Deepening Understanding of the "Nature of Science" through Undergraduate Research

Liz Bergeron, PhD
Department of Educational Studies
University of Wisconsin, La Crosse

Overview

This project enabled students to deepen their understanding of Nature of Science (NOS) while simultaneously learning about research questionnaire design.
Pre-service teachers:

- Evaluated instruments
- Designed their own instrument
- Collected data
- Analyzed data

Instruments

1) Views on Science Education (VOSE) instrument (Chen & Sufen, 2006)
2) Views of nature of science questionnaire (VNOS-C) (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002).

Results: General

- Designing items deepened their understanding of NOS.
- Evaluating responses from the in-service teachers challenged their understanding, resulting in higher level thinking.
- As one student stated***, "the data opened my eyes to the gap between understanding and implementation that exists for, I would assume, many teachers***."

Results: Items Developed

One question that arose during the review of existing instruments was, "How do you disentangle discipline specific content knowledge from the NOS tenets?"
After identifying gaps in the research students developed 6 additional items to use to assess in-service teachers' understanding of NOS.

Selected items displayed for illustrative purposes:

Item developed by pre-service teacher	In-service Teacher E Response	In-service Teacher D Response	NOS tenet being assessed
1. How would you explain the term "scientific theory" to a student compared to the everyday usage of the word "theory"?	I spend a lot of my time in 8th grade science class clarifying that most of what I teach are theories. We talk about how my job is to teach the scientific theories, but I won't be upset if they have their own, unique theory about any particular subject. . .We have to be respectful of all theories, even theories that aren't scientific.	. . .Scientific theories are the result of numerous investigations and supported evidence, so much so that most experts in the field believe the theory. Most scientific theories are so well supported that they have yet to be proven incorrect. Where as an everyday theory can be subject to ones own opinion, and change heavily from person to person.	tentative nature of scientific knowledge
2. Inquiry, alone, is sufficient to improve students' understanding of the tentative nature of science knowledge.	DISAGREE. Inquiry is definitely a catalyst to enhancing students' knowledge and understanding of any specific topic, but inquiry alone isn't enough. . .	Disagree	tentative nature of scientific knowledge
3. Explicit and implicit instruction on the tentative nature of scientific knowledge is absolutely necessary for student understanding of science.	UNDECIDED. Explicit instruction is a great time-saver, but implicit instruction (open discussions) definitely promotes curiosity. The tricky part is that with students at all different levels of both interest and ability, implicit discussions are difficult to have. . .	Agree	tentative nature of scientific knowledge

Conclusion

The description provided by one undergraduate student illustrates higher level thinking developed during this project,
*"On paper, I think [my cooperating teacher] shows an excellent understanding of the Nature of Science. However, his implementation in the classroom does not really correlate with what this data has shown. . .**this has really shown me is that you can have the greatest understanding of the Nature of Science out there, but if you don't take the time to understand your students and create lessons that follow the nature of science, then your acceptance does not mean much** . . .I am not saying any of this to berate [my cooperating teacher] (because I really like him!)"*

References

Lederman, N. G., Abd-El-Khalick, F., Bell, R. L., & Schwartz, R. (2002). Views of nature of science questionnaire: Toward valid and meaningful assessment of learner's conceptions of nature of science. Journal of Research in Science Teaching, 39(6), 497-521.

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