Journal of Agricultural Education
Volume 41, Number 1, pp. 69-78
DOI: 10.5032/jae.2000.01069

AGRICULTURE STUDENTS' COMPUTER SKILLS AND ELECTRONIC EXAMS

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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 the AgEE 62-Computer Applications in Agriculture course during spring semester 1999. Significant, positive, moderate associations resulted between academic achievement and exam delivery method; agriculture students (**n** = 45) who took the quiz using the paper-and-pencil method scored significantly higher than did students who took the quiz in an electronic version only. 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. Independent learners had significantly more computer enjoyment than did dependent learners. Field-independent learners had significantly lower levels of computer anxiety after the midterm than did field-dependent learners. AgEE 62 students agreed that taking computer skills exams electronically was not as easy as taking the exams in a more traditional paper-and-pencil fashion. Early identification of field-dependent learners allows the instructor, teaching assistants, and/or cooperative learning teams an opportunity to provide additional assistance for students who find learning computer skills an academic challenge.*

Theoretical Framework

Anxiety caused by computer malfunctions, destroyed data, lost files, and program errors have beleaguered most university students at some point during their academic careers. 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 such "computer anxious" times may be super-sensitized during moments when newly learned computer skills are tested without paper and pencil, under time constraints. The very nature of testing students' computer skills in an authentic situation lends itself to evaluations of those skills in a paperless environment. Antecedents to implementing this novel evaluation method are questions about the relationships between students' computer anxiety levels, attitudes toward computers, learning styles, and relevant demographic variables. Do relationships between these variables exist for agriculture students in a Computer Applications course?

Computer usage in secondary and post-secondary agriculture programs has increased dramatically in this decade. At the secondary level, a surplus of research has been conducted to better understand agriculture teachers' computer usage (Birkenholtz & Stewart, 1991; Camp & Stuphin, 1991; Miller & Connors, 1996; Nordheim & Connors, 1997) and teachers' related anxieties towards using computers in their programs (Fletcher & Deeds, 1994). Studies conducted at post-secondary levels have focused on students' attitudes towards computers, preferred learning styles, levels of computer 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). Research efforts concerning computer usage in agricultural education have grown extensive and noteworthy. One of the elements missing from those studies was the specific exclusion of using computers to evaluate, without paper, university students' application of computer skills.

Although student testing through an electronic medium (exclusively) is not new to education, it appears suspiciously devoid of mention and/or serious study in agricultural education. Recent scholarly work has been devoted to student assessment via an "electronic only" testing environment. Boo (1997) found respondents preferred taking the computerized sub-tests (Iowa Tests of Educational Development: Vocabulary, Ability to Interpret Literary Materials, Ability to Do Quantitative Thinking) over the paper-and-pencil versions, and they had favorable attitudes about the general features of computerized tests. A point of interest in Boo's study was respondents' differences in computer anxiety and computer experience did not moderate relationships between test scores and administration mode. This may be due to a predominance of younger students feeling more comfortable with testing situations involving the computer only. Because computers have become more pervasive in our society, we will see future students "expecting" computers in the teaching, learning, and assessment processes.

In support of the position stated above, Digh (1997) used the Lloyd and Gressard (1984) Computer Attitude Scale to find that 135 K- 12 preservice teachers in Tennessee significantly reduced their computer anxiety and increased their computing confidence, following a semester-long Instructional Technology course. Interestingly though, no significant difference was found for the perceived usefulness of the personal computer following the course. As teacher-educators, we should take particular interest in advocating the transference of computer skills beyond a single-semester computer applications course. Additional studies on students' computer anxieties, attitudes, and exam delivery method includes the study by Sternberger (1998) who 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 test score achievement for males.

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 computer administered 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 then for that difference to diminish with each successive test. These studies contribute to our knowledge base about traditional versus computerized testing, but they do not address evaluation methods used for testing students' computer application skills in a traditional versus electronic medium.

Extensive literature about computer usage, computer-assisted teaching methods, students' attitudes toward computers, computer anxiety, and preferred learning styles pervades agricultural education. Pursuant to an effective design and implementation of computer-related applications courses is an obligatory study of the evaluation methods used for testing students' computer skills. In particular, is there a relationship between academic achievement in computer skills and exam delivery method? Is there a relationship between preferred learning style and exam delivery method? It is imperative to study these questions before recommendations can be made to incorporate "electronic only" evaluations of students' computer applications 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 differences among group mean scores for academic achievement, computer anxiety levels, attitudes

towards computers, and attitudes towards electronic examinations when analyzed by learning style. These questions guided this study.

