DOES VIEWING VIDEO OF STATISTICS IN ACTION AFFECT STUDENT ATTITUDES?

J. Richard Alldredge, H. Dean Johnson, Jose J. Sanchez
Washington State University, United States
alldredg@wsu.edu

Recent studies have indicated that student attitudes can assist or impede learning and that students tend to have negative attitudes towards mathematics and statistics. We used a treatment-control experimental design to explore the effects of using video clips, showing applications of statistics in real world settings, on student attitudes toward statistics. Students with higher scores on standardized tests of mathematical and verbal ability, who were exposed to the video treatment, had more positive attitudes toward statistics than video exposed students with lower ability scores and more than students who were not exposed to the video treatment.

INTRODUCTION

In recent years, the assessment of new instructional methods, theories, and tools to improve student learning has been a common area of research. The objective of this study is to expand on this research by providing knowledge regarding the improvement of students' attitudes and beliefs concerning statistics, as they may contribute to the students' difficulty in learning the basic concepts in statistics. As Gal and Ginsburg (1994) noted, "to make the learning of statistics less frustrating, less fearful, and more effective, further attention by both statistics educators and researchers should be focused on beliefs, attitudes, and expectation students bring into statistics classrooms or develop during their educational experiences." Moore (1993) notes that on-location documentary segments available in a widely distributed video series are intended to change students' attitudes toward statistics. Taking this as a consideration, an experiment was designed to explore the effects of video usage on the attitudes and beliefs of students towards statistics. Although Gal, Ginsburg, and Schau (1997) define attitudes as relatively stable, intense feelings that develop as repeated positive or negative emotional responses that are automated over time, while beliefs were defined as individually held ideas, the terms are used interchangeably in this work.

As Gal, Ginsburg, and Schau (1997) noted, "students' attitudes and beliefs can impede (or assist) learning statistics." With this in mind, the purpose of the experiment was to determine if viewing videotapes, on how statistics is used in practice, improves the attitudes of students towards statistics. Other studies such as Alldredge and Som (2002) focused on differences between two educational statistical packages in their ability to improve statistical learning and attitude towards learning statistics. Also, Mvududu (2003) examined the "similarities and differences in perceptions and attitudes of students from two very different learning milieus," from Seattle Pacific University in the US and the University of Zimbabwe.

Demonstrating the benefits of video usage, Lang, Potter, and Grabe (2003) showed how local television news stories can significantly reduce the resources required to process a message and therefore increase the ability of viewers to understand and remember information from news. Harwood and McMahon (1997) observed positive effects on students' achievement and attitudes in a high-school chemistry course as a result of a video media curriculum enhancement. Moore (1993) noted that a strength of video is its ability to take students to real applications through documentaries shot on location. Our study was designed to determine if students' attitudes towards statistics improve as a result of viewing video clips showing real world applications of statistics.

EXPERIMENTAL SETTING

The experiment was conducted in an algebra-based introduction to statistics course during the Fall 2003 semester. The course satisfied a general education requirement for mathematics proficiency at Washington State University. In addition, it satisfied the statistics requirements of many departments. The students varied in regard to academic backgrounds, interests, age, and mathematical and statistical experience. The average age of the 203 students

who participated in the study was 21.5 years, 77% were White American, and 77% were female. Students came from more than ten different major academic areas of interest. Students had the option of registering for either of two different sections: One section met Monday, Wednesday, and Friday for 50 minutes while the other met Tuesday and Thursday for 75 minutes. Different professors taught the two lecture sections, however, both sections used the same textbook and followed a similar schedule: weekly homework, two midterm exams, a comprehensive final exam and a writing project. The Monday, Wednesday, and Friday lecture section had an enrollment of 75 students while the enrollment of the Tuesday and Thursday section was 150 students. Students were also required to register for one of the nine laboratory sections that met for two hours a week. Approximately 25 students were enrolled in each laboratory section. The laboratory covered questions on homework, problem solving using *Minitab* (2000) statistical software, and group activities dealing with the current topics covered in lecture.

