SATS AT BALL STATE UNIVERSITY: APPROACHES AND ATTITIUDES

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SATS survey data collected from three introductory statistics courses - college algebra-based, college calculus-based, and a high school AP course. Instructors of these courses also completed a questionnaire concerning their approach to a 1st course in statistics. What are the similarities and differences in the students' attitudes to each instructor's approach?

INTRODUCTION

Since the early 90s, many authors have been advocating changes in the teaching of introductory statistics courses (Hogg, 1992; Cobb, 1993; Garfield, 1995; Lock, 2000). Faculty are urged to update their methods and materials to include such items as student generated data, 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.

Concurrently, attention was also given to the assessment and role of beliefs and attitudes in learning statistics (Gal and Ginsburg, 1994; Garfield, Hogg, Schau, and Whittinghill, 2002; Schau, Dauphinee, and Del Vecchio, 1995). A number of instruments using Likert-type responses to statements were developed in the 80s and 90s (Roberts and 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) in the 90s and published an article about its development and validation in 1995.

The purpose of this paper is to describe the similarities and differences in students' attitudes to instructors' approaches in three introductory statistics courses. SATS survey data was collected from three introductory statistics courses taught at Ball State University: a college algebra-based course, a college calculus-based course, and a high school Advanced Placement (AP) course. Instructors also completed a Faculty Course Survey, constructed by the author.

BACKGROUND

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 as well as selected graduate programs.

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. 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.

The Indiana Academy is a two-year residential public high school for gifted and talented students located on the BSU campus. Three hundred juniors and seniors from across the state attend the Academy every year and work toward the Indiana Academic Honors Diploma. The curriculum has extensive offerings in science, mathematics, and humanities with a wide variety of options in higher-level and AP courses.

Candace Shau contends that using good assessments is essential to improving instruction and that attitudes are important in the teaching/learning process. The original version of the SATS was developed using pretest data from a sample of undergraduate students and supported the four-component structure of the SATS-28© (Schau, Stevens, Dauphinee and Del Vecchio, 1995): Affect, Cognitive Competence, Value, and Difficulty. The 28 items use a 7-point Likert-type response scale to assess these four components of students' attitudes toward statistics. Higher scores correspond to more positive attitudes. The survey also contains questions about relevant demographic and academic background information which may be related to instructional outcomes. A newer version, the SATS-36©, contains 36 items that assess six components, the original four plus two more, Interest and Effort. The SATS-36 also contains three single global attitude items in both the pretest and posttest versions, as well as a global Effort item in the posttest version only. Either version, SATS-28 or SATS-36, is designed to be given easily and usually takes about 10 to 15 minutes to complete.

A questionnaire for faculty to complete concerning their approaches to teaching an introductory statistics course was developed by the author for use in analyzing the SATS data. The survey was based primarily on the author's own practice in teaching an introductory course. It consists of questions about the following: type of textbook used; primary method of teaching; use of hands-on activities; use of homework; use of projects; use of tests, including final exam; attendance policy; class participation; extra credit, and grading practices. In addition, there are demographic/background questions about the instructor's education, experience teaching introductory statistics, experience with the current book, and gender. The complete questionnaire is available from the author.

METHOD

- *Participants.*BSU and Indiana Academy students in courses during fall 2004 and spring 2005 were surveyed. Pretest and posttest versions of the SATS-36 were given to students in three sections of MATHS 181 (one fall and two spring), three sections of MATHS 221 (one fall and two spring), and in the spring section of AP Statistics. Five instructors were given the faculty course survey to complete: two instructors for MATHS 181, one each term, two for MATHS 221, one each term, and one for the AP Statistics course.
- *Procedure.* The SATS-36 pretest survey was administered to the students present on the first day of class. For all but one of the sections the students were surveyed within the first 20 minutes of the first class and for the other section it was during the last 20 minutes. The SATS-36 posttest survey was administered at an instructor selected class meeting within the first 20 minutes during the week prior to the final exam.

Three of the instructors were asked to complete the faculty course questionnaire at the same time their students were given the posttest version of the SATS-36. Two instructors, one for MATHS 181 and one for MATHS 221, completed the faculty course questionnaire at the end of the semester following the semester in which they taught the course because the survey was developed after they taught the course.

DATA ANALYSIS

- *Faculty Surveys.* There were very few demographic differences among the five instructors. Three of the five instructors were male teaching MATHS 221 or the AP Statistics course. Two of the five instructors were female teaching MATHS 181. All the instructors were experienced teachers with 9 years, 23 years, and 30 or more years of teaching. All five had previously taught an introductory statistics course. Three of the five had previously taught the current course with the same book at least once. Four of the five had taught the course at least once with a different book. One had a Ph.D. in statistics, three had a Ph.D. in mathematics, and one had a master's in mathematics.

