PRETEST-POSTTEST MEASURE OF INTRODUCTORY COMPUTER STUDENTS' ATTITUDES TOWARD COMPUTERS

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ABSTRACT: An exploratory study was conducted in multiple sections of an introductory computer course to determine whether an introductory computer course changed computer attitudes. A sample of 329 individuals were given a computer attitude measurement (ATCUS) the first and last day of an introductory computer class. We have strong evidence to conclude that those enrolled in the class had worse attitudes after the class than before.

KEYWORDS: Introductory Computer Course, Computer Attitudes, Gender Differences, Computer Usage

INTRODUCTION

Researchers do not agree on whether introductory computer courses change student's attitudes. Kernan and Howard [1, p. 689] suggested that "interactions with the computer itself, especially over a 12-13 week period may change one's view of computers." Some researchers [2] hypothesize that students have more negative attitudes toward computers after they take a computer course. Does computer education change a person's attitude toward computers? Do certain individual characteristics determine a person's attitude toward computers? The purpose of this study was to address these questions. A pretest posttest analysis was performed using ATCUS with introductory computer students to determine if the participants' attitudes toward computers changed once they were exposed to an introductory computer course that included hands-on computer usage. Other tests were performed to determine if certain demographic characteristics obtained from the initial survey were associated with computer attitudes.

Four instruments for computer attitudes were identified: Attitudes Toward Computer Usage Scale (ATCUS) [3] and Computer Attitudes Scale (CATT) [4], Attitudes Toward Computers (ATC) [5], and Morrison's instrument [6]. Kernon and Howard [1] compared the four instruments, and found no evidence of significant differences between the scales. ATCUS [3] was arbitrarily chosen as the attitude measurement of interest.

ATCUS

The Attitudes Toward Computer Usage Scale (ATCUS) instrument was developed by Popovich et al. [3] to measure an individual's attitude toward computer usage. Popovich et al. identified four major components of computer attitudes: positive reactions to computers, negative reactions to computers, reactions to computer-related mechanisms, and computers and education of children. High ATCUS scores represent negative (poor) attitudes toward computers, while low ATCUS represent positive (good) attitudes toward computers. Brown et al. [7] further tested ATCUS using senior citizens to determine if the same factors were present for the senior age group. The results of the Brown et al. study [7] were very similar; however, the factor loadings were more consistent than the original Popovich et al. study [3].

METHOD

Subjects

Subjects selected for the study were enrolled in multiple sections of an introductory computer at a midsized midwestern university. (These sections were taught mainly by professors with Ph.D.'s in computer information systems. However, one section was taught by a MBA that had many years of experience in the "real world"). Because of the university's location, the students in the sample were from different environments taken from a tri-state region. The students' backgrounds varied from small rural school districts to large metropolitan areas. This sample allowed for varying computer skills: no prior computer experience to extensive

prior computer experience. A total of 329 students participated in the study. Subjects were given the ATCUS survey the first and the last day of class. Further, each student was asked the first day of class to fill out demographic questions that assessed prior computer experience and individual characteristic.

The introductory computer course was developed to introduce students to elementary concepts of computers. These concepts included the typical introductory topics: evolution of computers, hardware, software, computer organization, computer arithmetic, data entry, flowcharting, introduction to programming, software development, and development of information processing systems [8, 9 plus many other introductory texts]. Further, the students had hands-on experience with the most popular productivity tools and software: introductory programming, wordprocessing and spreadsheet analysis.

Analysis

The ATCUS scores were obtained from the two time periods (pre and post) to determine if differences existed. The difference in the ATCUS scores (DIFF) was obtained by subtracting the ATCUS scores at the beginning of the semester (BATCUS) from the ATCUS scores at the end of the semester (AATCUS). Malgady and Colon-Malgady [10] compare the difference scores with analysis of covariance (ANCOVA) on the residuals of the post scores when regressing on the pretest scores. They conclude that although ANCOVA is used often, little if anything is gained in the approach. Thus, the unadjusted difference scores were used mainly in this study. In addition, the ANCOVA approach will be presented in the Gender Differences section to insure that results are consistent across statistical methodologies. Based upon Simpson et al.'s hypothesis, the following hypotheses were used in the study:

H0: Students' attitudes toward computers will be as good as or more positive (better) on the average once they have taken an introductory computer course.

