ONLINE ARTICLE

# Structured Academic Controversy:

## A Peaceful Approach to Controversial Issues

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The teaching of evolutionary theory has historically been problematic, often times marred with legal and moral battles. In recent years, state boards of education (Hutton, 2003) have prohibited or somehow compromised the role of evolutionary theory in school science. Consistent with the diversity of beliefs in contemporary society, pre-service science teachers may hold personal beliefs, including creationism or intelligent design, that may restrict their willingness or ability to teach evolution concepts based in scientific theory. Other pre-service science teachers who agree that evolution is a fundamental scientific concept may be uncomfortable with the prospect of teaching evolution to their future students because of the potential for creating controversies in the classroom, or with parents. In science teacher education programs that model acceptance of diversity and student-centered instruction, reversal from constructivist teaching philosophy to a dualistic treatment of evolution versus creationism is inconsistent and may be perceived by students as a shortcoming of constructivist practice.

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Implementation of the instructional strategy, "structured academic controversy," is one means of teaching evolutionary theory while maintaining a constructivist approach. Use of Barbour's (2000) typologies of contemporary perspectives (Conflict, Independence, Dialogue, and Integration), which describe various relationships between science and religion, provide an organizational scheme on which to base a structured academic controversy (SAC). The typologies and structured academic controversy work in conjunction to help frame students' personal beliefs and fundamental scientific knowledge.

In this article, implementation of SAC and its effects on one class of pre-service science teachers will be discussed. The implications for use in middle school and high school classrooms will also be discussed.

## Rationale for Instructional Decisions

### Learning Goals

Teaching evolutionary theory may be a source of anxiety for the instructor as well as for the students. To avoid

potential areas of classroom conflict, the goals of this instruction were designed to create a positive learning experience by removing the negative connotations of teaching a controversial topic. The learning goals were to promote the teaching of evolution without: 1) taking a dualistic stance regarding the evolution/creationism controversy, 2) straining classroom interactions between students with diverse views, or 3) marginalizing students whose personal beliefs were challenged by evolutionary theory.

Structured academic controversies (SAC) are designed to engage students in controversy and then guide them to seek an agreement. Students are required to research and present a position, refute opposing positions, reverse perspectives, and create a synthesis that all group members can agree to (Johnson, Johnson & Smith, 1997). Enhancement of critical thinking skills stems from changes in students' views about an issue; continues through development of a state of uncertainty or disequilibrium, that in turn motivates a search for more information and a more adequate cognitive perspective, and the derivation of a new, reconceptualized conclusion (Johnson, Johnson & Smith, 1997.)

SACs can be used effectively to change perspectives and to enhance content knowledge. In particular, this strategy can be influential in studying evolutionary theory. Teacher-centered, factually verifiable instruction may not be the best, for beliefs about evolution are closely linked to historical, philosophical, and sociological perspectives (Mead & Scharmann, 1994). In a study of undergraduate biology students, implementation of a SAC resulted in significant changes in students' values. "These value positions (of students' prior to instruction) were previously based on a student's perceived need to make a dichotomous choice between scientific versus religious viewpoints. In fact, the increased benefit possessed by the diversified instructional strategy in generating direct student involvement is crucial to the success for the resolution of this issue in particular and an understanding of scientific theories in general," (Scharmann, 1990, p. 99). In a study of SAC lessons for high school biology students, Mead and Scharmann (1994) reported that critical thinking skills, motivation, and overall achievement increased.

Complete endorsement of the exclusive role of evolution is promoted in science standards documents (National Research Council, 1996) and professional science organizations (National Association of Biology Teachers). Yet there continues to be resistance to the teaching of evolutionary theory. Much of this resistance can be attributed to lack of understanding concerning the nature of science (Clough, 1994); some other resistance may result from deeply held personal beliefs or community (e.g. family) expectations. Science teachers should avoid debating against creationism, because the debate implies that one theory holds dominance over the other. Rather than leading to clarification of the issues, debates may lead to an unrewarding ending (Bybee, 2000). Debates force a decision between two ideas that may not be mutually exclusive: Evidence that does not support evolution does not in turn prove an alternative concept, such as intelligent design or creationism (Hanson, 1986). Rather than pushing students into an exclusionary position, it is much more fruitful to encourage students to think about the complexities and ambiguities that often characterize controversial issues.

## Barbour's Typologies

Barbour's (2000) typologies of contemporary perspectives describe various relationships between science and religion and provide an organizational scheme on which to base a SAC. Barbour categorized the various interrelationships of scientific knowledge and religious ways of knowing by using a fourfold typology, or sorting mechanism, to distinguish among the ways that people relate Science and Religion. The typologies (Conflict, Independence, Dialogue, and Integration) reflect relative degrees of exclusionary or inclusionary thinking about fundamental concepts that could be explored through either or both disciplines. Concepts include evolution, the origin of life, the implications of quantum physics, and genetics. The four typologies are clarified below:

**Conflict.** Science and Religion are exclusionary ways of knowing. People cannot believe in both God and evolution. (Science and Religion are "enemies.")

