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Self-Assessment and Student Improvement in an Introductory Computer Course at the Community College Level 1

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SELF-ASSESSMENT AND STUDENT IMPROVEMENT IN AN INTRODUCTORY COMPUTER COURSE AT THE COMMUNITY COLLEGE LEVEL

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ABSTRACT

The purpose of this study was to determine a student's computer knowledge upon course entry and if there was a difference in college students' improvement scores as measured by the difference in pretest and post-test scores of new or novice users, moderate users, and expert users at the end of a college level introductory computing class. This study also determined whether there were differences in improvement scores by gender or age group. The results of this study were used to determine whether there was a difference in improvement scores among the three campus locations participating in this study.

Four hundred sixty-nine students participated in this study at a community college located in Northeast Tennessee. A survey, pretest, and post-test were administered to students in a college level introductory computing class. The survey consisted of demographic data that included gender, age category, location, Internet access, educational experience and the self-rated user category, while the pretest and post-test explored the student's knowledge of computer terminology, hardware, the current operating system, Microsoft Word, Microsoft Excel, and Microsoft PowerPoint.

The data analysis revealed significant differences in pretest scores between educational experience categories. In each instance, the pretest mean for first semester freshmen students was lower than second semester freshmen and sophomores. The study also reported significant differences between the self-rated user categories and pretest scores as well as differences in improvement scores (post-test scores minus pretest scores). However, the improvement scores (post-test scores minus pretest scores) were higher than the other self-rated user categories. Of the three participating campus locations, students at Location 1 earned higher improvement scores than did students at Location 2. The results also indicated that there was a significant difference between the types of course delivery and course improvement scores (post-test scores minus pretest scores). The improvement scores for on ground delivery was 5 points higher than the hybrid course delivery. Finally, study revealed no significant differences according to the gender and age categories.

INTRODUCTION

College level computing skills are useful tools that serve students throughout their college career. However, many students enter college lacking necessary computing skills. While many students might be proficient in locating in-

formation online through search engines, less is known about the use and application of specific types of software often found in business and industry. As a result of this lack of knowledge, all students entering the participating community college must prove computer competency ei-

ther by taking a competency exam or by the completion of a college level introductory computing class. Approximately 97% of the students chose to take the introductory class to satisfy this competency requirement. Assessment methods used to evaluate students in the introductory class included hands-on project tutorials, a research paper, and multiple-choice quizzes.

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This study focused on student improvement in a college level introductory computing class using a pretest and a post-test at the participating community college. The assessment of the pretests and post-tests and the results of these tests were the criterion variables for the study. These independent variables included: gender, age, campus location, prior higher education experience, residential Internet access, and user's self-rated computer skill level.

RELATED LITERATURE

Within the literature, definitions of computer literacy have varied from author to author. Often, individuals' actual task-specific computer skills and their perceived computer skills do not coincide (Dettori, Steinbach, & Kalin, 2006). According to Messineo and DeOllos (2005), higher level of experience with forms of technology produced more confidence. However, it was suggested that with advanced applications, the confidence level and the exposure level was lacking. Incorrect assumptions are sometimes made by faculty members regarding student preparedness to take the introductory computer science class.

The term computer literacy has also varied throughout the years. For example, what we understand as computer literacy has assumed different names and meanings since the 1980s. Definitions were influenced by various theories. The National Science Foundation (NSF) hosted a conference in 1980 to discuss the meaning of the term "computer literacy" (Childers, 2003). Burniske (2000) stated that, "To prepare ourselves and our students for new types of literacy, we must be receptive to new definitions of the term itself" (p. 3). Burniske addressed two types of literacy. The first type of literacy was functional literacy. This concept was popularized by the United States Army dur-

ing World War II. Functional literacy included the lowest functioning level of literacy and rarely required an individual to use problem-solving techniques. Functional literacy focused on teaching the basics of reading and writing. The second literacy type was critical literacy, which often referred to a learned individual with the ability to solve problems. This type of literacy comprised teaching the student learning to interpret and apply new information presented. Many researchers considered computer literacy a type of critical literacy. To integrate computer literacy, the instructor often blended traditional teaching with new technologies. In the classroom, teachers are often required to move beyond simply teaching a skill, such as keyboarding, to integrating computer skills within the core curriculum. This required the teacher to have a combination of a technical skill set and a theory based skill set. According to Burniske, if we are to achieve literacy-across-the curriculum, formal teacher training is required.