1. What relationships existed between agriculture students' academic achievement in a computer applications course and exam delivery method?

2. What association existed between agriculture students' academic achievement and learning styles as measured by the Group Embedded Figures Test (GEFT)?

3. Did learning style groups significantly differ in their:
   a) Academic achievement scores?
   b) Computer anxiety scores?
   c) Attitudes towards computers?
   d) Attitudes towards paperless computer examinations?
   e) Time-of-day when taking computer exams?

4. What were students' attitudes towards paperless computer exams after experiencing both types (paper and pencil versus electronic format) of exam delivery method?

Procedures

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

AgEE 62-Computer Applications in Agriculture, was offered originally in a morning session (8:00-9:30) for students majoring in agricultural education. Due to the extreme demand, an afternoon section (12:30-2:00) 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 represented by all students who chose to enroll in the AgEE 62 course during the 1999 spring semester. The researcher treated the students in the study as a sample of all possible agriculture students who might enroll in the course (Allen, Abaye, McKenna, & Camp, 1995; Day, Raven, & Newman, 1998). 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 sample. AgEE 62 met twice a week (15 weeks total) in 90-minute sessions. The course instructor utilized a laptop computer and projection unit to teach key concepts and applications. A teaching assistant monitored students' progress in each section. Course content included operating systems, file management, electronic communications (e-mail), word processing, spreadsheets, presentation programs, Internet usage, and Web authoring.

As part of the AgEE 62 course requirement, all students agreed 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 (week four), academic performance in AgEE 62 consisted of five projects using MS-Word@ '97 and e-mail using Eudora Pro@. Prior to the midterm exam (week eight), AgEE 62 academic performance consisted of three projects using MS-Excel@ '97 and continued use of e-mail.

Data were collected in two rounds, using an original (round one in week one) and modified (round two in week eight) version of the computer attitude scale developed by Chou (1997). Chou's instrument had 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. Section two Cronbach's coefficients were .92 (round one) and .90 (round two). Also, section two was comprised of three sub-scales: computer confidence (Cronbach's = .81 in round one; .76 in round two), computer enjoyment (Cronbach's = .84 in round one; .72 in round two), and the computer as an instructional medium (Cronbach's = .81 in round one; .84 in round two). Chou's instrument was derived from previous testing (Raven, Newman, & Day, 1997) and was considered reliable and valid in this research study.

The original instrument (Chou, 1997) 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 Strongly Agree (5). The scale used to measure students' attitudes toward paperless exams was pilot tested in three consecutive semesters prior to 1999. Cronbach' s coefficients during those three semesters ranged from .78 to .82. For this study, Cronbach's coefficient was .84.

The GEFT (Witkin, Oltman, Raskin, and Karp, 1971) was used to determine students' preferred learning styles for which Witkin determined two learner types exist (field-dependent and field-independent). AgEE 62 students who scored greater than the national mean (11.4) were classified as field-independent learners; those who scored less than the national mean were classified as field-dependent. 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.

Computer anxiety and attitudes toward computers, using Chou's (1997) original instrument were assessed during the first week of class. Prior to the first computer skills quiz (50 points) in week four, students in both sections were informed that one-half (chosen randomly) would receive the quiz via e-mail and one-half would take the quiz using paper. During the quiz, students were separated so all e-mail examinees were seated on one side of the computer lab and all paper-and-pencil examinees were seated on the other side. E-mail examinees were required to download the quiz through Eudora Pro, answer the problems, save the results on 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) in week eight, except the e-mail and paper-and-pencil groups were switched. The quiz and midterm were closed-note, closed-book tests, but students could use any on-line resources for help, except for other students (via e-mail). The instructor scored all quizzes and midterms for both sections. The instructor assessed learning styles in the sixth week. The modified version of Chou's (1997) instrument was administered after the midterm (week eight).

Descriptive statistics, bivariate analyses, and analysis of variance described the data. Pedhazur's (1982) convention for dummy coding demographic variables was used. Relationships were explored using Pearson's product-moment correlations and point-biserial correlations were employed to examine interval and nominal data. Davis' (197 1) convention was used to describe the magnitude of relationships.

Findings

Table 1 shows a majority of male, junior class, agricultural education majors were enrolled in the AgEE 62 course during the 1999 spring semester. The average age of all students was 21.13 years (SD = 2.85). Due to low numbers for all other majors, the remaining students were categorized as "all others" to facilitate data analyses.

