

## Using the Activity Model of Inquiry to develop undergraduate students' views of the scientific inquiry process

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**Abstract:** The *Activity Model of Inquiry* (Harwood, 2004) is a theoretically-grounded and empirically-derived model of scientific inquiry. This research examines how undergraduate students' views of scientific inquiry shift after introduction of the *Activity Model of Inquiry* in a general chemistry course. Students are asked to respond to essay prompts and a pre- and post-questionnaire. Preliminary findings show shifts from a naïve view to a more informed view of nature of scientific inquiry for some students.

### Introduction and Rationale

If chemistry taught in the classroom is to add to the public's understanding of science, school science must "develop students' understanding of the scientific enterprise itself, the aims and purposes of scientific work, and the nature of the knowledge it produces" (Driver, Leach, Millar, & Scott, 1996). Many students come into the classroom with a particular image of science and how scientists conduct science that does not reflect the enterprise accurately, often because they do not understand the processes of sciences and the creation of scientific knowledge, which compose nature of science (NOS). Understanding NOS is important, for it has been noted, "an appropriate understanding of NOS will allow students to make more informed decisions on science-based issues in their daily lives" (Ibrahim, Buffler, & Lubben, 2009). However, what many students know about NOS comes from the media, everyday experiences, traditional presentations of "the" scientific method, and technology (Ryder, 1999) and these experiences provide a misleading foundation for becoming scientifically literate.

One way to make NOS explicit is to use a thinking frame. Thinking frames "guide the process of thought; supporting, organizing, and catalyzing that process" (Perkins, 1986). Commonly, teachers use the traditional scientific method (TSM) as a thinking frame to teach the process of science. However, there is a lot of dissatisfaction with the TSM model, for it includes an overall step-by-step linear view of the scientific process and lacks any theoretical, cultural, or social aspect to the creation of scientific knowledge. This is inaccurate both because of the non-linear aspect of many scientific inquiries and the fact that all knowledge should be thought of as a means for meeting human needs. Omitting the latter aspect, it has been argued, is both false and less likely to engage learners (Rudolph, 2005).

William Harwood's (2004) *Activity Model of Inquiry* is a recent, data-based model that may have the instructional potential as a thinking frame for teaching nature of science aspects. It was developed from interviews with fifty two faculty members across nine disciplines at a research university (Harwood, Reiff, & Phillipson, 2002). Within the model, there are ten activities in a web-like structure (Figure 1). There is no unique pathway for inquiry; students chose what to do next based on what they need. Questions are in the middle suggesting them as the central feature of inquiry. Questions include general and divergent questions that help frame the inquiry. In addition, the *Activity Model of Inquiry* has significant potential in discussing the aspects of NOS.

The research question for this study is: what happens with the *Activity Model of Inquiry* when using it as an instructional tool?

### Methodology

This research study uses an interpretive qualitative framework and includes a design component. Thirteen students provided consent within a first semester general chemistry course at an urban community college where the author was the instructor. Assignments relevant to NOS were a standardized questionnaire given at the beginning and end of the semester and four course-related writing assignments given throughout the semester. Assignments were chosen using a constructivist perspective. That is, knowledge is constructed from previous experiences (Bransford, 2000, p. 11). All students completed the Views of Nature of Science questionnaire Form-C (Lederman, Abd-El-Khalick, Bell, &



Figure 1.  
Harwood Activity Model

Schwartz, 2002), which probe for understandings of the empirical, tentative, theory-laden, creative and imaginative, and social and cultural embedded-ness nature of scientific knowledge, as well as, the myth of a universal scientific method, the difference between scientific laws and theories, and students' overall view of science. On the second day of class, students were asked to draw their model of the process of science. Students were then introduced to the *Activity Model of Inquiry*. Writing assignments were used as a means of eliciting students' evolution of understanding around the myth of the scientific method, which is the focus of this paper. The first writing assignment asked students to describe how, in their view, scientific knowledge is created and what approach scientists take to create it. The second and third writing assignments asked the students to interact with the *Activity Model of Inquiry*. Students were to analyze a scientific news article and their own laboratory work using the *Activity Model of Inquiry*. The fourth writing assignment prompted students to reflect on their understanding of science and how, if at all, their view had changed from the beginning of the semester. Instructor lesson plans and reflections were collected to inform further implementations.

Analysis is being conducted using an interpretive framework. The pre- and post-questionnaire responses will be coded using Lederman, et al. (2002) coding scheme. Follow-up interviews were conducted to validate the responses. The writing assignments have been coded for language and argument as well as students' descriptions of the myth of the scientific method and will later be coded for other NOS aspects. The instructor's lesson plans and reflections will be analyzed for what worked well versus what worked poorly.

## Findings and Discussion

Preliminary findings demonstrate the results of the analytic framework applied to this student data. To answer the research question, four student's responses are highlighted. Two student's responses show a typical change. They began the semester thinking all science follows the TSM. Both of their illustrations of the process of scientific inquiry depicted a linear process. However, toward the end of the semester the students began to incorporate *Activity Model of Inquiry* components in their responses, particularly the Communicating With Others component. Some students also developed more informed views regarding the different approaches taken to solve a scientific problem and that there is freedom within this process. One student showed a significant change in her view of the myth of a scientific method. Prior to introduction of the *Activity Model of Inquiry*, this student listed steps of the TSM to describe scientific investigations. However, at the end of the semester she stated, "no set order of procedure" but rather "based off our convenience" and "now I know experiments are very open ended." The fourth student illustrates a case where no changes were observed. For both the pre- and post-questionnaire, she responded that experiments are based off of the TSM and listed the steps of the TSM. These results suggest that the *Activity Model of Inquiry* can support shifts but also reminds us that major changes in deeply held beliefs are difficult to change in a short one-semester experience.

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