A study of the gender differences on spreadsheet grades for undergraduate students

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ABSTRACT

The purpose of this study is to investigate the differences between genders on the scores of a series of spreadsheet projects in a survey computer information systems course. This study hypothesizes that there will be significance in scores in the ten assigned projects between female students and males students; with the female students scoring higher than male students in a majority of the projects. Additionally, this study hypothesizes that there will be a significant difference in the mean project score for all ten projects with the female students scoring higher than the male students. Group statistics and t-tests were used to determine significance between females and males. Among the discoveries, except for a slight difference in two of the projects, there was no significance between female and male students' project scores. An interesting downward trend in mean scores emerged as the projects progressed.

Keywords: spreadsheets, student performance, gender differences, gender-based learning, automatic spreadsheet grading

INTRODUCTION

The purpose of this study is to investigate the differences between genders on the scores of a series of spreadsheet projects in a survey computer information systems course. The course in which the projects are administered, Principles of Information Systems, is designed as a required service class for all business majors but is also taken by other majors outside of the business college. Its purpose, including learning the fundamental principles of information systems, is to introduce Excel spreadsheet concepts that range from the most basic arithmetic concepts, to the more advanced what-if analysis. Excel is introduced to the student through a product called Casegrader for Excel 2007© by Crews and Murphy and published by Cengage Learning. "Casegrader is a Web-based technology plus printed workbook that contains hands-on, live-in-the-application projects for Microsoft Excel 2007. Students complete the projects, and then post them online through a secure portal to be automatically graded within seconds" (Cengage, n.d., ¶ 2). Class sizes typically range from 30 – 40 students with one instructor and no teaching assistants.

The basic premise for teaching the spreadsheet portion of these classes is to engage the student at their current spreadsheet knowledge level and assist them in learning more advanced skills over the course of the semester. While doing this, the student should increase his or her self-confidence as Lam (2009), implies that increasing their self-confidence will improve the students' strategies for the more difficult projects. Walker, Brownlee, Lennox, Exley, Howells, & Cocker (2009), posited that strategies are not inate; therefore, it is likely the desire of the instructor to assist the student in developing his or her strategy to successfully complete the course.

LITERATURE REVIEW

Historical View

There is an abundance of literature that compares the way females and males learn, but over time it is slowly changing. Hawi (2010), speculates that the causal attributions for success and failure are "learning strategy, lack of study, lack of practice, subject difficulty, lack of effort, appropriate teaching method, exam anxiety, cheating, lack of time, and unfair treatment" (p. 1127). He did not find any gender differences when these attributes were taken into account. However, thirty-five years ago females were found to have lower self-confidence than males in almost all achievement situations which resulted in lower success (Lenny, 1977, Sutherland, 1978). Just ten years later, Gigliotti & Secrest (1988), provided evidence that gender did not matter when the individuals were given clear directions to complete a specific task. Fry, Greenop, Turnbull, & Bowman (2010), corroborated this supposition in a more recent study finding that no gender differences were evident. They did find that the gender differences [in the past] could be attributed to lack of motivation and differences in risk-taking.

Stress and Self-Confidence

While, Hawi (2010), Gigliotti & Secrest (1988), and Fri et al (2010) did not take gender stress into consideration, Weinstein & Laverghetta (2009), found that female students reported higher stress scores than did males. Much of the stress associated with learning can be attributed

to lack of self-confidence. Hargrove, Wheatland, Ding, & Brown (2008), found that females entering an engineering program with better academic standing, had better educated parents, and better standardized test scores than male students, often have more anxiety and less self-confidence than their male counterparts. Ironically, the females' GPAs were not significantly different than their male counterparts. Lam (2009), addresses this phenomenon as females tend to be more self-directed learners, especially in web-based courses. One problem that may be experienced though is that students that have a "bad" beginning semester "end up disadvantaged throughout the program" (Noack, Antimirova, & Bilner-Bolotin, 2009).

Attitudes and Learning

Along with being self-directed, Meit, Borges, Cubic, & Seibel (2007), posited that female students are more dutiful and persevering in their studies, more self-disciplined but more likely to be self-doubting. These attitudes are favorable and generally more positive than males; however, females need face-to-face interaction to fully develop both teacher-student relationships as well as student-student relationships that enhance learning (Chen & Tsai, 2007). Learning success may be attributed to student strategies. In a study by Simsek & Balaban (2010), appropriate strategies were most effectively used by females. These strategies included rehearsal, organization and [self] motivation.

