Differences in Gender and Lecture Modes in Knowledge of Computer Concepts Prior to Computer Classes

Dr. Hyo-Joo Han, Georgia Southern University, hhan@georgiasouthern.edu
Dr. Ron MacKinnon, Georgia Southern University, rmackinn@georgiasouthern.edu
Dr. Tom Case, Georgia Southern University, tcase@georgiasouthern.edu

ABSTRACT

A computer concepts test was used to assess student computing concepts knowledge levels in traditional face- to- face and online sections of an introductory computing course. This assessment was conducted during the first semester of the course in order to measure the depth and breadth of student knowledge of computing when they first enter the course. More specific objectives of this study were to investigate whether there is a difference in the level of computer concepts knowledge between (1) students enrolled in online classes and students enrolled in traditional face-to-face classes and (2) male and female students. The results of this study indicate that students with higher computer concepts knowledge levels are more likely than students with lower levels of computer concepts to enroll in an online section. This paper provides an overview of the major computer concepts areas on which students were tested and includes summary of the analyses performed to test the investigation's hypotheses.

Keywords: Computer Concepts, Computer Literacy, Online Learning

INTRODUCTION

Like rapidly changing, technology-driven businesses, universities are challenged to monitor the baseline levels of computer knowledge possessed by their members and to take corrective action when there are deficiencies [5]. The prevalence of knowledge work has spurred most universities to include an introductory computer concepts course in their undergraduate curriculum. Because university students are among the most prolific computer users, online classes are becoming more popular and accepted by both students and instructors. Ongoing research about online students' characteristics and computing knowledge is needed to ensure that online instruction is successful.

Instructors who teach an introductory computing course at a mid-sized university decided to compare the incoming computer concepts knowledge levels of students enrolled in a traditional face-to-face section to those enrolled in an online section of the same course. In addition to studying the characteristics of students enrolled in traditional and online sections, gender differences in computer concepts knowledge was also examined. In 2004 and 2005, Wallace and Clatiana [19] used a Course Technology computer concepts test similar to the test that was used in the study described below. McDonald [12] also used a similar tool in his investigation that was developed by Thompson; Thompson Prometric's Introduction to Computing test is used to evaluate student knowledge of computer vocabulary, definitions, concepts, and general computer literacy [7].

For this study, the same 100-item test was used in both the traditional and online sections of the introductory computing course to assess the breadth and depth of student knowledge of computing concepts at both the beginning and end of the course. The same textbook was used in these sections of the course: *Discovering Computers* by Shelly, Cashman & Vermaat [17] published by Course Technology. The ancillary material for this text includes a "test out" package of 160 questions from 15 chapters of their textbook. The authors selected 100 questions from the "test out" package to serve as general computing concepts proficiency/literacy test.

The objective of this study was to investigate whether there is a difference in level of computer concepts knowledge, prior to any college level computer class, (1) between students enrolled in online classes and students enrolled in traditional face-to-face classes and (2) between male and female students.

LITERATURE REVIEW

Computer Literacy for Introductory Course

Computer literacy has frequently been observed to be a fundamental part of undergraduate education [15]. This has spurred educators to develop a number of different computer concepts tests for use as tools to test university students' basic computer skills and knowledge [2, 4, 12, 14, 15]. Today, most students complete one or more computing courses in high school before entering college [14]. College students are also among the most prolific everyday users of computers and many of their everyday computer use patterns began while they were in high school. High school computer exposure/experience has spawned a debate among university IS/IT educators about the value and need for an introductory computer course in university curricula [4].

Most high school and university students use computers extensively, for recreation as well as for academics. Those with more knowledge and positive perceptions of computers are often expected to be more successful in computer courses than peers who lack these attributes. However, Case et al. [2] determined that frequency of daily computer use was the only reliable predictor of success on a computer competency exam. The number of high school courses taken and the number of years of computer use (variables that are often assumed to correlate with greater computer knowledge) were not reliable predictors.

Lack of control over the breadth, depth, and quality of computer knowledge gained in high school and/or personal experience places university instructors of introduction to computer courses in a difficult position. If the level of computer knowledge is uniformly high for students in a class, the instructor is challenged to structure his/her course to build on the existing knowledge base and provide additional depth and breadth. The instructor faces difficult challenges when the mix of pre-existing knowledge and experience levels among students enrolled in the class is highly diverse.