Computer skills considered necessary for computer literacy varied according to position. For instance, students assumed computer literacy if they could play games or word process a document, activities important to them, thus producing self-efficacy. Self-efficacy included one's belief in their skill for successful task completion. Individuals who reported high levels of self-efficacy tended to face difficult challenges more easily than others. Additionally, individual beliefs affected how persons felt, behaved, and motivated themselves (Bandura, 1997).

Technology skills assessments have taken many forms. For instance, Martin and Dunsworth (2007) proposed formative assessment of computer literacy at the university level to improve curriculum design of a computer literacy course. This formative assessment included the technological advances of the workplace as well as the technological needs of the student. Class observations, student test scores, student and teacher focus groups, and instructor surveys were tools used to collect the data. Four hundred forty-four students received a Likert-type survey through the Blackboard Course Management System in which 329 students responded. The researchers interviewed five focus groups comprised of 25 students as well as the 11 instructors who delivered the course. Five class observations also aided in data collection. The compiled data formed two categories: 1) what to teach, and 2) how to teach it. The findings reported both instructors and students rated Microsoft Office Skills, particularly Word and PowerPoint, as necessary. Additionally, both groups agreed that in class activities and hands-on projects were useful approaches when teaching computer literacy. Instructors and students stated that the Internet and the World Wide Web were considered important tools. However, students reported that online quizzes and extended lectures were not helpful, while instructors deemed them valuable

teaching tools and a means to measure student learning. Neither students nor instructors considered knowledge of computer hardware (input, processing, storage, and output) as a necessary skill. Instructors submitted that File Management was a needed skill, while students assigned a lower rating to this skill. Recommendations from the study included the need for more in class and hands-on activities, and collaborative activities that provided a group learning atmosphere.

Several higher education institutions adopted computer literacy requirements. For example, in 2010 Cape Fear Community College (CFCC) in North Carolina mandated that students prove computer competency to graduate. The students were presented with two options which satisfied competency requirements. They must have successfully passed the computer competency exam, a one hour exam, or have completed a designated college transfer computer course. If students chose the proctored competency exam, it was administered through Blackboard, a course management software application. In preparation for the exam, CFCC provided a computer competency tutorial and a computer competency practice exam for students (Cape Fear Community College, 2010).

RESEARCH METHODOLOGY

Research Questions

The following research questions guided this study:

1. Are there significant differences in students' pretest scores among the three college experience categories (freshman – 1st semester, freshman – 2nd semester, and sophomore- 1st and 2nd semester) in college level introductory computing classes?
2. Are there significant differences in students' pretest scores among the five types of self-reported residential Internet access (dial-up, cable, DSL, wireless and no Internet access) in college level introductory computing classes?
3. Are there significant differences in students' pretest scores among the three self-rated user categories (new or novice user, moderate user, and expert user) in college level introductory computing classes?
4. Are there significant differences in students' improvement scores (post-test scores minus pretest scores) among the three self-rated categories

(new or novice user, moderate user, expert user) in college level introductory computing classes?

5. Are there significant differences in students' improvement scores (post-test scores minus pretest scores) among the three campus locations (Campus Location 1, 2, and 3) in college level introductory computing classes?
6. Are there significant differences in students' improvement scores (post-test scores minus pretest scores) among the three age categories (age 15-19, age 20-28, age 29 and older) as determined by gender in college level introductory computing classes?
7. Are there significant differences in students' improvement scores among the three self-rated user categories (new or novice user, moderate user, expert user) and the three age categories (age 15-19, age 20-28, age 29 and older) in college level introductory computing classes?
8. Are there significant differences in students' improvement scores (post-test scores minus pretest scores) among the course delivery types (on ground courses, online courses, and hybrid courses) in college level introductory computing classes?

