A Comparison of Student Characteristics and Student Knowledge of Computer Concepts in Online and Lecture Sections of an Introductory Course

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ABSTRACT

For many years a mid sized university has offered several sections of an introductory computer concepts course by the lecture method and has also offered at least one online section. There has been much speculation about whether there were differences between the two approaches and the students that self-select into each. In January 2008 it was decided to use the same computer concepts test to compare the students and student knowledge levels in traditional and online sections. The pre test was run in January 2008 at the start of the semester and the post test will be run at the end of April 2008. This paper describes the preliminary results of this study. An additional bonus of this study was the opportunity to examine the computer concepts preparation of enrolled students, mainly first and second year students. The results confirmed faculty speculation that students are not adequately prepared.

BACKGROUND

There have been many studies of the computer literacy of students at universities (Amini, 1993; Brock & Thompson, 1992; Clements & Carifio, 1995; Dologite,1987) having checked microcomputer literacy as far back as 1987. Most of the computer literacy tests reported in the literature have been basic skills tests in word processing, spreadsheets, DBMS and general computer skills but some of these computer literacy tests have also included computer concepts (Wallace & Clatiana, 2005). This paper focuses on testing the computer concepts knowledge of students in an introductory computer course and did not test computer skills abilities.

Many educators have questioned the value of the introductory computing course in IS/IT and university curricula. The relegation of the introductory course to prerequisite status in the IS 2002 Model Curriculum reflects the widespread belief that students enter universities with computing concepts knowledge making introductory course less and less important each year.

Debate about the value of the introductory course has been ongoing in the research literature for more than a decade. There is strong evidence that the percentage students enrolled in university introductory computing courses who completed one or more computing courses in high school is increasing (e.g., Case, MacKinnon, & Dyer, 2004). The increasing prevalence of students with high school computing backgrounds has led many college and university educators to scrutinize the need to offer introductory computing courses. IS/IT educators at many institutions question the value of continuing to offer a course that may be little more than a review or validation of computing concepts mastered during high school.

The perceived value of the introductory course is also influenced by research findings indicating that today's high school and university students are among the most frequent users of computers and the Internet. The results of studies performed by numerous Internet research firms indicate that the average high school and university student uses computers daily, often for multiple hours per day. Students with greater knowledge about computers and students who have positive perceptions of computers may be more likely to be successful in computing courses than counterparts with less knowledge and/or less positive perceptions. However, Case et al. (2004) found that frequency of computer use was the only reliable predictor of student scores on a computing concepts proficiency exam; number of high school computing courses and longevity of Internet and computer use (in years) were also examined by these researchers but were not observed to be reliable predictors of scores on the proficiency test.

The educational implications of students' computing background are not insignificant. Student familiarity and prior experience with such information technologies are likely to raise instructors' expectations for course outcomes. Many introductory computing course instructors would agree that their courses' ability to significantly contribute (add value) to the curriculum is either enabled or constrained by their students' incoming knowledge and prior experience with computing technology. If the foundation knowledge of incoming students is strong, introductory course content can be structured in order to add depth and/or breadth to their knowledge. When the knowledge base of incoming students is minimal, instructors are likely to have more modest expectations for course outcomes. In such instances, course content is more likely to focus on ensuring that students leave the course with the minimum knowledge base needed to enter upper-level courses.

INTRODUCTION

Introductory computing instructors at a mid sized university decided to compare the characteristics and knowledge of students enrolled in a Web-based section to those of students enrolled in a traditional lecture-based section of the same course. The same 100-item test was used in both sections to assess the breadth and depth of student knowledge of computing concepts at both the beginning and end of the course. The same textbook used was used in both sections: *Discovering Computers* by Shelly, Cashman & Vermaat, (Shelly, Cashman, & Vermaat, 2007) published by Course Technology. Course Technology provides a "test out" package of 160 questions from 15 chapters of their textbook. It was decided to select 100 questions from the test out package to serve as general computing concepts proficiency/literacy test.

As noted by Garber (2004), Thompson Prometric developed the test out package to evaluate student knowledge of computer vocabulary, definitions, concepts and general computer literacy. The computer concepts test used by Wallace & Clatiana (2005) was also a Course Technology computer concepts test similar to the test that was used for this study (Wallace & Clatiana, 2005). McDonald (2004) also used a Thompson Learning test in his investigation.

METHODOLOGY

In January 2008, the 100-item computer concepts “pre-test” was made available to students in both the traditional lecture section and an online section of the introductory computing course via WebCT. These sections were taught by two different instructors. Students in both sections were provided an extra credit incentive for completing the pre-test. The percentages of students in both sections choosing to complete the pretest were very high. Eighty-one percent (81%) of the students in the traditional lecture section completed the pre-test as did 82% of the students in the online section.

In order to minimize the potential for random guessing to affect the results, each of the items on the pre-test 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.).

Administering the pre-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.

