

Simulation software's effect on college students spreadsheet project scores

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ABSTRACT

The purpose of this study is to explore the potential impact of support materials on student spreadsheet skill acquisition. Specifically, this study examines the use of an online spreadsheet simulation tool versus a printed book across two independent student groups. This study hypothesizes that the online spreadsheet simulation tool will have a greater positive impact on student performance than a printed book. Student performance was measured using scores on 10 individual spreadsheet projects and an overall average of these 10 scores. T-tests were used to determine significance since the project scores are independent and means were compared only across two groups. Significant differences were observed between the groups for two of the ten projects, but further research is needed to identify additional factors that may influence these findings.

Keywords: spreadsheets, simulation, student performance, technology adoption

INTRODUCTION

University professors teaching survey of management information system courses routinely strive to find methods of engaging their students (Mukherjee, 2000; Ramiller, 2003). Spreadsheets used for business modelling are relevant to diverse disciplines like marketing, finance and accounting, and engaging to students (Alexander, 1996; Ganesh & Paswan, 2010; Van Mourik, 2006). Courses in these disciplines are diverse in terms of the appropriate mix of conceptual material and activities designed for enhanced skill proficiencies. There is also diversity in the types of students enrolling in such courses (Sabry & Barker, 2009). Accreditation plays a central role in any academic institution and schools of business are no exception placing great importance on inclusion into the Association to Advance Collegiate Schools of Business (AACSB). Business schools with AACSB accreditation require programs to provide “learning experiences addressing both general and management-specific learning goals” (AACSB, 2006) which includes the use of information technology. Using data collected over the last three years, two distinct methods for supporting undergraduate student spreadsheet skills acquisition have been employed. One method fits the more traditional approach of supplementing instructional lectures, both face-to-face and pre-recorded video formats, with a comprehensive spreadsheet reference book. The more recent adaptation involves using an online simulation software package that employs a methodological approach of “teach me, show me, let me try” for skill building (McGraw-Hill, 2005) in an interactive, spreadsheet-like environment. This paper investigates differences between the two approaches with regard to their impact on student performance. Because of the relatively short period of time that Internet-based, simulation tools have been available for student use, a review of the origins of tutorials is included.

LITERATURE REVIEW

The introduction of new technology into the education realm will inevitably create debate as to its effectiveness. Some educators will argue that technology enhances learning while others will take the stance that it may conflict with students’ thought processes (Jackson, Gaudet, McDaniel, & Brammer, 2009; Roman, 2009). When printed books were first introduced in large numbers in institutions, educators most likely perceived the new tool as either an aid to learning or felt threatened as the traditional conveyor of knowledge and certainly often hold different views than the textbook on core principles (Cuban, 2007; Leonidou, Kaminarides, & Panayides, 2007). When electronic calculators became widely available the debate as to whether students should be allowed to use them in class was almost immediate (Fleener, 1995; Herman, 2007). Personal computers added to this discussion, and as the costs of both computers and productivity software continues to decline additional fuel is being added to fire.

Electronic spreadsheet software, like Lotus 1-2-3[®] and Microsoft Excel[®] are useful to students in various ways. First, more disciplines are beginning to integrate computer-based skills into their curriculum (Alexander, 1996; Ganesh & Paswan, 2010; McKeown & Piercy, 1997). Perhaps more importantly, spreadsheet software is very useful for modelling business problems and enabling data analysis using what-if, pivot tables, and even statistical analysis functionality (Van Mourik, 2006).

The transference of knowledge in the use of spreadsheet software includes demonstrating its various uses and then providing the student with sufficient opportunities as to reasonably

ensure that competencies are acquired. One method may that produces results is the demonstration and practice method. Instructors in this approach demonstrate to students how selected functions work and then ask students to work through problems that require the demonstrated skills application. Often these results are limited by the student becoming dependent on the professor to demonstrate, observe, practice, and then examine (Vitt, 2006). Howard (2007), suggests that “we must look forward...testing promising developments...while holding on to the established practices of the past” (p.31). Moving forward may include the use of supplemental reference materials, like video tutorials, online guides, and software simulations. Tutorials can be enhanced by using a book that serves as a reference guide and can engage students actively and more deeply in the learning process (Gareis, 2007).