Population

Students from 26 sections of the introductory computer science course participated in the study. In each section, the instructor administered the pretest, post-test, and survey to those students who had chosen to participate. A total of 400 students, out of a potential 426, completed both the pretest and the post-test. The participating community college served ten surrounding counties with three campuses serving diverse populations. Students from three geographically unique campuses participated in this study. The campus locations in the study included: Location 1, centrally located; Location 2, located furthest southeast of the campuses; and Location 3, located furthest south. Because all course sections administered the pretest, post-test, and the survey, there was no skewing of the data by either the selection of a particular introductory computer science course or the time designation that each course was offered.

Instrumentation

A group of Computer Science instructors at the participating college aided in the development of the pretest and post-test. The questions represented each unit studied throughout the course. Administration of the pretest and post-test were managed through the course management system and consisted of 100 questions. The questions incorporated the chapter units of the course, as follows: (a) Chapters 1-3, operating system; (b) Chapters 1-4, basic word processing; (c) Chapters 1-4, basic spreadsheet chapters; (d) Chapters 1 and 2, basic presentation software.

The student survey instrument contained various demographic questions. The independent variables included: gender, age, college experience, campus location, residential Internet access, and the user's self-rated computing skill level. The survey questions were comprised of multiple choice answers. One particular survey question regarding the user's self-rated computing skill level was of particular importance to this study. The question required the participants to read descriptions of each of three defined categories. They then selected the category that best described their computing skill level. The three self-rated categories were new or novice user, moderate user, and expert user. Because the demographic survey was optional, some students chose not to participate in this portion of the study or they completed only portions of the survey.

Data Collection

The online course management system used in the study was Desire to Learn. The online course management system provided one central location for course materials, quizzes, surveys, calendars, and drop boxes for students to submit assignments with no installation of additional software required by the participants. The data provided for the study were collected through the course management system by a designee of the division dean.

In addition, a demographic survey was administered electronically along with the pretest. The demographic survey was developed with the assistance of the instructors in the Computer Science Department. Each instructor of the 28 participating course sections explained the purpose of the survey to each class and noted that student participation was optional. As with the pretest and post-test delivery, the demographic survey was administered electronically as part of the class through the course management system. Students logged in to the course management system and entered into their college level introductory computing class to take the survey located in the Surveys section of the course. If students chose to participate, students were then instructed to complete and submit the demographic survey questions electronically. Data provided by

the students in the study were used only for the purposes of this study and the Computer Science Department of the participating community college. Pretest, post-test, and survey data were collected by a designee of the division dean to protect the anonymity of students who chose to participate in the study.

RESULTS

Research Question 1

A one-way analysis of variance was used to evaluate the relationship between students' pretest scores and the college experience of students enrolled in college level introductory computing classes. The dependent variable was pretest scores. The independent variable, college experience, had three levels: first semester freshmen, second semester freshmen, and sophomores – first and second semester. The ANOVA was significant, $F(2, 423) = 11.01, p < .001$. The effect size as measured by η^2 was small (.05). That is, 5% of the variance in students' pretest scores was accounted for by college experience.

Because the overall F test was significant, multiple post hoc comparisons were conducted to evaluate pairwise differences in the pretest means of the three groups. The Tukey post hoc test was used because equal variances were assumed, $F(2, 423) = .85, p = .430$. The Tukey procedure determined that there was a significant difference between first semester and second semester freshmen ($p < .001$) and between first semester freshmen and sophomores – first and second semester ($p = .020$). In each instance, the pretest mean for first semester freshmen students was lower. The pretest mean for first semester freshmen was over six points lower than the mean for second semester freshmen and over 3.5 points lower than the mean for sophomores – first and second semester. There was no significant difference between second semester freshmen and sophomores – first and second semester ($p = .322$).

Research Question 2

A one-way analysis of variance was used to evaluate the mean differences in students' pretest scores among the five types of self-reported residential internet access. The dependent variable was the pretest scores. The independent variable, type of residential internet access, had five levels: dial-up; cable; DSL, wireless and no internet access. The ANOVA was not significant, $F(4, 421) = 1.48, p = .209$. The effect size as measured by η^2 was small (.01). That is, only 1% of the variance in pretest scores was accounted for by the type of internet access. The results indicated that the type of residential internet access did not significantly affect students' pretest scores.

