

STUDENT ATTITUDES TO REAL-WORLD PROJECTS IN AN INTRODUCTORY STATISTICS COURSE

Ann D. Bingham

Peace College, United States of America
abingham@peace.edu

Constructivist research has shown that for real mathematics learning to occur, students need to be engaged, active learners rather than passive recipients of knowledge. Student projects can often facilitate this engagement. In an introductory statistics class for liberal arts students, a series of authentic projects were assigned. The projects showcased real world applications of material recently studied in the classroom. They varied from analysis of public data available on the internet to gathering and analyzing data collected via student-designed surveys. This paper discusses student reflections on the learning that occurred while completing these projects. Initial reactions were often dismay and discouragement, but a survey given to all students near the end of the course found more positive attitudes. Longer surveys were sent to a random sample of students. We consider students' attitudes and perceptions of their learning successes and difficulties.

INTRODUCTION

The article "Statistics Education Fin de Siècle" (Moore et al, 1995) outlines many of the reasons instructors of statistics use student projects. Individual or group projects engage all the students, even the least motivated ones. (Santos & Cesar, 2006) Instructors who use student projects believe they assist learning statistics, and hopefully help the students develop useful statistical thinking skills. We hope these skills will last and the students will be able to apply what they have learned to their lives outside the classroom.

The Introductory Statistics class studied for this paper is a necessary course for graduation as part of the general education requirements at a small liberal arts institution in the Southeastern United States. Students are from varied majors and most will not take another statistics course. A few will continue in the social sciences and take a course on research methods in their field.

Math anxiety is high in this population. Similar to the students studied by Pan and Tang (2005), these students have anxiety about their own math deficiency. Students in the Introductory Statistics classes often avoid the requirement until late in their undergraduate career. The initial attitude towards the Introductory Statistics course is not positive. The research on constructivism convinced this instructor that active learning was the road to student understanding and positive outcomes. Student projects in statistics seemed a good fit, since the material lends itself to real world applications even at the beginning of the course. As time consuming as projects may be for both instructor and student, the projects are a valuable learning tool. As Groth (2006) states "if students are not exposed to the 'messy' side of data analysis, then they will not have opportunities to develop the type of thinking they need to evaluate statistical claims with which they are bombarded on a daily basis."

Choosing projects can be difficult. One major student-designed project per term has the advantage of allowing the student to feel ownership since the topic was chosen by the students. In reality students spend copious amounts of time making a decision on what topic to choose. Another method is to have a few smaller student-designed projects. The disadvantage of this method is that students procrastinate in choosing a topic, and the projects finally chosen are not particularly relevant to their lives. A literature review yielded suggestions for statistics projects (Smith, 1998) and, for the course studied in this paper, ten projects were assigned. Although the projects are instructor assigned, the student must make choices in data-collection. The students choose which bookstore or grocery store to visit to gather data. They design their own survey and means of procuring the results.

METHOD

A questionnaire was given to each student in two Introduction to Statistics classes at the end of the semester, with these open-ended questions:

Please make a short comment about each of the following—whether it works for you, what in class or out of class activity you remember, which ones taught you the most, which one was the best, what could be improved.

The responses were categorized as the student expressing either a positive or negative experience with the projects as reflected at the end of the term. The comments were then also read for students mentioning one or more of the following comments:

- the projects helped with understanding of that material,
- the projects had relevance to their lives,
- the material was interesting,
- the projects were too time-consuming,
- the projects were pleasurable or fun.

A detailed questionnaire was sent to a random sample of students four months after the class concluded. The questionnaire included questions on which projects they remembered after four months, and which statistical analyses were still understandable to them. They were given the option to comment on specific projects. Twenty two students were selected to receive the longer questionnaire. The questions posed in this longer survey asked specifically the above categories—interest, relevance, time considerations, and then also asked the student to rate their knowledge of many of the topics covered in the course—histograms, standard deviation, hypothesis testing, regression. Of the 22 students sent the second survey, 13 responded.

RESULTS

The initial hypothesis that students would consider the projects a waste of their time and that the responses would be mainly negative was incorrect. An analysis of the initial survey showed that 95% were categorized as positive. Student comments included “it helped in terms of applying what I learned” “I really liked these because they were fun to do. Another wrote that statistics projects “are really interesting and help us to learn more and more.”

The results showed that of the 37 students still enrolled in the course at the end of the term, 35 had an overall positive attitude towards the projects. Only two of the students had negative feelings towards the projects, and both reported that the time involved was excessive. Two other students were more ambivalent. One repeated the claim that the projects took too much time, but she admitted “but it wasn’t so bad and was semi-helpful.”