.xHowever, this same study identified that the correct strategies were dependent on the field of study. Female students in a technical or science field were twice as likely to use an effective strategy as their male counterparts to be successful. Walker et al (2009), added that successful strategies were not inate.

Learning Styles

Males and females have different learning styles but that has also evolved over time. In 1990, it was found that males tended to learn best by visual, tactual and mobility (Miller, Finley, & McKinley, 1990). However in a study by Ramayah, Sivanandan, Nasrijal, Letchumanan, & Leong (2009), it was discovered that females preferred visual and aural learning styles. This implies that female students may learn better by watching and listening to a demonstration whereas male students learn by actually performing the steps necessary for completing projects. Additionally, males tend to be more intuitive and females are more sensing (Alumran, 2008). Females tend to learn best when they work alone and generally shy away from team environments (Kaenzig, Anderson, Hyatt, & Griffin, 2006). One possible explanation to the contrast in the study by Chen & Tsai (2007), is that female students need to nurture their social relationships in order to excel in their university studies. With respect to the male student, this may explain why Quinn, Thomas, Slack, Casey, Thexton, & Noble (2006), found that pride was a leading attribute for male students to motivate learning.

METHODOLOGY

It is hypothesized that female students will score significantly higher than male students in Casegrader for Excel 2007 by Crews and Murphy when all ten projects are compositely averaged. This is based on the premise that female students are more dutiful, persevering, and self-disciplined in their studies (Meit et al, 2007).

The second hypothesis is that as each project increases in difficulty (increasing projects contain more rigor) female students will outperform male students. This is based on a finding by Chen and Tsai's (2007), that female students, more so than male students employ successful strategies.

PARTICIPANTS

The students in this study were selected based on a convenience sample in multiple classes at one south-central public university in the United States. The total number of students was 878 with 525 male students and 353 female students. The classes are fairly standardized across sections with each using similar syllabi, assignments, and assessments. Students' grade data were not used in the analysis if they completed less than eight projects or dropped the class.

DATA COLLECTION AND PROCEDURES

The data were collected from multiple classes beginning in the spring semester of 2007 and ending in the fall semester of 2009. The data were the percentage grades of each completed project of Casegrader Excel 2007 by Crews and Murphy and published by Cengage Learning. Each project was scored by an automated engine developed by the authors that has near-100% accuracy according to one of the authors, Dr. Thad Crews (personal interview, March 2, 2010). Dr. Crews said that over one million projects across the United States and Canada have been successfully uploaded by students and accurately graded by a sophisticated computer system.

Student biographical data were requested and obtained through the student records section of the university after permission was granted by the Institution Research Board. This data included the student's sex, age, class type (online or face-to-face), and program of study. The data were summarized in Table 2 (Appendix) according to project number, sex, mean scores, standard deviation, t-scores, degrees of freedom, and the upper and lower confidence intervals. A chart, annotating the difference in mean scores for female and males is found in the Appendix (Figure 1).

DATA ANALYSIS

The students were divided into two groups, females and males. A t-test was conducted to test the first hypothesis that there will be a significant difference in performance between genders for at least six of the ten projects. Additionally, this same t-test was used to test the second hypothesis that there will be a significant difference in the mean project scores between female and male students when all ten projects are considered.

FINDINGS

No support was demonstrated for the first hypothesis. However, while there was no statistically significant difference between female and male students' Casegrader scores (Appendix, Table 2 and Figure 1), female students scored higher in eight out of ten projects. The second hypothesis was also not supported. While female students scored slightly higher than male students when the mean of all ten projects were considered, there was not a significant difference. One anomaly that was discovered is the drastic drop in both female and male scores

from Project 4 to Project 5. Another anomaly that was discovered between the female students and the male students involved Project 6. The spread between scores was the greatest (2.88 points) found in the 10 projects.

