

The Role of Scientific Understanding in College

Student Acceptance of Evolution

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Studies show that approximately one-half of America's public school students miss studying evolution as a biological principle, because the schools do not present it to them (Eglin 1983; Johnson 1985; McCormack 1982). What's more, polls have indicated that a significant number of Americans favor the concept of Biblical creation. (Bible Science Association 1981; Ching 1984; Edwards 1981; Lang 1982). The logical question is: Why have the creationists been so successful in today's society?

In addition to the lack of adequate evolution teaching in public schools, one factor may be the general public's low level of understanding of science. Many of the creationist arguments against evolution deal with applications of the scientific method. These arguments state that evolution is not scientific (Gish 1981; Hevgold 1973; Lang 1983; Roth 1977; Utt 1980). The major issues leading to these assertions are the lack of direct observation (Gish 1977; Lang 1983) and testability or reproducibility (Gish 1977; Lang 1977; Utt 1980). Creation and evolution are viewed as different belief systems by creationists (Bergman 1979; Wolfrum 1975).

At the same time, creationists have put forth considerable effort in presenting an image of scientific credibility. Their literature attempts to promote the scientific nature of creationism (Brown 1983; Clark 1973; Melnick 1983). Moore (1983) explains the situation in this manner:

When contrasting points of view are expressed by individuals, both claiming to be scientists, the public is thoroughly confused. . . . And, to a poorly informed public, the Institute of Creation Research must sound just as reliable and impressive as the National Academy of Sciences or the American Association for the Advancement of Science.

The writings of other creationist organizations, the Bible Science Association, Creation Research Society and Geoscience Research Institute, also contribute to this confusion.

When communities from two opposing camps are perceived to have equally high expertise, trustworthiness alone may contribute to the change of attitude by a subject (Choo 1964). The appearance to the general public of an equality of expertise between creationists and evolutionists, and the tie of society to a Judeo-Christian ideology may help to explain the amazing success of creationists. Many Christians are eager to accept a scientific presentation of creation, in concert with their religious beliefs (Olson 1982).

This study was designed to investigate the relationship of the understanding of science to the acceptance of evolution by college students. To achieve this, the students were surveyed, by way of questionnaire, to measure their understanding of science and acceptance of evolution. The understanding of science for biology majors was measured in relation to grade level, as well. The student well versed in the nature of science should be able to discriminate between science, and, as Kitcher (1982) stated, the "pseudoscience" of creationism.

Methods

Questionnaire design

Twenty statements were designed in a Likert scale format to test student understanding of the nature of science and its methods. The most correct response to each statement received a score of five (5), and least correct response received a score of one (1). Scoring for understanding of science ranged from a

Table 1. Student responses to survey questions pertaining to the understanding of science (biology majors in parentheses). Means range from 5.000 (strongly agree) to 1.000 (strongly disagree).

Question	N	Mean (Range 1–5)	SD
1. The theory of evolution must deny the existence of a creator God.	1670 (904)	2.543 (2.449)	1.345 (1.374)
2. Scientists must limit their investigations to the natural world.	1758 (950)	2.635 (2.580)	1.291 (1.318)
3. Any scientific findings that contradict Biblical Scripture should be discarded.	1745 (940)	2.439 (2.279)	1.280 (1.293)
4. As a result of scientific methods, definite conclusions can be made as to the absolute and ultimate cause behind an event.	1672 (906)	2.754 (2.726)	1.088 (1.107)
5. Science can never reach absolute truth about a particular phenomenon in nature.	1732 (934)	3.124 (3.151)	1.188 (1.113)
6. Science is well prepared to investigate the validity of miracles.	1674 (917)	2.441 (2.398)	1.118 (1.113)
7. A fact in science is a truth which can never be changed.	1738 (936)	2.419 (2.389)	1.285 (1.307)
8. Science is responsible for improving the quality of life for man.	1739 (933)	3.336 (3.447)	1.237 (1.235)
9. The scientist is limited in observing only what he can see with the naked eye.	1732 (947)	2.076 (1.944)	1.453 (1.447)
10. Scientists must be accepting of all findings of their fellow researchers.	1705 (929)	2.521 (2.474)	1.282 (1.319)
11. Scientific experiments must be repeatedly performed in the laboratory to be considered valid.	1651 (899)	3.353 (3.408)	1.290 (1.321)
12. To make any scientific determinations about historic occurrences in nature, there must be direct observations.	1726 (941)	2.682 (2.580)	1.157 (1.185)
13. Random chance means that a particular phenomenon occurs by accident.	1649 (903)	3.047 (3.024)	1.098 (1.116)
14. The initial step of the scientific method is to test a hypothesis.	1686 (914)	2.864 (2.770)	1.433 (1.470)
15. A theory has been substantiated by many scientific facts.	1731 (936)	3.329 (3.462)	1.292 (1.284)
16. A hypothesis is a guess based on a premonition.	1687 (915)	2.793 (2.752)	1.321 (1.347)
17. A scientific law has been shown to be true by repeated observations and experimentation.	1721 (926)	3.577 (3.668)	1.311 (1.312)
18. If an experiment gives results which are contradictory to the hypothesis, then the experiment should be changed.	1748 (944)	2.434 (2.318)	1.292 (1.298)
19. A hypothesis must be capable of being tested in order for it to truly be in the realm of science.	1653 (900)	3.433 (3.481)	1.264 (1.262)
20. A hypothesis which has been validated by an experiment is elevated to the level of theory.	1700 (919)	3.188 (3.217)	1.090 (1.105)

high of 100 to a low 20, indicating high and low understanding, respectively.