One student remarked, though, that she was able to make a reasonable grade on an assignment and still not understand the material. But she was the only one (n=37). Most students remarked that they learned the topics covered. It was not only the A students who responded positively. The students who earned poorer grades also reported that they enjoyed the projects. A benefit students mentioned was that they could take their time and did not feel as rushed as they do in class assignments and tests.

Of the 22 students sent the second longer questionnaires, 13 responded. Sixty percent remembered all the projects. When asked which project was most memorable, the answers varied. The project that required testing the hypothesis that our students had more Facebook friends than students at another college was the one four of the students remarked as the most fun. That was in a tie for most memorable with the first project on histograms. For the histogram project students gathered data on the grams of sugar per cup of cereal from 75 different cereals in the grocery store. The data had to be organized by shelf, and the question asked was to determine whether the cereals with the most sugar were on shelves closest to a child’s eye level. Students were to analyze the histograms of sugar content on each shelf.

The students then remarked on which projects taught them the most. Three students said all the projects taught them statistics. Other students mentioned specific projects. One assigned project was a student-designed survey to gather information on how many hours of sleep students had in a 24-hour period, and how many students “pulled an all-nighter” staying up all night in the last semester. One student remarked on this one as the one that taught her the most: “I think the

Hours of Sleep project taught me the most. I learned to do the statistics for the project and it made the subject we were trying to prove more clear, all the projects did. “

The Birth Date project asked the question Malcolm Gladwell (2008) discussed in his book *Outliers*. His thesis was that professional sports players tend to be born in the first half of the year. In sports where the cut-off birth date is December 31st, children born in the first few months of the year have the advantage of being somewhat older than their peers in the younger sports leagues and so they are bigger and faster and get more opportunities. The project associated with that asked the students to pick a professional sport and consider the birth months of the players. This was the first project using hypothesis testing; the project involved finding data for the proportion of athletes in the chosen sport and testing the hypothesis that the proportion born in the first half of the year would be greater than .5. One student wrote “the Birth Date project taught me a lot because I really understood the math involved in it.” Another student wrote “I’d say the Birth Date project because it was the first one that really made complete sense to me. I’m not sure I could explain what I learned, but I know that I must have because things just kind of clicked for me while doing it.”

This last response of not being able to explain what she learned introduced the question of how much students take away from their introductory statistics course. The goal of the Introductory Statistics course is that students can think critically about the claims on the Internet or on TV or in the newspaper that they see on an hourly basis. A second goal is that students remember the statistics taught and be able to analyze data. Do students remember specific concepts? For the students who answered the longer second questionnaire, most can remember and understand histograms, mean and standard deviation. Linear regression and ANOVA were more problematic, but hypothesis testing in general was remembered. On a scale of 1 to 10, with 1 being “I have no idea what that means any more”, to 10 being “I totally understand and I could use it and do problems right now if I was asked to” more than 60% scored themselves at a 7 or higher for understanding histograms, probability, mean and standard deviation, confidence intervals, linear regression and hypothesis testing.

In terms of attitudes about the course and statistics, there were positive responses about the class. One student wrote about the project that asked students to do a linear regression: “I would say the flight project ... was the most “fun.” I found it interesting to see the distance between different places and how the prices did not really correlate with the distance.” Others wrote “I really enjoyed the Facebook and Cereal Projects. These projects made me learn a lot about the topics. I remember feeling more confident.” “They were all pretty fun; I really enjoyed collecting the data and analyzing it. It taught me a lot about my classmates and about Statistics.” “I really liked the Facebook project because it had to do with something we all did in our spare time. The Birth Date project was really interesting.”

DISCUSSION

Assigning student projects can be time consuming for the instructor of Introductory Statistics. Most students do not give positive feedback during the actual work of the course. This study was undertaken to analyze whether students had positive or negative responses to projects in Introductory Statistics by the end of the course. The high percentage of math phobic students in the population of the institution, and the high level of complaining during the course led this researcher to believe that students would not appreciate the projects as a valuable learning experience. Astonishingly the results of this study showed that most of the students had positive comments about the projects. The results show that students enjoyed the projects and understood the relevance of statistics. Many students remembered the projects and statistical concepts four months after the course was finished. The students mentioned the work and time involved but approved of the projects.

Students mentioned that the projects seemed relevant to their lives. Although the survey question asked whether the projects worked for the student, and whether the projects taught the material, many students mentioned how much fun the projects were. These math phobic students admitted to having fun with mathematics. They realized that statistics was something they could do.

Students remarked that the projects aided their learning. Overall these replies showed that student attitudes towards these student projects were highly positive. Apparently using student projects can lead to a student population who looks favorably on statistics as a field.

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