H1: Students' attitudes toward computers will be more negative (worse) on the average once they have taken an introductory computer course.

This sample allowed for varying computer skills: no prior computer experience to extensive prior computer experience.

The hypotheses were tested with the statistical package SAS using paired t-tests on the difference between the BATCUS and AATCUS scores. Table 1 has the t-test results. The estimated mean difference was -1.21. The paired t-test produced a t-score of -1.74 that corresponded to a p-value of 0.04. Using a 0.05 level of significance, the null hypothesis was rejected. Thus, there was sufficient evidence to conclude that the student's attitudes toward computers will be worse on the average once they have taken an introductory computer course.

Demographics and BATCUS

Since the demographic material was obtained with the initial ATCUS scores (BATCUS), the correlation coefficient between the BATCUS score for each student and each of the 6 questions in Exhibit 1 was obtained. (See Exhibit on page 58) Further, a hypothesis test was conducted to determine if there was a significant correlation between the results of each question and the BATCUS score. The hypotheses were:

HO: There is no significant correlation between the responses of each question and the BATCUS score.

H1: There is a significant correlation between the results of each question and the BATCUS score.

For question 1, the correlation coefficient was 0.209 which corresponded to a p-value of 0.0001. The significant positive correlation coefficient indicated that the more a student used a computer in high school classes the lower the ATCUS score.

For question 2, the correlation coefficient was -0.159 which corresponded to a p-value of 0.0039. The significant negative correlation coefficient indicated that as the number of computer courses increased the student tended to have a lower ATCUS score.

For question 3, the correlation coefficient was -0.326 which corresponded to a p-value of 0.0001. The significant negative correlation coefficient indicated that as the number of hours spent using a computer increased the student tended to have a lower ATCUS score.

For question 4, the correlation coefficient was -0.332 which corresponds to a p-value of 0.0001. The significant negative correlation coefficient indicated that as the number of types of computer packages that a student has used increased, the student tended to have a lower ATCUS score.

For question 5, the correlation coefficient was -0.025 which corresponded to a p-value of 0.6549. The negative correlation coefficient was not significant. Therefore, one cannot conclude that computer anxiety was related to computer attitudes.

For question 6, the correlation coefficient was -0.389 which corresponded to a p-value of 0.0001. The significant negative correlation coefficient indicated

Table 1: SUMMARY STATISTICS

N	Mean DIFF	T-score	Std Error	p-value
329	-1.21	-1.74	.70	.08

usage experience increased, the student tended to have a lower ATCUS score. Based upon the correlation analysis, the study showed that as an individual's experience with the computer (more computer courses, more hours per week of computer usage, usage of more types of computer packages and more years of computer usage experience) increased, the ATCUS score decreased. Therefore, more computer experience lead to more positive attitudes toward computers. It is important to note that the results in this section were based on BATCUS, the initial ATCUS scores. Table 2 summarizes the results.

Table 2: CORRELATION ANALYSIS WITH BATCUS

Variables	Pearson Correlation Coefficients Prob > |R| under Ho: Rho=0 Number of Observations
AATCUS	0.36912 0.0001 329
DIFF	0.34257 0.0001 329
Q1	0.20935 0.0001 28
Q2	0.15893 0.0039 329
Q3	0.32580 0.0001 329
Q4	0.33243 0.0001 325
Q5	0.02477 0.6549 328
Q6	0.38866 0.0001 328

NOTE: Q1 - Q6 refer to Questions 1 - 6 in Exhibit 1.

Gender Differences

Gender differences have been addressed by several researchers [3, 4, 11, 12, 13, 14, 15, 16]. These researchers found evidence that females had more negative attitudes toward computers than males. Based upon these studies, tests that examined the gender differences in the BATCUS, in the AATCUS and the difference scores (DIFF = BATCUS - AATCUS) were performed. There were 166 female students and 163 male students that participated in the study. The following hypotheses were used:

H0: The mean difference score (DIFF) in male students' attitudes toward computers will be the same as the mean difference score (DIFF) in female students' attitudes toward computers.

H1: The mean difference score (DIFF) in male students' attitudes toward computers will be different than the mean difference score (DIFF) in female students' attitudes toward computers.