DISCUSSION OF FINDINGS

It was not surprising that female students scored higher in most projects, but it was surprising that there was not a statistically significant difference between their scores and the scores of the male students. Female students have been found to be more strategic (Simsek & Balaban, 2010), tend to perform better individually as opposed to in a team environment (Kaenzig et al, 2006), and are more dutiful and self-disciplined (Meit et al, 2007). None of the classes where this data were obtained uses team concepts. While students are allowed to work with other students, most students are given ample lab time and typically work on their own, probably because of their unique schedules and the ability to come and go from the lab at will.

However, Weinstein & Laverghetta (2009), discovered that stress found in female students have a detrimental effect on their grades, although their GPA was not adversely affected in a technology-related program. Stress is related to self-confidence and self-confidence to grades but not to the student's GPA (Hargrove, et al, 2009). This could be attributed to the female student coping mechanism that provides them a strategy for overall success (Simsek & Balaban, 2010), implying that although stress may affect a project grade, or even a class grade, female students cope by excelling in another class.

One interesting disparity, and also the largest grade difference between the female and male students though, was Project 6. This project requires students to manipulate and solve several formulas and functions. This project is unique in that it requires the download, manipulation, and submission of multiple Excel files, as opposed to working with a single file. It is posited that female students pay more attention to detail and are more self disciplined than male students (Meit, et al, 2007). This could account for the disparity between female grades and male grades for this specific project, as it requires greater attention to detail than any other project in the series.

The other interesting phenomenon was the decreasing scores from Project one to Project ten (Appendix, Figure 1). While one could argue that the earlier cases are easier and the student is still learning, it would be reasonable to observe the opposite trend. Also, faculty spend minimal demonstration time with the first three cases but demonstrate in greater detail the spreadsheet concepts for the later, more rigorous, cases. It would stand to reason that based on the student's increased familiarity with spreadsheets and the fact that faculty members are demonstrating the case attributes, the trend would develop in an opposite fashion.

The final anomaly that is present in the data is the 12-point drop from Project 4 to Project 5. Not only is this the most dramatic drop, it is the only 5 point drop between projects. Students have already learned most of the project attributes in previous projects, so the only new attribute introduced to them is the spreadsheet data table. However, the pivot table and the pivot chart are complex in nature so they may be causing some anxiety. This is inconsistent with previous findings where females reported higher stress scores which might lead one to believe that their drop on this case would be more dramatic.

ADDITIONAL RESEARCH

Additional research is recommended that would compare the face-to-face class with the online class to see if there is any significant difference. Lam (2009) speculated that female students are more self-directed learners so that it would be reasonable to expect they would do better than male students in an online [isolated] environment; however, Chen and Tsai (2007) argue that female students need face-to-face interaction with the instructor moreso than male students.

A case study needs to be conducted that compares one instructor with another using several affective attributes. Gender, experience, degree, and methodology should be considered to see what effect, if any, these differences have on student performance. A case study is recommended because Yin (2003), states that a case study is used "when the researcher deliberately wants to cover contextual conditions, believing that they might be highly pertinent to the phenomenon of study" (p. 13).