Students who received the computer quiz via e-mail had significantly lower scores (M = 41.13, SD = 5.07), $t(43) = 2.32$, $p = .03$, than did students who received the quiz in paper version only (M = 44.14, SD = 3.43). No significant differences occurred between groups, $t(43) = 1.82$, $p = .07$, when taking the midterm exam (Table 2).

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

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

Table 2. Descriptive Statistics for Commuter Quiz and Midterm Exam Sub-Group Scores

Exam Delivery Method	M	SD	n
Quiz Score (50 points)			
Paper Group	44.14	3.43	22
E-mail Group	41.13	5.07	23
Total	42.60	4.56	45
Midterm Score (100 points)			
Paper Group	92.04	5.87	23
E-mail Group	84.91	17.86	22
Total	88.56	13.51	45

Table 3 illustrates that point-biserial analyses for academic achievement and exam delivery method resulted in 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. AgEE 62 students were nearly evenly split between field-independent (n = 22) and field-dependent (n = 23) learners as measured by the GEFT. Learning styles were coded as 1(field-dependent) and 2 (field-independent).

Table 3. Intercorrelations Between Academic Achievement and GEFT (n = 45)

Variable	Quiz Delivery	Sig.	Midterm Delivery	Sig.	GEFT [a]	Sig.
Quiz Score	-.326*	.029	--		.432**	.003
Midterm Score	--		-.233	.123	.043	.781

"Point-biserial correlation coefficients
*p<.05
**p<.01

A significant moderate relationship existed between academic achievement and learning style (r_{pb} = .432) for the quiz score (Table 3). Field-independent students achieved significantly higher quiz scores than did field-dependent learners. Analyses of variance were used to determine if significant differences existed in mean scores for academic achievement, computer anxiety, attitudes toward computers, attitudinal sub-scales, attitudes toward electronic exams, and time-of-day for taking exams when compared by learning style (Table 4). Field-independent learners had significantly higher quiz scores (M = 44.59) than did field-dependent learners (M = 40.70). Field-independent learners had significantly lower levels of computer anxiety after the midterm (M = 20.77) than did field-dependent learners (M = 25.26). Field-independent learners enjoyed using computers significantly more (M = 29.36) than did field-dependent learners (M = 26.57). No significant differences between groups were reported for the remaining variables under consideration, including time-of-day when taking computer exams.

Table 4. Descriptive Statistics and Significance Levels for Independent Variables (n = 45)

Variable	Mean Values			
First Administration	Grand	F-Dep.	F-Ind.	F-value
Quiz Score	42.60	40.70	44.59	9.89*
Computer Anxiety	22.44	23.39	21.45	1.12
Computer Attitudes	78.38	76.61	80.23	1.04
Attitudes Sub-scales				
Computer Confidence	31.64	30.87	32.45	1.43
Computer Enjoyment	28.73	28.00	*29.50*	.84
Computer as Instructional Medium	18.00	17.74	18.27	.29
Second Administration				
Midterm Score	88.56	88.00	89.14	.08
Computer Anxiety	23.07	25.26	20.77	5.29*
Computer Attitudes	*78.09*	75.35	80.95	3.50
Attitudes Sub-scales				
Computer Confidence	32.27	31.26	33.32	3.32
Computer Enjoyment	*27.93*	26.57	*29.36*	5.20*
Computer as Instructional Medium	17.89	17.52	18.27	.55
Electronic Exam Attitudes	60.11	*59.30*	61.00	.12

*p<.05

Additional analyses showed students' attitudes toward taking computer skills exams in a paperless exam environment were more positive after the midterm than before the quiz (Table 5). Interestingly, they planned to continue using e-mail after leaving the university, but were not sure if evaluating their computer skills in a paperless method was the best idea.

