Students' Attitudes Toward Statistics: Are there differences among various majors?

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Abstract

The SATS-36 pre-post survey data were collected from two introductory statistics courses at Ball State University, one college algebra-based and the other college calculus-based. Data were collected during 3 academic years from 14 classes with 5 different instructors and where the majority of students major in one of three areas – education, computer science, or construction management. Preliminary analysis of the mean scores on the six attitude components of the instrument shows mixed results among the three majors.

Key Words: Attitudes Toward Statistics, Major, SATS-36

1. Introduction

Over the last 20 years or so, many authors have been advocating changes in the teaching of introductory statistics courses (Hogg, 1992; Cobb, 1993; Garfield, 1995; Lock, 2000). Faculty have been urged to update their methods and materials to include such items as student generated/real-life data sets, hands-on experiments/active learning, a discovery approach, emphasis on concepts versus computation, student projects, and the use of technology in the form of calculators and/or statistical software. Most notable is the GAISE college report recently published by the American Statistical Association (2005).

During this same period, attention has also been given to the role of beliefs and attitudes in learning statistics (Gal & Ginsburg, 1994; Garfield, Hogg, Schau, & Whittinghill, 2002; Schau, Dauphinee, & Del Vecchio, 1995). A number of instruments using Likert-type responses to statements were developed in the 80s and 90s (Roberts & Bilderback, 1980; Wise, 1985; Zeidner, 1991). In response to limitations of these instruments, Schau, Stevens, Dauphinee, and Del Vecchio (1995) developed the Survey of Attitudes Toward Statistics (SATS) and published an article about its development and validation in 1995.

The purpose of this paper is to describe the similarities and differences in attitudes of students from various majors as measured with the SATS. SATS survey data were collected from two introductory statistics courses taught at Ball State University: an algebra-based course and a calculus-based course.

Ball State University (BSU) is a comprehensive, publicly assisted institution in the Midwest with approximately 18,000 undergraduate and graduate students across seven colleges: Applied Sciences and Technology; Architecture and Planning; Business; Communication, Information, and Media; Fine Arts; Sciences and Humanities; and Teaching, with more than 140 major and minor areas of study through undergraduate liberal and professional education (Pierce, 2006).

Introductory statistics courses are offered through various departments in several colleges including the Department of Mathematical Sciences, which offers three levels of introductory statistics courses. Only two of the courses are included in this study. The algebra-based course, MATHS 181, is primarily taken by students who are manufacturing engineering technology majors, industrial technology majors, elementary education majors who are pursuing a concentration in mathematics, or students pursuing a license in middle school/junior high mathematics since the course is required for each of these options. MATHS 181 is a three hour course with a prerequisite of a qualifying ACT or SAT score, placement test score, or passing grade in a college algebra course.

MATHS 221 is one of the two calculus-based courses offered and is primarily taken by Secondary mathematics education majors and computer science majors since it is required. It is a three hour course and has a prerequisite of one semester of calculus.

2. Method

2.1 Participants & Course Structure

BSU students in these two courses were surveyed over seven semesters from fall 2004 through spring 2008. MATHS 181 was taught each semester except spring 2007. MATSH 221 was taught in five of the seven semesters. Pencil and paper pre-test and post-test versions of the SATS-36 were given to students in all sections of both courses. The pre-test was administered on the first day of class and the post-test during the last week of class.

The ten sections of MATHS 181 were taught by four instructors, three contract faculty and one tenure track faculty. The seven sections of MATHS 221 were taught by four instructors, all tenure track faculty. One tenure track faculty taught several sections of both courses.

Students majoring in education obtain degrees from two different colleges. Students majoring in elementary education, and taking MATHS 181, are pursuing a degree from Teacher's College. Students majoring in secondary mathematics teaching, and taking MATHS 221, are pursuing a degree from the College of Sciences and Humanities. Students majoring in computer science, and taking MATHS 221, are also pursuing a degree from the College of Sciences and Humanities. While the industry and technology majors who take MATHS 181 are pursuing degrees from the College of Applied Sciences and Technology.

