USING TECHNOLOGY IN INTRODUCTORY STATISTICS COURSES

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Introduction

Statistics is often a difficult subject for many undergraduates taking introductory courses in college. Increasing the students' motivation and understanding is always a challenge. The emphasis in teaching introductory statistics courses has shifted lately from formulas and computations to a deeper discussion of the statistical concepts and thinking, as well as their connection to the real world (De Veaux & Velleman, 2008). The appropriate use of technology has been identified as a significant contributor to that end. Using technology can make college teaching of statistics more effective as it improves the quality of instruction, encourages students' active learning, and provides them with psychological incentives (Garfield, 1995; Higazi, 2002). In 2004, a committee created by the American Statistical Association produced the Guidelines for Assessment and Instruction in Statistics Education (GAISE) that recommended the use of technology for introductory statistics courses at college level.

PowerPoint has permeated all aspects of college teaching as a presentation technology resource. Students are more likely to attend classes taught via PowerPoint than traditional lectures (Hulsizer & Woolf, 2009). This success has been associated with the appropriate use of text, images and graphics. Handouts or course packs with the PowerPoint slides, distributed prior to lectures have been recommended to encourage active learning. Hulsizer & Woolf also reported that a majority of published research examining the utility and effectiveness of statistical software programs have focused on SPSS. Karp (1995) considered that the use of SPSS provides students with a tool that enhances their learning experience by allowing them to engage the statistical contents actively and analytically.

In this regards, the use of PowerPoint and statistical software has been previously described by Lock (2005) as a facilitator of learning statistics. Also, Gomez (2009, ICTCM-21) reported the successful integration of PowerPoint and SPSS in an introductory biostatistics course for a small group (n = 18) of selected science majors who had daily access to a desktop personal computer in class. Students learned more quickly and effectively with this technology integration and the use of real data.

This paper reports the daily use of PowerPoint presentations for lectures and the integration of statistical software (SPSS) at three different levels of introductory statistics courses. It summarizes the present author's experience with technology resources while

teaching at Florida International University (FIU) during the last two years. The present author was the instructor for all courses described here. The benefits of this technology integration are discussed, including statistical comparisons to the more traditional approach characterized by a low level use of technology resources.

Method

Course Design

Use of the Web Resources

Use of the Web resources is quite common nowadays while teaching statistics courses at college level. For all courses discussed here, materials posted on the instructor's website provided valuable information to the students. The following list describes the online contents: (a) course description and objectives, (b) syllabus, (c) recommended text exercises, (d) supplementary exercises, and (e) vocabulary. Supplementary exercises were comprehensive in nature and developed by the instructor. These exercises were meant to integrate different topics from the same chapter. The vocabulary file, organized by chapter, included a complete list of definitions and concepts.

Use of PowerPoint

The PowerPoint presentations developed by the instructor for these introductory statistics courses, included: (a) text in the way of definitions, concepts, formulas, examples and exercises (b) tables, figures, and graphs (c) SPSS output and (d) SPSS instructions. Use of burdening slides was avoided. These presentations were structured with the goal of maximizing the students' engagement and active learning in class. Course packs with the PowerPoint slides for these courses have been available since the fall of 2009 facilitating the students' participation in class discussions.

Use of SPSS

The use of SPSS was implemented at three different levels based on the type of introductory statistics course. The software was available at every university computer lab granted by a site license. A description of each level of SPSS application is discussed below.

At the lower level the statistical software was used for first statistics courses serving a variety of college students like psychology, sciences, and business majors. These courses cover three logical units: descriptive statistics, probability, and inferential statistics on a single sample. This type of courses involves a limited use of software, mainly confined to the discussion of SPSS computer output in the form of tables and graphs. Typical enrollment for courses at this level is 50-60 students seating in a classroom with a computer projection system and no personal computers. However, this technology integration was also implemented once in a large class of 200 students for a first statistics course, as previously reported by Gomez (2009, IIC Winter). Data from this large class is included in the results section below.

The middle level was used for second statistics courses serving basically psychology and sciences students. These courses cover five logical units: inferential statistics on two samples, analysis of variance models, regression analysis, chi-square tests for categorical data, and non-parametric statistics. The students were instructed in the use of SPSS during lectures and executed 3-4 take-home assignments at the university computer labs. Assignment reports, including a questions & answers section about the SPSS output and relevant statistical concepts, were required. Typical enrollment for courses at this level was also fifty-sixty students seating in a classroom with a computer projection system and no personal computers.

