AGRICULTURE STUDENTS' ACADEMIC ACHIEVEMENT, ATTITUDES TOWARDS PAPERLESS EXAMS, COMPUTER ANXIETY, COMPUTING ATTITUDES, AND LEARNING STYLES

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Abstract

The purpose of this study was to determine if a statistical relationship existed between academic achievement and exam delivery method for students enrolled in a Computer Applications in Agriculture course during spring semester 1999. A purposive sample of college of agriculture students (n = 45) had their computing application skills tested through traditional (paper and pencil) and electronic (e-mail) methods. Significant, moderately positive associations resulted between academic achievement and exam delivery method for the quiz exam scores. Agriculture students who took the quiz using paper and pencil had significantly higher scores than did students who took the quiz through an electronic version. A significant moderate relationship existed between academic achievement and learning style for the quiz; field-independent students achieved significantly higher quiz scores than did field-dependent learners. No significant associations were found between academic achievement and students' attitudes towards computers, computing anxiety levels, attitudes towards electronic exams, or gender. The variable of time may have a significant impact upon academic achievement for students involved in computerized testing situations. Early identification of field-dependent learners affords the instructor time to provide additional assistance for those who find learning computing skills an academic challenge.

Introduction

University students experience anxiety or stress, when computers malfunction, data are lost, or when program errors have caused complete computer file destruction. These anxious moments may be heightened during times of extreme pressure such as staying up all night to finish a term paper before a pre-determined deadline. It is fair to assume that students suffering such "computer anxious" times may be hypersensitive when newly learned computing skills are tested under time constraints and without paper and pencil. However, if agricultural educators are preparing students in a true work-related manner, then we can ill-afford to neglect the value of a computerized testing situation in our classrooms. Many agribusiness firms require interviewees to "demonstrate" their computing skills, without paper and pencil, and during an anxiety-filled job interview.

> The true power of computing (acquiring data electronically, formulating solutions to problems, and transferring saved data electronically to a distant location) may not be fully realized in most university-level computer applications courses. The very nature of testing students' computing skills in an authentic situation lends itself to evaluations of those skills in a paperless computing environment. As a precursor to implementing this evaluation method, certain questions must be addressed about the relationships between computing anxiety, students' attitudes towards computers, and students' learning styles. What relationships exist between these variables for university agriculture students in a Computer Applications in Agriculture course?

Conceptual Framework

The incidence of computer usage as an instructional aid in agriculture programs at the secondary and post-secondary levels of education has increased dramatically during the past decade. At the high school level, much research has been conducted to better understand agriculture teachers' computer usage (Raven & Welton, 1989; Birkenholtz, Stewart, McCaskey, Ogle, & Lindardt, 1989; Birkenholtz & Stewart, 1991; Camp & Stuphin, 1991; Miller & Connors, 1996; Nordheim & Connors, 1997) and teachers' related anxiety towards using computers in their programs (Drueckhammer, Kotrlik, & Parton, 1986; Fletcher & Deeds, 1994). Studies conducted at the post-secondary level have focused mainly on students' attitudes towards computers, preferred learning styles, and levels of computing anxiety (Marrison & Frick, 1994; Raven, Newman, & Day, 1997; Day, Raven, & Newman, 1998) and academic achievement, teaching method, and learning styles (Sexton, Raven, & Newman, 1998; Sexton, Newman, & Raven, 1998). The research efforts concerning computer usage in agricultural education are commendable. One of the elements missing from those studies was the specific exclusion of using computers to evaluate, without paper and pencil, university students' ability to apply their computing skills in a problem solving situation.

Although student testing through an electronic medium (exclusively) is not new to education, it is not mentioned in agricultural education studies. Recent scholarly work has been devoted to student assessment through an "electronic only" testing environment. Boo (1997) found respondents preferred taking the computerized sub-tests for the Iowa Tests of Educational Development (Vocabulary, Ability to Interpret Literary Materials, Ability to Do Quantitative Thinking) to the paper and pencil versions. Also, Boo's respondents had favorable attitudes about the general features of the computerized tests. A point of interest in Boo's study was that group mean differences in computer anxiety and computer experience did not fluctuate between test scores and administration mode. This may be due to a predominance of younger students feeling more comfortable with computerized testing situations. Because computers and communication mediums have become more pervasive in our society, we will continue to see future

university students “expecting” to use computers in the teaching, learning, and assessments processes.