Gender

Several studies have demonstrated differences in attitudes towards computers and technology between males and females. Higher levels of computer anxiety and avoidance have been observed among females [10]; computer anxiety has also been found to be negatively related to computer efficacy [3]. Because higher levels of anxiety, avoidance, and lower levels of computer efficacy are likely to translate into less frequent computer use and knowledge, the authors hypothesized that male students are likely to know more about computers than female students at the beginning of a university-level computing concepts class.

***H1**: Male students have more computer concepts knowledge than female students upon entry into an introductory computer concepts course.*

It is important to note that H1 only concerns the level of computer concepts knowledge at the beginning of the course. Other studies, including Friday at el [3], indicate that women may out-perform men in computing courses. Hence, while males may enter course with greater knowledge than females, it is possible that female students will have better final grades than male students at the end of this semester and that gaps between male and female computer knowledge levels may be reversed at the conclusion of the course.

Online and Traditional Class Students Characteristics

The effectiveness of online learning has become an issue for most universities as online instruction becomes an increasingly important educational delivery process [9, 11]. Some online learning studies have focused on students' perceptions of the quality of their online learning experiences [6, 8] and their satisfaction levels [9, 11, 18]. Other online learning studies have attempted to address whether students online learning outcomes are comparable to those of students in traditional classes [1, 6, 11, 13, 16].

The research literature suggests that learning in an online environment requires good time management skills, a significant amount of self-discipline and self-motivation [6, 18]. There is also evidence that students who select to take online courses may be more independent than students who select traditional face-to-face classes [20]. It is also possible that pre-existing knowledge of the subject-matter could influence students to be more accepting of taking an online course on a specific topic. H2 was constructed to test whether differences in self-discipline, independence, and pre-existing knowledge of computing concepts affect whether or not individual students self-select into online computing concepts classes.

***H2**: Online students who enroll in online computer concepts classes have higher pre-existing levels of knowledge of computing than students who enroll in traditional computer concepts classes.*

Gender and Course Delivery Mode Differences in "I Don't Know the Answer" Counts

Each of the 100 items on the computing concepts test included an "I don't know the answer" response item in order to minimize the possibility of students choosing a correct answer through random guessing. Case et al. [4] could not rule out random guessing as an alternative explanation for their findings and suggested using a "can't answer" option to minimize guessing.

The results of previous studies suggest that individuals with high self-efficacy in computer concepts and skills are likely to possess more confidence in their computer skills and knowledge. Hence, the authors reasoned that students who have confidence in their computer skills and knowledge are less than students with lesser confidence to provide "I don't know the answer" responds; since we expected students in online sections to be more confident about their knowledge of the subject matter than students in traditional sections, H3 was advanced as an hypothesis:

***H3**: Students in online sections will provide fewer "I don't know the answer" responses on the concepts test than students in traditional sections of the introductory computing course.*

The researchers also reasoned that students who provide fewer "I don't know the answer" responses will have more correct answers on the computer concepts test than students with higher numbers of "I don't know the answer" responses. This expectation is summarized in H4.

***H4**: Students with fewer "I don't know the answer" responses will have higher scores on the computer concepts test than students with higher numbers of "I don't know the answer" responses.*

Because male students were expected to enter the course with higher levels of computer knowledge than female students, they were also expected to provide fewer "I don't know the answer" responses than females. H5 was developed to formally articulate this expectation.

***H5**: Male students will provide fewer "I don't know the answer" responses than female students on the computer concepts test.*

The authors also expected to observe a negative relationship between the correct answer totals and the total number of "I don't know the answer" responses on the computer concepts test. This expectation is summarized in H6.

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***H6**: There is a negative correlation between students' correct answer scores and "I don't know the answer" counts.*

METHODOLOGY

The total sample for this investigation consisted of 287 students enrolled in two different course delivery modes: traditional lecture and online. The students were enrolled in two different sections of the same course (online vs. face-to-face) and the two sections were taught by different instructors. The 100-item computer concepts multiple-choice test was created in Respondus® and uploaded to the WebCT home pages for each section. Students had the opportunity to access and complete the text for two days during the first week of Spring Semester 2008 classes. Upon opening and beginning the test, the students had one hour to complete it. The test was designed to assess the pre-existing knowledge of computing concepts before taking the introductory computing course. Students in both sections were provided an extra credit incentive for completing the test. Administering the computer concepts test via WebCT also enabled the instructors to identify additional information about the test takers (such as age and major) from the university's student information system.

