AN ANALYSIS OF ONLINE EXAMINATIONS IN COLLEGE COURSES

Andrew P. Barkley[1]

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[1]Department of Agricultural Economics, Kansas State University, Manhattan, KS 66506-4011. Phone: 785.532.4426. FAX: 785.532.6925. E-mail: barkley@ksu.edu

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Abstract

This research evaluates the use of online examinations in college courses from both instructor and student perspectives. Instructional software was developed at Kansas State University to administer online homework assignments and examinations. Survey data were collected from two classes to measure the level of student support for online examinations. The determinants of the level of student support for online testing were identified and quantified using logistic regression analysis.

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The use of information technology in college-level instruction has become nearly ubiquitous (Gilbert; Green; Green and Gilbert; Barkley 2001; Newman et al.; O'Kane and Armstrong). Classroom technologies such as presentation software, course websites, and online homework assignments have been rapidly implemented as computer technology advanced (Barkley 2000; Barkley and Haycock). However, online testing, or examinations administered via the internet, has yet to be utilized extensively. The adoption and use of online examinations could help college and university instructors meet several pedagogical and instructional objectives, including frequent assessment of student learning, elimination of grading requirements and costs, immediate feedback to students, and elimination of paper and copying costs (Pyle). The relatively low interest level and slow adoption of online testing may be due to: (1) software requirements, (2) hardware requirements, (3) issues associated with cheating and/or dishonesty, and (4) logistical constraints, including space and time requirements. Space requirements may involve the use of an existing computer laboratory, or development of a new laboratory. Successful implementation of online examinations requires the devotion of faculty, staff, and administrative time and energy to logistical and institutional change. Since both space and time are scarce resources in colleges and universities, these constraints can be binding, slowing the adoption of online exams.

The objective of this research is to evaluate and assess the use of online examinations in college courses from the perspective of both the instructor and the student. Instructional software has been developed and used at Kansas State University

to administer both homework assignments (Barkley and Haycock) and examinations over the internet. Students can complete homework assignments at literally any time by submitting answers to multiple-choice questions from any location in the world that has internet connectivity. Examinations can be securely administered by limiting access to the internet to computers located in a specific location such as a computer lab, by restricting access to the web page to only those IP addresses for the computers in the testing laboratory.

This paper will provide an evaluation of online testing from the instructor point of view by describing and discussing the benefits and costs associated with online testing. Next, student opinions are evaluated with the use of survey data collected from two large Principles of Agricultural Economics and Agribusiness courses (AGEC 120) at Kansas State University during Spring 2000 and 2001 (301 observations). These data were used to measure the level of student support and approval of the use of online examinations. The determinants of the level of student support for online assignments and testing were identified and quantified using logistic regression analysis.

Background and Motivation for Online Testing

The primary motivation for the development and implementation of online examinations in a large course was the elimination of the high costs of grading assignments and exams in a large class. Large courses force instructors to carefully consider how assignments and examinations will be administered, since grading can be time-consuming (when instructors grade) or expensive (when teaching assistants grade).

For this reason, the use of multiple choice questions is pervasive in college courses with large enrollments, but may be inferior to essay questions that require critical thinking, evaluation, or assessment from a pedagogical point of view (Bracey; Haney and Madaus; and Borcher et al.). Many instructors use electronic scanning devices to grade multiple-choice examinations. Suen and Parkes described this situation: "…formal education has been dominated by objective testing, epitomized by such assessment formats as multiple choice testing with optically scanable responses."

The use of online examinations can extend and enhance scanner technology by having students select answers to multiple-choice questions on a computer connected to an internet site. A computer then automatically grades examinations, and a score is reported to both (1) an instructor grade book (spreadsheet), and (2) to the individual student, via a personal spreadsheet available only to each student.

These perceived benefits associated with computer grading initiated the development of software to administer examinations. A second major source of institutional benefits was soon identified: enhancement of student learning through frequent testing. Interestingly, in this case, the technological advance was adopted prior to knowledge of how learning could be positively affected. Hanna described the potential benefits of frequent assessment of course material:

> Perhaps the most vivid examples of the benefit of more frequent testing can be found at the college level, at which it is common for courses to have only two or three exams. In such classes it is not unusual to find students who do not 'crack the textbook' until shortly before the midterm. Rather than lament this deplorable reality, an instructor can do something to change it—test more frequently (p. 287).