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APPENDIX

Table 1: Demographics

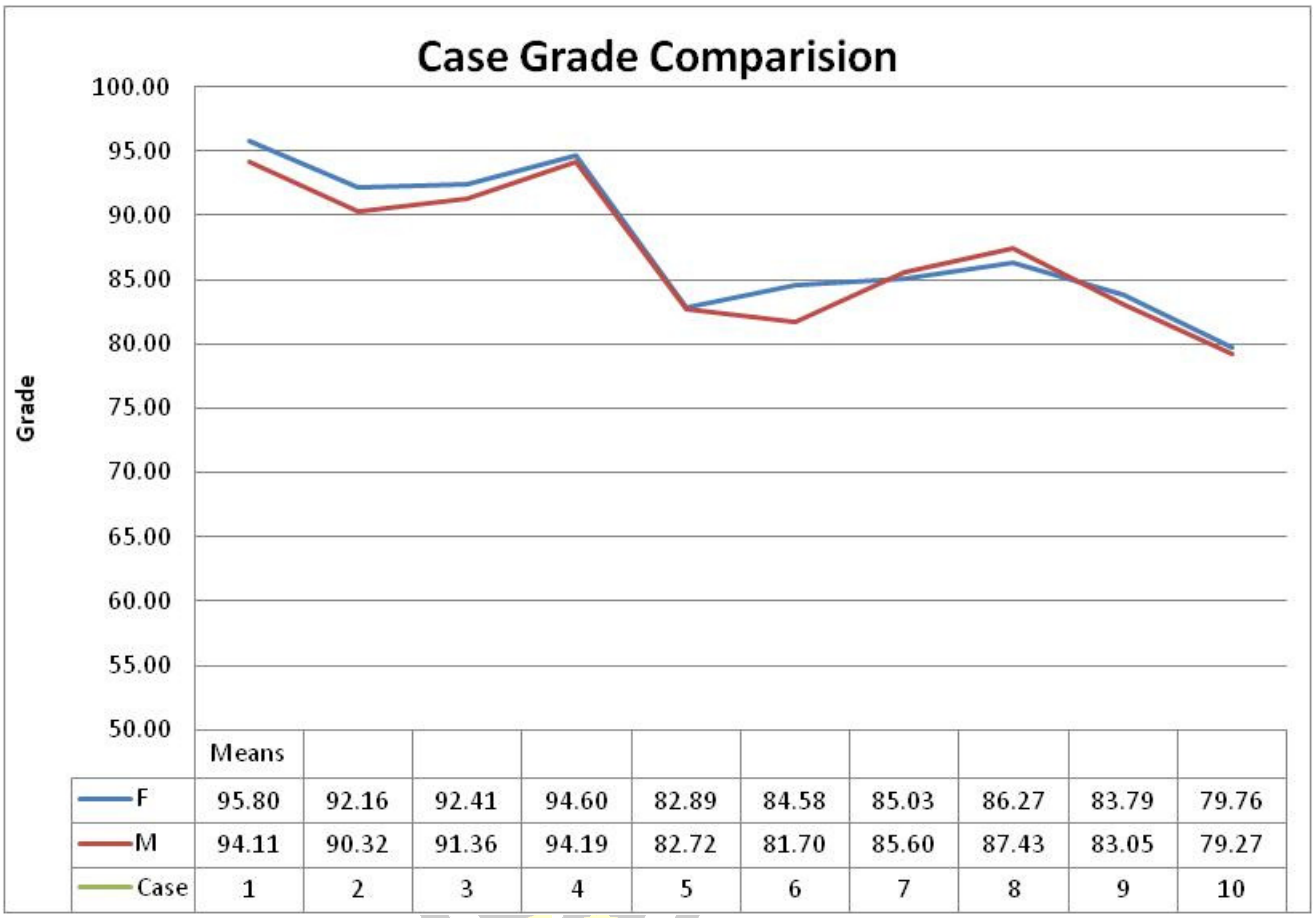
		Total
Gender	Male	525
	Female	353
Age	Average	23
	Minimum	19
	Maximum	55

Table 2: Data Analysis Results

						95% CI	
Project	**Sex**	**Mean**	**Std Dev**	**t**	**df**	**Lower**	**Upper**
1	F	95.80	16.22	1.422	820	-0.6441	4.0277
	M	94.11	18.76				
2	F	92.16	14.71	1.761	790	-0.2116	3.8929
	M	90.32	15.86				
3	F	92.41	14.91	0.973	808	-1.0685	3.1676
	M	91.36	16.74				
4	F	94.60	10.94	0.497	849	-1.224	2.0549
	M	94.19	13.71				
5	F	82.89	26.06	0.096	733	-3.3031	3.6411
	M	82.72	25.11				
6	F	84.58	26.00	0.122	876	-0.7757	6.5374
	M	81.70	28.55				
7	F	85.03	27.50	0.459	778	-2.3626	5.2302
	M	85.60	28.94				
8	F	86.27	21.87	0.424	691	-3.9939	4.617
	M	87.43	19.55				
9	F	83.79	28.97	0.71	737	-3.1451	4.617
	M	83.05	28.25				
10	F	79.76	25.01	0.778	774	-2.9474	3.9349
	M	79.27	26.10				
Average	F	87.73	1.16	0.228	744	-0.6033	2.5241
	M	86.77	1.15				

N = 878

Figure 1: Comparison of Female and Male Project Grades



	Means									
F	95.80	92.16	92.41	94.60	82.89	84.58	85.03	86.27	83.79	79.76
M	94.11	90.32	91.36	94.19	82.72	81.70	85.60	87.43	83.05	79.27
Case	1	2	3	4	5	6	7	8	9	10