**Independence.** Science and Religion refer to different domains of life or reality. Science and Religion ask and answer two different kinds of questions, and serve two different masters. Or, in other words, Independence posits that Religion and Science offer complementary perspectives on the world that are not mutually exclusive. (Science and Religion are "strangers.")

**Dialogue.** One form of Dialogue is a comparison of the methodology of the two ways of knowing. Dialogue may occur when one domain asks questions at its boundaries, and the other domain may provide an answer or methodology to find the answer. A third means of Dialogue is when analogies from science are used to describe religious concepts. Dialogue is marked by mutual respect for the integrity of the other's field of study. (Science and Religion are "partners.")

**Integration.** A closer partnership than in Dialogue exists, seen in the philosophies of natural theology, theology of nature and process philosophy, in which the conceptual frameworks of Science and Religion share many common elements. (Science and Religion are "partners.")

## Importance of Including Controversies in Science Methods Courses

By choice or not, science teachers are involved, either actively or passively, in contemporary American cultural views of what should go on in science classrooms. National and local standards in many ways define school science,

but to what extent will non-experts (non-scientists or non-science educators) continue to influence the science curriculum? And to what extent do teachers' personal beliefs influence science curricular decisions? These questions can be addressed through the use of structured academic controversies.

# Implementation of SAC

## Format for SAC

This SAC was structured to allow students uninterrupted class time to present content knowledge and diverse perspectives, as well as time for clarification questions, small-group discussion, large-group discussion, and consensus building. The instructor facilitated the schedule, but also led the large-group discussion periods and the culminating consensus-building dialogue. Time management was crucial, as it allowed dedicated time for sharing summaries of the book, as well as requiring students to *think* about evidence before they were given the opportunity to question or challenge the evidence (see Appendix).

The schedule for the SAC was distributed to the students prior to the in-class presentations. The SAC was conducted during one three-hour class period. The instructional goals for the class were to provide an opportunity for examination of dominant perspectives on the nature of science, the nature of religion, and the existence and location of boundaries between these disciplines. Justification to the students for inclusion of the SAC in the methods course was the recent statewide controversy over the teaching of intelligent design in addition to evolutionary theory in the public schools.

## Context of the Instruction

A SAC was implemented in a senior-level science methods course with 11 undergraduate middle childhood preservice science teachers. The students, placed in cooperative groups, were assigned readings from Barbour (2000) and were given advance instruction about the SAC and individual and group roles and expectations. Groups of two or three students were assigned specific topics to read and present to the class. Topics included evolution, origin of life, quantum physics, and genetics. Students were responsible for presenting on the state of the current scientific knowledge, and for synthesizing the dominant views about the interactions between science and religion. As part of the out-of-class preparation for the SAC, students were expected to become familiar with historical and contemporary scientific knowledge as well as cultural influences in the development of scientific theories. The background readings included evidence and arguments for the multiple perspectives or typologies, so as students prepared for their role in the class discussion, they studied about not a single position but about several. They were not given the opportunity to pursue a single stance, but rather to attempt to understand a concept, evolution, from multiple perspectives. It was through this set of requirements that students engaged in the critical cognitive progressions intrinsic to participating in a SAC. Students are required to research and present a position, refute opposing positions, reverse perspectives, and create a synthesis that all group members can agree to.

The SAC began with an introduction by the instructor of the goals of the SAC. Then each group's spokesperson presented an oral and written summary of the scientific information and the four interrelated perspectives (Conflict, Independence, Dialogue, and Integration). Each group provided the instructor and the other students with a written summary of its topic. Following each presentation, a brief time was allowed for any clarification questions generated by the student audience. These were questions of a factual nature. Forums were the next step, which followed the initial presentations. The forums were opportunities for analytical and open-ended questioning and discussion by all the students and instructor. In the two forums, the students were asked to analyze the predominate typologies reinforced in K-12 and higher education communities; the predominant typologies in the larger community (media, citizenry, government); and which typologies best met national and state standards documents' philosophies. The culmination of the SAC was to build consensus among the students by developing a class resolution on which typology/ies best met the needs of a diverse student body in a K-12 public school setting. While SACs sometimes encourage debate, this format was designed to encourage students to become aware of evidence for scientific theories while helping them understand why people held different beliefs about natural events.