RESULTS

The key results from the administration of the pre-test are shown in Table 1. The average correct response total across students in both the traditional and online sections was approximately 40 out of 100. This suggests that the average student in the introductory course knows less rather, than more about computing concepts. While these results are likely to disappoint university educators who think that an introductory course is no longer needed at colleges and universities, they are consistent with 2004 and 2005 studied by other researchers (Case et al., 2004; Wallace & Clatiana, 2005).

In the traditional lecture class the average number of correct answers was 39 and in the online course the average number of correct responses was 42. However, it was noted that the highest correct total was 82 in the lecture course and 79 in the online course indicating a sprinkling of knowledgeable students in both sections. The higher average correct totals for the online course suggest that students who think they are knowledgeable about computing concepts may be more likely to self-select into the online section.

Table 1: Pre Test Results.

	Traditional	Online
Total number of test takers	180	98
Average Number of Correct Responses	38.93	42.36
Median Correct Score	38	42
Highest Correct Score	82	79
Lowest Correct Score	12	18
Standard Deviation	11.71	10.43

Table 2 depicts the frequency breakdown for total number of correct answers for students in both the traditional lecture and online courses. The frequencies and percentages suggest that more students in the traditional lecture section are more likely than students in the online sections to have scores of 60 or better; they are also more likely to have scores of 30 or less. The differences in the distributions indicate that notion that more knowledgeable students self-select into the online section may not be correct.

Table 2: Pre Test Grades.

Grades	Traditional		Online	
	Frequency	Percent	Frequency	Percent
90-100	0	.000	0	.000
80-89	2	.011	0	.000
70-79	1	.006	2	.020
60-69	5	.028	3	.031
50-59	19	.106	16	.163
40-49	54	.300	40	.408
30-39	61	.339	26	.265
20-29	32	.217	10	.102
10-19	6	.033	1	.010
0-09	0	.000	0	.000

It can be seen in Table 2 that there was a wide variety of total correct answer scores in both sections of the introductory course. It is also quite apparent that there are a few students with a very good knowledge of computer concepts and there are a significant number of students with less than stellar knowledge of computer concepts.

Who Are the Characteristics of the Students in the Computer Concepts Course?

Tables 3 through 6 provide a glimpse of demographic characteristics of the students in the two sections of the introductory computing course. Table 3 indicates that we have a higher percentage of females than males in both sections.

Table 3: Gender.

Grades	Traditional	Online	Total
Females %	53.89%	68.37%	58.99%
Males %	46.11%	31.63%	41.01%

The instructor of the traditional lab section was surprised to learn that slightly less than 54% of his students were female. From class attendance it appeared to him that his class consisted of about 75% females. An obvious conclusion is that in this course female students generally attend more lectures than the male students in the traditional lecture section.

Table 4: Enrollment by College.

	College	Traditional	Online	Total
1	College of Health & Human Sciences	35.00%	33.67%	34.53%
2	College of Liberal Arts & Social Sciences	25.56%	26.53%	25.90%
3	College of Science & Technology	13.33%	8.16%	25.90%
4	College of Education	8.89%	9.18%	8.99%
5	Undeclared	8.89%	9.18%	8.99%
6	Interdisciplinary	5.00%	7.14%	5.76%
7	College of Business Administration	3.33%	6.12%	4.32%
	Total	100%	100%	100%

Table 4 illustrates that the majority of the students in both the traditional and online sections are College of Health & Human Services or College of Liberal Arts & Social Sciences majors. The percentage of business majors is lower than each of the others because they can only count the introductory course as an elective. Business majors take both a MIS course and a business applications course that address IT concepts in more detail than the introductory course. Because the introductory course is a basic computer concepts course for the entire university (beyond the College of Business), these percentages are not surprising. Students from 47 different majors across the university were enrolled in this course during Spring Semester 2008.

The introductory computer concepts course was designed for first or second year students who are not business students. The breakdown of students by class year provided in Table 5 illustrates that first and second year students dominate course enrollments for Spring Semester 2008. It can be seen that in the lecture section of course 80% of the students are in their first or second year at the university and only 20% of the lecture section students are in their third or fourth year. For the online course, 78% of the students are in their first or second year and 22% of the students are in their third or fourth year.

Table 5: Year.

	Traditional	Online	Total
Freshman	36.67%	37.76%	37.05%
Sophomore	43.33%	39.80%	42.09%
Junior	14.44%	17.35%	15.47%
Senior	5.56%	5.10%	5.40%

The breakdown of student ages in Table 6 also suggests that first and second year students dominate student enrollments in this course.

Table 6: Age.

	Traditional	Online	Total
17-19	52.78%	43.88%	49.64%
20-21	33.33%	31.63%	32.73%
22 and older	13.89%	24.49%	17.63%

What is the Breadth and Depth of Student Knowledge?