The simple, straightforward conclusion that student learning is increased with more frequent testing is based not only on common sense and experience, but also on evidence (Bangert-Downs et al.). Hanna concluded,

> …replacing 3 50-minute tests with 15 10-minute weekly quizzes can do wonders to keep students up to pace. Although the total amount of testing time can remain the same, the impact can be great in causing students to distribute their study time more evenly. At the college level, more frequent testing can also improve attendance (p.287).

The next two sections are devoted to the benefits and costs of online examinations, from the instructor's point of view. Analysis of student opinions follows.

Benefits of Online Examinations

The two primary benefits of administering examinations online were identified above: (1) the large cost savings of the substitution of machines for labor in grading, and (2) the potential for enhanced student learning due to more frequent assessment. Another significant benefit is immediate feedback to students on homework assignments and examinations. Upon submission of the assignments and exams, the software provides students with answer keys and their own responses. According to Suen and Parkes, "The advantage of [computer-assisted testing] is the efficiency in scoring and report generation." Carlson (p. 16) concluded, "Instantaneous feedback is an excellent learning tool for the student." Rapid feedback rewards well-prepared students and motivates students who did not perform well to increase effort levels. The linkage between student preparation and performance is a strong motivational tool, which gives students the opportunity to increase learning outcomes through expeditious and continuous

knowledge of performance, early on in the course and throughout the semester. Kulik and Kulik summarized a meta-analysis of 254 studies with evidence that students enrolled in computer-based classes achieved higher post-test scores than those enrolled in traditional lecture and textbook courses.

Another easily overlooked benefit of online exams is the enjoyment and satisfaction that students receive by using the internet to look up course materials and learn course material. Not only is the computer an efficient method of providing course information, assignments, and examinations, but it provides an environment that students enjoy, which can lead to enhanced learning. Instructors who have administered examinations in large courses have experienced the high stress level that many students bring to the exam. A testing environment with only 30 computers dissipates this stress and fear, with an instructor and/or teaching assistant available to monitor the exam. Some of this stress reduction appears to be the smaller number of individuals taking the test, and some is undoubtedly due to the shorter exam length, since exams are given over only two weeks of course material.

Online examinations move exams out of the regular class time, allowing for instructors to cover more material, or the same material in more depth (Barua). Giving frequent online examinations keeps the instructor involved in the student learning process by providing instant access to "item analysis," or statistical analyses of the reliability and validity of exam and assignment questions. This quantitative feedback to instructors can be extraordinarily valuable in the improvement of student assessment over time.

Assignments and exams can be continuously updated through the elimination of inappropriate questions and addition of new questions.

The last major benefit of online testing is the "paperless" aspect of computer assignments and examinations. Placing course materials online results in significant cost savings: paper, copying, and distribution expenses are all reduced or eliminated. The elimination of paper costs alone is extraordinary. The copying and distribution of assignments to a large class is often unwieldy and inefficient. Administrators anxious to reduce expenditures are likely to strongly favor the transition from paper assignments and examinations to online learning opportunities.

Costs of Online Examinations

Perhaps the largest issue associated with online examinations is the potential for dishonesty and/or cheating (Barua). Carlson (p. 16) bluntly stated, "…the opportunity for academic dishonesty abounds." If examinations are placed online, students could cheat in several ways, including (1) using unauthorized books, lecture notes, or other course materials, (2) getting help from an individual or group, (3) taking more time than allocated, or (4) viewing the questions before studying. These issues were dealt with at Kansas State University by the development of a computer laboratory exclusively devoted to online testing (Barua reports that the same technique was used at the University of Akron, and Pyle developed a testing laboratory at Concordia College).

