2004

Attitude toward Learning Science of Students in Introductory Geology Courses

Joan Y. Jach
Iowa State University

Cinzia Cervato
Iowa State University, cinzia@iastate.edu

Follow this and additional works at: http://lib.dr.iastate.edu/ge_at_pubs

Part of the Curriculum and Instruction Commons, Educational Assessment, Evaluation, and Research Commons, Educational Methods Commons, and the Science and Mathematics Education Commons

The complete bibliographic information for this item can be found at http://lib.dr.iastate.edu/ge_at_pubs/13. For information on how to cite this item, please visit http://lib.dr.iastate.edu/howtocite.html.

This Article is brought to you for free and open access by the Geological and Atmospheric Sciences at Iowa State University Digital Repository. It has been accepted for inclusion in Geological and Atmospheric Sciences Publications by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
Attitude toward Learning Science of Students in Introductory Geology Courses

Abstract
Research into attitudes in science focuses largely on determining if certain instruction methods affect student attitude and there is a broad range of opinions as to what attitude means and how to study it. We have analyzed the attitude of students enrolled into two introductory geology classes with the goal to test if demographic factors and success in the class play a significant role in determining students attitude towards science and learning science. A pre-test and a post-test Likert-type attitude questionnaire were administered to two introductory Geology classes at Iowa State University during the Autumn semester 2002. Results were analyzed for statistically significant relationships between attitude, gender, major and final grade. The results show that male students, science, math and technology majors, and students who successfully passed the class have a better attitude towards learning science.

Keywords
students, STEM, academic success, attitude, science

Disciplines
Curriculum and Instruction | Educational Assessment, Evaluation, and Research | Educational Methods | Science and Mathematics Education

Comments
This is a manuscript of an article in Teaching Earth Science 29 (2004): 28. Posted with permission.

Rights
© Earth Science Teachers’ Association (ESTA). Reproduced with kind permission of ESTA for use in Iowa State University material only.
ATTITUDE TOWARD LEARNING SCIENCE OF STUDENTS IN INTRODUCTORY GEOLOGY COURSES

Joan Y. Jach Department of Geological Sciences Iowa State University, Ames, IA 50011 jyjach@iastate.edu
Cinzia Cervato Department of Geological Sciences Iowa State University, Ames, IA 50011 cinzia@iastate.edu

Research into attitudes in science focuses largely on determining if certain instruction methods affect student attitude and there is a broad range of opinions as to what attitude means and how to study it. We have analyzed the attitude of students enrolled into two introductory geology classes with the goal to test if demographic factors and success in the class play a significant role in determining students attitude towards science and learning science. A pre-test and a post-test Likert-type attitude questionnaire were administered to two introductory Geology classes at Iowa State University during the Autumn semester 2002. Results were analyzed for statistically significant relationships between attitude, gender, major and final grade. The results show that male students, science, math and technology majors, and students who successfully passed the class have a better attitude towards learning science.

Introduction

Attitude toward a science course is a conglomerate of many components including self-image, peer influence, parental influence, and classroom environment. Attitudes are developed over the course of a person’s life and tend to change with cognitive states.

This study is intended to demonstrate that attitude assessment can be a valuable tool in the science classroom especially when there is an established style of instruction and a desire for improvement. The most convenient way of assessing attitude change is the pre/post test method where a survey is given at the beginning of the instruction segment and at the end of the segment.
There is a difference between the terms “scientific attitude” and “attitude toward science”, which can translate into a difference in the researcher’s goals. Gardner (1975) describes *attitudes towards science* as ‘interest in science’, ‘attitudes towards scientists’, ‘attitudes toward social responsibility in science’ and *scientific attitudes* as ‘open-mindedness’, ‘honesty’, and ‘skepticism’. This study focuses on attitude toward science or the “views and images young people develop about science as a result of the influences and experiences in a variety of different situations” (Gardner, 1975; Ramsden, 1998). Positive change in student attitude can mean positive gains in understanding and science literacy, thus research on attitude assessment and improvement mostly concerns the attitude toward science.

**Methods: Attitude assessment in Geology 100, Iowa State University**

Libarkin’s (2001) research was used as a model for this study done at Iowa State University during the Autumn semester in 2002. Student attitudes were assessed using a Likert-type scale attitude survey at the start of the course and again at the end of the course with the goal of examining any attitude change over the semester. The courses assessed for this study were two sections of a three-credit introductory geology class with no lab or small-group discussions with a teaching assistant outside the classroom (commonly referred to in the US as ‘recitation’) and a total enrollment of about 460 students, taught by the same instructor (Cervato).

**Student makeup**
Typically, students enroll in introductory science courses to meet a science requirement set by the college or university. In the course researched for this study about three-quarters of the students raised their hands when asked on the first day of class who was taking this class to meet a science requirement and about 80% of the 460 students enrolled in the two sections were non-science-math-technology (SMT) majors. The final letter grade (A-D are passing grades, F is the failing grade), gender, and year in school were also recorded for each student and used to determine if there were factors outside of the specific treatment that could affect a student’s attitude. Specifically, gender is one of the most studied variables in attitude toward learning science and it has been shown in many studies that male students tend to have a more positive attitude toward science than female students (Jovanovic and Dreves, 1998; McEneaney and Radeloff, 2000).