In order to minimize the potential for random guessing to affect the results, each of the items included an "I don't know the answer" option in addition to the correct answer and three distracters. Correct answers were associated with particular response option exactly 25% of the time (i.e., 25% of the correct answers were A, 25% were B, etc.). The 100 items used to assess student knowledge of computing concepts addressed fifteen different concept categories (see Table 1).

Although nearly 300 students attempted to complete the test, only 278 usable responses were obtained. To be usable, the student had to respond to each of the 100 items, all items, and correctly save their answers.

<insert Table 1 here>

RESULTS

Demographic Data

Usable responses were obtained from 97 students enrolled in the online section; of these, 68.37% were provided by females and 31.63% were provided by males. Usable responses were obtained from 180 students enrolled in the traditional, face-to-face lecture section of the introductory computing course; 53.89% were provided by females and 46.11% were provided by males. Students self-selected into online and traditional sections of the course during the Fall 2007 pre-registration period.

Gender Differences

T-tests were performed to test Hypotheses 1 and 2. Table 2 summarizes the differences between the pre-existing computing concepts knowledge of male and female students (as measured by the computer concepts test) during the first week of the semester. As may be observed in Table 2, the average number of correct answers for males (43.82) was nearly six points higher than the average number of correct answers for females (37.59). The difference between male and female was statistically significant, [t (df=276) = 4.56, p < .001]. These results provide support for **H1**.

There is a conflict between this result and the demographics data on gender difference with lecture modes. It was presumed that more male students would take the online section than female students, considering male students having a higher level of computer concepts. However, the previous studies demonstrated that female students who previously had disadvantages in a traditional learning environment felt more advantage in an online learning environment than males. This might be the reason why a higher number of females have enrolled in an online section.

<insert Table 2 here>

Online vs. Traditional Delivery Differences

Table 3 summarizes differences in the pre-existing knowledge (as measured by the computer concepts test) of students enrolled in the online and traditional sections of the introductory computing course. The pattern of means for the total number of correct answers suggests that students who enrolled the online section know more about computer concepts at the beginning of the semester than students enrolled in the traditional section. The significant test statistic [t (276) = -2.42, p < .02) provides support for hypothesis ***H2****: Online students will have higher level of knowledge on computer concepts than traditional class students* is supported.

<insert Table 3 here>

Different Disciplines

Although not directly related to the hypotheses, the decision was made to look at whether academic major is related to pre-existing computer concepts knowledge. The computer concepts course is generally taken by first or second year students who have not completed many classes within their discipline areas. Approximately 79% of students enrolled in these two sections for Spring Semester 2008 were in their first or second year, however, no statistically significant differences were observed for year in school. No differences were observed for academic major despite the fact that the pattern in Table 4 suggests that such differences might exist.

<insert Table 4 here>

Analyses of "I don't know the answer" Responses

On average, students answered "I don't know the answer" 16.18 times. However, students in the traditional lecture class provided more "I don't know the answer" responses than students in the online section (see Table 5). The significant test statistic [t (276) = 3.12, p < .002] indicates support for ***H3****: Students in online sections will provide fewer "I don't know the answer" responses on the concepts test than students in traditional sections of the introductory computing course.*

<insert Table 5 here>

Among the 278 students who provided usable responses, 55 students (19.8%) did not choose the last option, "I don't know the answer" as a response for any test item. To measure whether there is any difference between students with a high number of "I don't know" answers and students with a lower numbers of "I don't know" answers, the students were categorized into two groups: Low and High. Students who provided ten or fewer "I don't know" answers were placed in the Low group; this encompassed about half of the students, 50.7%. The students who had more than ten "I don't know" answers were placed in the High category. A significant difference between the Low and High groups was observed for total number of correct answers. As may be observed in Table 6, students in the High “I don’t know” group had an average total correct score of 34.99, while those in the Low “I don’t know” group had an average total correct score of 45.14. The highly significant test statistic [t (275) = 8.27, p < .001] supports

<insert Table 6 here>

Table 6 shows that on the average, female students provided more “I don’t know the answer” responses than male students. The test statistic [t (276) = -2.73, p < .006] provides support for ***H5****: Male students will provide fewer “I don’t know the answer” responses than female students on the computer concepts test.*

<insert Table 7 here>

Pearson’s correlation was used to measure the correlation between students’ correct answer scores and their “I don’t know the answer” counts. As expected, a negative correlation between student correct answer scores and “I don’t know the answer” counts. The correlation is significant at the .001 level. These results support Hypothesis 6: *There is a negative correlation between students’ correct answer scores and “I don’t know the answer” counts.* The fact that the correlation is not higher and only accounts for about 25% of the total variation suggests that students may not be aware of what they don’t know.

