AC 2011-161: GK-12 ENGINEERING FELLOWS CHANGE STUDENT PERCEPTIONS; SCIENCE FELLOWS, NOT SO MUCH

Jed S. Lyons, University of South Carolina

Jed Lyons is a Professor of Mechanical Engineering and the Faculty Director of the Center for Teaching Excellence at the University of South Carolina. His passion is engaging K-12 students, undergraduates, graduate students and faculty in inquiry- and design-oriented learning activities.

GK-12 Engineering Fellows Changed Student Perceptions; Science Fellows, Not So Much

Abstract

The broad objective of this research was to investigate middle school students' attitudes towards, and perceptions of, engineering and science. Additionally, the research investigated what impact, if any, long-term school-based collaboration with graduate level students from STEM disciplines had on middle school student attitudes and perceptions of engineering and science. To capture student attitudes, two surveys were designed. The first assessed student attitudes towards, and perceptions of, engineering while the second assessed attitudes towards, and perceptions of, science. Surveys were administered to middle school students in science classrooms taking part in a NSF-funded Graduate STEM Fellowship in K-12 Education program. In this program graduate students in engineering or science (Fellows) worked one-two days a week in middle school science classrooms, enhancing science education through inquiry and design projects that support state education standards. Students in classrooms with engineering graduate students were given the engineering survey; students in classrooms with science graduate students were given the science survey. In both cases, pre-surveys were administered to the middle school students before the graduate student's first visit to the classroom and post-surveys were administered at the end of the school year. Approximately 1000 pre-post surveys could be matched for analysis in this study. The findings suggest that students with engineering Fellows showed significant pre to post change in their attitudes towards engineering and perceptions of engineers. Conversely, students with science Fellows did not exhibit significant pre to post change in their perceptions of scientists or attitudes towards scientists. This paper discusses the differences and similarities in how the middle school students reacted to their interactions with engineering and science GK-12 Fellows.

Introduction

The National Science Foundation's Graduate STEM Fellows in K-12 Education (GK-12) program was established in 1999 and supports fellowships and training for graduate students in science, technology, engineering, and mathematics (STEM). Through interactions with teachers and students, the program is designed for graduate level students from STEM disciplines, known as GK-12 Fellows (Fellows), to improve their communication and teaching skills while enriching STEM content and instruction in K-12 schools. Through about 300 projects in more than 140 different universities throughout the United States and Puerto Rico[1], thousands of graduate students majoring in engineering, science, mathematics and other technology-related majors have interacted with hundreds of thousands of K-12 students. The characteristics and focus of GK-12 projects vary by site; however most follow one of two operational designs[2]. Some projects use an "Exposition Model" that has Fellows completing presentations in many schools or districts over the course of a year. Other projects follow a "Classroom Immersion Model" that places Fellows into the classrooms of one or two teachers so that the Fellow can work directly with teachers and students over an extended period of time. Investigating the impact that different GK-12 programs have had on graduate students and K-12 teachers and students is therefore of interest to the academic community. This study focused on one GK-12 project that followed a Classroom Immersion model.

Much of what has been written about GK-12 programs describes the activities of Fellows[3-15]. Most of the literature that includes assessment - or research-based results has focused on how the GK-12 program impacted graduate students[16-27] and teachers[28-32]. Few studies investigated how K-12 students were affected by involvement in GK-12 programs[33-39]. Preliminary research focused on students involved in GK-12 programs reveals the potential of such programs to positively impact students. For example, a previous study by Thompson[28] highlighted how minority students' perceptions and understandings of engineering were enhanced as a result of program participation. However, this study involved a small student sample size and little other available research on students involved in such programs exists. This research discussed in this paper sought to address this shortcoming by studying a larger audience of GK-12 student participants and attempting to determine if previously reported findings were the influenced by the project design or discipline of the Fellows. The study reported here contributes to our understanding of the impact that GK-12 programs can have on the K-12 students.

Many of the GK-12 projects have been themed towards specific disciplines (e.g. marine science, mathematics or engineering). While the literature clearly indicates the positive effects of GK-12 programs on K-12 students, it is difficult to make comparisons across studies and investigate the effects of specific variables, such as the grade level (elementary, middle or high school), the design of the GK-12 program, or the major of the GK-12 Fellow. For the project involved in this study, GK-12 Fellows were recruited from both science and engineering disciplines, but all were engaged in middle school science classrooms. All had the common goal of implementing inquiry-based, hands-on activities for the students. This included efforts to explicitly connect the Fellow's research and disciplinary content to classroom instructional activities. The types of Fellow activities have been previously described (references to be added in final paper). The study reported in this paper investigated if the GK-12 Fellows degree discipline (engineering or science) was a variable that influenced student perceptions and/or attitudes towards engineering and science.

Study Design

To capture student attitudes, two surveys were designed (see Appendix A). The first assessed student perceptions of, and attitudes towards, engineering while the second assessed perceptions of, and attitudes towards, science. The development of these surveys has been previously described in the context of an investigation of how student gender affects attitudes towards engineering (reference to be added in final paper). The wording of individual items was identical on both surveys, except engineers were the subject of one survey and scientists the subject of the other. For example, on the Engineer in Science Class (EISC) survey, students were asked to rate their agreement with the statement "Engineers make people's lives better." The parallel statement on the Scientist in Science Class (SISC) survey was "Scientists make people's lives better." Sixteen questions on each survey asked students about the characteristics of engineers or scientists, three questions asked about their personal attitudes towards engineering and science, and one question asked the student if she or he would like an engineer (or scientist) to help teach in their science classroom. This last question also asked "why or why not," which invited a free response.

The GK-12 program that is associated with this study provides fellowships to graduate students in engineering and in science to work one or two days a week in middle school science

classrooms, enhancing science education through inquiry and design projects that support state education standards. Surveys were administered to sixth, seventh and eight grade students who attended public schools in or near a metropolitan area in the Southeastern United States with a population of about 350,000. Two-thirds of these students had a GK-12 Fellow majoring in Engineering (Biomedical, Chemical, Computer, and Mechanical) and one-third had a Fellow majoring in Science (Geological Sciences, Marine Science, Biomedical Science, and Biology).