In support of the position stated above, Digh (1997) used the Lloyd and Gressard (1984) Computer Attitude Scale to find that 135 pre-service teachers (K-12) in Tennessee significantly reduced their computer anxiety and increased their computing confidence after taking a semester-long Instructional Technology course. However, no significant difference was found for the perceived usefulness of the personal computer following the course. As educators, we should take particular interest in advocating the transference of computing skills beyond a single-semester computer applications course. Chmielewski (1998) explored the transfer of Internet training. Transfer of training was divided into four categories: e-mail knowledge, Web knowledge, e-mail use, and Web use. The study focused on working adults who represented a range of characteristics. Results showed that people who participated in the Internet training used e-mail and the Web significantly more often and had significantly higher e-mail and Web knowledge scores than did those people not participating in the training.

Additional studies on students’ computer anxieties, attitudes, and electronic versus paper and pencil assessments includes the study by Sternberger (1998). Sternberger found that of 180 nursing students, females had more negative computer attitudes than did males. Also, consistent with computer attitudes, females who took the mathematics test using the computer-based format had lower achievement scores. Regardless of testing format, there was no difference in achievement scores for males. Sternberger used the Lloyd and Gressard (1984) Computer Attitude Scale to measure attitudes towards computers. Contrary to these findings, Otomo (1998) found no significant gender differences concerning computer anxiety and test anxiety for 153 community college students. Similarly, Lynch (1997) found no significant differences in test mean scores for 87 community college students enrolled in three sections of Introductory Psychology when comparing computerized versus paper and pencil tests. However, Lynch did find a tendency for computer test scores to be higher initially than paper and pencil scores, but the differences diminished with each successive test. Although these studies contribute to our knowledge base about traditional versus computerized testing, they do little to address the evaluation methods used for testing students’ computer application skills in a traditional versus electronic medium.

College students do experience anxiety when using computers for the first time. They may experience additional stress if asked to demonstrate their computing skills through an electronic only testing situation. The research studies mentioned above help us understand that students may experience less academic achievement in computerized testing situations initially, but the detrimental effects (computing anxiety and/or test anxiety) appear to diminish with time. Successive computerized testing environments produced notably higher academic achievement for several groups. However, the diminishing effect may not hold true for female students. Does the mere passage of time reduce students’ anxiety towards computers in general? Does the same passage of time reduce students’ anxiety towards computing skills tests in particular? What is the nature of computer anxiety, test anxiety, and a student’s preferred learning style? Future employees in public and private sectors alike will have demands placed on them that specifically entail their computing skills before they are offered employment.

Extensive literature concerning computer usage, computer-assisted teaching methods, students’ attitudes towards computer, preferred learning styles, and computer anxieties pervades the agricultural education profession. Effective design and implementation of computer applications courses are incomplete without a study of the evaluation methods used to test students’ computing skills. If field-independent students had significantly positive attitudes toward computers (Raven, Newman, & Day, 1997) would this hold true when taking a computing skills examination through an electronic medium? Is there a relationship between a student’s preferred learning style and exam delivery method? It is necessary to address these questions before recommendations can be made to incorporate “electronic only” evaluations of students’ computing skills.

Purpose and Objectives

The purpose of this study was to investigate relationships between agriculture students’ academic achievement in a computer applications course and exam delivery method. A secondary purpose was to explore relationships between agriculture students’ academic achievement and their learning styles, computer anxiety levels, attitudes towards computers, attitudes towards electronic examinations, and gender. The following research questions guided this study.

1. What were students’ academic achievements, as measured by quiz and midterm scores, computer anxiety levels, attitudes towards computers, and attitudes towards paperless computer examinations?
2. What relationships existed between agriculture students’ academic achievement and exam delivery method (paper and pencil versus electronic format) or gender?
3. What was the association between agriculture students’ academic achievement and learning style as measured by the Group Embedded Figures Test (GEFT)?
4. Did relationships exist between students’ academic achievement and their attitudes towards paperless computer exams, computer anxiety scores, attitudes towards computers, or gender?

Procedures

Descriptive survey methodology and a correlational design were used in this study (Ary, Jacobs, & Razavieh, 1996). The dependent variables were quiz and midterm exam grades in the AgEE 62-Computer Applications in Agriculture class. The independent variables were learning styles, exam delivery method, computer anxiety levels, attitudes toward computer scores, attitudes toward electronic exams, and gender.