The final grade obtained by the students was factored in the analysis to test the hypothesis that it may affect the student attitude at the end of the course. The survey was given a few days before the final exam, but students could keep track of their performance since the grading scale and exam, quiz, and homework scores are accessible to them through the course’s WebCT page.

The attitude survey

The attitude survey consisted of a pre-test (26 questions) and a post-test (31 questions). The post-test included five additional questions on peer and familial influences (Table 1). The ability of a student to cope with the different demands of post-secondary science classes may factor into their attitude toward
science, and this ability to cope may have developed in high school. For this reason, a question was added on the post-test asking how many science classes the respondent took during high school.

The 26 questions of the survey were divided into three groups based on what they specifically addressed: Attitude toward Learning Science (ALS - 7 questions), Attitude toward Science (AS - 5 questions), and Conception of Science (CS - 14 questions). Dividing attitude into distinctive scales can give a researcher the ability to specifically determine how attitudes are formed and how they change. Sources for the survey items are given in Libarkin (2001).

Content validity of the original survey (Libarkin, 2001) was established by asking faculty to comment on the relevance of each test item and by testing undergraduate and graduate students as a control group. Typically, a control group is a randomly selected group of participants from the original test population. The term “control group” as used in this study refers to a specific population chosen for their assumed positive attitude to science in each scale of the survey. For comparison purposes, the control group of the University of Arizona’s study was chosen (Libarkin, 2001)

Results

Acceptable student scores on the attitude scales are set at two standard deviations below the control group mean. Thus, for students to be considered as having a positive attitude, they must score at or above 0.81 on the ALS scale, 0.66 on the AS scale, and 0.60 on the CS scale. This ensures that all variability associated with testing individuals is accounted for (Libarkin, 2001).
All attitude scales show improvement from pre- to post-test. Attitude means reported for the post-test show that the students’ attitudes are not acceptable based upon the standard deviations set by Libarkin (2001).

SMT majors have overall a more positive attitude than non-SMT majors on all scales. This is true both for pre-test and post-test. Their attitude toward learning science improved at the end of course, while their attitude towards science slightly decreased. Pre- and post-test scores do not vary substantially in non-SMT majors.

To test the hypothesis that success in class and positive attitude are related (i.e. students who had more positive attitudes received a higher final grade or students who had higher final grades displayed a more positive attitude at the end of the semester), the students were divided into groups based on their final grades with the line between successful/unsuccessful being moved to encompasses fewer and fewer students in the successful group. This was done to even out the sample sizes for analysis and to determine if, as the final grade improved, attitude improved as well. The terms “successful” or “unsuccessful” are useful in this study when considering groups of students and their final grades, but do not consider actual learning or retention of material.

Unsuccessful students showed no significant difference between their pre- and post-test scores only when D+ to F was considered unsuccessful. There was a significant increase in the students’ ALS from pre- to post-test for all but the D+ to F unsuccessful students. On the other hand, the students who were successful had a significant increase in their ALS in all group divisions and a
significant decrease in their AS for all except the A to B group. The change in CS was not significant in any of the successful groups. The more successful the students were, the more of their attitude scales showed a significantly positive result. This could also be a result of student views on what grade they consider successful and what grade they consider unsuccessful. The D+ to F category of unsuccessful had no significantly positive attitudes but contains the university approved passing grade of D+. This could mean that, even though the student received a passing grade, the grade was considered as unsuccessful by the student. More likely is that most students view a successful grade differently to the university because of the expected easiness of an introductory class.

These results suggest that students who are successful in the class may have more positive attitudes toward learning science, which may help them in the learning process.

The students’ class rank did not show any significant results when compared with their attitude.

Based on previous studies found in the literature (e.g., McEneaney and Radeloff, 2000) and on results from questions added to the post-test about peer and family influence, we had expected male students to have a more positive attitude than female students in all scales. A question on the post-test revealed that male students from the student population had taken more science classes in high school than female students (Fig. 2). There were about 10% more male students than female students who took 6 to 9 science classes in high school (17.7% male and 7.9% female) and about 4% more male students than female
students who took more than 9 science classes in high school (6.2% male and 2.0% female). Also, when asked if the student would do well if they decided to major in science, 17% more male students than female students replied “yes” (57.0% male and 39.4% female). As for family influence, the results indicated that while neither male nor female students had a high attendance at science fairs and museums (4.5% for males and 4.1% for females in the category of “quite often”), the male students had 4% more “occasional” attendance than the female students to these types of events (34.2% male and 30.6% female).

Results from the Post-test questions supported the hypothesis that male students had more previous experiences in science and prior positive attitudes that would predispose them to doing better in a post-high school setting.