All of the Fellows, regardless of major, worked to implement inquiry-based student-performed activities that addressed state science standards. However, the way that the Fellows presented themselves and the way that they discussed the student activities differed. Each Fellow made an introductory presentation to the students about themselves, their research, and their profession. Each Fellow wore a badge daily with their name and discipline (e.g. Chris Doe, Chemical Engineer). When conducting activities with the students, each Fellow made explicit connections between the middle school science content and their discipline, saying things like "You know, an engineer would use an understanding of waves to help design buildings that don't fall down in earthquakes." In these ways, students with engineers or scientists in their classrooms received different messages over the course of the academic year.

To investigate the effects of these messages, students in classrooms where engineering graduate students worded were given the EISC survey; students in classrooms with science graduate students were given the SISC survey. In both cases, the pre-surveys were administered to the middle school students by the classroom teacher before the GK-12 Fellow's first visit to the classroom. A total of thirty-two classes were given the EISC survey and twenty-eight the SISC survey. Parental consent forms were distributed and collected, enabling an analysis of a total of 1008 surveys. Of these, 651 were engineer in the classroom surveys, and 357 were scientist in the class surveys.

Statistical Analysis

In each survey, students rated 16 belief statements based on a five-point scale: *strongly disagree* (1)*; disagree* (2); *not sure* (3); *agree* (4); and, *strongly agree* (5). Scoring was reversed for three negatively worded statements. Two non-evaluative statements were eliminated from the analysis. The student's attitude score was obtained by summing across the 14 item scores. A one-way analysis of variance (ANOVA) procedure was conducted using the SAS GLM procedure to determine if students expressed an overall significant difference in their beliefs towards scientists and engineers after Fellows served as teacher-partners in the science classrooms.

Additionally, two multiple-choice type questions elicited information regarding students' attitude toward science and engineering and a third item asked students to indicate the "amount" of science they learned during the year. One open-ended question asked if students enjoyed having a scientist or an engineer in the classroom; a follow-up question asked students to provide a reason for their response. These items were examined and analyzed qualitatively.

Findings

Frequency responses to the sixteen Likert scale questions are shown in Figure 1. ANOVA results for the engineering pre-post procedure were statistically significant, $F(1,1130) = 32.88$, $p = .0001$. Means (with standard deviations in parentheses) for the pre and post engineering

surveys were 53.83 (5.67) and 55.78 (5.77), respectively. Although students' understandings of engineering were fairly accurate on the pre-survey, the possible range was 14 to 60 points on the survey, students ended with more “accurate” understandings of the characteristics of an engineer. These mean score changes also indicate that student beliefs about engineers tended to become more “positive,” as a group, from the beginning to the end of the school year. This change in beliefs regarding engineers may be attributable to the inclusion of an Engineering Fellow in the science classroom.

ANOVA results for the science pre-post procedure were not statistically significant $F(1,632) = 2.60$, $p = .1075$ indicating no substantial change in the students’ understandings of science from the beginning to the end of the school year. The means and standard deviations for pre and post science surveys were 54.48 (5.71) and 55.23 (6.03), respectively. Although the means suggest that students held clearer understandings about science at the end of school, there was only a 1 point increase from pre to post measurements. The amount was not sufficient to be significant at the .05 level. This finding suggests that the introduction of Fellows majoring in a science discipline did not significantly impact student understandings of science or perceptions of scientists.

Overall, pre-survey results were significantly different from post-survey results indicating a slight change in student attitudes and/or understandings. Examination of the response patterns for each item provides information regarding the type or nature of the changes. Three of the 16 Likert-type statements are negatively worded so that it is expected that students to disagree with these items. Frequency data confirms these expectations for two or the three items. Students disagreed with statements that the engineer/scientist “do boring things” and “usually work alone.” This trend was observed for the pre and the post survey results. Student responses were mixed for the statement that engineers/scientists always agree on the best way to solve a problem on the pre and the post surveys. On the post surveys, 31 and 21 percent of the students disagreed with this statement, 29 and 30 percent of the students were not sure, and 40 and 50 percent of the students agreed with this statement. Similar results were observed on the pre-study survey.

Individual item analysis revealed additional patterns in the ways that students understood engineering or thought about engineers. For example, on every pre-survey item students who completed the engineering surveys were more likely to respond "I don't know" (N) than students who completed the science surveys. The summaries also showed that every pre to post N response total declined for engineering, but not for science. This supports earlier findings that typically students do not have much understanding of engineering or what engineers do (references already used). These positive changes seem to indicate that exposure to GK-12 engineering Fellows had a significant influence on participating middle school students.

Other response patterns showed how students thought about science and engineering in similar ways. Three statements elicited a substantially large percentage of “not sure” student responses. Students were uncertain if engineers or scientists, approximately 56 and 46 percent, respectively, “get to be the boss.” The remaining students were split between agreement and disagreement with this statement. Also, on the post survey, students indicated they were not sure if engineers or scientists work alone; approximately 42 and 38 percent of the students, respectively, selected the uncertain option. Approximately 48 percent of the students on both engineering and scientist

surveys disagreed with the statement indicating that they believe engineers and scientists do not work alone. In addition, approximately 53 (engineers) and 54 (scientists) percent of the students expressed uncertainty regarding the potential salaries of engineers and scientists. Approximately 42 percent of the students believe engineers and scientist "make a lot of money."

Four questions on the survey addressed student attitudes towards engineering and science. The frequency distributions of responses to these questions are shown in Figure 2. The first two of these questions asked students to select the statement that best reflected their feelings or "affection" for the engineering or science disciplines. Approximately 63 percent of the student indicated they either "love" or "like" engineering on the pre-survey. This percentage increased to 72 percent on the post-study survey. When examined separately, by group, post study results show that 75 (science) and 84 (engineering) percent of the students "love" or "like" science. Approximately 73 percent (scientist) and 70 percent (engineering) of the students "love" or "like" engineering. For the total group, approximately 92 percent of the students indicated on the pre-study survey that they "loved" or "liked" science. On the post survey, only 80 percent of the students made the same observation. This is the only place I didn't try to edit for meaning…..

A third question asked students to select a statement that represents their belief about how much science they learned during the school year. On the post-study survey, 78 percent of all students indicated that they "learned a lot in science class." Examination of the results by the type of Fellow participating in the classroom does not reveal a difference in their response patterns for this item. Post study results for both surveys reveal that 77 percent (engineers) and 79 percent (scientists) of the students "learned a lot in science class" during the school year.