The laboratory at Kansas State University has 30 computers connected to the internet. During the first week of class, students signed up for 30-minute appointments to

take exams every two weeks throughout the semester. The instructor and two teaching assistants matched students with photo Ids, and administered the examinations. During software development, the examination process was labor-intensive. This was to ensure a positive atmosphere for test taking and an efficient, fair, and safe environment. As more online test experience occurred, labor costs fell rapidly as confidence is gained in the hardware, software, and logistics associated with administration of online exams. The labor costs of online exams are significant, and include: (1) software development, if a program is not purchased, (2) bureaucratic costs of acquiring an appropriate computer laboratory for online examinations, and (3) administration costs.

Development costs can be avoided by the adoption of one of several software packages available for college courses (Gibson et al.). As these packages become widely used, their quality and usefulness improves rapidly. Finding space to develop a test location can be time consuming and frustrating. However, as administrators and faculty learn about the potential gains from computer-based testing, these bureaucratic hurdles are likely to diminish.

Thus, the large benefits of online examinations are likely to outweigh the additional costs of computer testing, and some evidence for this is presented in what follows. Since online testing is relatively new, the costs associated with adoption can be high. However, these costs are likely to dissipate over time. The next section reports on student perceptions and experiences with online examinations.

Student Analysis of Online Testing: Data Description

Computer examinations were administered biweekly to two introductory Principles of Agricultural Economics and Agribusiness courses in Spring 2000 (175 students enrolled) and Spring 2001 (144 students enrolled). Survey data were collected from students enrolled in these two classes. Information concerning student opinions on computer testing was collected as an in-class assignment during the last week of the semester. Student responses to several questions on online assignments and examinations were then merged with data on student grades for analysis, as described below.

One limitation of this study is that the responses were not anonymous: student names appeared on the top of the assignment/questionnaire. The lack of anonymity was purposeful: the benefits of matching answers with grades were considered greater than the bias resulting from lack of anonymity. It is important to note that the assignment score was not impacted by the student responses: all students who completed the assignment were given full credit. Course grades were not influenced by student responses: the course grade was calculated from objective numerical scores on multiple-choice assignments and examinations.

Responses to survey questions are summarized in table 1. The first question concerns homework assignments, and is included to compare student opinions on online assignments to preferences for online examinations. An overwhelming majority (93 percent) of surveyed students preferred weekly computer homework assignments to paper assignments, providing evidence that most students find online learning attractive. Similarly, a large majority (81 percent) of students preferred computer exams to paper exams. It has been argued above that frequent assessment can lead to higher levels of

student learning. Interestingly, 97 percent of all students enrolled in two Principles of Agricultural Economics courses preferred six short exams every two weeks to three long midterm exams. Hanna reported that, "…students themselves tend to favor more frequent testing" (page 287). This research provides evidence that a major shift toward more frequent assessment could improve student learning in college courses… a consequential result.

Online examinations were conducted outside of regular class time. While this can be considered to be a benefit from the instructor's point of view (Barua), many students were less enthusiastic: only a small majority (53 percent) preferred taking exams outside of class time. Discussions with students led to the conclusion that this is typically due to busy schedules that include courses, work, and labs.

Every Friday, students enrolled in AGEC 120 were subjected to an in-class quiz covering the material presented during the week. Survey responses demonstrated that approximately one-half (49 percent) of all surveyed students "like taking quizzes every Friday." This result is strikingly different to the strong support for online exams. The fundamental result of this research is that frequent online examinations may result in (1) an improved learning environment, (2) a greater degree of student satisfaction, and (3) a higher level of student learning.

Empirical Model: The Determinants of Student Opinion on Online Testing

To further understand student opinions concerning online testing, an empirical model was developed to identify and quantify the determinants of the student opinions

reported in table 1. Since the survey information was gathered in a qualitative fashion (1=agree, 0=disagree), logistic regression was used to estimate the determinants of student opinions on online testing (Greene) The empirical model is specified in equation (1) for individual i's response to the five survey questions (j=1,…,5) reported in table 1.

(1) $OPINION_{ij} = f(COMPSKILL_i, YEAR2000_i, STUDY_i, MAJOR_i, YEAR_i, GRADE_i)$

Self-reported computer skills (COMPSKILL) reflect agreement or disagreement to the survey question, "I have excellent computer skills." Carlson stated, "Students who view the online environment and technology as a way to enhance their learning experience will usually perform better when tested than the students who have fear and trepidation about the delivery method of the course."

