High School Students’ Perceptions of Evolutionary Theory
[With Implications for Instruction]
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Condensation of article, with emphases added.

Abstract
The subjects for this study were 518 students, enrolled in grades 9-12, from a large high school in the Midwestern United States. Quantitative and qualitative methods were utilized to examine factors involved in subjects’ acceptance of evolutionary theory. A causal-comparative or ex post facto design was employed for the quantitative aspect. The dependent variable was acceptance of evolutionary theory. Independent variables were science locus of control, logical thinking ability, grade level, gender, race/ethnicity, and teacher. In order to answer questions more conducive to qualitative research methods, additional data were collected from semi-structured interviews. Approximately ten percent of the subjects were interviewed. The authors present an examination of perceptions held by high school science students concerning evolutionary theory. This is followed by implications for science instruction. The authors conclude that we need to strive to provide learning opportunities that encourage high school students to find their own “place to stand” between what many perceive to be an “evolution vs. creation” choice. Positioning learners to take that next step is crucial if we are to promote a more adequate understanding of the nature of evolutionary theory and why biologists consider it to be a powerful unifying theme for study in the biological sciences. If we fail to do this, at best we risk students memorizing what they think we want to hear. Worse still, we risk alienating their future study of the biological sciences. Finally, worst of all, we continue to perpetuate a misunderstanding of evolutionary theory among future adults.

If we are to be successful in teaching evolution, we must take into account our students’ worldviews as well as their individual understandings and misconceptions. It is important to know our students their cultures, personal histories, cognitive abilities, religious beliefs, [and] scientific misconceptions. [It is also important] to address directly the likely cultural/religious concerns with evolution and to do so early on so as to break down the barriers that keep many students from hearing what you say. (Smith, 1994, p. 591).

Smith penned these words for a special issue of the Journal of Research in Science Teaching which focused on the “Teaching and Learning of Biological Evolution.” One inference to be drawn from Smith is that, should we fail to account directly for the needs of our target learners, we are destined to develop curriculum materials and instructional plans that fall far short of the level of scientific literacy we wish to engender. Thus, although the standards they set possess scientific integrity, efforts initiated by the American Association for the Advancement of Science (AAAS, 1993) and National Research Council (NRC, 1996) — to accurately characterize the foundational importance of evolutionary theory to the discipline of biology — may not be fully realized. Does the research literature support Smith’s contention? The purpose of this study was to examine students’ perception about evolutionary theory.

Contextual Background for the Study
Cummins, Demastes, and Hafner (1994) point out the relative paucity of research on evolution education. This fact is not as surprising as it may seem given that evolutionary theory is so badly misunderstood by the general public (National Academy of Sciences, 1999). In other words, it is very difficult to comprehensively research that which sometimes gets left out of or is often only integrated into the biology curriculum in a piecemeal fashion (Skoog, Cielen, Jordan, Lariviere, Scharmann, & Scott, 1998). If we are, as a science education community, to do justice with respect to evolution theory, how might we more effectively integrate evolutionary theory within the biology curriculum?

Joseph J. Schwab (1973) offers invaluable insights concerning the proper foci for initiating and/or revising science curricula. Schwab was educated at the University of Chicago (B.S., Physics/English Literature, 1930; Ph.D., Biology, 1939) and performed a post-doctoral fellowship at Teachers College, Columbia University, Schwab, a William Rainey Harper Distinguished Professor of Natural Science and Professor of Education at the University of Chicago (1940-1974), forcefully argued that four commonplaces exist in defensible educational thought in relation to curriculum building: “the learner, the teacher, the milieu, and the subject matter” (pp. 508-509). He further argued that these commonplaces must not just be present but be equal in rank in the initiation of new or the revision of existing curricula “coordination, not superordination-subordination is the proper relation of these four commonplaces” (p. 509).

What happens when we apply Schwab’s “commonplaces” theory to the inclusion of evolution in the biology curriculum? Given the tortuous history of acceptance, or lack thereof, for evolution and the fact that school board
presidents (and consequently public school teachers) remain sensitive to local religious sentiments (Zimmerman, 1991), it is not difficult to note that the cultural or political milieu of the community may quickly become superordinate. In other words, no matter how well versed in the biological sciences teachers may be, how well they may understand their students, or how well they choose appropriate teaching methods, there may not exist an equality of rank among the four curriculum commonplaces. Alternately, despite a prevailing negative cultural community milieu, teachers may present evolutionary theory with a great deal of scientific integrity but do so at the expense of the psychological needs of their students. In this situation, subject matter becomes superordinate to the other three commonplaces. It is not that the other three are missing; however, they are not coordinated well enough with subject matter to be considered of equal rank.

In a similar fashion, one can conceive of a variety of situations in which, despite our best efforts, evolution is not appropriately represented in the biology curriculum. Schwab warns us that such situations will always occur whenever the four commonplaces are not of equal rank. A review of recent research efforts whose focus is evolution education continues to illustrate the explanatory value of Schwab’s “commonplaces” curriculum theory. Let’s consider a few examples [detailed in the article].

Implications for Instruction
When dealing with a potentially volatile topic such as evolutionary theory, teachers should take great care not to alienate students (Smith, 1994; Smith & Scharmann, 1999). An alienated student will not learn. It is evident from this study (and others) that students already possess many different views of evolutionary theory that potentially impede rather than facilitate their acquisition of scientifically literate information. In addition to activities that increase logical reasoning skills (consistent with the Lawson studies), students should be provided with inquiry-based activities (consistent with the “Teacher” curriculum commonplace) that challenge their prior knowledge of evolutionary theory (National Academy of Sciences, 1998; Mead & Scharmann, 1994; Jensen & Finley, 1996). Such activities coupled with accurate conceptual information on evolution (consistent with the “Subject Matter” curriculum commonplace) may enable students to begin to reconstruct their own knowledge of evolutionary theory. This non-alienating approach will include students and give them some ownership in their education while allowing them to begin to question their attitudes about a topic. Such a suggestion is consistent with the “Learner” curriculum commonplace as delineated by Schwab (1973).

Once the topic of evolutionary theory is initiated, activities should be included that encourage students to develop and share their personal perceptions and scientific explanations with classmates (Dagher & BouJaoude, 1997; Scharmann, 1990; Scharmann, 1993). This can be achieved with periodic group discussions in which all participants are allowed to present their views and compare them to both other students’ as well as professional scientists’ views. This approach does not seek, as a learning outcome, to change students’ beliefs; instead, it aims to prepare students for future science courses and future dealings with evolutionary theory. Acquisition of knowledge is not a one step process rather it is long term. During this entire process teachers should keep in mind that they are educating the “whole” student (consistent with the “Milieu” commonplace); consequently, not only are they dealing with students’ prior knowledge they are also dealing with students’ emotional states and community pressures factors that influence everything students do. Therefore, the ultimate goal of high school instruction involving evolutionary theory might be to challenge dualistic views and allow students to bridge their cognitive and social-personal realms including their religious beliefs.

In other words, we need to strive to provide learning opportunities that encourage high school students to find their own ‘place to stand’ between what many of them perceive to be an ‘evolution vs. creation’ choice. This ‘place to stand’ is similar to “positioning the learner for the next step” (Duschl & Gitomer, 1991). Positioning learners to take that next step is crucial if we are to promote a more adequate understanding of the nature of evolutionary theory and why biologists consider it to be a powerful unifying theme for study in the biological sciences. If we fail to do this, at best we risk students memorizing what they think we want to hear. Worse still, we risk alienating their future study of the biological sciences. Finally, worst of all, we continue to perpetuate a public misunderstanding of evolutionary theory among future adults.