Student Attitudes Toward Science: Majors and Non-majors

Katherine Moynihan, PhD

Department of Cell and Developmental Biology and Cardiovascular Medicine, Vanderbilt University, Nashville, TN 37232

Context & Questions

My main interests for this project were the scientific literacy and attitude toward science in two undergraduate student populations: science majors and non-science majors. Both groups are required to take different introductory science courses, either to fulfill the science requirement or as preparation for their concentration in science. I was interested in their level of scientific literacy and attitude toward science before and after they are exposed to the classroom designed for their specific classification. I was interested to see if the two groups show a similar trajectory after the class – both improving their scientific literacy, as well as increasing their respect for the scientific field.

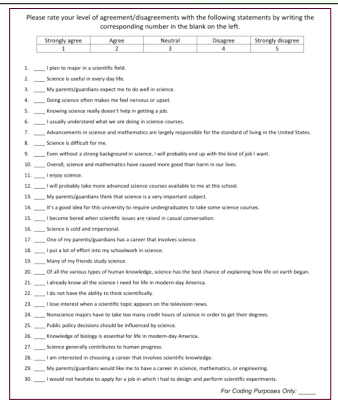
Students who are encouraged in science and labeled as "good" in science appear to be less intimidated by it, while those students who are not encouraged in science or struggle with science sometimes view science as difficult and not applicable to their lives. Instructors with deeper and more accurate understandings of students' varying attitudes toward science are well positioned to be effective teachers. This is true not only in biology, but in other scientific and technical fields (math, physics, engineering, etc), so the results of this study have the potential for broad interest.

Resources & Obstacles

There were many possible resources and allies for this project, including: Steve Baskauf, Denise Due-Goodwin, and Carl Johnson (access to introductory science courses); David Bader (IRB sponsor); Ann Kindfield (scientific literacy assessment). Additionally, the previous collaborative work between Ann Kindfield and those instructors in the Biological Science department (including Steve and Denise) will assist me in the completion of this project. My own inexperience with this type of research – controlling for variables, setting up the survey/literacy exam in an effective way, making sure the survey doesn't take up very much class time, but that it is thorough – could have presented some difficulties, but with the help of those resources listed above, I am confident that the assessments went smoothly. Unfortunately, with time constraints, it was not possible to include the scientific literacy assessment part of the study and I reduced the experimental design to simply assessing attitude via questionnaire.

Ethical Considerations

I used informed consent in the course of this project, allowing students to opt-out if they so chose. The opt-out process could have occurred during the assessment, or with later contact, either via email, face to face interaction, or in writing. Additionally, to protect student privacy, I will used ID numbers to match surveys to the literacy test scores, thus all data was de-identified. I also ensured that the students were aware that participation and scoring in the project had no effect on their class assessment. This project has IRB approval.



Please rate your level of agreement/disagreements with the following statements by writing the corresponding number in the blank on the left.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	2	3	4	5

1. ____ I plan to major in a scientific field.
2. ____ Science is useful in every day life.
3. ____ My parents/guardians expect me to do well in science.
4. ____ Doing science often makes me feel nervous or upset.
5. ____ Knowing science really doesn't help in getting a job.
6. ____ I usually understand what we are doing in science courses.
7. ____ Advancements in science and mathematics are largely responsible for the standard of living in the United States.
8. ____ Science is difficult for me.
9. ____ Even without a strong background in science, I will probably end up with the kind of job I want.
10. ____ Overall, science and mathematics have caused more good than harm in our lives.
11. ____ I enjoy science.
12. ____ I will probably take more advanced science courses available to me at this school.
13. ____ My parents/guardians think that science is a very important subject.
14. ____ It's a good idea for this university to require undergraduates to take some science courses.
15. ____ I become bored when scientific issues are raised in casual conversation.
16. ____ Science is cold and impersonal.
17. ____ One of my parents/guardians has a career that involves science.
18. ____ I put a lot of effort into my schoolwork in science.
19. ____ Many of my friends study science.
20. ____ Of all the various types of human knowledge, science has the best chance of explaining how life on earth began.
21. ____ I already know all the science I need for life in modern-day America.
22. ____ I do not have the ability to think scientifically.
23. ____ I lose interest when a scientific topic appears on the television news.
24. ____ Nonscience majors have to take too many credit hours of science in order to get their degrees.
25. ____ Public policy decisions should be influenced by science.
26. ____ Knowledge of biology is essential for life in modern-day America.
27. ____ Science generally contributes to human progress.
28. ____ I am interested in choosing a career that involves scientific knowledge.
29. ____ My parents/guardians would like me to have a career in science, mathematics, or engineering.
30. ____ I would not hesitate to apply for a job in which I had to design and perform scientific experiments.

