EFFECT OF A CURRICULUM Containing Creation Stories on Attitudes about Evolution

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Evolution is frequently described as a cornerstone concept in biology, the thread that connects life forms with one another. It has been suggested (Dobzhansky 1973) that nothing in biology makes sense except in light of evolution and that, without evolution, biology is merely an intellectual form of stamp collecting (Dickerson 1990).

Despite its importance, evolution runs counter to some of the most basic human assumptions about our origins, our place among other creatures, and some of our religious beliefs. A survey of attitudes toward evolution (Gallup 1982) showed Americans to be almost evenly divided in their beliefs: 44% held the view that humans were created by God around 10,000 years ago; 47% supported the idea of evolution; and 9% were undecided. A decade later (Gallup 1993) the percentage of Americans who are strict creationists increased to 47%, while 46% supported evolution, and 7% were undecided. Despite this division of ideas, many scientists and educators have concluded that "only evolution should be taught in science classes because it is the only *scientific* explanation of why the universe is the way it is today" (National Academy of Sciences 1999). Educators feel that if they teach evolution well enough, if they provide enough compelling examples, students will learn and accept the scientific view of evolution through natural selection. The reality, however, does not support this perception. The traditional method of teaching about evolution that begins with Charles Darwin and natural selection and proceeds from there has been largely ineffective (Aguillard 1999). Even after instruction, most students retain their original nonscientific conceptions (Bishop & Anderson 1990; Johnson & Peeples 1987; Lawson & Worsnop 1992; Short 1992). It would appear that the current curriculum model is lacking and that approaches to instruction which utilize findings from educational research are needed (Champagne, Klopfer & Gunstone 1982).

Teaching students what we want them to know is not enough when students already have their own deeply held ideas (Chinn & Brewer 1993). This resistance to conceptual change can be explained within the learning theories of Vygotsky (1934/1987), Driver et al. (1985), and Posner et al. (1982).

Most students come to biology with some ideas about the origin of life, although most of these ideas are nonscientific (Driver et al. 1985). While Jensen and Finley's study (1996) provides evidence that teaching evolution for conceptual change is more effective than the traditional lecture method, their curriculum did not directly address students' preexisting notions about the origin of life. Posner et al. (1982) suggests that consideration of students' existing ideas is important for conceptual change to occur. It is through such deliberation that students compare their existing ideas with new ones and subsequently accommodate, assimilate, or reject these ideas. Without the opportunity to compare their existing ideas with new ones, students may simply reject new ideas outright as unreasonable and, despite instruction, retain their existing nonscientific beliefs.

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It was hypothesized, therefore, that students who participate in an evolution curriculum which contains creation stories construct more scientific attitudes about evolution than biology students who participate in a traditional evolution curriculum. This paper describes a study that investigates the effects of a nontraditional curriculum containing creation stories on student attitudes about evolution. The attitudes of students were assessed based on their answers to a survey administered before instruction, directly after instruction, and at the end of the semester.

Method

The sample for this study consisted of 37 students enrolled in two sections of a mixed-majors General Biology course at a junior college in upstate New York. The students were mostly nonmajors (78%), female (81%), and were ethnically diverse (60% Caucasian, 32% African American, 5% Hispanic, 3% Asian American), reflecting the gender and racial make-up of the school. Of the 37 students who completed the pre-instruction survey, 34 students completed the post-instruction survey.

Table 1 contains the 15-item survey, *Attitudes Toward Evolution*. A 5-point Likert type scale was used with 1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree. Lower values represent a scientific view while higher values represent a nonscientific view.

The *Questionnaire Assessing Belief in Special Creation or Evolution and Related Beliefs* (Lawson & Worsnop 1992) was the basis of the measuring instrument used in this study. These items are designed to identify students' ideas about the origin of life, whether it be scientific or based on nonscientific notions such as vitalism or special creation. Ten of the items (#1-9, #15) were the same as questions included on the Lawson and Worsnop questionnaire. Two of the items were similar (#10, #12) and were altered to reflect examples given in class earlier in the year. Three items were different (#11, #13, #14) than the items included in the Lawson and Worsnop questionnaire. Two of the changes (#11 and #13) reflect questions or comments made by students earlier in the year. One additional change (#14) probed students' sense of the importance of evolution to an understanding of the discipline of biology and their notions about scientific literacy.