The progression from tutorial-type books to an electronic tutorial or simulation may allow students to test their abilities within a “realistic, real-time environment” (Newman, 2007, p. 466). Natarajan (2006) suggests that the Internet allows students to have more opportunities and overcomes the challenges of time and travel restraints of face-to-face education. When students are conducting simulation activities, they are also learning about processes. According to Foti (2007), simulations are tools used for learning rather than tools for productivity. In this instance, productivity would be constrained to work-place environment effectiveness. Batscha & Moloney (2005) posits that simulations when used as a study tool, are helpful for preparing for and passing examinations; Polito, Kros, and Watson (2004) had similar results when examining simulation-based tools for improving exam scores, and other studies suggests that simulations are beneficial for critical thinking and problem-solving skills in clinical settings (Feingold, Calaluce, & Kallen, 2004).

In the business environment, needs are met using simulation modelling and analysis (Hwarng, 2001). Today’s business environment presents a series of complex tasks; tasks that students will face as they embark in a competitive and often unforgiving workplace. “We must equip our business students with simulation modelling skills or leave them incompetent for the dynamic business world of today” (p. 74). Tools that are prevalent in organizations and the skills to utilize them are necessities for today’s college students. Simulation tools are becoming increasingly available to people and the need to understand the impact of such tools is critical. Bert (1998), a civil engineer, proposed that simulation will reassure them [the students] that the theory does match the practice. Providing sufficient relevance to enable the learner to utilize an spreadsheet-based simulation to model business problems and then to practically apply those using spreadsheet skills is the ultimate goal.

METHODOLOGY

It is hypothesized that there are significant positive differences between college students’ individual spreadsheet project scores when a computer-based simulation spreadsheet learning tool is used as compared to a reference book. Further, there are significant positive differences between college students’ spreadsheet composite scores when a computer-based simulation spreadsheet learning tool is used as compared to a reference book.

The initial hypothesis links each individual simulation lesson with the associated spreadsheet project score. The second hypothesizes that student’s overall spreadsheet average scores among ten projects will indicate a positive significance when the simulation software lessons are used as a teaching tool.

Participants

Participants selected in this study were students in established sections of principles of management information systems survey courses at one south central, public university. The total number of students included in this study is 879; with 730 students using the reference book between fall 2007 and summer 2009, and 149 students using the electronic simulation beginning in the fall of 2009.. The sections represent a convenience sample and there are no perceived differences between these sections in terms of student selection beyond the typical registration process. Students that dropped the class or students that completed less than eight out of ten projects were not used in our study.

Data Collection and Procedures

The data was collected across several semesters beginning in 2007 using spreadsheet projects offered through Casegrader for Excel 2007® by Crews and Murphy and published by Cengage Learning. The projects in this particular text are scored using an automated engine that has been shown to be accurate, consistent, and reliable. According to one author, Dr. Thad Crews (personal interview, March 2, 2010), over one million projects have been consistently and successfully graded for thousands of students across campuses throughout the U.S. and Canada. The Excel Reference text, *New Perspectives - Excel 2007 Comprehensive*, published by Course Technology, was the book used from fall 2007 until the fall of 2009. The book was replaced with an Internet-based, simulation package beginning in the fall of 2009. The simulation software in use, SimNet® by McGraw-Hill, uses a sophisticated Flash simulation model to emulate Excel 2007 and provides for the creation of lessons, examinations and other learning support mechanisms. The use of two disparate tools, Casegrader for Excel 2007 and SimNet, developed separately, is expected to reduce research bias.

Biographical data was requested and obtained from university records and merged using Excel with the student score data. This data included the students' sex, course section number, student identification number, as well as other biographical data. The course section number is coded so that face-to-face and online sections are distinguishable, and a simple code to identify each type of class offering was inserted for each participant to enable further data analysis for future studies. The demographic data are summarized in Table 1 (Appendix).

Data Analysis

The students were divided into two groups, those who used the reference book and those who used the electronic simulation tool. To test hypothesis H1, a single-tailed t-test was performed to compare students' individual Casegrader project scores between the two groups. To test hypothesis H2, a second single-tailed t-test was then performed to compare students' overall project score averages across the two groups. According to Bekiroğlu (2001) and Hair et al. (1998), when two means taken from independent groups are compared, the t test is sufficient for determining if the means are significantly different. In this instance, the mean score of each independent project was compared between the group that used a reference book and the group that used the software.