The laboratory sections were randomized to receive a video or serve as a control. Because it was not possible to randomly assign individual students to a treatment/control group, we considered the nine laboratory sections to be the experimental units in the study. There were a total of 5 laboratory sections receiving the treatment and 4 receiving the control. The sections in the treatment group watched videotape for about 5 minutes, at the start of each of eight laboratory sessions. The sections in the control group were not given that opportunity. After the treatment group finished watching the short video clip, they were given 5 minutes to answer a) "What were some of the main concepts presented in the video you viewed today? b) Which of these are most meaningful to you? Why?" The responses to these questions were not graded.

DATA COLLECTION

We collected data on a number of variables including: potential confounding variables, pre and post-course attitudes, performance measures (not presented here), and student interviews (not presented here). Potential confounding variables included SAT total, SAT math, SAT verbal, Grade Point Average (GPA), and a score on an eight question quiz of algebra ability commonly used by the department that was given during the first week of class. The SAT is a three-hour test that measures verbal and mathematical reasoning skills that is administered to secondary school students. Many colleges and universities use the SAT as one indicator of a student's readiness to do college-level work (SAT I, http://CollegeBoard.com).

The first day of class, students were informed that they were going to be part of a study to help improve statistics education. As part of the research study, students were allowed fifteen minutes to complete a questionnaire. The questionnaire used in this experiment contains 40 items that use a Likert-type scale to assess components of students' attitudes toward statistics. Possible responses were from 1 for strongly disagree to 7 for strongly agree. The questionnaire was based on Schau's "Survey of Attitudes Towards Statistics," (Schau 2003) with added questions and components. The added questions, in the pre-questionnaire, asked about plans for the course and their expected use of statistics. These questions were: I plan to complete all of my statistics assignments, I plan to work hard in my statistics course, I am interested in being able to communicate statistical information to others, I am interested in using statistics.

On the last meeting of the laboratory class, the students completed a post-questionnaire, and the same procedure and response categories were used as for the pre-questionnaire. Students who did not attend the last laboratory were given the opportunity to finish the questionnaire on the day of the final exam. The difference between the students' post-questionnaire score and the pre-questionnaire score was used to create a difference score for each of the questions that were common to both questionnaires.

ANALYSIS AND RESULTS

The question of interest was: Do students' attitudes change in a different manner over time among the treatment and control groups? Factor analysis was used to reduce the dimensionality of the questionnaire responses. This analysis was carried out using the *SAS* statistical package (*SAS* Stat, 1999) on the difference between the post and pre questionnaire scores. By examining scree plots and eigenvalues, the following factors, based on difference scores, were identified:

- Factor D1-Attitudes about usefulness, relevance and worth of statistics in personal and professional life
- Factor D2-Confidence towards statistical education
- Factor D3-Positive feelings concerning statistics
- Factor D4-Difficulty of statistics as a subject
- Factor D5-Negative feelings concerning statistics
- Factor D6-Mathematics achievement and confidence

These factors are similar to those identified by Schau (2003) with some differences due to inclusion of additional questions in our questionnaires. The factor scores were obtained by summing the difference scores for the questions that loaded highly on that factor, similar to Schau (2003). For negative questions, a sign change was applied to the difference between post and pre-questionnaire so higher scores represent a more positive change in attitudes and beliefs.

There were no significant differences between unadjusted treatment means for the treatment and control groups for any factor according to the analysis of variance. Analysis of covariance was conducted using the same 6 response variables (Factors D1 through D6), explanatory variable (video treatment or control), and covariate SAT total, SAT math, SAT verbal, or preliminary algebra test score. Statistically significant interactions were identified between the explanatory variable, that is treatment group, and a covariate for two factors as discussed below.

Factor D3: "Positive feelings concerning statistics" was not significantly different between the video and control group, however, there was a significant interaction effect between the treatment group and the preliminary algebra test score. Students in the video group who had more algebraic ability had increased positive feelings toward statistics compared to students who had lower scores on the algebra pre-test. Whereas, students with higher pre-test algebra scores in the control group showed no change in feelings toward statistics.

Factor D4: "Difficulty of statistics as a subject" had an interaction effect between SAT total score and treatment/control groups. As SAT total score increased for students in the video group, the appreciation concerning the difficulty of properly applying statistics increased. The opposite was seen for the control group where as the SAT total score increased, student attitudes concerning the difficulty of properly applying statistics decreased slightly.