# Results

During the preliminary stages of the SAC, the student presenters shared printed copies of the summaries with fellow classmates, and fielded questions about content knowledge background. They were respectful of each other's work and opinions. During the forums, students had an opportunity to explain their perspectives, analyze contemporary views and political agendas, and raise questions to others about the intersection of scientific knowledge and cultural perspectives. The final component of the SAC was to develop a shared understanding of which typology best serves the needs of a diverse student body. As students brainstormed, first in small groups and then in large groups, teaching issues associated with each of the typologies began to emerge. Ideas proposed in this discussion converged toward the Independence and Dialogue typologies. Some pre-service teachers thought that their middle grades students should have their choice of instructional topics (e.g. evolution, creationism, intelligent design), whereas other pre-service teachers felt that children in this grade range did not have the intellectual maturity to make this kind of instructional decision. After more large-group discussion, the class came to consensus that

the Independence typology was most appropriate, because it included all students in learning accepted scientific knowledge, while recognizing that students held a broad spectrum of religious beliefs that were equally legitimate ways of finding out about the world. Yet despite the pre-service teachers' agreement that their students' religious views should be respected, the process made the pre-service teachers realize that accepting other views and teaching diverse views were two different issues. As science teachers, they collectively made the decision to respect all views by teaching only science in the science classroom.

A post-instructional anonymous survey was distributed to the students. At this time, they had the opportunity to share their personal feelings about evolutionary theory. Among the pre-service teachers involved in this study, the results indicated that the SAC promoted consensus building among students, enhanced students' propensity for including evolution in their future classrooms, avoided confrontation, and emphasized currently accepted scientific thinking. All students reported that they felt comfortable with the SAC, and commented that they had a better understanding of the complexities of the issues involved, both scientific and non-scientific.

## Discussion

What is the difference between *telling* preservice teachers that only science must be taught in the public school classroom from *engaging* them in a SAC which guides them to the same decision? The difference is in the process. Rather than a mandate from the instructor, or from "official" knowledge, the students are drawn in, for perhaps the first time, to the body of scientific evidence that has shaped evolutionary theory, or quantum physics, or genetics. This body of empirical evidence, integrated into coherent and predictive theories, reinforces the pre-service teachers' confidence in the ability of science to answer complex questions. The process of SAC similarly guides the pre-service students through the diverse range of religious and philosophical positions on the complex relationships between those disciplines and scientific theories. Religion is no longer perceived as a single block of beliefs or values, but rather as a continuum from literal to liberal insights. And because of the new awareness of the multiplicity of religious views, respecting adolescent students' religious beliefs is no longer a matter of teaching one alternative approach, such as creationism or intelligent design.

The ultimate goal of pre-service science education is effective and informed K-12 science teaching. As pre-service teachers become "in-service" teachers, they assume responsibilities for making curricular and instructional decisions, as well as for establishing a science classroom with intellectual integrity. Prepared with a deeper understanding of the development of scientific theories and the ability to use diverse instructional strategies such as SAC, biology teachers can approach the teaching of evolution and other controversial concepts without a sense of obligation to non-scientific alternatives. Middle school and high school biology students can participate in a SAC, address the diversity of evidence and positions, and be guided to consensus on scientific thinking, which can be respectfully distinguished from non-scientific thinking. Students' personal beliefs are not compromised, but neither is their advancement in scientific knowledge and understanding.

More important, perhaps, is the increased awareness and respect for the processes of scientific ways of knowing. Pre-service teachers, when given the opportunity to learn about the "big picture" of a fundamental scientific theory (such as evolution or quantum physics) can better appreciate how theories are built upon empirical evidence and share that understanding with their students. Use of a structured academic controversy can enhance both the science content knowledge of pre-service teachers, while guiding them into democratic pedagogical practices and the development of a peaceful learning environment.

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# Appendix. Class Agenda for Structured Academic Controversy

## "When Science Meets Religion" Agenda

**I. Overview goals and rules for town meeting**

**II. Premise of text and intent of author**

**III. Summary Findings – by chapter**

a. Groups to summarize current scientific knowledge of each topic

i. Chapter 2: Astronomy and Creation

ii. Chapter 3: Quantum Physics

iii. Chapter 4: Evolution and Continuing Creation

iv. Chapter 5: Genetics, Neuroscience, and Human Nature

b. Present four different typologies

c. Field "clarification" questions from audience

**IV. Forum — Part A**

a. Summary response to Question Set A

Question Set A

1. Which perspective is generally characteristic of public school science, K-12 and higher education?
2. Which perspective was generally characteristic of the discussion through the state of Ohio last year regarding the teaching of evolution?
3. Which perspective/s has the Ohio Department of Education adopted in the (2002) Ohio Academic Content Standards? (Available online at http://www.ode.state.oh.us/academic_content_standards/.)
4. Which perspective is generally characteristic of the *NSES*?

(Be able to offer evidence for your responses.)

**V. Forum – Part B**

a. Summary response to Question Set B

b. Open discussion regarding Question Set B

c. Each spokesperson has right of 2 rebuttal/rejoinders

Question Set B

1. Should multiple perspectives be brought into the classroom? K-12? Higher education?
2. Is there a single best perspective that best meets the needs of a diverse, middle childhood classroom? Consider various kinds of diversity – socioeconomic, ethnic, religious, morality/value-set, racial, intelligences/abilities, maturity, etc.

**VI. Formation of resolution on middle school science**

a. Should there be a predominant typology (perspective) in the 4-9 classroom?

b. Formation of resolution