Research Question 3

A one-way analysis of variance was completed to evaluate the relationship between students' pretest scores and the self-rated user category in college level introductory computing classes. The dependent variable for this ANOVA model was the pretest scores. The independent variable, self-rated user category had three levels: new or novice user, moderate user, and expert user. The ANOVA was significant, $F(2, 422) = 40.74, p < .001$. The effect size as measured by η^2 was large (.16). That is, 16% of the variance in pretest scores was accounted for by self-rated user category.

Because the overall F test was significant, follow up tests to evaluate the differences among the pairs of pretest means were conducted. The Tukey post hoc test was used because equal variances were assumed, $F(2, 422) = .78, p = .459$. The Tukey procedure determined that all pairs of pretest means were significantly different at $p < .001$. In each pair of means evaluated, the lower the self-rated user level had the lower pretest mean. That is, the pretest mean for self-rated new or novice users was over 7.0 points lower than self-rated moderate users and almost 15 points lower than self-rated expert users. The pretest mean for self-rated moderate users was 7.4 points lower than self-rated expert users.

Research Question 4

A one-way analysis of variance was completed to evaluate the relationship between students' improvement scores and the self-rated user category in college level introductory computing classes. The dependent variable was improvement scores. The independent variable, self-rated user category had three levels: new or novice user, moderate user, and expert user. The ANOVA was significant, $F(2, 372) = 15.54, p < .001$. The effect size as measured by η^2 was medium (.08). That is, 8% of the variance in improvement scores was accounted for by self-rated user categories.

Because the overall F test was significant, post hoc multiple comparisons were conducted to evaluate which pair of improvement score means was different. Levene's Test of Equality of Error Variances showed equal variances could not be assumed, $F(2, 372) = 4.33, p = .014$. Therefore, the Dunnett's C post hoc test was used to test pairwise differences. All three pairs of means were significant at the .05 level. Self-rated new or novice users' improvement score mean was 5.6 points higher than self-rated moderate users and 10 points higher than self-rated expert users. Moderate users' mean improvement was 4.5 points higher than expert users.

Research Question 5

A one-way analysis of variance was completed to evaluate the differences in students' improvement scores among the three campus location in college level introductory computing classes. The dependent variable was improvement scores. The independent variable, campus locations had three levels labeled: Location 1, Location 2, and Location 3. The ANOVA was significant, $F(2, 369) = 3.57, p = .029$. The effect size as measured by η^2 was small (.02) indicating that 2% of the variance in improvement scores was accounted for by campus location.

Because the overall F was significant, multiple post hoc comparisons were conducted to determine which pair of means was different. Dunnett's C was used because equal variances were not assumed, $F(2, 369) = 6.03, p = .003$. Dunnett's C showed there was a significant difference in improvement score means between Location 1 and Location 2. The improvement mean for Location 1 was 3.1 points higher than the mean for Location 2. No other pairs of means were significantly different.

Research Question 6

A two-way ANOVA was used to determine if any significant differences in improvement scores between any of the three age categories. The ANOVA showed there was no significant age by gender interaction, $F(2, 370) = .536, p = .585$. The effect size as measured by η^2 was small (<.01) indicating that less than 1% of the variance in improvement scores was accounted for by age by gender interaction. There was no significant difference in the improvement score means among the age categories, $F(2, 370) = 2.966, p = .057$. The effect size as measured by η^2 was small (.02) indicating that 2% of the variance in improvement scores was accounted for by age. Finally, there was no significant difference in improvement score means between male and female students, $F(1, 370) = .489, p = .485$. The effect size as measured by η^2 was small (<.01). That is, less than 1% of the variance in improvement scores was accounted for by gender.

Research Question 7

A two-way ANOVA was used to determine if there were differences in students' improvement score means based on age and self-rated user categories in college level introductory computing classes. The ANOVA showed that there was no significant two-way interaction between age by self-rated user category, $F(4, 366) = .61, p = .653$. The effect size for the interaction term as measured by η^2 was small (.01). The ANOVA also revealed that age categories were not significant, $F(2, 366) = 1.80, p = .167$. The effect size as measured by η^2 was small (.01). That is, 2% of

the variance in improvement scores was accounted for by age. However, the self-rated user category was significant, $F(2, 366) = 12.54, p < .001$. The effect size as measured by η^2 was medium (.06) indicating that 6% of the variance in improvement scores was accounted for by the self-rated user category.