For Coding Purposes Only: _____

Figure 1.
Attitude Assessment Tool

Gathering Evidence

I used a science attitude survey (compiled from Sundberg, Dini, & Li, 1994, and Columbia University's Summer Research Program for Science Teachers study [http://www.ncrrsepa.org/eval_non_funded.jsp?grant_id=129]) together as a pre- and post-course assessment. These assessments were administered at the beginning and end of introductory level science courses in Fall 2009, assessing those students enrolled in the lab section of BSCI110A, an introductory science course for majors, and BSCI105, an introductory course fulfilling the science lab requirement for nonmajors. Due to the large lecture format of each course, the lab environment provides a more manageable sampling size and Steve Baskauf and Denise Due-Goodwin, the coordinators of these courses, facilitated my access to these settings. The attitude assessments were to provide insight into the background of science and nonscience students and how their attitudes changes during a course structured for one type of student. These data are both qualitative and quantitative, as well as direct and indirect. The attitude surveys will be scored by averages along the spectrum of agreement with each statement, with statistical analysis to determine significant differences. From these sources of evidence, I expected to learn how the influence of stereotyping (oneself and by others) has on interest, intimidation, and motivation in science.

The following procedure applies to all students in all lab sections such that the course instructors (Baskauf/Due-Goodwin) did not know who has consented to participate in the study until after final grades were submitted. All individuals enrolled in BSCI 111/105 were free to consent (or not) to being included in the research study. Only the results of consenting students' pre- and post-tests were used for research purposes. This study took place at the beginning and end of the fall 2009 semester. At beginning of the first lab session I explained the study and distributed the informational handout and consent form. I administered the pre-test to all students, and then collected consent forms and pre-tests and all materials were taken by me to my laboratory. I then made a code key, assigned codes, and removed student names from tests. These consent forms and code key were placed in a sealed envelope with my signature across the seal and these envelopes stored in a locked file cabinet. Finally, I sorted tests according to consent status and all de-identified pre-tests will be available for instructional (not grading) purposes; de-identified consenting students' pre-tests will be sorted out and available for analysis. During the last lab session I administered post-test to all students in the same manner. In my lab, I retrieved the code key from sealed envelopes, added codes to post-tests, and removed student names. All de-identified post-tests will be available for instructional (not grading) purposes; de-identified consenting students' post-tests will be sorted out and available for analysis. After both pre and post-tests were coded, the master code sheet linking student names with the data was destroyed to further protect student confidentiality.

Figure 2
Comparing the data sets with the Student's T-test

T-test, p-values

NM1:NM2	Question	M1:M2
0.5396	1	0.0573
0.8830	2	0.0570
0.3736	3	0.6090
0.1812	4	0.3255
0.1403	5	0.0940
0.4099	6	0.0515
0.5961	7	0.4877
0.2086	8	0.0123
0.9010	9	0.1448
0.3575	10	0.2093
0.2895	11	0.2794
0.2282	12	0.0008
0.8434	13	0.8919
0.4504	14	0.1135
0.4026	15	0.6648
1.0000	16	0.0008
0.2974	17	0.3815
0.3471	18	0.2408
0.3823	19	0.8672
0.8159	20	0.0702
0.0540	21	0.0083
0.6654	22	0.7083
1.0000	23	0.6090
0.3090	24	0.6990
0.5416	25	0.2608
0.1410	26	0.0243
0.3074	27	0.0864
0.5416	28	0.0123
0.0752	29	0.6406
0.6211	30	0.0030

T-test, p-value

NM1:M1	Question	NM2:M2
0.00008	1	0.00000
0.00000	2	0.10990
0.00008	3	0.03120
0.72497	4	0.78782
0.00008	5	0.00288
0.01118	6	0.07429
0.20221	7	0.19534
0.01188	8	0.82008
0.00008	9	0.00000
0.72874	10	0.45694
0.00008	11	0.00024
0.00008	12	0.00000
0.00008	13	0.00092
0.00298	14	0.07550
0.01248	15	0.05716
0.46280	16	0.12556
0.00108	17	0.02795
0.00048	18	0.03321
0.06840	19	0.52630
0.27198	20	0.88850
0.00048	21	0.12948
0.30322	22	0.42458
0.09794	23	0.16876
0.13471	24	0.08768
0.30968	25	0.61467
0.35870	26	0.05432
0.00038	27	0.12391
0.00008	28	0.00008
0.00008	29	0.00000
0.00008	30	0.00068