A fourth question asked students if they enjoyed having an engineer or scientist help teach in their science classroom. For the total group, approximately 96 percent of the students indicated that they enjoyed having an engineer or scientist in the classroom. Response patterns by type of Fellow in the classroom indicate that approximately 95 percent of the students participating in the engineering survey responded affirmatively. Approximately 98 percent of the students indicated they liked having a scientist in their classroom.

Students were also asked to indicate why they did or did not like having a scientist or engineer in their classroom. Student explanations for their responses were varied, but analysis of this data reveals some major themes. Students frequently indicated that they enjoyed having an engineer or scientist in the classroom. Students indicated that science class was "fun," "cool," "new," or "interesting" because they participated in a lot of experiments or activities. Typical student responses reflecting this opinion include:

- Because we see a lot of cool gizmos.
- Because we get to try new and interesting things.
- At the end of the week we usually would get a break from notes and we would get to do cool experiments.
- He came up with cool ways to teach us new things.
- We got to do fun activities
- We got to do lots of really cool experiments.
- It related to science and it's fun.
- We did a lot more experiments every week.

- We go to do some fun activities and we get to see some cool example and videos.
- We go to do a lot of new experiments and I had a great time.
- It was more fun.
- It is awesome and very fun doing experiments.
- To me it makes science more fun.

Other student responses emphasized the "learning" aspect of the experience. Comments such as the following were frequently written by the students regarding this aspect of the GK-1 Program.

- He opened your eyes to what all they do and it teaches you a lot more…
- It helped me grasp some concepts better.
- He helped us enhance learning whatever we were learning, he brought in cool contraptions and inventions and he was a lot of fun.
- We learn a lot doing multiple experiments.
- Because he taught one a lot.
- It's really cool to know how stuff works and who make them.
- It is another way of learning and understanding science.
- It is another helpful and easy way to learn things.
- It helps me understand the lesson more when he does experiments with us.
- It brings out our creative sides and enhances your thinking power.
- We learn more by doing.
- It's helpful and we learn more with two good science teachers in the class.
- It is helpful and we learn more than reading out of the book when doing hands on things.
- It helps us understand how things work more.
- We were able to learn more and we were also able to complete more experiments.
- Engineers are a lot of fun and are very creative.
- You learn more with them and get to do a lot of hands-on activities.

Many of the students expressed the observation that they learned another perspective from the Fellow in the classroom. The following student statements reflect this belief.

- It was good to have another teacher to get a second opinion.
- He gives us another way to look at everything.
- We had a different perspective.
- She gives a different perspective on how to solve problems.
- They help us learn in new ways other than what we are use to.
- They help show us different perspectives of science and help us think about things in different ways.
- He showed us and explained to us different ways to look at science.
- He helped explained things differently.
- You get new views and ideas from someone else, a different perspective. Also our engineer is very creative and I learned a lot of new things.

- It gives another insight on science in the classroom.

Other students emphasized the new information they learned about careers. Here are some of those student comments.

- It helped us learn about the world of engineering.
- It helps me understand engineering.
- It is something different and it's interesting to see what an engineer does.
- I learned many different things about engineering I never knew.
- It gets to show me that they are really good at doing their jogs and that they just don't use machines – they have to use their brains as well and their knowledge of learning.
- His expertise was beneficial to our study and activities.
- It is neat to see a real engineer in out class and he is very good at explaining things to us.

There was also the perception that the Fellows in the classroom knew more than the regular teacher. The following are a few of the comments that make this point.

- We get a better advantage and more knowledge from the scientist than the science teacher.
- I think they know more things than a regular teacher so they can help you better in experiments.
- Scientists help explain more than our regular teacher.
- They know more than some teachers.
- You can learn science from the mouth of a true professional.
- The scientist can break it down easier for me to understand.
- If we did not have a scientist teacher, we wouldn't have learned any science.
- They help the teachers and the students learn more about what they need to learn.
- We learned more about some subjects and things our teacher couldn't tell us about.

Concluding Remarks

Comparison of the pre-post survey results helps investigate the effects of the graduate student's efforts. The findings suggest that students with engineering Fellows showed a statistically significant change in their perceptions regarding engineering and engineers at the end of the school year compared to the beginning of the school year. Students with science Fellows did not exhibit a significant change in their perceptions regarding science and scientists from the pre to the post survey. Two items asked students to select the statement that best reflects their feelings or "affection" for the engineering and science disciplines. Among students with engineering GK-12 Fellows, there was an increase in the number of students who either "love" or "like" engineering from the pre- to post-survey. Regardless of whether the Fellow was an engineer or a scientist, fewer students responded that they either "love" or "like" science on the post survey than on the pre survey. Whether or not this is a consequence of the GK-12 program, or other factors that affect middle school students, is not clear. What is encouraging for engineering

educators is that the change in student attitudes towards science was less significant in classrooms with engineers than with scientists. This finding may have implications for individuals and organizations interested in improving scientific literacy among the general public by improving student awareness of what engineering and science are all about.

Acknowledgement

This study was supported by the National Science Foundation's Graduate STEM Fellows in K-12 Education Program through award number 0440568.