The BATCUS scores were tested first to determine if there was a gender difference in the scores at the start of the course. The variances of the BATCUS scores for the two genders were considered equal (F = 1.00 with a p-value = 1.00). The test statistic for equal means in the BATCUS scores for the two genders was -0.24 which corresponded to a two-tailed p-value of 0.80. Thus, initially, there was no gender difference in the ATCUS scores at the beginning of the course. Second, the DIFF scores were tested to determine if there was a gender difference in these scores. The variances were not equal (F = 1.60 with a p-value of 0.003). To compensate for the unequal variances, Snedecor's t statistic was used. The value of Snedecor's t statistic was 0.89 which corresponded to a two-tailed p-value of 0.38. There was not enough evidence to conclude that the mean difference in the ATCUS scores was different for both male and female students. Thus, no gender difference in the BATCUS and AATCUS scores was observed. Table 3 summarizes the results.

An additional analysis was performed that used SEX as the independent variable (or factor). It used the before ATCUS (BATCUS) score as a covariate along with student responses for the questions listed in Exhibit 1 as the other covariates. The dependent variable was the after ATCUS scores (AATCUS). In this analysis using the seven covariates, this model controls for the effects of the student's response on the six demographic variables and the before ATCUS score (BATCUS). Even after controlling for the

effects of the 7 covariates the model was still significant (p-value = 0.0001 with a r-squared of 0.163820). The results are presented in Table 4. Please note that none of the responses to the demographic questions shown in Exhibit 1 on page 58 were statistically significant.

Gender Specific Attitudes

Consider the following alternative hypothesis stated as a question. Within a specific gender, does the student's attitude toward computers get worse, on the average, once they have taken an introductory computer course? The hypotheses concerning males were stated as follows:

H0: Male students' attitudes toward computers will be as good as or more positive (better) on the average once they have taken an introductory computer course.

H1: Male students' attitudes toward computers will be more negative (worse) on the average once they have taken an introductory computer course.

For the 163 males in the study, the average difference score (BATCUS - AATCUS) was 1.83. The test statistic for testing the alternative hypothesis above was -1.67 which corresponded to a p-value of 0.048. With a significance level of 0.05, this result indicated that males have a higher ATCUS score on the average after the computer course than before this course. (See Table 5)

The hypotheses concerning females were stated as follows:

H0: Female students' attitudes toward computers will be as good as or more positive (better) on the average once they have taken an introductory computer course.

H1: Female students' attitudes toward computers will be more negative (worse) on the average once they have taken an introductory computer course.

Table 3: T TEST PROCEDURES

DIFF

SEX	N	MEAN	STDERROR
F	166	-0.60	.86
M	163	1.83	1.10

VARIANCES	T	DF	PROB>|T|
UNEQUAL	.89	308	.38
EQUAL	.89	327	.37

BATCUS

SEX	N	MEAN	STD ERROR
F	166	37.87	0.70
M	163	38.11	0.71

VARIANCES	T	DF	PROB>|T|
UNEQUAL	-0.24	327	0.80
EQUAL	-0.24	327	0.80

Table 4: ANCOVA
Dependent Variable: AATCUS

Source	DF	Sum of Squares	F Value	Pr > F
Model	8	8672.40809119	7.71	0.0001
Error	315	44266.29252609		
Corrected Total	323	52938.70061728		

RSquare	C.V.	AATCUS Mean
0.163820	30.19292	39.2623457

Source	DF	Type III SS	F Value	Pr > F
BATCUS	1	4230.78552904	30.11	0.0001
SEX	1	201.05756472	1.43	0.2325
Q1	1	2.02814010	0.01	0.9045
Q2	1	0.28657675	0.00	0.9640
Q3	1	18.32156276	0.13	0.7183
Q4	1	449.79260904	3.20	0.0746
Q5	1	302.92679616	2.16	0.1430
Q6	1	0.00272347	0.00	0.9965

SEX	AATCUS LSMEAN	Std Err LSMEAN	Pr > |T| H0:LSMEAN=0	Pr > |T| H0: LSMEAN1=LSMEAN2
F	38.4578383	0.9413325	0.0001	0.2325
M	40.0768469	0.9473204	0.0001	

For the 166 females that completed this study, the average difference score (BATCUS - AATCUS) is -0.60. The test statistic for the females for testing the alternative hypothesis above was -0.70 which corresponded to a p-value of 0.244. Although the -0.60 indicates that females have higher ATCUS scores after the computer course than before, the p-value indicated that the results are not statistically significant. (See Table 5)

RESULTS

Based upon our analyses, there was evidence to conclude that students have a more negative attitude toward computers after taking an introductory class than before. Furthermore, males seem to have significantly higher ATCUS scores after the exposure to the class than before. Generally, the demographic correlation analysis with BATCUS found that more computer courses, more hourly usage per week, more exposure to different computer packages and more years of experience with the computer were representative of lower ATCUS scores.