Five questions were designed to test student acceptance of evolution. Scoring was achieved through Likert scaling, with values ranging from five (5) to twenty-five (25). A score of 15 indicated neutrality.

Pearson-Product correlation coefficient was performed to determine the relationship between understanding of science versus acceptance of evolution. Tukey's alternate method for analyzing variance was utilized to measure understanding of science with increasing grade level.

Reliability for understanding of science and acceptance of evolution was tested through the internal consistency method. Reliability levels were 0.78 and 0.77, respectively. Significance was determined at the 95 percent confidence level.

Student Population

Undergraduate students enrolled in biology courses at institutions in the West North Central States were the subjects of this study. Thirty-four institutions participated with a student population of 1,812 (Appendix A). Of these, 971 were biology majors. The questionnaires were administered and anonymously completed in the classroom during the 1983 fall term.

Results

Understanding of Science

This survey showed that biology majors had a low understanding of science. A mean score of 61.96/120 was obtained by all students surveyed, as compared

"A large proportion of the lay population understands a theory as nothing more than an educated guess, changing widely upon the whims of researchers in the field."

to 63.01/120 for biology majors (Table 1).

For biology majors, understanding of science rose with increasing grade level (Table 2). Seniors had a significantly greater understanding than freshmen and sophomores. However, even with increased understanding, all grades measured low understanding of science.

Few questions elicited strongly correct responses from students. Characteristics of science well understood were: limitations of scientific observation (#9); Scripture versus science (#3); validation of miracles (#6); absolute truth (#7); scientific law (#17); and experimental methodology (#18).

A significant percentage (20.8) of the students was either undecided or had no response to questions pertaining to the understanding of science scale. This, combined with the low scores obtained, suggests the low understanding of science by college students. Characteristics of science particularly poorly understood were: limitation in the neutrality of science in regards to improving the quality of life (#8); investigating the natural world (#2); scientific experimentation (#11); definitions of a theory (#20); and random chance (#13).

Acceptance of Evolution

College students are primarily neutral towards evolution. Biology majors had a mean score of 15.18, as compared to 14.72 for all students (Table 3). A score of 15 indicated neutrality. Although slightly positive responses were obtained for pro-evolution statements, a statement regarding special creation was scored as neutral. The strongest anti-evolution statement, number 25, had the greatest disagreement. Question 25 was stated such that evolution

Table 2. Understanding of science by biology majors as a function of grade level (ANOVA).

Grade	N	Mean (Range 20–100)	SE _x	Sign.
Freshman	362	62.4254	0.5350	
Sophomore	201	62.5224	0.7116	
Junior	174	64.4368	0.8936	
Senior	168	65.4643	0.8316	1,2
Other	11	67.4545	3.5378	

1. Mean significantly greater than for freshman.
2. Mean significantly greater than for sophomores.

and the Bible were in opposition. The converse of this, question 23, also provoked positive responses, indicating consistency in thought.

Acceptance of evolution was significantly related to understanding of science. This was true for all students surveyed, including biology majors, with correlation coefficients of 0.4461 and 0.4524, respectively (Table 4).

"Science is a tentative discipline, a direct contrast to the absoluteness of religion. As new scientific discoveries are made and models reevaluated in light of new information, modification occurs and a once useful model may be discarded."

Discussion

Creationists are negligent in their critiques of scientific methods and terminology. This appears to stem from a lack of understanding of the very essence of science, that is, the development of predictive models to explain the natural world. Science is a tentative discipline, a direct contrast to the absoluteness of religion. As new scientific discoveries are made and models reevaluated in light of new information, modification occurs and a once useful model

Table 3. Student responses to survey questions pertaining to the acceptance of evolution (biology majors in parentheses). Means range from 5.000 (strongly agree) to 1.000 (strongly disagree).

Question	N	Mean (Range 1–5)	SD
21. Evolution is a valid scientific theory.	1662 (897)	3.115 (3.249)	1.206 (1.212)
22. Man and ape have a common ancestry.	1725 (936)	3.101 (3.198)	1.216 (1.234)
23. Special creation is the means by which God created the earth in its present form.	1661 (901)	3.094 (3.074)	1.124 (1.122)
24. I accept the theory of evolution.	1689 (917)	3.044 (3.165)	1.183 (1.224)
25. The theory of evolution can not be correct, since it disagrees with the Biblical account of creation.	1698 (920)	2.626 (2.505)	1.273 (1.308)

may be discarded.