<insert Table 8 here>

CONCULSION

The results of differences in computer concepts knowledge suggest that differences exist on the pre-existing computing concepts knowledge of male and female students as well as between that of students enrolled in online and traditional face-to-face classes. These differences can be observed in patterns for correct and “I don’t know” answers provided for a computer concepts test taken during the first week of the semester. The study results suggest that students who self-select into online sections of computer concepts courses possess more computer knowledge than students who enroll in traditional sections of the same course. A post-test scheduled for the end of the semester will enable us to assess improvement levels in both genders and course delivery modes. Future research should focus on a wider range of students’ characteristics and learning styles that may account for why some students self-select into online sections

H4*: Students with fewer “I don’t know the answer” responses will have higher scores on the computer concepts test than students with higher numbers of “I don’t know the answer” responses.*

when they have a choice between online or traditional instructional systems. Such investigations should provide insight into what type(s) of learning models are most likely to optimize online students’ learning outcomes.

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TABLES

Table 1. Categories Used for the Computer Concepts Test

Concept Area Title	**Number of Items on Test**
Basic Computer Concepts	6
The Internet and the World Wide Web	6
Application Software	6
System Unit Components and Operations	7
Input Technologies	7
Output Technologies	5
Storage Technologies	5
Operating Systems and Utilities	12
Communications and Networks	10
Data Management	6
Computer Security, Privacy and Ethics	10
Information System Development	9
Programming Languages and Program Development	5
Enterprise Computing Systems	3
Computer Careers and Certification	3
Total	**100**

Table 2 . Gender Difference on Computer Concepts Test Scores (Total Number of Correct Answers)

Gender	N	Mean	Std. Deviation	Std. Error Mean
Male	114	43.82	11.74	1.10
Female	164	37.59	10.41	.81

Table 3. Modes (Online vs. Traditional) Difference on Scores (Total Number of Correct Answers)

Mode	N	Mean	Std. Deviation	Std. Error Mean
Traditional Lecture	180	38.93	11.711	.873
Online	98	42.36	10.431	1.054

Table 4. Differences among Colleges on Correct Scores

College	N	Mean	Minimum	Maximum
CLAS	72	41.00	16	82
COST	32	42.22	24	67
CHHS	96	37.86	18	61
COE	25	41.56	18	79
INTER	16	43.62	21	81
COBA/CIT	12	37.50	12	51
Undeclared	25	41.36	22	61
Total	278	40.14	12	82

Table 5. Differences between Online and Traditional “I don’t know the answer” Response Totals

Mode	N	Mean	Std. Deviation	Std. Error Mean
Traditional Lecture	180	18.4611	18.199	1.35649
Online	98	12.0000	12.846	1.29760

Table 6. “High” vs. “Low” I don’t know the answer

Low vs. High	N	Average Total Correct Score	Std. Deviation	Std. Error Mean
Low I don’t know	140	45.14	10.864	.918
High I don’t know	137	34.99	9.495	.811

Table 7. Gender Differences for “I don’t know the answer” Responses

Gender	N	Mean “I don’t know” Responses	Std. Deviation	Std. Error Mean
Male	114	12.91	15.241	1.427
Female	164	18.46	17.448	1.362

Table 8. Correlation between "I don't know the answer" Counts and Total Correct Scores

	Mean	**Std. Deviation**	**N**
Total Correct Score	40.14	11.376	278
"I don't know the answer" Count	16.1835	16.77432	278

		Score	total
Total Correct Score	Pearson Correlation	1.000	-.567**
	Sig. (2-tailed)		.000
	N	278.000	278
"I don't know" Count	Pearson Correlation	-.567**	1.000
	Sig. (2-tailed)	.000	
	Total	278	278.000

**. Correlation is significant at the 0.01 level (2-tailed)