Bibliography

1. National Science Foundation, *About NSF GK-12*. http://www.gk12.org/about/ retrieved January 19, 2011from http://www.nsfgk12.org/
2. Mitchell, J., Levine, R., Gonzalez, R., Bitter, C., Webb, N. and White, P. (2003). Evaluation of the National Science Foundation Graduate Teaching Fellows in K-12 Education (GK-12) program. Paper presented at the American Education Research Association, Chicago, IL, April, 2003.
3. Levey, D. Adding Spice to Science [University of Florida's Science Partners in Inquiry-based Collaborative Education]. *Science Scope* v. 28 no. 7 (April/May 2005) p. 30-1
4. Kapila, V., Iskander, M., Kadashev, A., Yakubov, N., Kriftcher, N., Sobhan, S. (2005). Integration of real-time sensor based experiments in high school science labs: a GK-12 project. *Proceedings of the 2005 ASEE Annual Conference and Exposition*, Portland, Oregon, June 12-15, 2005.
5. Chapman, E., Haworth, D., Lueking, A., Avery, L., Henning, P., Tallon, R., and Carlsen, W. (2005). Penn State University NSF GK-12 project: using web-based education and interaction with k-12 and college freshmen to promote science and engineering. *Proceedings of the 2005 ASEE Annual Conference and Exposition*, Portland, Oregon, June 12-15, 2005.
6. Ganesan, R., Kumar, A., Edwards, C., Okogbaa, G., Centeno, G., Hunnicutt, L., Martin-Vega, L., Project Fellows, and Tapas Das. The stars GK-12 program at the University of South Florida. *Proceedings of the 2005 ASEE Annual Conference and Exposition*, Portland, Oregon, June 12-15, 2005.
7. Baumgartner, E., et. al., Student-Scientist Partnerships at Work in Hawaii. *Journal of Natural Resources and Life Sciences Education* v. 35 (2006) p. 72-8
8. Kapila, V., Walia, M., Iskander, M., Kriftcher, N., and Yu, E. (2006). Using real-time sensors in high school living environment labs: a GK-12 project. *Proceedings of the 2006 ASEE Annual Conference and Exposition*, Chicago, Illinois, June 18-21, 2006.
9. Henning, P., Sterling, D., and Ganesan, R. (2008). Partnerships for building the nation's STEM educational enterprise: a NSF GK-12 Fellows project. *Proceedings of the 2008 ASEE Annual Conference and Exposition*, Pittsburgh, Pennsylvania, June 22-25, 2008.
10. Watson, J., and Lyons, J. (2009). Teaching engineering in single-gender middle-school classrooms. *Proceedings of the 2009 ASEE Annual Conference and Exposition*, Austin, Texas, June 14-17, 2009.
11. Allen, J., et. al., How Middle School Students Come Face to Face with Down Syndrome Research. *Science Scope* v. 33 no. 5 (January 2010) p. 20-5
12. Wolf, M., et. al., Crawl into Inquiry-Based Learning: Hermit Crab Experiments [Part of the special issue, Ocean Literacy]. *Science Activities* v. 46 no. 3 (Fall 2009) p. 32-8
13. Bearden, K. K., et. al., In Search of the Active Site of PMMO Enzyme: Partnership between a K-12 Teacher, a Graduate K-12 Teaching Fellow, and a Research Mentor. *Chemical Engineering Education* v. 43 no. 4 (Fall 2009) p. 273-8
14. Duboise, S. M., et. al., Collaboration at the Nanoscale. *The Science Teacher* v. 76 no. 4 (April/May 2009) p. 32-9
15. Kapila, V., Iskander, M., and Kriftcher, N. (2010). Integrating graduate student research into k-12 classrooms: a GK-12 fellows project. . *Proceedings of the 2010 ASEE Annual Conference and Exposition*, Louisville, Kentucky, June 20-23, 2010.
16. Thompson, S. L., et. al., Exploring Graduate-Level Scientists' Participation in a Sustained K-12 Teaching Collaboration. *School Science and Mathematics* v. 102 no. 6 (October 2002) p. 254-65

17. Lyons, J., and Brader, J. (2003). GK-12 enhances teaching skills of engineering graduate students. *Proceedings of the 2003 ASEE Annual Conference and Exposition,* Nashville, Tennessee, June 20-23, 2003.
18. Lyons, J., and Fisher, S. (2004). Effects of elementary- and middle school-based GK-12 programs on graduate student teaching and communication skills. *Proceedings of the 2004 ASEE Annual Conference and Exposition,* Salt Lake City, Utah, June 19-24, 2004.
19. Cunningham, C., Gavel, B., Knight, M., and Faux, R. (2005). Learning through teaching: a longitudinal study on the effects of GK-12 programs on teaching fellows. *Proceedings of the 2005 ASEE Annual Conference and Exposition,* Portland, Oregon, June 12-15, 2005.
20. Lyons, J., Thompson, S., and Fisher, S. (2005). Effects of participating in a GK-12 program on the graduate students' programs of study. *Proceedings of the 2005 ASEE Annual Conference and Exposition,* Portland, Oregon, June 12-15, 2005.
21. Buck, G. A., et. al., Self-Definition of Women Experiencing a Nontraditional Graduate Fellowship Program. *Journal of Research in Science Teaching* v. 43 no. 8 (October 2006) p. 852-73.
22. Mumba, F., et. al., Mathematics and Science Teaching Fellows' Instructional Planning for K-12 Classrooms. *Science Educator* v. 16 no. 2 (Fall 2007) p. 38-43.
23. Lyons, J., and Thompson, S. (2007). Comparison of outcomes for engineering and science GK-12 fellows. *Proceedings of the 2007 ASEE Annual Conference and Exposition,* Honolulu, Hawaii, June 24-27, 2007.
24. Spence, A., and Medoff, J. (2007). Impact of a GK-12 program on the development of university students academic and professional skills. *Proceedings of the 2007 ASEE Annual Conference and Exposition,* Honolulu, Hawaii, June 24-27, 2007.
25. Trautmann, N. M. Learning to Teach: Alternatives to Trial by Fire. Change: *The Magazine of Higher Learning* v. 40 no. 3 (May-June 2008) p. 40-5
26. Borrego, M. (2008). Assessment of a prestigious graduate teaching fellowship program. *Proceedings of the 2008 ASEE Annual Conference and Exposition,* Pittsburgh, Pennsylvania, June 22-25, 2008.
27. Lyons, J., Thompson, S., and Watson, J. (2010). Measuring change in engineering and science graduate students' teaching efficacy as a result of participation in a GK-12 project. *Proceedings of the 2010 ASEE Annual Conference and Exposition,* Louisville, Kentucky, June 20-23, 2010.
28. Thompson, S. L. Development of a Framework to Measure Science Teachers' Inquiry Perceptions and Practices, *Proceedings of the Annual Meeting of the Association for the Education of Teachers of Science.* St. Louis, Missouri, 2003.
29. S. Thompson, and J. Pelt, (2005). Measuring the influence of engineer and elementary science teacher collaborations using the draw an engineer instrument. *Proceedings of the Association for the Education of Teachers of Science Annual Conference,* Colorado Springs, Colorado, January 20, 2005.
30. Cunningham, C., Lachapelle, C and Lindgren-Streicher, A. (2006). Elementary teachers' understandings of engineering and technology, *Proceedings of the 2006 ASEE Annual Conference and Exposition,* Chicago, Illinois, June 18-21, 2006.
31. Caicedo, A., Lyons, J., and Thompson, S. (2006). Investigating outcomes for GK-12 teacher partners and GK-12 summer institute participants. *Proceedings of the 2006 ASEE Annual Conference and Exposition,* Chicago, Illinois, June 18-21, 2006.
32. Lyons, J., Thompson, S., and Addison, V. (2007). GK-12 engineering workshop for science and math teachers. *Proceedings of the 2007 ASEE Annual Conference and Exposition,* Honolulu, Hawaii, June 24-27, 2007.
33. Bottomley, L., Parry, E., Hollebrands, K., Smith, R., Smith, A., and Albers, L. (2009). The ways in which K-8 students' participation in a GK-12 program affects achievement in and beliefs about mathematics. *Proceedings of the 2009 ASEE Annual Conference and Exposition,* Austin, Texas, June 14-17, 2009.
34. Lyons, J., Fralick, B., and Kearn, J. (2009). A survey of middle-school students' attitudes toward engineers and scientists. *Proceedings of the 2009 ASEE Annual Conference and Exposition,* Austin, Texas, June 14-17, 2009.
35. Bottomley, L., Parry, E., Hollebrands, K., Smith, R., and Albers, L. (2010). Attitudes towards and support provided for mathematics learning reported by parents of students involved in a GK-12 program. *Proceedings of the 2010 ASEE Annual Conference and Exposition,* Louisville, Kentucky, June 20-23, 2010.
36. Knight, M. & Cunningham, C.M. (2004). Draw an engineer test (DAET): Development of a tool to investigate students' ideas about engineers and engineering. *Proceedings of the 2004 ASEE Annual Conference and Exposition, Salt Lake City, Utah*, June 20-23, 2004.

