were given for each question with a score of "1" representing a naïve response and a score of "5" representing a well-informed response. The PST participants were administered the VNOS-D on the first day of class prior to any instruction and again on the last day of class following explicit instruction throughout the semester.
- **Raters:** Participant's responses were scored by two raters each of whom scored responses independently of the other. The raters consisted of one Science Education faculty and one undergraduate science education student. The raters scored responses independently of each other and then convened to discuss their scores.

Results

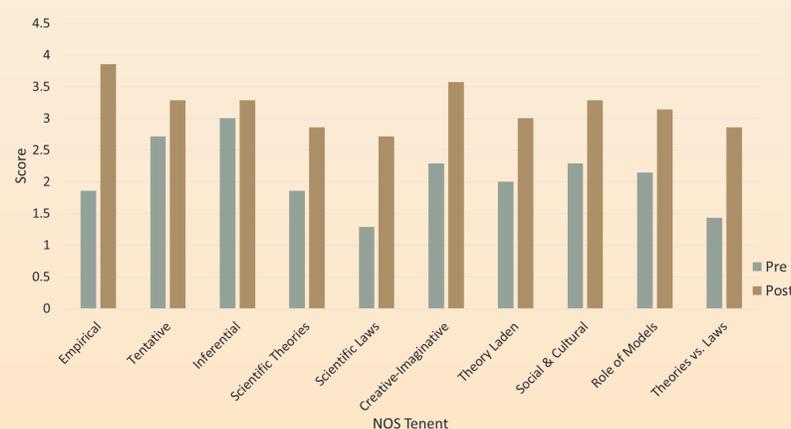


Figure 1. Average of student's scores on each tenant of the NOS both pre- and post-instruction

- Participant's scores increased overall as well as for each tenant of the nature of science.
- PSTs VNOS scores increased by an average of 1.1 points (based on a 5 points scale).
- As a group, PSTs demonstrated the largest increase in their understanding of the empirical NOS. Participant's views of the empirical NOS increased 2 points as it is shown in Figure 1.
- Individually, the largest increase in their overall understanding of the NOS was seen in participants 1, 3, and 5 whose overall scores increased 1.6 points as seen in Figure 2.

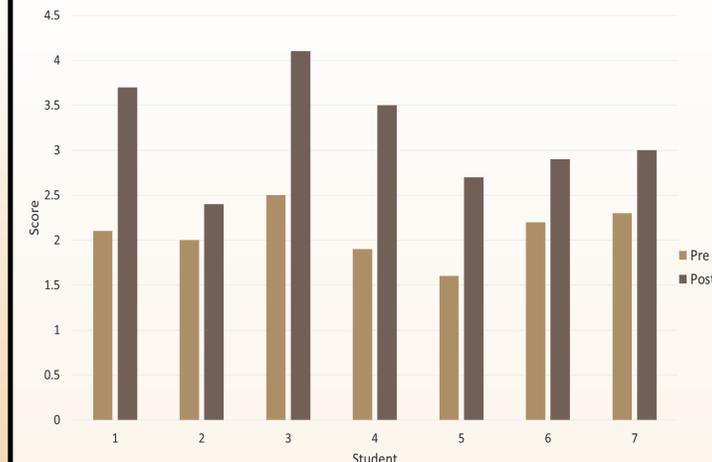


Figure 2. Comparison of individual student's overall average score pre- and post-instruction

Discussion and Conclusions

Based on the results of this study, it can be suggested that explicit instruction throughout a science methods course was effective at improving pre-service science teacher's views of nature of science. These results are supported by Bell et. al (2003) who found that an explicit approach to teaching the nature of science was most effective at changing student's views of the nature of science. If science teachers are to teach their students to become scientifically literate, it stands to reason that the teacher must also achieve this same level of literacy. This study suggests that all PST should participate in a science methods course where NOS is explicitly addressed.

Acknowledgements

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