All of the instructors used technology, either calculators only, software only, or both calculators and software. The two instructors of MATHS 181 used a "self-guided" text with Fathom. The other three used a traditional textbook with technology. Three of the five, all male, listed their primary method of teaching as traditional lecture more than 50% of the time. The two

females listed their primary teaching method as traditional lecture less than 25% of the time. All the instructors listed using hand-on activities at least sometimes and using homework for every section covered. Four of the five instructors counted homework toward the final grade. One male and one female instructor used projects in the course and counted it toward the final grade to some degree. Only one instructor required the use of technology, considered writing an important part of all projects, had rubrics, and required the projects be word processed. All the instructors had two or more tests in addition to a final exam, except the AP Statistics course which had eight. Four of the five instructors had a final exam which each described as "comprehensive and contained questions on all material covered." The final exam was 16 to 28 percent of the final grade.

Two of the instructors did not take attendance and only one instructor had attendance affect the final grade. Class participation was required by three of the five instructors. Of these three, only one counted it toward his final grade but two of the three specified that 100% of the students participated in class on a regular basis. Four of the five instructors described their rapport with the class as above average or excellent. One instructor described the rapport as below average. All the instructors indicated that students responded positively to the requirements of the course with a majority of the students completing a majority of the requirements. Four of the five instructors returned graded items within one week of when the item was due. Four of the five provided some means of extra credit. Two of the instructors graded all items and two used student graders for homework. One instructor did not complete this part of the survey. The reported expected grade distributions were very similar except that two of the instructors did not expect to give any Fs.

- *Student Surveys.* Approximately 79%, 89 of 112, of the students completing the pretest version of the SATS-36 also completed the posttest version. Eighty-three students selected White American as their ethnicity, while three selected Asian American, two African American, and one Other American. Among the college students, 74 were pursuing a bachelor's degree, two listed a master's degree, two an associate's degree, one was pursuing certification, and one specified other. The gender breakdown in the two college courses is about 50/50 while the breakdown for the high school course is notably male dominated. There were 20 different majors listed for the college courses.

For the pretest, students across all the courses were the most positive with regard to the effort component, least positive about the difficulty component, slightly positive about both the cognitive competence and value component, and about equally neutral about the affect and interest components. On the three global attitudes scores students across all courses were slightly positive about their math and statistics cognitive competence, but more neutral about career value.

Considering the average differences on the six components and the three global attitude scores, there was only very slight movement after participating in each course. Three of the components, affect, cognitive competence, and difficulty, showed very minor positive differences; while the remaining three, value, interest, and effort, showed minor negative average change. For the three global attitude scores, math cognitive competence showed no difference but career value and statistics cognitive competence both showed minor negative differences.

The average differences for each of the six components and the three global attitude scores were further analyzed to determine if greater difference could be found for students based on various demographic criteria. There was no evidence of any notable differences among the results based on class type (algebra-based, calculus-based, or high school AP course), gender, ethnicity, expected grade in the course, or professor.

DISCUSSION

Essentially the results indicate that students' attitudes toward statistics were not affected by participating in any of the three courses, that is, their attitudes were unchanged from pre to post and there were no differences between the three courses. This in itself is very disappointing. However, it is also alarming that students' attitudes were mostly neutral, averages ranging from 3.7 to 6.3, on all six components and the three global attitude scores. The only noteworthy result is the average pretest score on the effort component which was 6.3 but the average post test score decreased by 0.6.

The results are somewhat surprising in that the author was expecting to see differences between courses and among the professors. Given that the two MATHS 181 instructors used the "self-guided" text with Fathom and used traditional lecture less than 25% of the time, one might expect to see some distinction in the average differences on the six components. However, there was no evidence to support either positive or negative movement. The results seem to indicate that further reform is needed in the two courses at BSU. The small sample size, 9, for the high school AP course precludes any significant determination as to what, if any, changes should be made.

The author plans to continue using the SATS-36 to survey students in the MATHS 181 and MATHS 221 courses since changes are scheduled to occur for the MATHS 221 course. A new textbook has been adopted for the fall 2005 semester and a new, younger and less experienced, faculty member will be teaching the course. In addition, the author plans to further revise her methods of teaching MATHS 181 and there are plans to have additional faculty also teaching the course. It will be interesting once again to look at data collected from several sections to see if any differences are evident.

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