FINDINGS

The results of our data analysis were mixed. The hypothesis that states that there are significant positive differences between college student's individual spreadsheet scores when a computer-based simulation spreadsheet learning tool is supported in two projects. The results for projects 7 and 8 indicated significant support for this hypothesis. The secondary hypothesis states that there are significant positive differences between college student's spreadsheet composite scores when a computer-based simulation spreadsheet learning tool is used, was not supported. The results of the hypotheses testing are presented in Table 2 (Appendix). Although the differences were insignificant in most projects, it should be noted that a positive and growing gap was observed between SimNet and the book, especially across projects 5 through 8 as shown in Figure 1 (Appendix). In addition, though not significant, the composite score for students using SimNet was also greater than the score of those using the book.

DISCUSSION OF FINDINGS

The original hypothesis that significant differences would exist between the use of a reference book and an online simulation tool is largely a perceived one. As noted, significant differences were not observed for several projects. One possible explanation for these results may be the specific book used as a reference. The book was written in conjunction with Casegrader; thus it provides specific examples that coincide directly with the steps of each project. This direct linkage to Casegrader may have led to somewhat inflated scores, as students could directly imitate the steps provided in the book. In addition, the Excel book contains definitions of terms as well as explanations of how the terms are used within the spreadsheet. The SimNet simulation did not precisely follow the projects; and in some instances, key spreadsheet competencies were absent. While omission of the book-similar steps was explained to the students during orientation and again during lab sessions, many students later commented that they did not take additional time to perform their own research to resolve the more arduous steps.

Batscha and Moloney (2005) found that simulations can aid exam success when used as a study tool. In the current study, it is likely that most students used SimNet as a help resource rather than a study tool. In other words, they accessed SimNet only for assistance on difficult steps in each project, as opposed to completing the entire simulation. An increased significance for student performance may have resulted had students completed each simulation prior to beginning the project.

Projects 7 and 8 did indicate significance which may be explained by the introduction of skills that students are less likely to have encountered previously, such as nested if statements, lookup functions, macros, and even database commands. Projects 6 and 10 did not indicate significance which was surprising due the complexity of multiple workbooks in project 6 and the introduction of data tables and what-if tools in project 10. Project 9 integrates relatively simple skills into several worksheets that solve accounting and finance problems. It is posited that business students are better equipped to relate the application of the skills in this instance with the problems presented for purely contextual reasons. McKeown and Piercy (1997) demonstrated this by integrating spreadsheets into introductory marketing and finance courses that resulted in students performing significantly higher using a pre- and post-test methodology. Finally, it should be noted that the individual learning styles of each student were not taken into

consideration. In order to further explain the scores of each project, the student's individual learning style should be taken into account (Baldwin & Sabry, 2003).

It is interesting to note that, although the differences in scores across the two groups were insignificant for most projects, Figure 1 (Appendix) demonstrates a gap in the scores that tends to widen in favor of SimNet across the more complicated projects. This is perhaps due in part to an increase in faculty-student interaction as the semester progresses. Very little time is spent during labs covering details for the first few projects; however, as the projects progress in number and rigor, each faculty member describes the project in greater detail, and demonstrates examples during the open lab sessions allowing students to ask questions. These observations are in line with the findings of Vitt (2006), who indicated that, traditionally, technology skills have been taught through active student-instructor interaction, including demonstration, practice, and observation. It is likely that these interactions have not yet been replaced by SimNet, but rather have been supplemented, especially in the face-to-face classes. Thus, the impact of SimNet on student performance may be diluted due to the continued presence of student-teacher interaction.

Additional Research

Additionally, the computer information systems course in which these assignments are assigned is offered in both face-to-face and online venues. Additional analysis is necessary to further identify differences between student performance comparing the use of the reference book and SimNet within each type of offering, differences in performance using gender as the control variable, and differences between majors within the various disciplines represented.

While each faculty member uses the same course resources, additional studies should be considered that compares perceived pedagogical differences between instructors to explore implications on student performance. The types of differences proposed should focus on the strategic approach to teaching and learning. For example, Hornby, Jennings, & Nulty (2009) report that faculty should consider using an action research framework to engage in deep approaches to learning, while Mathews (2008) posits that Case-Based Reasoning [CBR] allows the student to explore the depth of the material and they actually enjoyed this approach better than non case-based approaches to learning. Additionally, Mathews said that it did not matter whether the class was internal [face-to-face] or distance-based; and the student's perception was that "CBR enhanced their learning" (p. 26). Specifically, further work should be performed that would compare teaching style differences, professor reputation, and student project lab participation.