Regarding the significance of the self-rated user category, as reported in the discussion of Research Question 4, Dunnett's C showed all three pairs of improvement score means were significant at the .05 level. New or novice users' improvement score mean was over 5.5 points higher than moderate users and 10 points higher than expert users. Moderate users' mean improvement was 4.5 points higher than expert users.

Research Question 8

A one-way analysis of variance was completed to evaluate the relationship between students' improvement scores among the course delivery types in college level introductory computing classes. The dependent variable was improvement scores. The independent variable, course delivery type had three levels: on ground, online and hybrid. The ANOVA was significant, $F(2, 397) = 3.36, p = .036$. However, the effect size as measured by η^2 was small (.02) indicating that 2% of the variance in improvement scores was accounted for by the course type.

Because the overall F was significant, multiple pairwise comparisons were conducted to determine which pair of means was significant. The Tukey test was used because equal variances were assumed, $F(2, 397) = 1.49, p = .226$. The Tukey procedure determined that there was a significant difference in the improvement means between on ground and hybrid courses ($p = .048$). The improvement score mean for on ground courses was five points higher than the mean for hybrid courses. However, there was no significant difference between on ground and online course ($p = .447$) and no significant difference between online and hybrid courses ($p = .801$).

SUMMARY AND RECOMMENDATIONS

Onsite, online and hybrid courses comprised the methods of course delivery available to students. The findings revealed no significant difference between mean students' improvement scores (post-test scores minus pretest scores) in the on ground and online courses. However, there was a significant difference between improvement scores in the on ground and hybrid courses. Mean improvement scores for on ground courses were 21% higher than hybrid courses and 13% higher than online courses. One potential reason for this disparity could be that instructors clarify class

concepts and assignments for on ground courses with just-in-time teaching, while online courses might require several communications to explain an instruction or assignment.

Advanced, detailed knowledge of course delivery methods would provide additional information for the student before they registered for a course. The institution would benefit from the creation of an online columnar table of delivery types. The table would detail specific components included in each course type, on ground, online, and hybrid. This would provide better understanding when registering for courses, thus improving a student's success rate in the course. The participating community college should continue to standardize course requirements for all sections of the college level introductory computing class to ensure quality for students. Each college level introductory computing class should continue to administer an exit survey to elicit student feedback.

For new or novice users, the college level introductory computing class should provide a "first steps" video library embedded in D2L. Camtasia (<http://www.camtasia.com>) or Jing (<http://www.jing.com>) are two common editing software packages used to create videos. Some introductory video topics would include opening and closing a file, saving a file to different storage locations, and downloading and extracting a file from the course management system. Students could also be directed to free resources that are available online to increase a student's initial computing skill level. In 2009, Microsoft established the Microsoft Digital Literacy Program. This program is comprised of a series of videos that teach standard literacy skills. The Standard Skills Curriculum includes computer basics, the Internet an introduction to productivity software, security, and leading a digital lifestyle to build computing self-efficacy. As Orr, Allen and Poindexter (2001) stated, instructors could apply interventions if they had better understanding of the computer attitudes of their students.

Adobe Connect (<http://www.adobe.com>) is another way to link with students through the use of technology. The purchase and use of Adobe Connect web conferencing software in a college level introductory computing class would facilitate more immediate feedback for online and hybrid students while providing student engagement data for the instructor.

The participating college should develop course learning modules for the college level introductory computing class to tailor student learning. These course learning modules are units of study that students could complete within a specified time period at their own pace and with little instructor interaction. In order for students to move forward to the next module, they would have to attain a predetermined minimum module score. For self-rated expert

users, this would provide an alternative to the traditional classroom instruction.

Connected Tennessee's (<http://www.connectedtn.org>) organizational mission statement emphasizes design strategies to educate, use, and deliver technology access to Tennesseans. Location 2 would continue to benefit from expanded broadband connectivity for its rural users.

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