To test for potential differences between years, a qualitative variable (YEAR2000) was included (=1 if year=2000, =0 if year=2001). Students who were well prepared may prefer all aspects of the course, including exam format, better than less-prepared students. To test for this possibility, the self-reported number of hours studied per week (STUDY) was included in the regression analysis. The mean number of hours studied per week was 2.68, with a standard deviation of 1.4 (see Gortner and Zulauf, and Kember et al. for two interesting studies of the use of time by students). The student's major field of study (MAJOR) and year in school (YEAR) were also included as independent variables.

Student performance was expected to influence student opinion of assessment type. To account for this, student grades (GRADES) on exams, assignments, and quizzes were included as a separate variable in each regression. These variables reflect actual grades, as opposed to the self-reported variables COMPSKILL and STUDY. The included grades were predetermined and exogenous, since all of the assignments, exams, and quizzes were administered prior to the survey date. The comprehensive final exam score was not included in the regressions, because the final exam occurred after the survey date. Mean exam grades equaled 74.95, with a range from 39.75 to 95.25. Quiz and assignment grades were similar, but slightly higher than exam grades.

It was anticipated that grades on assignments, quizzes, and examinations may be highly correlated, leading to the potential for collinearity. Correlations between grade variables were calculated and are reported in table 3. Interestingly, grades for different assessment types are not highly correlated, ranging from 0.40 to 0.72. This result is important and interesting, since it provides evidence that student performance differs with assessment tool, perhaps due to differences in learning styles. While this result is not new, it does reinforce the idea that a variety of performance tools may be appropriate for college courses. Table 3 also shows stronger correlations (0.74 to 0.94) between the assignment, quiz, and midterm exam, final exam grades and course grade (GRADE). This result simply reflects that the course grade is a weighted average of the other grades.

Results

Logistic regression results appear in table 4 for each of the five survey questions reported in table 1. The first regression explores student preferences for computer assignments. Positive coefficients indicate agreement with the statement that computer assignments are superior to paper assignments. Students enrolled in AGEC 120 in Spring, 2001 preferred computer assignments significantly more than those enrolled in Spring 2000 (YEAR2000). This could reflect broader acceptance of computers over time, or self-selection of students uncomfortable with computers out of the course (the course is also offered in the Fall with no computer assignments and/or examinations). Weekly study hours (STUDY) were positively associated with a preference for computer assignments, indicating that well-prepared students preferred computer assignments. The variables MAJOR and YEAR were not statistically associated with the preference for computer vs. paper assignments. The only other statistically significant variable was assignment grades (ASSIGNS), which was positively associated with a preference for computer assignments. This reflects the idea that those who did well on computer assignments relative to other students liked the assignments.

The second column in table 4 reports logistic regression results for student preferences for computer examinations. Students in 2001 preferred computer examinations relative to those enrolled in 2000, and those who studied more hours per week preferred computer exams relative to those who studied fewer hours per week. Predictably, students who earned higher examination grades (EXAMS) were more likely to prefer computer assignments than those with lower exam grades. Interestingly, however, students with higher assignment grades (ASSIGNS) preferred computer exams

less than those with lower assignment grades. This may reflect differences in learning styles, as captured by the low correlation coefficient (0.59) between assignment grades and exam grades (table 3). Borcher et al. found that personality tests and temperament/learning style can influence student performance.

The logistic regression for student preference for 6 short exams or 3 long midterm exams is not as significant as the other regressions, based on a relatively low and statistically insignificant log-likelihood value (78.83). However, the regression has high predictive ability (96.6 percent concordant observations), because 293 out of 301 responding students preferred more frequent examinations. Students with more study hours (STUDY) favored 6 shorter exams relative to those who studied fewer hours. Students who did well on the examinations (EXAMS) preferred 6 short exams relative to those with lower exam grades. Students enrolled in Agricultural Journalism, Agronomy, and Arts and Sciences were less enthusiastic about 6 short exams relative to students enrolled in the default major of Animal Sciences and Industry. This reflects small sample bias, since a small number of observations (8) indicated a preference for 3 long midterm exams.

