The History and Nature of Science in Secondary Education

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Background

Two major educational reform projects created what the National Assessment for Educational Progress (2009) calls the "best thinking" in science standards:

- AAAS Project 2006’s "Benchmarks for Science Literacy" (1993)
- The National Academy of Science’s "National Science Education Standards" (1996)

Both benchmarks and the NSES emphasize students learning about science as an enterprise, a way of thinking, and a body of knowledge accumulated over time. Benchmarks refer to such ideas collectively as "The Nature of Science," and includes a chapter on "Historical Perspectives" to supplement the NSES, which ends with both an overview, "The History and Nature of Science," and a handbook, "History and Nature of Science," (H&NoS hereafter).

Since their publication, each state has created its own science standards and/or curriculum framework. However, each state has responded to the H&NoS guideline in different ways. Some states have included historical events…"Students develop characteristics for which to look in the state standards. Not all states include these ideas, but most states do specify particular historical episodes that are very central ideas, but there may be reasons for including these modalities. The H&NoS guidelines are more specific in certain theories separately from the H&NoS. The Big Bang Theory, Evolution, the Atomic Model, and Cell Theory are very central ideas, but there may be reasons for including these modalities. The H&NoS guidelines are more specific in certain theories separately from the H&NoS.

Incorporated National Level Curriculum Reform in the History and Nature of Science?

Why look at standards?

Standards-based educational reform is historically rooted in 1965’s "A Nation at Risk," but picked up significant political speed with the “No Child Left Behind” Act of 2001. While state standards are not necessarily representative of classroom practice, they do indicate those learning goals which education policy-makers think most vital.

Methods

- Exploratory review: I retrieved the high school science standards documents from each state’s Department of Education website, and skimmed for H&NoS content.
- Descriptive Coding: Based on the guidelines of Benchmarks and NSES, and the exploratory review, I developed characteristics for which to look in the state standards.
- Modeling: From coding data, I developed inclusion modalities regarding H&NoS.

So What?

It is to be expected that each state will have slightly different standards, with quirky characteristics. This descriptive work is useful because the four modalities that emerged from this work serve as tools to further investigate the more interesting question: How did national level reform projects influence state standards in the adoption of the H&NoS guideline? Future historical archive work will use these modalities for case studies to understand how policy makers have decided to include H&NoS.

In the context of standards-based education reform and potential national-wide standards, understanding how the H&NoS guideline has filtered down to the state standards is useful for would-be reformers.

Discussion

The most definitive thing that can be said is that there is no consensus model of how to teach H&NoS to which state standards adhere. However, this review of state standards yielded 4 distinguishable modalities — general approaches to the inclusion of the H&NoS standard.

Within each modality, states fall into a small number of categories. The choices that the standards’ framers have made in regards to H&NoS are clearer to articulate based on these modalities.

Inquiry and History and Nature of Science

Inquiry standards generally encompass student science laboratory or field-work experiences. Even though students' lab experiences may include investigations of historical events, teachers are cautioned that performing inquiry can only help students learn about the H&NoS if their experiences "progressively approximate good science."

History of… Nature of…? Just the Science.

Seven states do not include H&NoS in the standards at all, or include it only as an optional topic. Based on the Fordham Foundation’s 2006 scores for state standards, the lack of H&NoS does not appear tightly coupled with "star" standards. Is H&NoS necessary to include in the science standards? Or should the standards include only scientific knowledge?

Science as a Human Endeavor in Society

"Science as a Human Endeavor" and the relationships between Science, Technology, and Society are closely linked in the state standards. Not all states include these ideas, but those that do tend to include both. What should students be expected to know about the human dimensions of the scientific enterprise?

History of Theories for Science Content

Most states do not specify particular historical episodes that students ought to learn, but some states include the history of certain theories separately from the H&NoS. The Big Bang Theory, Evolution, the Atomic Model, and Cell Theory are very central ideas, but there may be reasons for including this history. Is the History of Science important only for illuminating the Nature of Science?

Literature Cited


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