37. Lyons, J., and Thompson, S. (2006). Investigating the long-term impact of an engineering-based GK-12 program on students' perceptions of engineering. *Proceedings of the 2006 ASEE Annual Conference and Exposition*, Chicago, Illinois, June 18-21, 2006.
38. Thompson, S., et. al., Engineers in the Classroom: Their Influence on African-American Students' Perceptions of Engineering. School Science and Mathematics v. 108 no. 5 (May 2008) p. 197-210.
39. National Science Foundation (2006). *NSF Graduate Teaching Fellows in K-12 Education (GK 12)*, retrieved October 1, 2009 from http://www.nsfgk12.org/

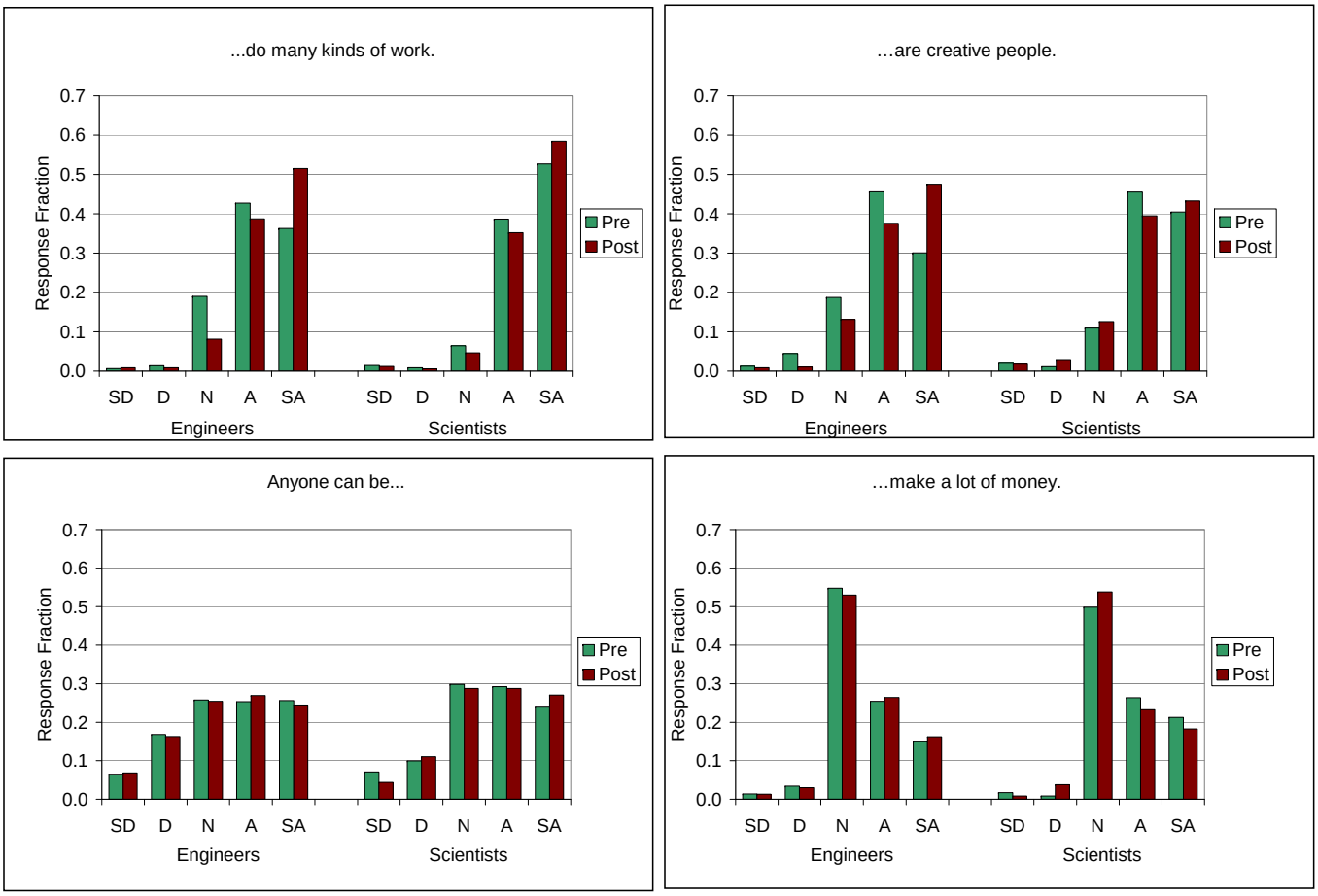

Figure 1. Pre/Post responses to perception questions on the Engineer in Science Class and Scientist in Science Class surveys.