The fourth regression reports results for student preferences for taking examinations outside of regular class time. This regression is of particular interest, since the students were nearly evenly split on their preference for outside exams. Students with self-reported excellence in computer skills were statistically associated with a preference for exams outside of class. This result demonstrates a significant relationship between student ability to use a computer and preference for online examinations. This is a

concern for instructors considering adoption of online examinations. However, the level of computer competence necessary to take the exams is rudimentary. As computer skills increase over time, this concern is likely to dissipate in the future.

Milling science majors (MILL SCI) preferred outside exams, while PREVET students did not. This result demonstrates that students from similar backgrounds or majors may share similar opinions, either due to self selection of like-minded individuals into the same major, or due to consensus building by individuals within the group of majors.

The fifth regression reports the statistical determinants of student preferences for weekly in-class quizzes, which were administered on paper. Students enrolled in Spring 2000 showed a statistically significant dislike of weekly quizzes relative to students enrolled in Spring 2001. Students enrolled in OTHER majors than those listed in table 2 demonstrated less approval of weekly quizzes than students in Animal Sciences and Industry (the default category). Following the pattern of the other regressions, students who performed well on the weekly quizzes (QUIZZES) were associated with stronger preferences for the quizzes than those with lower quiz grades. Conversely, students with higher exam grades (EXAMS) were less likely to prefer quizzes than those with lower exam grades.

Implications and Conclusions

The fundamental result of this research is that frequent online examinations may result in (1) an improved learning environment, (2) a greater degree of student

satisfaction, and (3) a higher level of student learning. While it is difficult to quantify improvements in learning environments and the level of learning, the survey results demonstrated a strong preference for computer assignments and examinations relative to traditional examinations, and a strong preference for frequent examinations.

Students enrolled in the second year of the period under investigation had stronger preferences for online course assessment tools than the first year. This is likely to have resulted from less uncertainty about the course in the second year, and self-selection of students who are attracted to computers into the course over time. Students with higher levels of self-reported computer skills preferred exams given outside of class time relative to those with less confidence in their computer skills.

Students who worked harder in the two courses, as evidenced by a higher number of self-reported study hours per week preferred computer assignments, examinations, and exam times outside of lectures. This result affirms that the new technology of online testing is preferred by harder-working students, but may provide a warning that less well-prepared students may have more trouble in a course that uses computers than in a traditional course. This implication deserves serious consideration. Students in some majors preferred online testing more or less than other majors, but it is difficult to find a consistent pattern in these results. The results indicate that people in the same major can share similar opinions about the new technology. The year in school was statistically unrelated to student preferences for online exams and assignments.

Students who performed well with one type of assessment tool (assignments, exams, and quizzes) indicated a preference for that assessment tool, and a dislike for

other forms of assessment. The relatively low correlation coefficients calculated for different assessment tools reveal that student performance is not uniform across assessment types. This result is important and interesting, since it provides some evidence that the choice of assessment tool can influence student performance, perhaps due to differences in learning styles. One implication of this result is that a variety of assessment tools may be appropriate to reach a group of diverse students in an entry-level course.

One way to provide a portfolio of assessment tools is the adoption and implementation of online examinations (Haney and Madaus). Gilbert pointed out that adoption and use of a new technology such as online examinations not only provides information about the technological innovation itself, but can real valuable information about how students learn, and learning outcomes. The adoption and use of online examinations has provided insight into how students learn, including some evidence that: (1) student performance is affected by assessment tools, (2) frequent testing is likely to improve learning outcomes, and (3) computer assessment can enhance the learning environment for many students.

References

Bangert-Drowns, R.L., J.A. Kulik, and L.C. Kulik. Effects of Frequent Classroom Testing. ERIC Document Reproduction Series No. 274-672. Paper presented at the 67th annual meeting of the research association, San Francisco, CA, April 16-20, 1986. *http://edrs.com/*

Barkley, Andrew P. "Unanticipated Benefits from the Use of Computer Technology in a Large Introductory Course." In: *Interactive Learning: Vignettes from America's Most Wired Campuses*. Ed. David G. Brown. Bolton, MA: Anker, 2000.