Procedure

On the first day of the semester, a 15-item *Attitudes Toward Evolution* survey was administered to ascertain students' existing views about evolution. Three creation stories, Genesis 1:1-30; Genesis 2:1-24 and a Bering Strait Eskimo Creation Myth (MacQuade 1994), were subsequently distributed and students were asked to write a two-page paper in which they compared and contrasted the three stories with one another. During the next class, these papers were used as the basis of a discussion which the instructor facilitated, while refraining from sharing her own views. To further stimulate discussion, students were read a Hopi creation myth (Suzuki & Knudtson 1992) which exposed students to the notion of a female creator. Over the next month students were encouraged to think about their existing ideas and to consider the reasonableness of the scientific creation story: evolution. The walls of the classroom were turned into a time line using an activity from *Microcosmos* (Zook 1992). Fossils and radioactive dating were discussed followed by viewing part of the NOVA video: *The Iceman*. Students, working in groups, considered the questions: "How do antibiotic resistant strains of bacteria arise?" and "How did the human hand arise?" Students read from *The Sixth Extinction* (Leakey 1995) and *The Beak of the Finch* (Weiner 1995). A historical treatment of theories of evolution was conducted including creationism, catastrophism, Lamarckianism, and natural selection. Speciation, the pace of evolution, and evolution of hominids were discussed. At the end of the unit, which lasted four weeks, the 15-item *Attitudes Toward Evolution* survey was administered as a post-test. This same survey was administered on the last day of the semester as a post-post-test.

Results

Table 1 contains the means and standard deviations of student response to each question on the *Attitudes Toward Evolution* survey.

A repeated measures analysis of variance (ANOVA) was used to analyze the data. An ANOVA allows one to identify changes in the score on the *Attitudes Toward Evolution* survey administered to a population over time (pre-instruction, post-instruction, and post-post instruction). Table 2 contains the means and standard deviations of the score on *Attitudes Toward Evolution* survey over time by gender.

Table 1. Student responses to *Attitudes Toward Evolution* survey.

	Pre-Test n=37	Post-Test n=34	Post-Post Test n=34
[1]1. Landforms like the Grand Canyon were created by God and have not changed since then.	X=2.18 SD=1.0	X=2.12 SD=.92	X=2.15 SD=.99
[2]*2. Certain types of living things such as dinosaurs that once lived on Earth no longer exist.	X=3.82 SD=1.0	X=3.68 SD=1.5	X=3.93 SD=1.3
3. Fossils were intentionally put on the Earth to confuse humans.	X=1.35 SD=.49	X=1.38 SD=.49	X=1.41 SD=.50
4. The color of a person's skin depends on whether God favored or punished their ancestors.	X=1.41 SD=.82	X=1.29 SD=.58	X=1.37 SD=.63
5. Genesis is the best account of how the Earth was created and populated with life.	X=2.85 SD=1.1	X=2.59 SD=.99	X=2.81 SD=.96
6. Humans and apes do not share a more common ancestry than humans and dogs.	X=2.65 SD=1.0	X=2.38 SD=1.1	X=2.26 SD=1.0
7. Living organisms are different from nonliving things because they possess some kind of special force or spirit.	X=2.97 SD=1.1	X=2.8 SD=1.1	X=3.04 SD=1.2
8. Human beings are different from nonliving things because they possess a soul.	X=3.2 SD=1.1	X=2.94 SD=1.1	X=3.3 SD=1.0
9. All events in nature occur as part of a predetermined plan.	X=2.76 SD=1.2	X=2.85 SD=1.1	X=2.92 SD=1.0
*10. You share genes for essential life processes with bacteria.	X=3.44 SD=.75	X=3.5 SD=.83	X=3.85 SD=.99
11. Living organisms on Earth may have come from an alien life form.	X=2.5 SD=1.1	X=2.1 SD=.87	X=2.4 SD=1.0
12. It seems reasonable that the universe was created by God.	X=3.5 SD=1.1	X=3.2 SD=1.0	X=3.4 SD=1.0
13. Aliens sometimes land on Earth.	X=3.0 SD=.74	X=2.7 SD=.90	X=2.6 SD=1.0
*14. Evolution should be taught in biology class.	X=3.4 SD=1.0	X=3.5 SD=1.2	X=3.8 SD=1.0
15. All events in human life occur as part of a predetermined master plan.	X=3.0 SD=1.2	X=2.9 SD=1.3	X=2.9 SD=1.3