Depending upon the breadth and degree of evidence in support of a model, the model may be placed at the level of a hypothesis, theory or law. Creationists challenge the placement of evolution as a law or principle because of a misconception of the tentative nature of science (Lang 1977; Moore 1973). Creationists instead opt for the use of the term "models," such as evolution model and creation model (Bergman 1979; Gish 1979; Morris 1974). This infers that evidence supporting both is on an even par and it is up to individuals to choose an explanation that best suits their needs. As long as the populace perceives that both options are equally viable, they will opt for the viewpoint most in agreement with their philosophical or religious beliefs. Olson (1982) stated the following:

For a long time such Christians saw the alternatives as science or faith—choose one. Then came the new generation of "creationists" with the message that Christians can now have their cake and eat it too. The Bible has been right all along: science is now seen to affirm the simple story to which the faithful have been holding for so long.

On the other hand, there is a degradation by creationists of the theoretical explanations of evolutionary mechanisms. A large proportion of the lay population understands a theory as nothing more than an educated guess, changing widely upon the whims of researchers in the field. This was evident in a presidential campaign speech that Reagan made in 1980 to a group of fundamentalist voters.

In addition to teaching evolution in college, extensive effort must be put forth to establish scientific literacy in majors and nonmajors alike. Acceptance of

"... extensive effort must be put forth to establish scientific literacy in majors and nonmajors alike."

evolution is significantly correlated to understanding of science. This emphasis by college teachers will shield the student against the misapplication of science by creationists.

College students have a low understanding of science; even among biology majors, 74 percent of the students had a low or very low understanding of science. Understanding of science for majors did significantly increase with increasing grade level, but even seniors had a relatively low understanding of science. This suggests that the methods college biology teachers are using are not effective in educating students as to the methods and nature of science. Although religion should not be taught in the classroom, a comparison of the scope, methods and goals of science and religion would aid the student in discriminating between science and pseudo-science.

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Table 4. Acceptance of evolution as a function of understanding of science (biology majors in parentheses).

Understanding of Science	Acceptance of Evolution					Row Total
	Very Low	Low	Moderate	High	Very High	
Very Low	283 (119)	219 (98)	180 (79)	47 (26)	10 (7)	739 (329)
Low	155 (73)	137 (67)	247 (137)	103 (69)	54 (39)	696 (385)
Moderate	32 (21)	32 (24)	98 (58)	63 (46)	32 (27)	257 (176)
High	9 (6)	16 (9)	35 (20)	32 (25)	24 (19)	116 (79)
Very high	0 (0)	1 (1)	1 (1)	1 (0)	1 (0)	4 (2)
Column Total	479 (219)	405 (199)	561 (295)	246 (166)	121 (92)	1812 (971)

Correlation Coefficient:
 College Students $r = 0.4464$
 Significance = 0.000
 Biology Majors $r = 0.4524$
 Significance = 0.000

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Appendix A. Institutions participating in the administration of questionnaires to students of the West North Central States.

State	Institution	Number of Students/Majors	
Iowa	Briar Cliff College	45/12	
	Buena Vista College	37/26	
	Central College	17/17	
	Coe College	63/29	
	Grinnell College	18/16	
	Iowa State University	195/109	
	Simpson College	12/9	
	William Penn College	28/22	
	Kansas	Benedictine College	24/24
		Emporia State College	229/41
Kansas Wesleyan University		20/4	
McPherson College		35/28	
Mid-America Nazarene College		25/21	
St. Mary of the Plains College		19/14	
Southwestern College		17/15	
Sterling College		22/22	
Tabor College		12/7	
Minnesota		Bemidji State University	83/3
	Concordia College: Moorhead	149/123	
	Hamline University	61/48	
	Moorhead State University	18/13	
	St. Mary's College	50/44	
Missouri	Avila College	19/15	
	Drury College	43/38	
	School of the Ozarks	16/6	
	University of Missouri: Rolla	28/27	
	University of Missouri: St. Louis	104/4	
Nebraska	Concordia College	38/31	
	Doane College	57/42	
	Hastings College	64/46	
	Nebraska Wesleyan University	36/2	
	Union College	76/53	
South Dakota	Augustana College	121/53	
	Northern State College	29/7	

Future NABT Conventions

Be a part of it all - plan now to be a presenter, committee member or an attendee. 1987 presentation proposals are due by March 15. Forms were published in the January issue of the *American Biology Teacher* and the 1987 Winter issue of *News and Views*.

1987 - Cincinnati's Netherlands Plaza Hotel and the Cincinnati Convention Center - October 14-18 - Theme: "Biology: A Closer Look"

1988 - Chicago's Downtown Marriott - November 16-20 - Theme to be announced, but this is NABT's 50th Anniversary Celebration event

1989 - San Diego, California's Town & Country Hotel - October 24-29