At the higher level, the statistical software is used with a smaller group of selected science majors seating in a twenty five seat computer lab with a projection system. These students are sophomores enrolled in a special undergraduate program at FIU. This pilot program identified as QBIC (Quantifying Biology in the Classroom) intends to expose students to a more rigorous curriculum that is both interdisciplinary and quantitative in nature. The students take two biostatistics courses that are more rigorously designed and have daily access in class to a desktop personal computer loaded with SPSS. They systematically use the software in class for computations and analyses of real data from biological/biomedical studies. SPSS take-home assignments are also required for this group.

Course Organization and Assessment

All these introductory statistics courses met two/three times per week, between 50 and 100 minutes each depending on the course level and class schedule. A computer connected projector and a screen were used for the PowerPoint presentations. A dry erase board was also used as a supplement for class discussions. Students were required to bring the text book to class as well as the course pack with the PowerPoint slides (or a folder including the Website materials before the course packs were available). Hence, limited notes were needed during classes, allowing students to focus on the discussion of statistical concepts, exercise solutions, as well as the SPSS output and execution.

Student evaluations for all courses at these three levels included two/three midterms and a cumulative final exam, in which SPSS computer output was usually involved. The exams were designed using the "show all work" format, except for the large class. In addition, three SPSS take-home assignments, including software execution, were a component of the evaluation system for the middle and higher levels. For the latter, execution of SPSS procedures was also part of the exams. The inclusion of statistical software in the evaluation system was expected to contribute to the success of this technology based teaching-learning model.

Results

The tables below show the comparison of relevant indicators of the students' performance between groups taking the same course with and without the inclusion of

PowerPoint and SPSS. The indicators used for these comparisons were the retention and passing rates, calculated as the number of non-dropped and passing students relative to enrollment, respectively. Groups and academic terms were chosen in such a way that the comparisons resulted more meaningful in all cases. Table 1 shows data for the Intro to Statistics I course during the last three years (2007-09). Table 2 shows data from the last four times the Intro to Statistics II course was taught. Table 3 shows data from the two times the first introductory biostatistics course has been taught.

Level 1

Table 1: Introduction to Statistics I

Method	*Students Enrolled*	*Students Dropped*	*% Retention*	*Students Passing*	*Gross % Passing*
Traditional	228	16	93%	127	56%
Technology	255	6	98%	198	78%

Level 2

Table 2: Introduction to Statistics II

Method	*Students Enrolled*	*Students Dropped*	*% Retention*	*Students Passing*	*Gross % Passing*
Traditional Summer 2006-07	102	20	80%	60	59%
Technology Summer 2008-09	94	6	94%	78	83%

Level 3

Table 3 Statistics I for *QBIC*

Score Interval (percent of total points)	*No. of students Fall 2008*	*No. of students Fall 2009*
90.0 or above	9	6
80.0 - 89.9	5	7
70.0 – 79.9	4	2
Below 70.0	0	0
Total	18	15

Discussion and Conclusions

Despite possible limitations involved, these comparisons provide useful information about the effectiveness of integrating PowerPoint and SPSS in introductory statistics courses. A data analysis from Table 1, with low level groups, indicates that the retention rate was statistically higher for classes with technology resources (p-value = .007). Also, the gross passing rate with technology integration was 22 points of percentage higher than the result of the non-technology classes; this difference was highly significant (p-value < .0001).

Similar analysis for Table 2 with midlevel groups indicates that the higher retention rate for classes with the two technology additions was statistically significant (p-value < .0001). The gross passing rate with technology integration was 24 points of percentage higher than the non-technology classes; this statistical difference was also highly significant (p-value < .0001).

Table 3 shows grouped data summarizing the performance of QBIC students (high level group) on Statistics I during the fall of 2008 and fall of 2009. The grade categories are expressed as percentages of the totality of evaluations. All QBIC students passed the class in either year. The median score was 90 for the fall of 2008 and 89 for the fall of 2009. The consistently high performance of QBIC students is notable.

Concurrently to the implementation of this technology integration I have observed that overall students' satisfaction has increased. The percentage of students' assessment of instruction with excellent/very good opinions (overall assessment) during the last two years (2008-2009) has risen to 88% with 67% in the category of excellent compared to 80% and 54% respectively for my previous eight years at FIU (1999-2007).

The use of Power Point where text was presented in conjunction with graphs and other pictorial representations helped students with a more visually oriented learning style. The course pack with PowerPoint slides and the use of SPSS results for graphs and data computations provided more time and helped students to focus on class discussions.

This methodology based on technology integration has promoted overall active learning as students' engagement increased, and consequently their understanding of statistics improved. This discussion suggests that the integration of PowerPoint and SPSS into other traditional resources provided a very effective teaching-learning model for these three types of introductory statistics courses at college level. The use of these two technology resources improved the quality of instruction as well as students' motivation and understanding.

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