Barkley, Andrew P. "The Future of Teaching Undergraduate Agricultural Economics: Lifelong Learning in an Era of Rapid Technological Change." *Journal of Agricultural and Resource Economics* July 2001 26(1):1-19.

Barkley, Andrew P. and Ann Haycock. "Development and Use of the Homework Helper, an Online Homework Grader." *NACTA Journal*. March 2001 (45):27-32.

Barua, Jibak. "Computer-Based Testing on Campus." *Syllabus*, April 1999: 51-52.

Borcher, G., B. Pinckney, and E. Clemens. "Temperament Learning Styles Associated with True/False, Multiple Choice, and Multiple-Multiple Choice Exam Formats." *NACTA Journal* March 1994 38(1):10-12.

Bracey, G.W. "Teachers, Thinking, and Testing." *Phi Delta Kappan* January 1990, 71:404-407.

Carlson, Rosemary. "Assessing Your Students: Testing in the Online Course." *Syllabus*, March 2000: 16-18.

Gibson, E.J., P.W. Brewer, A. Dholakia, M.A. Vouk, and D.L. Bitzer. "A Comparative Analysis of Web-Based Testing and Evaluation Systems." *http://waltoncollege.uark.edu/disted/*

Gilbert, S.W. "Making the Most of a Slow Revolution." *Change: The Magazine of Higher Learning* March/April 1996 28:10-23.

Gortner, Amy K. and C.R. Zulauf. "The Use of Time by Undergraduate Students." *NACTA Journal*. March 2000 44(1):22-30.

References (continued)

Green, K.C. "The Coming Ubiquity of Information Technology." *Change: The Magazine of Higher Learning* March/April 1996 28:24-31

Green, K.C. and S.W. Gilbert. "Great Expectations: Content, Communications, Productivity, and the Role of Information Technology in Higher Education." *Change: The Magazine of Higher Learning* March/April 1995 27(2):8-18.

Greene, William H. *Econometric Analysis*, Second Edition. New York: Macmillan Publishing Company, 1993.

Haney, W. and G. Madaus. "Searching for Alternatives to Standardized Tests: Whys, Whats, and Whithers. *Phi Delta Kappan* May 1989 70:683-687.

Hanna, Gerald S. *Better Teaching Through Better Measurement.* New York: Harcourt Brace Jovanovich Publishers, 1993.

Kember, D., Q.W. Jamieson, M. Pomfret, and E.T.T. Wong. "Learning Approaches, Study Time, and Academic Performance." *Higher Education* 29:329-343.

Kulik, C. and J.A. Kulik. "Effectiveness of Computer-Based Instruction: An Updated Analysis." *Computers in Human Behavior* 1991 7(1-2):75-94.

Newman, M.E., M.P. Ram, and T.M. Day. "The Effects of World Wide Web Instruction and Traditional Instruction on Achievement and Change in Student Attitudes in a Technical Writing in Agricommunication Course." Proceedings of the National Agricultural Education and Research Meeting, 1996, 23:80-90.

O'Kane, M. and J.D. Armstrong. "Developing Course Materials Using the World Wide Web" *NACTA Journal*. June 1997 41(2):10-15.

Pyle, Jerry. "Perception On-line Testing and Tutorials." Concordia Computing *www.cord.edu/dept/computing/faculty/tools/perception*

Suen, Hoi K., and Jay Parkes. "Challenges and Opportunities in Distance Education Evaluation." Distance Education Resource Center. *http://waltoncollege.uark.edu/disted/ challenges_and_opportunites_in_.htm*

Table 1. Survey Results of Student Preferences for Computer Assignments and Exams.[1]

Student response to survey statement:	AGREE (%)	DISAGREE (%)
"I prefer homework assignments on the computer to homework assignments on paper."	280 (93)	21 (7)
"I prefer taking exams on the computer to taking exams on paper."	244 (81)	57 (19)
"I prefer six short exams every two weeks to three long midterm exams."	293 (97)	8 (3)
"I prefer taking exams outside of class time to taking exams in class."	161 (53)	140 (47)
"I like taking quizzes every Friday."	146 (49)	155 (51)

[1]A survey of 301 students enrolled in AGEC 120, Principles of Agricultural Economics and Agribusiness at Kansas State University, Spring Semester 2000 and 2001. The response rate is 94 percent.