All instructors for MATHS 181 used a "self-guided" text with Fathom, Workshop Statistics: Discovery with Data and Fathom (Rossman, Chance, & Lock, 2001). The MATHS 221 instructors used several different textbooks during the semesters of the study. These texts ranged from several traditional texts with technology to most recently Investigating Statistical Concepts, Applications, and Methods (Chance & Rossman, 2006). All of the instructors in both courses used technology, either calculators only, software only, or both calculators and software. However, instructors of both courses did not uniformly use any other innovative teaching strategies, i.e. those suggested in the GAISE report.

2.2 Instruments & Procedure

The SATS-36© contains 36 items that assess six components: Affect, Cognitive Competence, Value, Difficulty, Interest, and Effort. The items use a 7-point Likert-type response scale to assess the six components of students' attitudes toward statistics. Higher scores correspond to more positive attitudes. The SATS-36 also contains three single global attitude items in both the pretest and post-test versions, as well as a global Effort item in the post-test version only. The survey also contains questions about relevant demographic and academic background information which may be related to instructional outcomes.

The SATS-36 pre-test survey was administered to the students present on the first day of class. In the majority of sections for both courses the students were surveyed within the first 20 minutes of the first class. However, a few sections students completed the pre-test during the last 20 minutes of the first class. In both courses and all sections, the SATS-36 post-test survey was administered at an instructor selected class meeting within the first 20 minutes during the week prior to the final exam.

3. Data Analysis & Discussion

One hundred three education majors completed the pre-test but only 88 also completed the post-test. Forty industry and technology majors completed the pre-test but only 34 also completed the post-test. Among the computer sciences majors 56 completed the pre-test while only 31 completed the post-test.

Six repeated measures analysis of variance (ANOVA) were conducted, each with one of the subscales and time of test as the within-subjects factor and college major as the between-subjects factor. A Bonferroni adjustment of $\alpha=.01$ was made to account for the inflation of Type I error. The "affect" and "cognitive" subscales of the SATS showed no differences between the majors in pre- to post-test scores.

The "value" subscale of the SATS did show differences between the majors in pre- to post-test scores, $F(2, 349)=6.617$, $p=.002$. Post hoc analyses showed that education and computer science majors significantly differed on the pre-to post-test 'value' scores from time 1 to time 2 ($p=.002$). The change in value scores from pre- to post-test was greater for

computer science majors than education majors; all students subscale scores for "value" decreased from time 1 to time 2, but computer science majors made the largest decline.

The "difficulty" subscale of the SATS did show differences between the majors as well, $F(2, 349)=6.916$, $p= .001$. Post hoc analyses showed that technology majors differed from both education ($p= .01$) and computer science ($p=.002$). While the "difficulty" scores of education majors did not change from time 1 to time 2, and the "difficulty" scores of computer science majors decreased, the "difficulty" scores of technology students increased from time 1 to time 2.

The "interest" subscale also showed significant differences between the majors, $F(2, 349)=7.673$, $p=.001$. Post hoc analyses showed that education majors significantly differed from both technology ($p=.005$) and computer science ($p=.012$). While all students' scores on the "interest" subscale decreased from time 1 to time 2, education majors made a significant drop in "interest" from time 1 to time 2, nearly a 1 point drop.

The "effort" subscale showed significant differences between the majors in pre- to post-test scores, $F(2, 349)=14.779$, $p=.001$. Post hoc analyses showed that education majors significantly differed from both technology ($p=.02$) and computer science ($p=.001$). Education major's scores on "effort" were relatively stable from time 1 to time 2 compared to technology and computer science majors. Both technology and computer science majors made a decline of nearly 1 point from time 1 to time 2 on "effort".

The results of this study suggest that students' attitudes toward statistics for the most part declined over the course of the semester. It would appear that something in the statistics environment, perhaps the current teaching methods employed, is resulting in a decline in students' attitudes toward statistics. This study provides further evidence for the need to adjust statistics teaching methods such that student attitudes are more positive toward statistics.

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