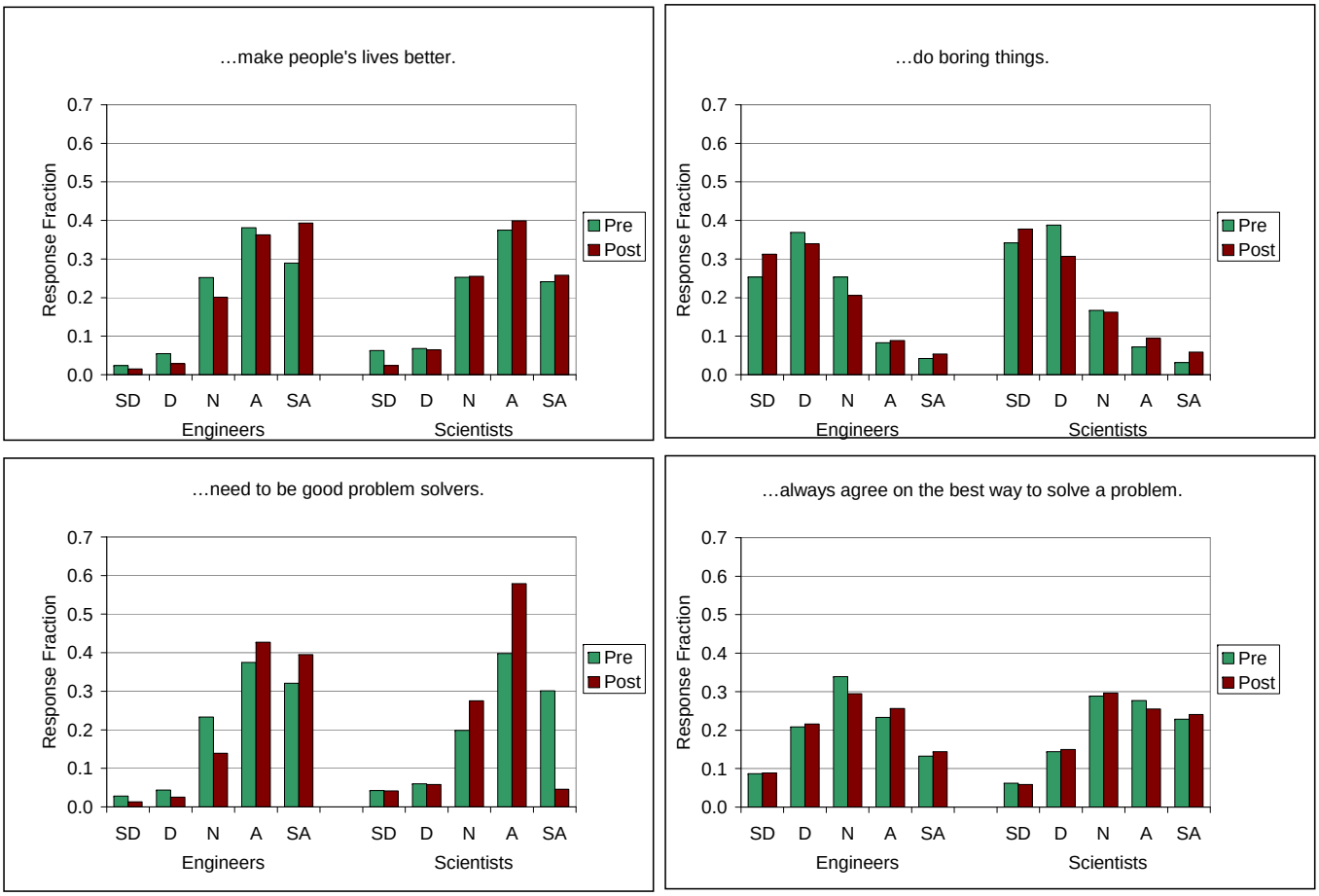

Figure 1 (cont). Pre/post responses to perception questions on the Engineer in Science Class and Scientist in Science Class surveys.