CONCLUDING REMARKS

Before exposure to the class, there was evidence to show that more experience lead to lower ATCUS scores. However after exposure to the class, there was evidence to show that an introductory computer course tended to raise ATCUS scores. The authors believe that this incongruence can be explained by looking at student expectations. Most introductory computer students have high expectations of the introductory class. Students have even expressed verbally that they are looking forward to the introductory class because they will learn "all" about the computer. The introductory class simply does not teach a student "all" about computers. It simply introduces students to the concepts and starts the learning curve for the productivity packages. At most, the student becomes a novice user of some of the packages. At the end of the semester, some students may be disappointed because they never quite reached their original expectations. Further, most students experience a larger learning curve than originally anticipated. Students need to be educated about the purpose of the introductory course before the semester begins.

Further, more research needs to be performed to determine how the course can be handled in a more efficient way. Perhaps, a single introduction class is not enough. Perhaps, the tools should be separate from the literacy. Perhaps, students and other individuals need multiple types of exposure to the computer before they can truly have positive attitudes toward using the computer. A single introduction class is simply not enough.

Also, this study needs to be replicated at multiple universities to determine if the current results can be replicated. The authors of this paper are currently working on similar studies with other universities.

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Table 5: GENDER DIFFERENCES OF STUDY VARIABLES

Female

Variable	N	Mean	Std Error	T	Prob>|T|
BATCUS	166	37.87	0.70	54.00	0.0001
AATCUS	166	38.47	0.86	45.00	0.0001
DIFF	166	-0.60	0.86	-0.70	0.4886

Male

Variable	N	Mean	Std Error	T	Prob>|T|
BATCUS	163	38.12	0.71	53.85	0.0001
AATCUS	163	39.95	1.12	35.70	0.0001
DIFF	163	-1.83	1.10	-1.67	0.0965

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Exhibit 1: DEMOGRAPHIC QUESTIONS*

1. Did you use a computer in any of your high school classes?

A - frequently. . . . . E - never
A - 22.9% B - 20.2% C - 23.3% D - 13.3% E - 20.4%

2. How many college courses have you taken that have involved using a computer?

A - 0 B - 1 C - 2 D - 3 E - 4 OR MORE
A - 48.5% B - 28.1% C - 14.3% D - 4.1% E - 5%

3. How many hours a week do you now spend using a computer?

A - 0 B - 1 C - 2 D - 3 E - 4 OR MORE
A - 57.3% B - 17.1% C - 10.2% D - 4.7% E - 10.7%

4. How many types of computer packages have you used?

A - 0 B - 1 C - 2 D - 3 E - 4 OR MORE
A - 23.7% B - 31.2% C - 25.3% D - 8.9% E - 10.9%

5. How anxious do computers and computerized mechanisms make you feel?

A - very anxious . . . . . E - not anxious at all
A - 10.8% B - 22.4% C - 37.1% D - 18.6% E - 11.1%

6. How many years of computer usage experience have you had?

A - less than one year (37.3%)
B - 1 year (23.5%)
C - 2 years (17.4%)
D - 3 years (7.5%)
E - more than 3 years (13.8%)

*Following each question are the percentage responses.

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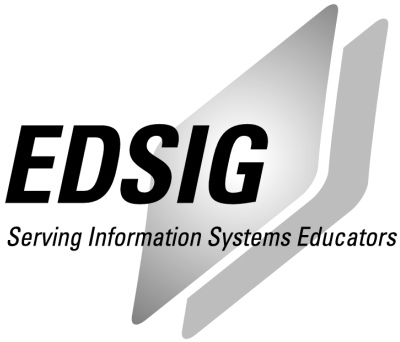

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ISSN 1055-3096