Table 5. Descriptive Statistics for Attitudes toward Electronic Exams

Statements	M	SD	n
I plan to continue using e-mail after I leave the university environment.	4.72	.55	43
After participating in this class, my computer skills have increased.	4.60	.82	43
If more people used e-mail, valuable resources could be conserved.	4.33	1.02	43
I had no trouble downloading my midterm from my e-mail message.	3.93	1.11	22
My computer skills were adequate for taking my first computer quiz.	3.90	1.01	42
I had no trouble downloading my quiz from my e-mail message.	3.90	1.30	23
I had sufficient instruction prior to completing my computer quiz.	3.88	1.09	42
I had sufficient instruction prior to completing my computer midterm.	3.84	.99	32
I had no trouble sending my quiz through the Eudora e-mail system.	3.75	1.41	23
I had no trouble attaching my quiz to an outgoing e-mail message.	3.73	1.34	23
My computer skills were adequate for taking my electronic midterm.	3.72	1.05	22
I had no trouble attaching my midterm to an outgoing e-mail message.	3.67	1.33	22
Completing computer exams by paper/pencil is easier than using e-mail.	3.60	1.25	42
I had no trouble sending my midterm through the Eudora e-mail system.	3.59	1.34	22
Electronic exams are the best for testing my computer skills.	3.40	1.25	42
Electronic exams are the best evaluations for a computer skill class.	3.14	1.30	42
After participating in the paperless exam, I will use e-mail more often.	2.76	1.09	41
Completing my quiz by e-mail was easier than with paper/pencil.	2.41	1.36	23
Completing my midterm by e-mail was easier than with paper/pencil.	2.32	1.29	22

Note. Scale: 1=Strongly Disagree; 2=Disagree; 3=Undecided; 4=Agree; 5=Strongly Agree

Conclusions

Contrary to the popular belief that computers and e-mail are ubiquitous in our society and that younger students entering our colleges have a relative advantage for using these technologies (Marcus, 1999), the findings in this study did not bear witness to this claim. AgEE 62-Computer Applications in Agriculture students performed significantly worse on the quiz if they took it through an electronic medium only. No significant differences 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 the significant differences between evaluation delivery methods diminished with each successive test, as was found in this study. One explanation 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 note that this trend may reverse in the next five years as families and schools continue to purchase and use (especially e-mail) computers daily (Marcus, 1999).

Learning style was significantly associated with academic achievement for the quiz; field-independent learners did significantly better on the quiz than did field-dependent learners. This finding supports those of Newman, Raven, and Day (1997) who found that field-independent learners were more likely to achieve higher academic achievement in a computer applications course than were field-dependent learners. A lack of significant differences among groups during midterm exam delivery method and learning style indicates a possibility that as the semester progressed, both learner types became more comfortable with using computers. Their comfort levels may have transcended the "expected" testing procedures used in this computer applications course, thereby nullifying the notion that field-dependent students have more difficulty in solving problems (Witkin et al., 1971).

When analyzing mean scores of academic achievement, computer anxiety, attitudes toward computers, attitudinal sub-scales, attitudes toward electronic exams, and time-of-day for taking exams, field-dependent learners experienced significantly more anxiety about the whole computing process after the midterm than did field-independent learners. Also, field-independent learners achieved significantly higher quiz scores and held significantly stronger feelings of enjoyment while using the computer than did field-dependent learners. These findings strongly support those found by Newman, Raven, and Day (1997) and Raven, Newman, and Day (1997). Interestingly, both field-dependent and field-independent students' overall anxiety level increased, while their attitudes and enjoyment levels decreased from the semester's start to the midterm. The overall changes were not significant; the most probable explanation was due to data collection timing, rather than computing. AgEE 62 students were most likely frustrated with school in general during midterm week, which occurred two weeks before spring break.

The findings in this study further support the expanded research concerning learning styles, academic achievement, and computer skills. In support of previous research (Newman, Raven, & Day, 1997), AgEE 62 students who were field-independent learners enjoyed using computers, experienced less computer anxiety, and achieved higher academic performance in the computer applications in agriculture course than did field-dependent learners. Witkin et al. (197 1) 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, field-dependent learners are at a disadvantage when learning computer applications skills. Students who are afraid, anxious, and/or timid about learning new computer 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. Computer skills cannot be learned vicariously.

Implications and Recommendations

The most important implication resulting from this study involves recognizing the magnitude of variation among learning styles and its effect on academic achievement, computer anxiety, and attitudes toward computers. The AgEE 62 instructor intends to assess future AgEE 62 computer students' learning styles at the onset of each semester, thereby affording students who may have computing difficulties, more out-of-class practice time. 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 computer skills an academic challenge. Eventually, field-dependent learners will enjoy using computers, be less anxious about computers, and maybe achieve greater academic success.

Additional study is warranted concerning the differences among groups when compared by exam delivery method. This researcher believes the next generation of students entering our classrooms will fully utilize e-mail and other forms of electronic communications yet to be discovered, long before they reach our doors. As educators are we ready to provide challenging, intellectual, and practical teaching and learning environments for future students, who will be technological decades ahead of today's students? 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. Our state, nation, and world are dependent upon it.

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