Each of the items on the pre-test falls into one of 15 concept categories. An examination of the average percentage of correct answers and average percentage of “I don’t know the answer” provides some insight into the breadth and depth of student knowledge of each category at the beginning of the semester. Categories demonstrating the greatest breadth of knowledge (with the highest average percentage of correct responses to the questions in that category) include Basic Computer Concepts, Output Technologies, Application Software, Data Management, and System Unit Components and Operations. Categories with the greatest depth of knowledge (with the lowest average percentage of “I don’t know the answer” responses to questions in that category) include Application Software, Input Technologies, Communications and Networks, and Computer Security, Privacy, and Ethics).

The categories that students taking the pre-test seem to know the most about are Basic Computer Concepts, Application Software, and Input Technologies because these demonstrate reasonable breadth and depth percentages. Students seem to be least knowledgeable about Storage Technologies, Programming Languages and Program Development, Enterprise Computing Systems, and Computer Careers and Certification because these have relatively low Percent Correct averages and some of the higher “I don’t know” percentage averages.

Table 7: Correct and Don't Know Percentages for Computing Concepts Categories.

Concept Area Title	Number of Items on Pre-Test	Average Percent Correct	Average Percent "I don't know"
Basic Computer Concepts	6	.6151	.1391
The Internet and the World Wide Web	6	.3723	.1211
Application Software	6	.4910	.1007
System Unit Components and Operations	7	.4359	.1670
Input Technologies	7	.4562	.1012
Output Technologies	5	.5062	.2554
Storage Technologies	5	.2849	.1712
Operating Systems and Utilities	12	.3842	.1930
Communications and Networks	10	.3534	.1007
Data Management	6	.4396	.1960
Computer Security, Privacy and Ethics	10	.3501	.1126
Information System Development	9	.2842	.1859
Programming Languages and Program Development	5	.2991	.2403
Enterprise Computing Systems	3	.3653	.2710
Computer Careers and Certification	3	.2288	.2314
Total	100		

Post Test Results

The key results of the post test are shown in Table 8. In most respects the results of both teaching approaches are very similar.

Table 8: Post Test Results.

	Traditional	Online
Total number of test takers	126	84
Average Number of Correct Responses	50.06	50.86
Median Correct Score	51	51
Highest Correct Score	83	83
Lowest Correct Score	15	23
Standard Deviation	11.87	12.17

From tables 1 and 8 it can be seen that there is a significant improvement in the median correct scores from 38 and 42 in Table 1 to 51 in Table 8. It is noted that the online course had a higher median correct score of 42 in Table 1 and the traditional median correct score was 38 in Table 1 but the final median correct scores were 51 for both teaching approaches.

The distribution of the post test grades are shown in Table 9

Table 9: Post Test Grades.

Grades	Traditional	Online
90-100	0	0
80-89	2	1
70-79	6	4
60-69	12	17
50-59	49	22
40-49	36	26
30-39	14	9
20-29	6	5
10-19	1	0
0-09	0	0

With a median correct score of 51 in Table 8 it is not surprising to see that the grades in Table 2 are significantly better than the grades in Table 2.

Table 10 provides the Percent Correct and Percent "I don't know" averages for the concept categories. If the course is adding breadth and depth to student knowledge of computing concepts, there should be increases in average percent correct and decreases in average "I don't know" percentages.

Table 10: Correct and Don't Know Percentages for Computing Concepts Categories on the Post-Test.

Concept Area Title	Number of Items on Pre-Test	Average Percent Correct	Average Percent "I don't know"
Basic Computer Concepts	6	.7143	.0310
The Internet and the World Wide Web	6	.5635	.0310
Application Software	6	.3968	.0230
System Unit Components and Operations	7	.3905	.0497
Input Technologies	7	.6871	.0143
Output Technologies	5	.4343	.0724
Storage Technologies	5	.5524	.0429
Operating Systems and Utilities	12	.5103	.0433
Communications and Networks	10	.5729	.0381
Data Management	6	.4492	.0746
Computer Security, Privacy and Ethics	10	.5433	.0419
Information System Development	9	.4397	.0624
Programming Languages and Program Development	5	.2600	.1067
Enterprise Computing Systems	3	.5127	.0968
Computer Careers and Certification	3	.3603	.0825
Total	100		

In Table 10 it can be seen that the "I don't know" answers are much smaller than the "I don't know" numbers in Table 7 which indicates that students were more confident of their answers in the post-test. In general, most of the "Average Percent Correct" numbers in Table 10 are higher than in Table 7.

By comparing the data in Tables 5-7 to that in Tables 8-10 it can be seen that the introductory course is succeeding in increasing the breadth and depth of student knowledge of computing concepts.

CONCLUSION

The results of the pre-test suggest that there are gaps in the computing concepts knowledge at the beginning of the semester for students enrolled in the introductory computing course. This is consistent with the anecdotal observations of faculty members involved with teaching the course. The pre-test data also provided new insights into the backgrounds of students enrolled in the course and suggest that there are more similarities than differences between the backgrounds and knowledge levels of students enrolled in traditional lecture and online sections of the course. Identifying changes in pre-test and post-test results may yield valuable course assessment data.

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