Creationist vs. Evolutionary Beliefs: Effects on Learning Biology

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Evolution—To believe it or not to believe? To teach or not to teach the biblical account of creation? This question has not been stilled even though Darwin's *Origin of the Species* was published almost 150 years ago. The theory of evolution has long been fundamental to biological science and is now basic to the newer fields of sociobiology and evolutionary psychology. Yet today, 75 years after John T. Scopes was convicted of breaking the Tennessee law prohibiting the teaching of evolution, conflict between evolution and the biblical account of creation still persists. Randy Moore's series of articles in *The American Biology Teacher* gives a detailed history of the continuing battle (Moore 1998a,b,c; 1999a,b,c). The decision of the Kansas Board of Education to eliminate evolution from the state tests and the decision of the state board in Oklahoma to require all biology texts in Oklahoma schools to state that evolution is "a controversial theory" brought the conflict to the fore once again with articles in popular as well as scientific periodicals. Even foreign news magazines decried the Kansas decision (L'Express, Paris, August 19, 1999).

As yet we do not know how students who enter college biology classes believing in creationism will fare. Thus, data we had collected in connection with a larger study of college learning and teaching may be helpful at least in providing a base for further research (NCRPTAL Report, 1990).

Here we address the following questions:

- How does a biology course affect student beliefs about evolution?
- How do students' beliefs affect their performance in biology?
- How do students believing in creationism differ from other students in motivation, anxiety and learning strategies?

Method

Participants

Seventy five students were enrolled in an introductory biology course in a Midwest community college. Of these, 60 completed a pretest questionnaire on their beliefs about evolution, and 28 of the 60 completed the same questionnaire during the last week of the term. As Table 1 indicates, 19 students dropped
the course and 13 failed to take the posttest. A dispro-
portionate number of these students were those who
did not believe in evolution.

Measures

We designed a four-item questionnaire about stu-
dents' beliefs and attitudes toward creation and ev-
olution.

1. With respect to the theory of evolution I believe:
   (a) Evolution is a theory that is not true.
   (b) Evolution is a scientific theory, not yet
       proven.
   (c) Evolution is a scientific theory supported
       by much evidence.
   (d) Evolution is a fact.

2. The Bible’s account of creation:
   (a) Is true, and evolution theory is false.
   (b) Is supported by more evidence than evolu-
       tion theory is, but which is true is not yet
       definite.
   (c) Is compatible with the theory of evolution
       if the Bible is interpreted properly.

3. Which of these statements closely fits you?
   (a) I do not accept evolution as a proven fact. I
       believe in the literal interpretation of the
       Bible.
   (b) I do not know enough about evolution or the
       Bible to accept either as correct.
   (c) I accept evolution, but I believe in the teaching
      s of the Bible.
   (d) I accept evolution as a proven fact.

4. I would say that my knowledge about evolution is:
   (a) Poor, almost none.
   (b) Below average; I think I know a little.
   (c) Average.
   (d) Above average.
   (e) Very good.

The participants also completed the Motivated
Strategies for Learning Questionnaire (MSLQ)
(Pintrich, Smith, Garcia & McKeachie 1993) at the
beginning of the semester. The MSLQ is a self-report
instrument to assess students’ motivation and learn-
ing strategies. The students rated themselves on a 7-
point scale with 1 as “Not at all true of me” to 7 as
“Very true of me”. We used the MSLQ to compare the
motivation and learning strategies of students differing
in their beliefs about evolution.

Results

I. What were students’ beliefs at the beginning of
the course?

Question 3 provides a reasonable summary of stu-
dent beliefs. Of the 60 students who responded to it,
10 chose (a) “do not accept evolution—believe in
the literal interpretation of the Bible”
22 chose (b) “don’t know enough”
17 chose (c) “accept evolution—believe in the
Teaching of the Bible”
11 chose (d) “evolution a fact”.

II. How did they change?

As Table 1 indicates, changes were toward belief in
evolution. Those students who did not accept evolution
were more likely to drop the course or fail to complete
the posttest than those who believed in evolution.

III. How were beliefs related to achievement?

Table 2 shows the grades received by each group.

As might be expected, creationist students did less
well than students believing in evolution. Nonetheless
they passed the course. The pattern of grades increas-
ing from creationist, through “Don’t know” and
“Religious evolutionists” to “Evolutionists,” is consistent. The same pattern occurs whether pretest or posttest beliefs are used.

IV. How did creationists differ from other students?

As Table 3 indicates, the three steadfast creationists differed from other students on every scale. It was not surprising that in a class in which their basic beliefs were challenged, they began the course with higher motivation for grades and lower interest; they were more anxious, and lower in intrinsic motivation, self-efficacy, and task value. In addition, their scores were low on the learning strategy and thinking scales. They memorized more and thought about ideas less. Even though the N is low, the consistency of results is impressive.

The seven firm evolutionists present a more positive picture—high intrinsic motivation and self-efficacy, and good learning strategies. The six students who moved from non-belief to belief in evolution began the course with high intrinsic interest and task value and less concern about grades.

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**Table 2.**

Mean final grades.

<table>
<thead>
<tr>
<th></th>
<th>No Posttest</th>
<th>Posttest Question #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades: A = 4, B = 3, C = 2, D = 1, E = 0.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posttest #3 items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Do not accept evolution, believe the Bible</td>
<td>2.00</td>
<td>2.88</td>
</tr>
<tr>
<td>(b) Don’t know</td>
<td>2.67</td>
<td></td>
</tr>
<tr>
<td>(c) Accept evolution, and believe in teachings of the Bible</td>
<td>2.88</td>
<td></td>
</tr>
<tr>
<td>(d) Accept evolution as a fact</td>
<td>3.14</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3.**

Means and standard deviations of Motivation and Learning Strategies of groups differing in beliefs about creation and evolution.