OTHER CONSIDERATIONS, DISCUSSION AND RECOMMENDATIONS

There are other factors that could affect the results. For example, two different professors taught lecture sections of the course, there were three teaching assistants who had different levels of teaching experience, and the laboratory sections were taught at different times. An analysis of the difference factor scores found no differences due to professor, no difference due to teaching assistant, and no difference due to laboratory time.

The question posed in this study is: does viewing videotapes, on how statistics is used in practice, improve the attitudes and beliefs of students towards statistics? The results from this study suggest that viewing videotapes may improve attitudes among those students who are engaged in the learning process, but not all students appeared to benefit from the value added opportunity offered by video viewing as implemented here.

As mentioned before, the results from Factor D3: "Positive feelings concerning statistics," show that students in the video group had higher scores on this factor as their preliminary math score increased, but no similar increase was observed for the control treatment. Perhaps students, who are more capable mathematically, are more receptive to the video message showing positive uses of statistics. The challenge therefore is to find methods to engage less able students to benefit from the value added by videotape viewing.

These thoughts are supported by two of Garfield's ten principles of learning statistics (Garfield, 1995). These principles are: *Students learn better if they receive consistent and helpful feedback on their performance;* and *Students learn to value what they know will be assessed.* In an effort to present the video treatment without introducing experimental bias or greatly altering other components of the course, we did not emphasize assessment or feedback involving the

videotape content. In doing so, we may have reduced the effectiveness of exposure to videotapes for many students.

Results from Factor D4 indicate that students in the video group see statistics as being more complex as their SAT scores increase, while students in the control group had no similar positive trend in the belief that statistics is complex as their SAT scores increased. One reason for this result may be that more capable students in the video group are more engaged in viewing the videos showing the complexity of the use of statistics in real life.

We recommend that more research be done on video usage in introductory statistics classes to assess the consistency of results observed in this study. Also of interest would be to see if increasing the commitment of the instructor and students to videotape viewing would have a corresponding influence on increasing positive attitudes related to statistics.

REFERENCES

Alldredge, J. R. and Som, N. A. (2002). Comparison of multimedia educational materials used in an introductory statistical methods course. In B. Phillips (Ed.), *Proceedings of the Sixth International Conference on Teaching of Statistics*, Cape Town. Voorburg, The Netherlands: International Statistical Institute.

Gal, I. and Ginsburg, L. (1994). The role of beliefs and attitudes in learning statistics: Towards an assessment framework. *Journal of Statistics Education*, 2(2), http://www.amstat.org/publications/jse/v2n2/gal.html.

Gal, I., Ginsburg, L. and Schau, C. (1997). Monitoring attitudes and beliefs in statistics education. In I. Gal and J. B. Garfield (Eds.), *The Assessment Challenge in Statistics Education*, (pp. 37-51). Amsterdam: IOS Press and the International Statistical Institute.

Garfield, J. (1995). How students learn statistics. *International Statistical Review*, 63, 25-34.

Harwood, W. S. and McMahon, M. M. (1997). Effect of integrated video media on student achievement and attitudes in high school chemistry. *Journal of Research in Science Teaching*, 34(6), 617-631.

Lang, A., Potter, D. and Grabe, M. E. (2003). Making news memorable: Applying theory to the production of local television news. *Journal of Broadcasting and Electronic Media*.

Minitab Statistical Software. (2000). *Minitab* Inc.

Moore, D. S. (1993). The place of video in new styles of teaching and learning statistics. *The American Statistician*, 47(3), 172-176.

Mvududu, N. (2003). A cross-cultural study of the connection between students' attitudes toward statistics and the use of constructivist strategies in the course. *Journal of Statistics Education*, 11(3), www.amstat.org/publications/jse/v11n3/mvududu.html.

Rouse, L. P. (1995). Women and minorities in a social statistics course. *Journal of Women and Minorities in Science and Engineering*, 2, 181-192.

SAS Institute Inc. (1999). *SAS/STAT User's Guide, Version 8*. Cary, NC: *SAS* Institute Inc.

Sax, L. J. (1994). Predicting gender and major-field differences in mathematical self- concept during college. *Journal of Women and Minorities in Science and Engineering*, 1, 291-307.

Schau, C. (2003). *The Survey of Attitudes Toward Statistics (SATS)*, http://www.unm.edu/~cschau/satshomepage.htm.