The results showed that male students had a significantly better attitude toward learning science in both pre- and post-test scores. Female students showed a more positive attitude toward science but not at a statistically significant level. The attitude toward learning science improved in the post-test in both groups, while the attitude towards science and conception of science scores decreased slightly or remained constant in both groups. Male students may be more positive towards learning science from the onset because of past experiences (e.g., encouragement from family and teachers and competition among peers for high scores in science and math, McEneaney and Radeloff, 2000). The increased ALS score in the post-test scores of both groups possibly suggests that the teaching style and/or classroom environment made the students like the class and encouraged them to learn. These factors may not
have affected the attitude towards science and the conception of science as strongly because these attitudes encompass broader areas including societal opinions, ethics, and religion.

The SMT students had significantly more positive scores than the non-SMT students for the ALS and CS on the pre-test. The SMT students also had a higher ALS and CS for the Post-test but it was not statistically significant. Both groups show an improved attitude toward learning science at the end of the course, while AS and CS scores slightly decreased. These results were expected since the SMT majors would probably have had previous experiences with science that predisposed them to a more positive attitude toward learning science and a more positive conception of science.

The students who successfully passed the class showed a significant increase in their ALS, which could suggest that their attitude was positively influenced by the expectation of a good grade in the class. None of the tests run indicated a difference between freshmen and second through fourth year students.

**Conclusions**

From this study it can be concluded that there is a relationship between attitude toward learning science and gender, success in the class, and major. Overall male students, successful students, and SMT majors have a more positive attitude toward learning science. The relationship between these factors and the attitude toward science and the conception of science is more ambiguous. There seems to be no relationship between the year in school,
freshman through senior, and attitude but these results are still unclear because of sample size. Overall students showed a more positive attitude toward learning science at the end of the course. While exogenous variables such as gender, socioeconomic status, and family mobility are not under the direct influence of the school or instructor (Haladyna, Olsen, and Shaughnessy, 1982), a teaching environment that attempts to actively engage students and involve them in the learning process such as the one used in the classes surveyed for this study, can improve student attitudes.

Acknowledgments

We wish to thank Moses Langley and ISU Statistical Lab assistants for their assistance with the statistical analyses, and the students in Geology 100 (Autumn 2002) for allowing us to test their attitude towards science. Partial support for this study was provided by the U.S. National Science Foundation’s Course, Curriculum and Laboratory Improvement program under grants DUE-0228491 and DUE-0231246.

References


Figure 1. Means of the pre-test and post-test scores for the student group from this study (N=221), of the Iowa State University control group (N=27) and the University of Arizona control group (N=31). No standard deviation was available for the University of Arizona control group (Libarkin, 2001).
Figure 2. Number of high school classes that the surveyed students declared to have taken.
Table 1. Attitude survey used in the Autumn 2002 Geology 100 course. Questions 1-26 from Libarkin (2001); questions 27-31 adapted from Gogolin and Swartz (1992).

1. I like to read about new scientific discoveries.
2. I like learning about the Earth and how it works.
3. I often wonder why the Earth looks the way it does.
4. I like science because it challenges me.
5. I think science is interesting and would like to learn more.
6. Science classes are boring.
7. I like to talk about interesting classes with my friends.
8. Nothing interesting can be learned from rocks.
9. Geologic discoveries made today are important for the future.
10. Geologists are not as scientific as other scientists.
11. I think that science has done more harm than good.
12. People with poor social skills tend to become scientists.
13. Scientific beliefs do not change over time.
14. Scientists believe that we will one day know everything there is to know about the universe.
15. Scientists will accept scientific information even if test results are now consistent.
16. The evidence for scientific information does not have to be repeatable.
17. The laws, theories, and concepts of all areas of science are not connected.
18. The truth of all scientific knowledge is beyond question.
19. When scientific investigations are done correctly, scientists gather information that will not change in future years.
20. When scientists classify something in nature, they are classifying nature this way because that is the way nature is; any other way would be incorrect.
21. Even when scientific investigations are done correctly, the information that scientists discover may change in the future.
22. The laws, theories, and concepts of all areas of science are related.
23. Scientific laws, theories, and concepts are tested against reliable observations.
24. Scientists classify nature through schemes which were originally created by another scientist; there could be other ways to classify nature.
25. Scientists reject the idea that we will one day know everything about the universe.
26. Today’s scientific laws, theories, and concepts may have to be changed in the face of new evidence.
27. How many science classes did you take during high school? A. 0-3 B. 3-6 C. 6-9 D. 9 or more
28. Were there science labs in your high school? A. Yes B. No
29. How many college level science classes have you taken? A. 0-3 B. 3-6 C. 6-9 D. 9 or more
30. Would you do well in science if you tried to major in it? A. Yes B. No
31. Did your family attend things such as science fairs or science museums when you were growing up? A. Never B. Rarely C. Occasionally D. Quite often