AgEE 62-Computer Applications in Agriculture was offered originally for students majoring in agricultural education. Due to the extreme popularity of this course, another section was offered on an open-enrollment basis for all college of agriculture students. Each section attained the maximum enrollment of 23 students for a total of 46. The accessible population ($N = 46$) was all students who chose to enroll in the AgEE 62 course during the 1999 spring semester. During this study, one student did not complete the AgEE 62 quiz or midterm exams; therefore only 45 (97.82%) respondents were included in the purposive sample. AgEE 62 met weekly (15 weeks total) for two 90-minute sessions. The course instructor utilized a laptop computer and projection unit to teach key concepts and applications. Each section had a teaching assistant who monitored students' progress. Course content included computer operating systems, file management, electronic communications (e-mail), word processing, spreadsheet applications, presentation/graphical programs, Internet use, and Web authoring.

AgEE 62 course enrollment required all students to participate in a paperless computer exam environment at the onset of the semester. Students were required to activate their e-mail accounts during the first week of class. Weekly practice assignments for sending, receiving, and attaching files were conducted with the instructor. Prior to the first quiz (occurring in week four), academic performance consisted of five projects in Word® '97 and e-mail using Eudora Pro®. Before the midterm exam (occurring in week eight), academic performance consisted of three projects using Excel® '97 and e-mail use.

Data were collected in two rounds, using Chou's (1997) original computer attitude scale (round one in week one) and a modified version (round two in week eight). Chou's instrument contained three sections measuring 1) computer anxiety, 2) attitudes toward computers, and 3) demographics. The first section contained a twelve-item, four-point, Likert type scale measuring responses to computer anxiety. Responses could range from Strongly Disagree (1) to Strongly Agree (4). Cronbach's alpha coefficients for section one were .86 (round one) and .89 (round two). Section two contained the same Likert type scale, but consisted of 26 items that measured attitudes toward computers. Cronbach's alphas for section two were .92 (round one) and .90 (round two). Also, section two was comprised of three sub-scales measuring a) computer confidence (Cronbach's = .81 in round one; .76 in round two), b) computer enjoyment (Cronbach's = .84 in round one; .72 in round two), and c) using the computer as an instructional medium (Cronbach's = .81 in round one; .84 in round two). Chou's instrument was derived from extensive development and testing (Raven, Newman, & Day, 1997) and was considered reliable and valid in this research study.

Chou's (1997) original instrument was used in its entirety for the first administration, but the demographic section was deleted during the second round. A researcher-developed section measuring attitudes toward paperless exams was included as the third section during the second round. Students' perceptions regarding the paperless exam process were recorded on a 19-item, five-point Likert type scale. The researcher chose a five-point scale since this was a relatively new research area. Responses could range from Strongly Disagree (1) to Undecided (3) to Strongly Agree (5); it was pilot tested in three consecutive semesters before the 1999 spring semester. Cronbach's coefficients during those three semesters ranged from .78 to .82. For this study, Cronbach's alpha was .84.

The GEFT (Witkin, Oltman, Raskin, and Karp, 1971) was used to determine students' preferred learning styles. Witkin et al. (1971) determined two types (field-dependent and field-independent) of learners exist. AgEE 62 students who scored greater than the national mean (11.4) were classified as field-independent learners, while those who scored less than the national mean were classified as field-dependent learners. Internal consistency was measured by treating each scored section as split halves. Witkin et al. (1971) reported a Spearman-Brown reliability coefficient of .82 on the GEFT. For this study, the Spearman-Brown reliability coefficient was .87.

> Prior to the first computer skills quiz (50 points possible) in week four, students in both sections were informed that one-half (chosen randomly) would receive the quiz through e-mail and one-half would take the quiz using paper. E-mail examinees were required to download the quiz using Eudora Pro, answer the problems, save the results on their diskette, attach all answer files to an outgoing e-mail message, and turn in the diskette to the instructor. They were not permitted to print any instructions. Paper and pencil examinees were given the exact same quiz on paper, required to answer all questions, print all results, save all files on diskette, and turn in paper answers and diskette to the instructor. The same procedures were followed for the midterm (100 points possible) in week eight, except the e-mail and paper and pencil groups were switched. The computer quiz and midterm exam were closed-note, closed-book tests, but students could use any on-line resources for help except for another student (via e-mail). All test problems were patterned after the projects completed during the course of the semester. Both exams were deemed valid and reliable assessments of students' computing skills by the researcher. The instructor scored all quiz and midterm exams for both sections. The instructor assessed and scored all students' learning styles in the sixth week.