<table>
<thead>
<tr>
<th>MSLQ PRETEST</th>
<th>1 (a, a)</th>
<th>2 (b, b)</th>
<th>3 (c, c), (c, d)</th>
<th>4 (a, c), (b, c), (b, d)</th>
<th>5 (d, d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Anxiety</td>
<td>4.22 (.65)</td>
<td>3.33 (2.60)</td>
<td>3.12 (1.68)</td>
<td>3.45 (.91)</td>
<td>3.56 (1.63)</td>
</tr>
<tr>
<td>Extrinsic Motivation</td>
<td>5.42 (1.38)</td>
<td>5.50 (.50)</td>
<td>4.87 (1.40)</td>
<td>4.29 (1.40)</td>
<td>4.86 (.61)</td>
</tr>
<tr>
<td>Intrinsic Motivation</td>
<td>4.00 (.50)</td>
<td>4.67 (72)</td>
<td>5.53 (1.43)</td>
<td>5.96 (.51)</td>
<td>5.96 (.55)</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>5.00 (1.25)</td>
<td>5.87 (.95)</td>
<td>6.05 (1.10)</td>
<td>5.87 (.58)</td>
<td>6.31 (.82)</td>
</tr>
<tr>
<td>Task Value</td>
<td>4.78 (.67)</td>
<td>5.17 (1.44)</td>
<td>5.77 (1.69)</td>
<td>6.39 (.39)</td>
<td>6.38 (.68)</td>
</tr>
<tr>
<td>Critical Thinking</td>
<td>4.33 (.42)</td>
<td>5.13 (1.51)</td>
<td>5.02 (1.28)</td>
<td>4.64 (.84)</td>
<td>5.56 (.56)</td>
</tr>
<tr>
<td>Rehearsal</td>
<td>4.87 (1.01)</td>
<td>6.20 (.87)</td>
<td>5.68 (.58)</td>
<td>4.92 (1.20)</td>
<td>4.94 (1.16)</td>
</tr>
<tr>
<td>Organization</td>
<td>4.53 (.23)</td>
<td>4.53 (.76)</td>
<td>5.70 (1.01)</td>
<td>4.56 (.93)</td>
<td>5.34 (.86)</td>
</tr>
<tr>
<td>Elaboration</td>
<td>4.57 (.38)</td>
<td>5.19 (.50)</td>
<td>5.70 (.62)</td>
<td>5.03 (.92)</td>
<td>5.69 (.27)</td>
</tr>
<tr>
<td>N</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Grade</td>
<td>2.00 (.00)</td>
<td>2.67 (.58)</td>
<td>2.78 (.97)</td>
<td>2.83 (1.47)</td>
<td>3.57 (.79)</td>
</tr>
</tbody>
</table>

* Groups are based on students’ response to Question #3 on pretest and posttest.

Group 1: Firm believers in creation.

Group 2: Those who don’t know enough about evolution and the Bible.

Group 3: Accept both evolution and the Bible (religious evolutionist).

Group 4: Those who changed toward a stronger belief in evolution.

Group 5: Accept evolution as a fact.
Discussion

Our findings are not surprising. Although the sample is small, representing only one class, the consistency of the results for motivation and learning strategies should contribute to a better understanding of some of the differences among students in introductory biology courses. Students entering the course with creationist beliefs must experience cognitive dissonance. Some of them resolved the dissonance by dropping the course. Others avoided some dissonance by not filling out the questionnaire. Even though three creationist students who remained in the course did not change their beliefs, they achieved C grades and on Question #4 believed themselves to have an average understanding of the theory of evolution.

Is this enough? If understanding was the goal, the course was successful. Yet most biologists would probably prefer a more basic change of attitude or belief. Can students who don’t believe in evolution participate as informed citizens on public policy issues involving biology? Will they support funding for biological research?

In his classic paper, “Compliance, identification and internalization: three processes of attitude change,” Kelman (1958) suggests that the effect of favorable attitudes on learning, thinking and behavior depends on the degree to which the attitude simply involves going along with the norms of the group (compliance) or rather represents internalization integrated with other beliefs and values. Probably most teachers would like to move students toward the latter position.

But how can this be accomplished? Clearly motivation is at least an element of the answer. Note that those with religious beliefs shifted toward evolution began the course with more intrinsic motivation and value for the course. Although we don’t have data on changes in motivation, this suggests that stimulating curiosity and emphasizing relevance to future vocational or other uses of biology would be two possible strategies for enhancing belief in evolution at a more fundamental level than mere compliance.

But what about the firm believers in creationism? Is it ethical to attempt to change a belief so fundamental to their religion? What can teachers ethically do? Is it ethical to challenge creationism and attempt to prove its inadequacy? Could one start by providing opportunities for students to observe relevant phenomena and develop their own explanation? Another approach might be to stage a debate between three positions:

1. Creationism.
2. The Bible and evolution are compatible.
3. Evolution is a fact, the Bible is wrong.

Suppose one asked the debaters to defend the position most discrepant from their own belief (a technique known to influence attitude change)? Can students discuss their views with respect for another’s position without fear that a frank discussion will threaten their grade in the course? Can we check students’ ability to listen to one another by asking them to put into their own words (either orally or in writing) what other students have said?

Different teachers will answer these questions in different ways. And, as usual, psychologists conclude with the statement, “More research is needed on the effects of different approaches on changes in beliefs.”

Acknowledgment

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References