APPENDIX

Table 1: Demographic Data

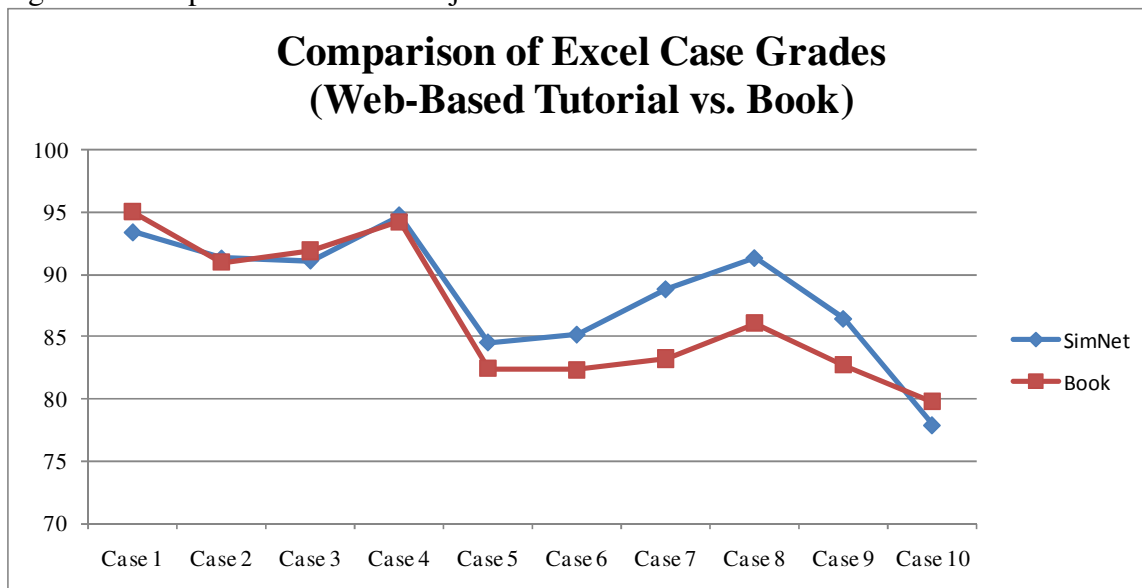
		Book Users	SimNet Users
Gender	Male	440	85
	Female	289	64
Age	Average	24	23
	Minimum	19	19
	Maximum	55	41
Class Type	Face to Face	336	79
	Online	393	70
Program of Study	Accounting	98	20
	Management	187	35
	Marketing	134	37
	Finance	74	17
	Business & Marketing Education	7	0
	Economics	22	9
	Computer Information Systems	20	3
	Business Administration	5	1
	Undeclared	33	8
	Outside the College of Business	149	19

Table 2: Data Analysis Results

Excel Project	Resource	Mean	Standard Deviation	t-Statistic for Differences
Project 1	Web-Based	93.40	22.25	0.865
	Book	95.07	16.73	
Project 2	Web-Based	91.31	15.49	-0.211
	Book	91.01	15.42	
Project 3	Web-Based	91.14	18.68	0.474
	Book	91.92	15.44	
Project 4	Web-Based	94.78	14.62	-0.396
	Book	94.28	12.24	
Project 5	Web-Based	84.55	23.77	-0.971
	Book	82.44	25.80	
Project 6	Web-Based	85.17	26.48	-1.159
	Book	82.39	27.77	
Project 7	Web-Based	88.83	23.68	-2.516*
	Book	83.24	29.14	
Project 8	Web-Based	91.33	13.16	-3.985**
	Book	85.96	21.81	
Project 9	Web-Based	86.44	25.15	-1.640
	Book	82.62	29.27	
Project 10	Web-Based	77.87	28.39	0.775
	Book	79.81	25.06	
Overall Project Grade	Web-Based	88.48	11.01	-1.609
	Book	86.87	11.62	

Web-Based N = 149, Book N = 729.
 p<.05*, p<.01**.

Figure 1: Comparison of Excel Project Grades



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