Descriptive statistics and bivariate analyses were used to describe the data. Pedhazer's (1982) convention for dummy coding variables was used. Relationships were explored using Pearson's product-moment correlations for interval-type data and point-biserial correlations were employed to examine interval and nominal data. Davis' (1971) convention was used to describe the magnitude of relationships.

Findings

Table 1 shows that a majority of male, junior class, agricultural education majors were enrolled in the AgEE 62-Computer Applications in Agriculture course during the 1999 spring semester. The average age of all students was 21.13 years (SD = 2.85).

Table 1.
Descriptive Statistics for AgEE 62 Students' Demographics (n = 45)

Factor	Label	f	Percent
Gender	Male	24	53.3
	Female	21	46.7
Class Status	Junior	16	35.6
	Sophomore	12	26.7
	Senior	11	24.4
	Freshmen	6	13.3
Major [a]	Agricultural Education	27	60.0
	All Others	18	40.0
Age	19	13	28.9
	20	10	22.2
	23+	9	20.0
	21	7	15.6
	22	4	8.9
	18	2	4.4

[a] Majors other than Agriculture Education included students from Animal Science, Forestry, Plant Science, Agricultural Economics, and Environmental Protection.

In answering the first research question, AgEE 62 students who took either exam using the paper and pencil version achieved higher scores than did students who were in the e-mail group (Table 2). In general, respondents held similar attitudes towards electronic exams, computing anxiety levels, and attitudes towards computers, regardless of exam delivery method. However, computing anxiety levels increased from the quiz to the midterm exam for students who were required to complete the exam using the paper version. Computing confidence increased for both groups from the time respondents took the quiz to the time they finished the midterm exam. AgEE 62 students had more positive attitudes towards electronic computer exams while participating in the paper exam version, but held more negative attitudes towards electronic exams while being tested in an electronic only situation.

Table 2.
Descriptive Statistics for Dependent and Selected Independent Variables (n = 45)

Variable	Mean Values		
First Administration	Grand	E-mail (n = 23)	Paper (n = 22)
Quiz Score	42.60	41.13	44.13
Computer Anxiety	22.44	22.83	22.05
Computer Attitudes	78.38	78.52	78.23
Attitudinal Sub-scales			
Computer Confidence	31.64	31.61	31.68
Computer Enjoyment	28.73	28.96	28.50
Computer as Instructional Medium	18.00	17.96	18.05
Second Administration			
Midterm Score	88.56	84.91	92.04
Computer Anxiety	23.07	22.41	23.70
Computer Attitudes	78.09	78.17	78.00
Attitudinal Sub-scales			
Computer Confidence	32.27	32.72	31.82
Computer Enjoyment	27.93	27.68	28.17
Computer as Instructional Medium	17.89	17.77	18.00
Electronic Exam Attitudes	60.11	58.52	61.57

Bivariate analyses were used to answer the second research question. Table 3 illustrates a moderately negative relationship between students' quiz scores and exam delivery method (r_{pb} = -.326). Exam delivery method was coded as 0 (paper) and 1 (e-mail). Students who took the quiz using the paper version had significantly higher scores than did students in the electronic only quiz group. No significant relationships occurred for the midterm exam.

Table 3.
Correlations Between Academic Achievement and Exam Delivery Method (n = 45)

	Exam Delivery Method	
Variable	r	Sig.
Quiz Scores	-.326*	.029
Midterm Exam Scores	-.233	.123

[a] Point-biserial correlation coefficients.
*p<.05

A near even split existed between students who were field-dependent (n = 23) and field-independent (n = 22) learners. Cumulative scale scores for learning styles were correlated with raw quiz and midterm exam scores. Table 4 shows a significant moderately positive relationship existed between academic achievement and learning style (r_{pb} = .432). Field-independent students had significantly higher quiz scores than did field-dependent learners. No significant relationships occurred for the midterm exam (Table 4).