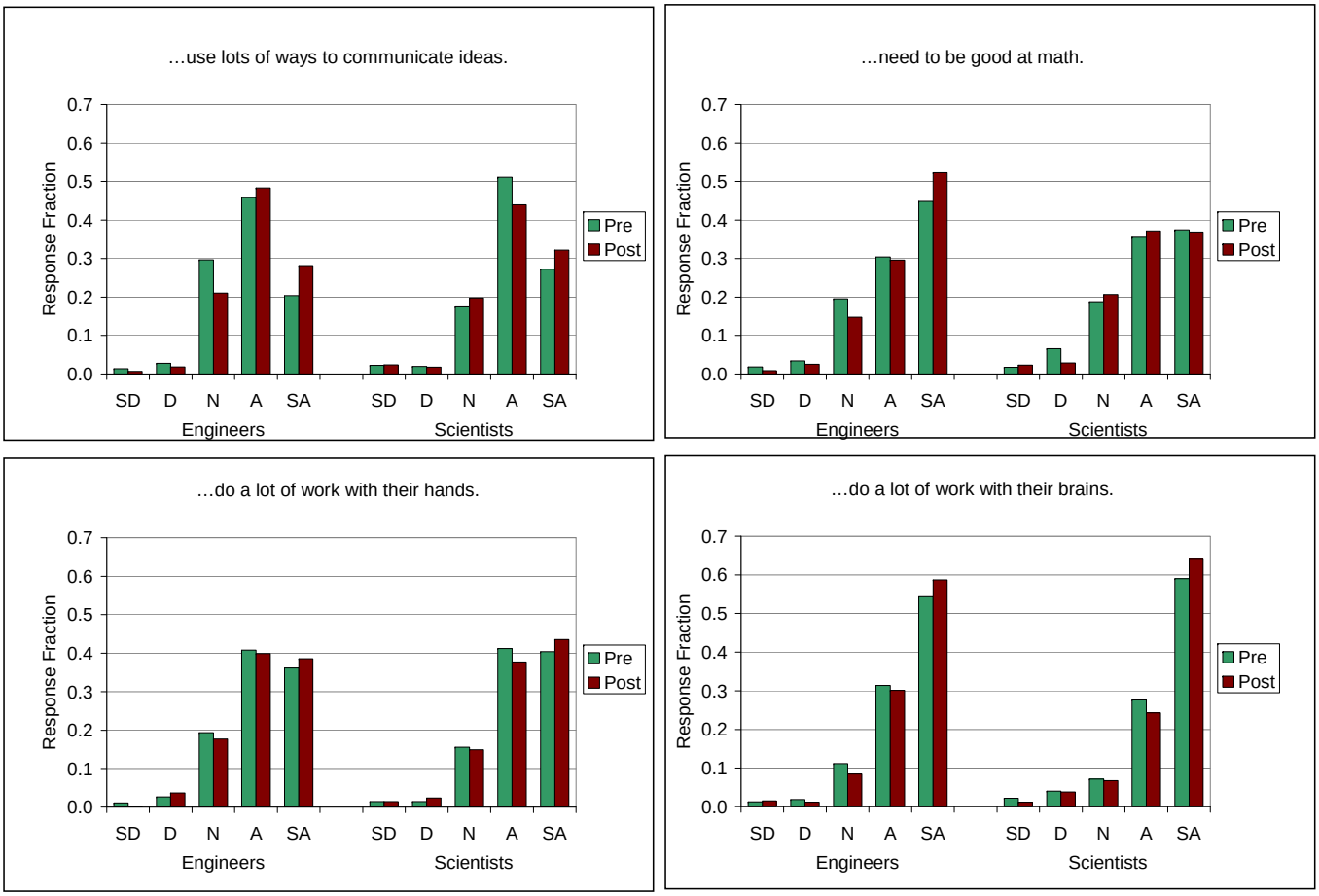

Figure 1 (cont). Pre/post responses to perception questions on the Engineer in Science Class and Scientist in Science Class surveys.

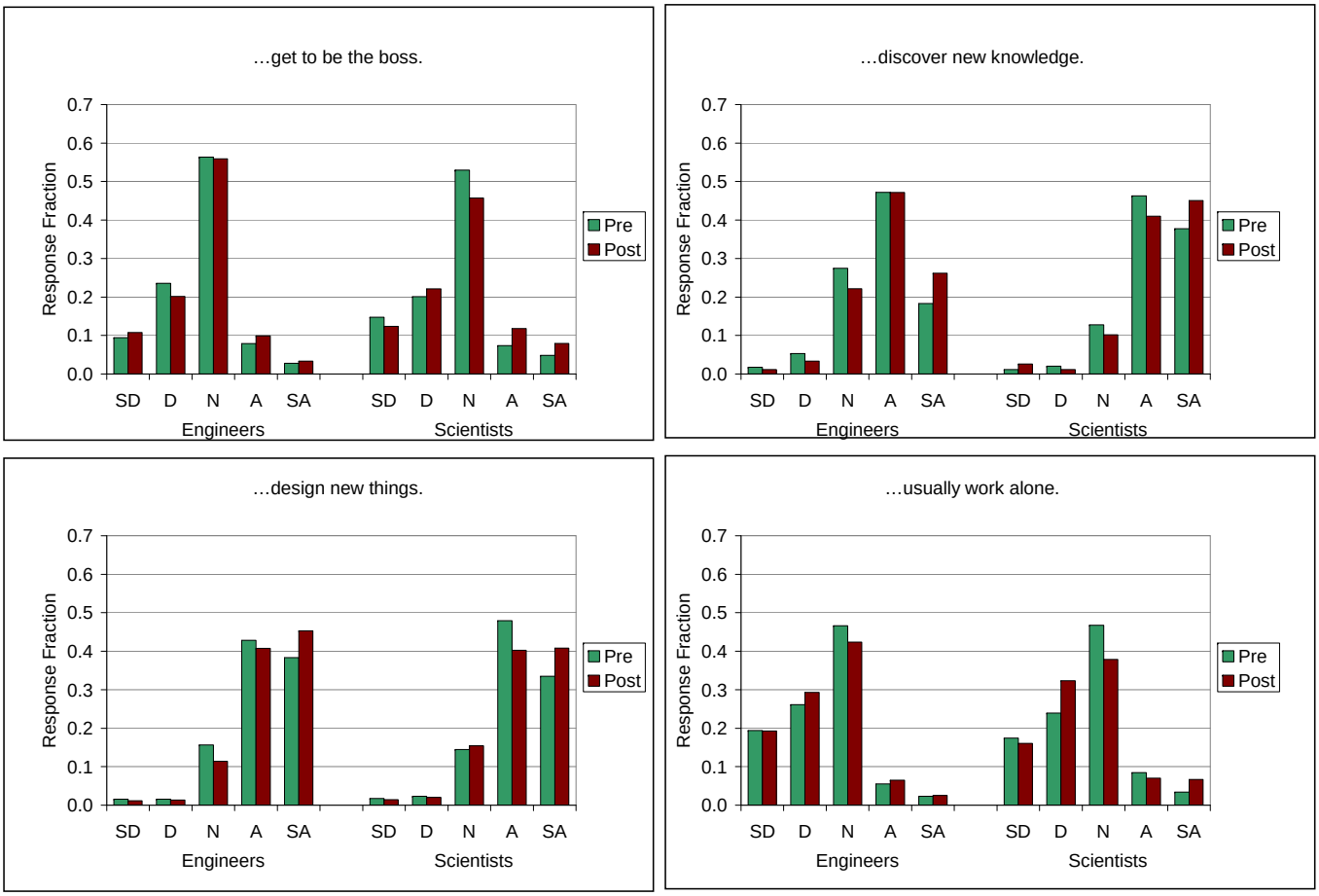

Figure 1 (cont). Pre/post responses to perception questions on the Engineer in Science Class and Scientist in Science Class surveys.