[1]1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree

[2]Values for items with an * were reversed prior to ANOVA analysis to maintain consistency in direction.

Summarized in Table 3 are the results of the repeated measures ANOVA. Examination of Table 3 indicates no significant interaction between gender and time ($F=1.04$; $df=1,2$; $p>.05$).

Examination of this table also indicates no significant difference for gender ($F=1.19$; $df=1$; $p>0.05$). However, a significance difference in the scores on the *Attitudes Toward Evolution* survey was found for time ($F=3.79$; $df=2,66$; $p<.05$). Further analysis reveals that students gave more scientific responses at the end of the semester than at the beginning of the semester. Shown in Figure 1 is a graph of the means for attitudes toward evolution by time.

Discussion

Science educators are faced with a dilemma. While evolution is described as the seminal biological principle, most biology students hold nonscientific views about the origin of life on Earth, even after formal instruction. The results of two recent Gallup polls indicate that the perception that humans were created by God about 10,000 years ago is common and is becoming more pervasive.

The existence of a multitude of creation stories indicates that humans have a need to explain the world to themselves. Creation stories fulfilled that need before explanations based on scientific evidence were available. Science educators, however, cannot simply tell students the scientific creation story and expect them to accept it without question. Students' existing

Table 2. Mean scores on the *Attitudes Toward Evolution* survey of males and females over time.

		TIME		
		Pre-Test	Post-Test	Post-Post Test
Males	M	38.00	35.57	33.49
	SD	7.52	5.47	5.32
	n	7	7	7
Females	M	38.81	37.18	37.37
	SD	5.73	5.49	4.47
	n	27	27	27
Total	M	38.65	36.85	36.57
	SD	6.02	5.45	4.8
	n	34	34	34

Table 3. Source table for *Attitudes Toward Evolution* study.

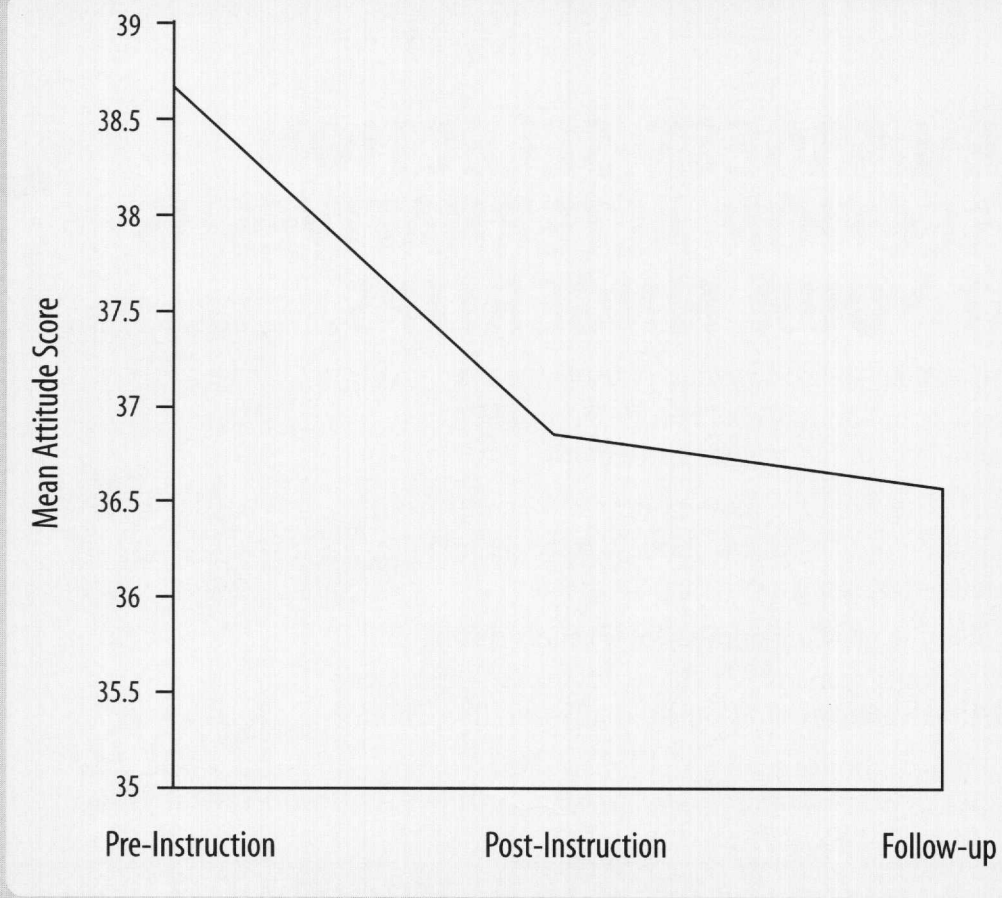
Source	SS	df	MS	F
gender	73.85	1	73.85	1.193
Between (error)	1981.43	66	61.92	
time	102.75	2	51.37	3.786*
gender x time	28.20	2	14.10	1.04
Within (error)	868.51	64	13.57	
Total	3054.74	198	214.81	