Table 4.
Correlations Between Academic Achievement and Learning Style (n = 45)

	GEFT	
Variable	r	Sig.
Quiz Scores	.423**	.004
Midterm Exam Scores	.160	.294

[a] Point-biserial correlation coefficients.
**p<.01

Bivariate analyses (fourth research question) were used to determine if significant relationships existed between students' academic achievement and their attitudes toward electronic exams, computer anxiety levels, attitudes toward computers, attitudinal sub-scales, or gender. No significant associations existed between these variables.

Conclusions

AgEE 62-Computer Applications in Agriculture students performed significantly worse on the quiz if they took it through an electronic medium only. No significant relationships were found between groups when analyzing midterm exam scores. These findings are the converse of what Lynch (1997) found when psychology students performed better on computerized tests than did those who took the paper and pencil versions. Lynch also found that significant differences between evaluation delivery methods diminished with each successive test, as was found in this study. One explanation of this finding may be that students were not sufficiently comfortable with using e-mail prior to the quiz. As a group, they agreed that taking computer skills exams electronically was not as easy as taking the exams in a more traditional paper and pencil fashion. Educators should take note that this trend may reverse direction within the next five years as families, as well as elementary and secondary level schools continue to purchase and use (especially e-mail) computers daily (Marcus, 1999).

Field-independent students had a significantly higher likelihood of doing well on the quiz than did field-dependent learners. This finding supports those of Raven, Newman, and Day (1997) who found that field-independent learners were more likely to attain higher academic achievement in a computer applications course than were field-dependent learners. Due to the absence of significant relationships between academic achievement and midterm exam delivery method or learning styles, it is possible that with time, AgEE 62 students became more comfortable with using computers in general and with the "expected" testing procedures used in this computer applications course. This result provided further support for Lynch's (1997) study, while it nullified the notion that field-dependent students have more difficulty in solving problems (Witkin et al., 1971).

The lack of significant relationships between students' academic achievement and their attitudes toward electronic exams, computer anxiety levels, attitudes toward computers, attitudinal sub-scales, or gender could be attributed to any extraneous variable, but is most likely the cause of a small, homogeneous sample. Caution is warranted in generalizing this finding to other groups and/or other computerized testing situations.

The findings in this study further support the expanded research concerning learning styles, academic achievement, and computer skills. Field-independent learners achieved higher academic performance in computer applications than did field-dependent learners. Witkin, et al. (1971) described field-dependent learners as people who perceived the world in a global fashion, found it difficult to solve problems, were highly sensitive, were conscience of their social environment, and favored the spectator approach to learning. Unfortunately, students who are field-dependent

learners are at a disadvantage when learning computer applications skills. Students who are afraid, anxious, and/or timid about learning new computing skills on their own, would not do well in a computer applications course where 23 students are vying for one instructor's time. Additionally, the very nature of becoming a proficient computer user, who is at-ease with computers, has generally positive attitudes toward computers and electronic communications, will require something other than a "spectator approach" to learning. Acquiring computing skills is much like welding; it is a practiced skill.

Implications and Recommendations

The most important implication resulting from this study is recognizing that the next generation of students will utilize e-mail and other forms of electronic communications long before they reach our classrooms. The next generation of students will be technological decades ahead of today's students. Are we ready to provide challenging, intellectual, and practical teaching and learning environments for future students? Continued study of computing skills is warranted when considering possible differences among learner groups' computing skills in comparison by exam delivery method.

The magnitude of variation among learning styles and its effect on academic achievement, computer anxiety, and attitudes towards computerized exams should be studied in other situations and with larger samples. It is believed that early identification of field-dependent learners will allow the instructor, teaching assistants, and/or cooperative learning teams an opportunity to provide additional assistance for students who find learning computing skills an academic challenge. The eventual goal is that field-dependent learners will find using computers enjoyable, have less anxiety about using computers, and maybe achieve greater academic success.

In an ever-expanding world of technological frontiers, we owe it to our students and to ourselves, to push the envelope in our computing prowess. The agricultural industry continues to seek graduates who have the most proficient computing skills upon entering the workforce. Electronic communication will play a major role in many educational and business settings beyond the year 2000. Agricultural educators who teach computing skills at the university level must advance their curricula design, implementation, and evaluation (in an authentic testing environment) of students' computing skills.

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