

## Use of ID Material Unsupported

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### Use of ID Material Unsupported

Most biologists argue that intelligent design (ID) theory, which has recently been judged a pretext for advancing religious belief (see [www.pamd.uscourts.gov/kitzmiller/kitzmiller\\_342.pdf](http://www.pamd.uscourts.gov/kitzmiller/kitzmiller_342.pdf)), has no place in the classroom. Yet Steven D. Verhey proposes in “The Effect of Engaging Prior Learning on Student Attitudes toward Creationism and Evolution” (*BioScience* 55: 996–1003) that allowing ID to be critically discussed in the college classroom may facilitate appreciation of evolution. Verhey tested this proposal by contrasting sections of introductory biology that included or did not include creationist information. He reports that adding creationist materials to the curriculum did enhance attitude change. In an accompanying editorial, “How Can We Help Students Really Understand Evolution?” (*BioScience* 55: 923), Craig E. Nelson lauds these results as “powerful evidence” that introducing ID into the classroom led to “extensive change toward more scientifically viable views.”

I applaud Verhey’s attempt to provide empirical evidence in support of

this novel approach. Unfortunately, his study does not provide a sound basis for Nelson’s enthusiastic endorsement. The design of the study is flawed, as the two groups differed not only in whether ID materials were provided, but also in which text chapters and supplementary proevolution texts were assigned. Moreover, students were asked to state their initial attitudes toward creationism only at the end of term, when their recollections may have been influenced by the experience of taking part in the study.

The most serious problem is with data analysis. While Verhey’s primary finding is that attitude change was greater for the group exposed to creationist information, his measure inexplicably includes change *away* from evolution. Thus this measure cannot be used to determine the effectiveness of this approach in instilling proevolution change, the goal of this study. Verhey did provide data that allow this critical issue to be examined. He reported that 9 students out of 38 in the creationism-plus-evolution group shifted their attitudes toward evolution, compared with 5 students out of 28 in the

evolution-alone group. However, I have been informed that the 5-students datum is in error, and the correct number is 2. Using the correct value, the groups do not differ significantly by Fisher’s exact test ( $p = 0.10$ , two-tailed). A two-tailed test is appropriate here, given that a plausible alternative outcome is that the teaching of ID may instead shift attitudes toward creationism. Nevertheless, even with a one-tailed test, the results remain nonsignificant ( $p = 0.07$ ). Moreover, 3 students in the creationism-plus-evolution group shifted toward creationism; none in the evolution-alone group did. Consequently, Verhey’s report does not provide evidence supporting the introduction of ID into the college classroom as a pedagogical technique to promote acceptance of evolution.

STEPHEN L. BLACK

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### Correction

My article, “The Effect of Engaging Prior Learning on Student Attitudes toward Creationism and Evolution” (*BioScience* 55: 996–1003), included errors in the data reported and in some statistical comparisons. I take full responsibility for these mistakes, which would have been impossible for reviewers or editors to find. Although regrettable, the errors do not change the basic conclusion of my article, which was that students in sections A and B (comparative pedagogy) experienced a greater degree of attitude change with respect to creationism and evolution than did students in sections C and D (evolution-only pedagogy).

I have reexamined the original survey sheets and note here the most important corrections; full details and corrected figures are posted on my Web site at [www.cwu.edu/~verheys/](http://www.cwu.edu/~verheys/). Table 2 and figure 3 contain the primary data regarding changes in attitude. Table 2 included errors relating to sections C and D (evolution-only pedagogy). The correct information for section C is as follows: 12 students did not change attitudes, 5 students changed by less than one CL–AE unit, and 2 students changed by one or more CL–AE units. The correct total number of section C students is thus 19. This is the correct information for section D: 10 students did not change attitudes and 1 student changed by less than one CL–AE unit. The correct total number of section D students is 11, and the total for sections C and D combined is 30. Using the corrected data, one-way between-subjects ANOVA comparing the amount of change in each of the four sections indicates that the differences between the groups is significant ( $F = 3.656$ ,  $p = 0.0169$ ). The published  $p$  value for this test was 0.028.

Counting only change in the rationalist direction, as suggested by Professor Black, it is appropriate to omit the students in sections AB and CD whose initial views precluded further change in that direction. Thus, for sections AB (comparative pedagogy), 9 students changed toward more rationalist views, and 26 students could have changed in that direction but did not; for sections CD, 2 students changed toward more rationalist views, and 25 students could have changed in that direction but did not. Fisher’s exact test yields  $p = 0.059$  (one-tailed),  $p = 0.094$  (two-tailed).

Because figure 2 was constructed using data from table 2, it is inaccurate as published. The difference between sections AB and CD for changes of less than one unit is not significant for the corrected data ( $p = 0.5716$ ,  $\chi^2 = 0.32$ ,  $df = 1$ ). Other comparisons based on figure 2 data yield  $p$  values that are little changed.

As published, figure 3 omitted four students from pooled section AB and one student from pooled section CD. All of these students reported theistic evolution as their before- and after-class attitude. The article states, “None of the 5 students in the other sections whose direction of change could be determined moved toward the nonrationalist end of the spectrum.” The correct number is 2, not 5. A minor error appears in the text on page 1001, where I incorrectly wrote that 8 of 15 preclass CL and YE creationists were in sections A and B. The correct total of CL and YE creationists is 16.

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### Nelson's Response to Black

**B**lack correctly notes that many biologists have argued against teaching creationism in the science classroom. This may be changing. Alberts (2006) states: "I believe that intelligent design should be taught in college science classes.... It is through the careful analysis of why intelligent design is not science that students can perhaps best come to appreciate the nature of science itself" (emphases in original).

Black suggests that my enthusiasm for Verhey's results might not be justified. Verhey compared two pedagogical approaches: one teaching only evolution and the other comparing creationism and evolution. Quite helpfully, Black's letter led to the discovery of several errors, now corrected. Fortunately, the original conclusions remain strongly significant. Black suggests refining these by comparing only changes toward greater acceptance of evolution. Testing these appropriately (i.e., excluding the students who could not have changed toward greater acceptance of evolution) yields a difference that is suggestive but not conclusive ( $p = 0.094$ , two-tailed;  $p = 0.059$ , one-tailed). The immense amount of work with misconceptions in science (below) might make a one-tailed assumption more appropriate. Importantly, all 9 students who shifted toward evolution with comparative pedagogy started in one of the three more conservative positions (positions that reject large parts of evolution), as did only 1 under the evolution-only pedagogy. Thus, with comparative pedagogy, almost 50 percent (9 of 19) of the most religiously conservative students became more accepting of evolution, shifting to a modal position of theistic evolution.

Advocates of theistic evolution typically accept the full array of evolution. Although the data are only suggestive, statistically, for the smaller numbers available for this narrower comparison, the

effect size is quite large and important and is concordant with much research on changing conceptions in science. I still find this notable, if not powerful, evidence that Verhey's pedagogy produced "extensive change toward more scientifically viable views."

Black also suggested that a number of possible confounding variables were present. I agree, but find them quite unlikely to have spuriously led to Verhey's results. Differences in learning outcomes among instructors using similar, traditional pedagogies are small compared with the differences between pedagogies (Hake 1998, Sundberg 2003). Importantly, deeply held prior ideas are typically unaffected by instruction in science that does not directly engage them (Bransford et al. 2003, Duit 2006).

The evolution-specific literature suggests several scientifically rigorous ways to compare evolution with alternative conceptions (e.g., Sinclair and Pendarvis 1998, Nelson 2000, Alters and Nelson 2002, Alters 2005, Scharmann 2005, Wilson 2005).

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### Letters to the Editor

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