

Does Taking an Introductory Astronomy Course Increase Student Understanding of the Nature of Science?

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An accepted yet elusive learning goal

1. Increasing students' understanding of the nature and process of science is an important learning goal of "Astro 101" courses. It is, in fact, one of the justifications for the science "breadth requirement" that supports most of the Astro 101 enterprise in the US. Nevertheless, little work has yet been done to measure whether and how this goal is achieved.

What do we mean by the "nature of science"?

Of the many aspects of scientific thinking and the nature of science, we chose to study:

1. How well do students understand what science is?
2. What kinds of attitudes do students have towards science?
3. Can students distinguish believable scientific results from bogus ones?
4. Do students possess a "basic science literacy" of astronomy?

Strategies employed for teaching the nature of science

Students learn better when they know what they are expected to learn (learning goals) and when they practice what they are learning. As such, our **TEST CLASS** incorporated three strategies not traditionally included in ASTRO 101 classes:

1. Discussion of the "Nature of Science" learning goals and of the question "What is Science?"
2. Promotion of metacognitive skills through EXPLICIT discussion of questions such as "How do you learn science?" and "How do you know when you know?"
3. Ask students to distinguish between good science and bad science (i.e. pseudoscience) through assignments (Figure 1 and Figure 2).

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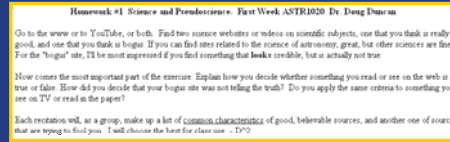


Figure 1. Sample assignment

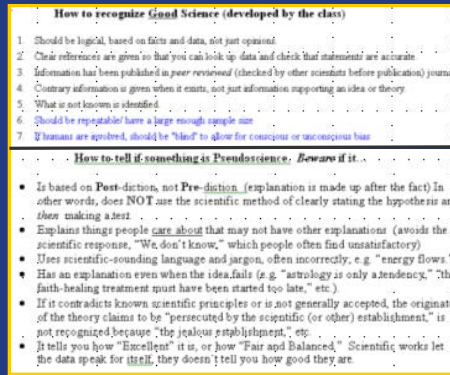


Figure 2. Sample student responses

Assessment of learning the nature of science

We looked for differences at semester's end between the **TEST CLASS** and a **CONTROL CLASS** that did not incorporate the metacognitive discussions or science-pseudoscience assignments. A second control was an astronomy class surveyed before any instruction had taken place. Two different assessments were used:

1. The EBAPS multiple choice survey (Elby et al. 2001) of student beliefs and attitudes about science was given to all students.
2. Sixty one students were asked 9 questions each during interviews. All interviews were transcribed and common themes identified. Full results will be published in 2009. Here we report answers to the question, "What is a Scientific Theory?"

Assessment Results are Interesting!

Six of 30 EBAPS questions showed highly significant differences between the **TEST class (GREEN)** and control (**RED**) in Fig. 3. Five of six differences are on this subject: *Is the ability to do and understand science innate to just some people, or can anyone do it if they work at it? The test class believes much more strongly "anyone can do science or think scientifically if they work at it."*

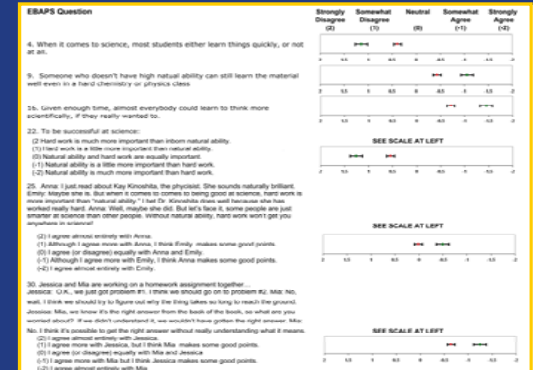


Figure 3. Comparison of EBAPS results from TEST and CONTROL classes

One of the 9 interview questions is presented in Fig. 4: "What is a Scientific Theory?" One of our rubrics categorized as incorrect responses that said, "(just) an idea, a guess, an opinion or hypothesis" without mentioning any testing. We categorized as "correct" ones that used any of the phrases, "based on data, evidence, experiment, observations, a proven or tested idea."

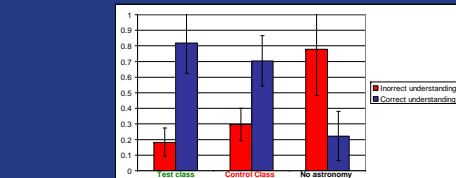


Figure 4. Comparison of interview results from TEST and CONTROL classes



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