NM1:NM2
Nonmajors Week 1 vs. Nonmajors Week 14

M1:M2
Majors Week 1 vs. Majors Week 14

NM1:M1
Nonmajors Week 1 vs. Majors Week 1

NM2:M2
Nonmajors Week 14 vs. Majors Week 14

*Nonmajors showed NO significant changes in answering the attitude assessment from the beginning to the end of the semester. (see p-values)

Findings

Figure 3
Nonmajors Week 1 vs. Majors Week 1

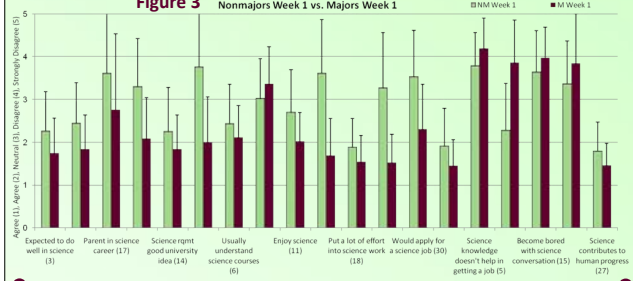
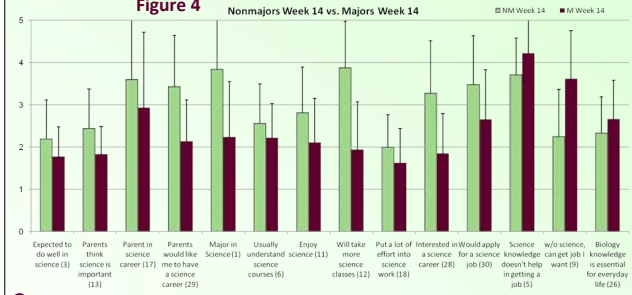


Figure 4
Nonmajors Week 14 vs. Majors Week 14



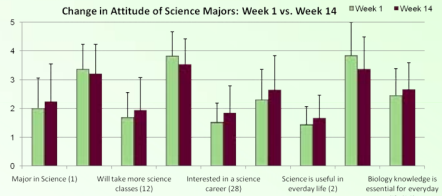
Data

- Differences in parental background (#3, 13, 17, 29) differ consistently between Majors and Nonmajors at both time points. These differences indicate more emphasis on science with Majors' parents
- Academic attitude toward science (#14, 1, 6, 8, 11, 12, 18) differs as one would expect between Majors and Nonmajors. Majors have more interest in science and science classes and find the subject easier.
- At the end of semester time point, there was no longer a significant difference between Majors and Nonmajors concerning the requirement of science class at a university (#14) or whether science was hard for them (#8)
- Future interest in a science job differed as expected (#28, 30, 5, 9) between Majors and Nonmajors at both time points.
- The "science in everyday life" category showed an interesting trend between Majors and Nonmajors and between the 2 time points.
  - At the beginning of the semester, Majors demonstrated more appreciation for science in everyday life than Nonmajors (#2, 15, 21, 27).
  - However, at the end of semester, there was no longer a significant difference between Majors and Nonmajors in any of these questions and Majors were NOT in as much agreement that biology knowledge is essential for everyday life (#26) compared to Nonmajors.

However, Majors showed several shifts between the two time points:

- Less likely to major in science (#1)
- See science as hard for them (#8)
- Less likely to take more science classes (#12)
- See science as colder/more impersonal (#16)
- Less interested in a science career (#28)
- Less likely to apply for a science job (#30)
- See science as less useful in everyday and feel more like they know all necessary science for normal life (#2, #21)
- Less convinced that biology knowledge is essential for everyday life (#26) *Majors were less convinced than Nonmajors at this time point.

Figure 5



Conclusions

✓Majors and Nonmajors showed expected differences in attitudes toward science and science background.

✓Nonmajors did not demonstrate any significant shifts in science attitude after the duration of the introductory science course geared toward their interest.

✓Majors showed declining interest in science and science careers after the duration of the introductory science course geared toward their interest.

✓This gives credence to the idea of using introductory science courses for potential majors as a "weeding out" process.