*p<.05

ideas influence their readiness to accept alternative explanations.

Our current approach to evolution education is failing. But is the situation hopeless? Do we throw up our hands and say that beliefs about the origin and diversity of life on Earth are so personal and intertwined with religious beliefs that science should not attempt an explanation? Or do we, as educators, "evolve," adapt and change in response to a failing curriculum model and to new understandings of teaching and learning?

Figure 1.



Means of student attitudes toward evolution over time. (Lower values indicate more scientific views about evolution).

It is not sufficient to simply teach the scientific creation story for students to undergo the cognitive shift we call learning. Our students do not come to us as a "blank slate." They have pre-existing ideas which are shaped by their intuitive understandings and their enculturation, although most of these ideas are nonscientific. If students are comfortable with their existing

views, it may be more reasonable for them to reject scientific evidence as flawed, or simply preposterous, rather than undergo a cognitive shift and a rethinking of their beliefs. This may be especially true when their own existing ideas are ignored within the instructional setting.

The study described in this paper provides tentative evidence that a curriculum which includes creation stories is more effective in fostering scientific views about evolution than traditional curricula which lack creation stories. A statistically significant difference in attitudes about evolution was achieved at the end of the course when compared to students' attitudes, regardless of gender, at the beginning of the course.

These results support a conceptual change approach to evolution education. While the teacher is ultimately the agent of scientific enculturation, students should be allowed and encouraged to consider their own existing ideas. Through activities that encourage reflection about these ideas, learners are better able to compare new ideas with old ones and progress through the sequence of rejection, assimilation or accommodation. It is my opinion that the exclusion of discussion of students' existing views about the origin of life from the science classroom has contributed to the failure of traditional evolution education, perhaps even giving students the sense that "a cover-up" exists. Discussion of contrasting creation stories may allow students to critically examine the reasonableness of this explanation, which is based on a belief system and lacks scientific evidence, with the scientific explanation of the origin of life. The findings from this study suggest that such an approach may actually result in students developing more scientific views about evolution.

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WANTED: SCIENCE EDUCATORS

Dr. Bernd Blossey – Director of the Biological Control of Non-indigenous Invasive Plant Species, **Dr. Marianne Krasny** – Department Extension Leader and Associate Professor, and **Linda J. Tompkins** - High School Biology teacher on sabbatical/graduate student, all of the Department of Natural Resources, Cornell University – are seeking teachers from across the continental United States for a project studying the distribution and abundance of insects attacking *Phragmites australis*, and the development of a corresponding student-scientist partnership (SSP).

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Expectations:

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