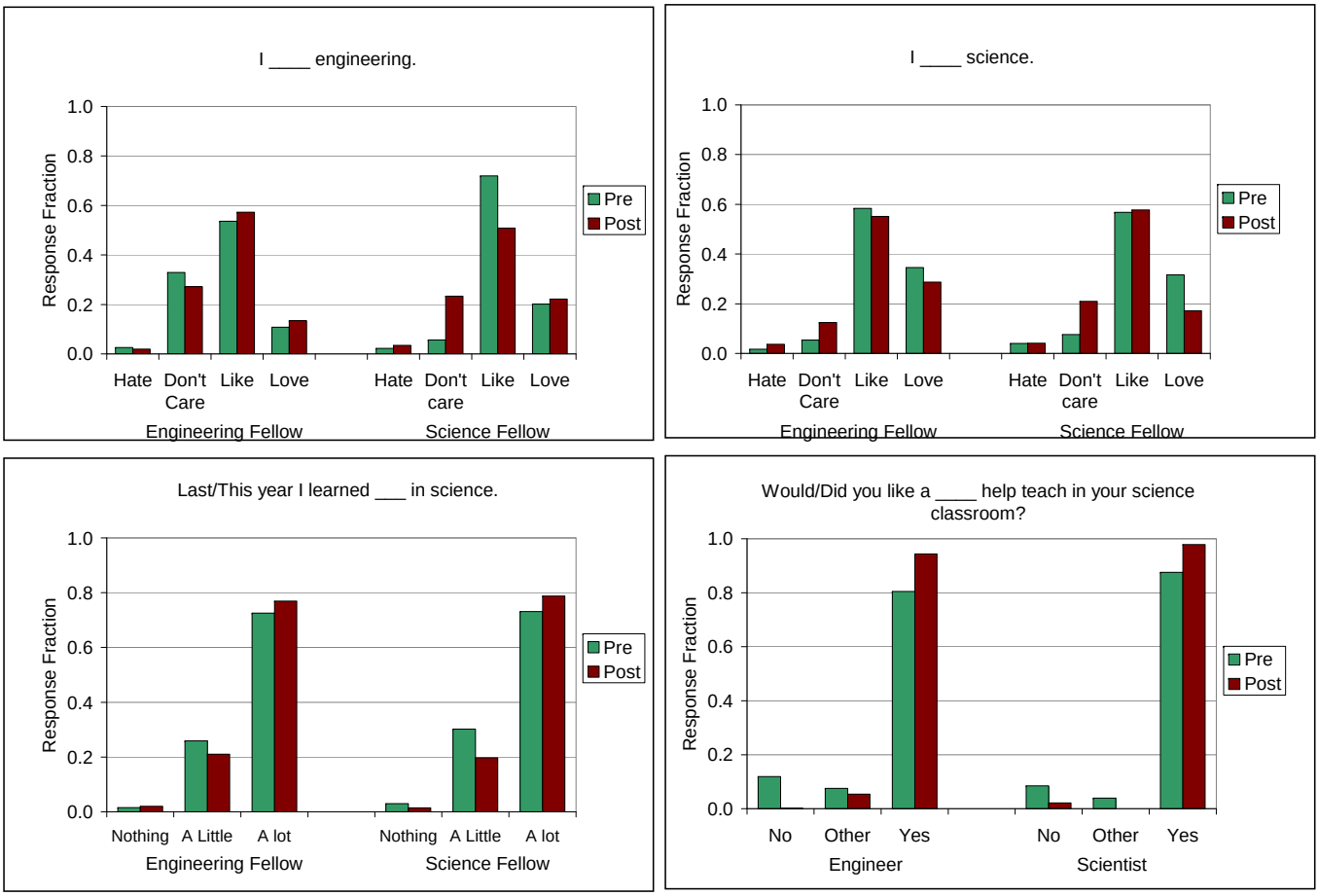

Figure 2. Pre/post responses to attitudinal questions on the Engineer in Science Class and Scientist in Science Class surveys.

Appendix A
Engineer in Science Classroom Survey

First Name _____ Last Name_____

Directions: Please read the following statements and tell whether you agree or disagree with them. Rate your responses 1 to 5, with 1 meaning "Strongly Disagree" and 5 meaning "Strongly Agree".

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1. Engineers do many different kinds of work.	1	2	3	4	5
2. Engineers are creative people.	1	2	3	4	5
3. Anyone who wants to can become an Engineer.	1	2	3	4	5
4. Engineers make a lot of money.	1	2	3	4	5
5. Engineers make people's lives better.	1	2	3	4	5
6. Engineers do boring things.	1	2	3	4	5
7. Engineers need to be good problem solvers.	1	2	3	4	5
8. Engineers always agree on the best way to solve a problem.	1	2	3	4	5
9. Engineers use lots of ways to communicate ideas.	1	2	3	4	5
10. Engineers need to be good at math.	1	2	3	4	5
11. Engineers do a lot of work with their hands.	1	2	3	4	5
12. Engineers do a lot of work with their brains.	1	2	3	4	5
13. Engineers get to be the boss.	1	2	3	4	5
14. Engineers discover new knowledge.	1	2	3	4	5
15. Engineers design new things.	1	2	3	4	5
16. Engineers usually work alone.	1	2	3	4	5

Circle the sentence that fits you best:
I love engineering.
I like engineering.
I don't care about engineering.
I hate engineering.

Circle the sentence that fits you best:
I love science.
I like science.
I don't care about science.
I hate science.

Circle the sentence that fits you best:
This year I learned a lot in science class.
This year I learned a little bit in science class.
This year I learned nothing in science class.

Did you like having an Engineer help teach in your science classroom? Why or why not?

Scientist in Science Classroom Survey

First Name _____ Last Name_____

Directions: Please read the following statements and tell whether you agree or disagree with them. Rate your responses 1 to 5, with 1 meaning "Strongly Disagree" and 5 meaning "Strongly Agree".

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
1. Scientists do many different kinds of work.	1	2	3	4	5
2. Scientists are creative people.	1	2	3	4	5
3. Anyone who wants to can become a Scientist.	1	2	3	4	5
4. Scientists make a lot of money.	1	2	3	4	5
5. Scientists make people's lives better.	1	2	3	4	5
6. Scientists do boring things.	1	2	3	4	5
7. Scientists need to be good problem solvers.	1	2	3	4	5
8. Scientists always agree on the best way to solve a problem.	1	2	3	4	5
9. Scientists use lots of ways to communicate ideas.	1	2	3	4	5
10. Scientists need to be good at math.	1	2	3	4	5
11. Scientists do a lot of work with their hands.	1	2	3	4	5
12. Scientists do a lot of work with their brains.	1	2	3	4	5
13. Scientists get to be the boss.	1	2	3	4	5
14. Scientists discover new knowledge.	1	2	3	4	5
15. Scientists design new things.	1	2	3	4	5
16. Scientists usually work alone.	1	2	3	4	5

Circle the sentence that fits you best:

I love engineering.
I like engineering.
I don't care about engineering.
I hate engineering.

Circle the sentence that fits you best:

I love science.
I like science.
I don't care about science.
I hate science.

Circle the sentence that fits you best:

This year I learned a lot in science class.
This year I learned a little bit in science class.
This year I learned nothing in science class.

Did you like having a Scientist help teach in your science classroom? Why or why not?