Table 2. Summary Statistics of Variables Used in Regressions of Computer Exams.

Variable	Mean	Std. Dev.	Min.	Max.	
Computer Skills (COMPSKILL)[1]	0.68	--		0	1.00
YEAR2000 (2000=1; 2001=0)	0.55	--		0	1.00
Hours Studied per Week (STUDY)[2]	2.68	1.40		0	8.50
Major Field of Study (MAJOR):					
Undecided	0.04	--		0	1.00
Agribusiness	0.08	--		0	1.00
Agricultural Economics	0.09	--		0	1.00
Agricultural Education	0.04	--		0	1.00
Agricultural Journalism	0.03	--		0	1.00
Agricultural Tech. Management	0.06	--		0	1.00
Agronomy	0.07	--		0	1.00
Animal Sciences and Industry[3]	0.24	--		0	1.00
Bakery Science and Management	0.01	--		0	1.00
Feed Science and Management	0.02	--		0	1.00
Food Science and Industry	0.003	--		0	1.00
Horticulture	0.07	--		0	1.00
Horticultural Therapy	0.01	--		0	1.00
Milling Science and Management	0.06	--		0	1.00
Park Resource Management	0.003	--		0	1.00
Pre-Veterinary Medicine	0.07	--		0	1.00
Other	0.05	--		0	1.00
Business	0.02	--		0	1.00
Engineering	0.01	--		0	1.00
Arts and Science	0.02	--		0	1.00
Year in School (YEAR):					
Freshman[3]	0.42	--		0	1.00
Sophomore	0.28	--		0	1.00
Junior	0.19	--		0	1.00
Senior	0.11	--		0	1.00
GRADES (percent):					
Exams	74.95	10.55		39.75	95.25
Assignments	83.05	9.74		20.00	97.91
Quizzes	80.46	10.87		30.00	98.05

[1]Response to statement: "I have excellent computer skills." Agree=1; disagree=0.
[2]Student response to survey statement: "Average number of hours PER WEEK spent studying AGEC 120 this semester (please be as accurate as possible!)."
[3]Default category omitted from the logistic regression analysis.

Table 3. Correlations of Grade Variables Used in Analysis of Computer Exams.

Pearson Correlation Coefficients.[1]
Number of Observations = 301.

	ASSIGN[2]	QUIZ[3]	EXAM[4]	FINAL[5]	GRADE[6]
ASSIGN	1.00	0.65	0.59	0.40	0.76
QUIZ	--	1.00	0.72	0.43	0.84
EXAM	--	--	1.00	0.66	0.94
FINAL	--	--	--	1.00	0.74
GRADE	--	--	--	--	1.00

[1]All of the correlation coefficients are statistically significant at greater than the 0.01 level.
[2]Average grade on weekly online assignments (percent).
[3]Average grade on weekly in-class quizzes (percent).
[4]Average grade on biweekly computer examinations (percent).
[5]Grade on comprehensive final examination (percent).
[6]Course grade, a weighted average of the other reported grades (percent).

Table 4. Logistic Regression Results of Student Preferences for Computer Exams.[1]

	PARAMETER ESTIMATES				
Variable	Prefer Computer Assignments	Prefer Computer Exams	Prefer Six Short Exams	Prefer Outside Exams	Like Weekly Quizzes
INTERCEPT	-2.49 (2.31)	3.82 (1.85)**	-1.57 (4.84)	-0.68 (1.25)	-1.42 (1.35)
COMPSKILL	0.60 (0.58)	-0.05 (0.35)	1.12 (1.01)	0.53 (0.27)**	-0.16 (0.27)
YEAR2000	-1.46 (0.67)**	-0.99 (0.38)***	0.54 (0.97)	0.19 (0.27)	-0.47 (0.27)*
STUDY	0.63 (0.30)**	0.33 (0.14)**	1.84 (0.96)**	0.11 (0.10)	0.11 (0.10)
Major Field of Study:					
UNDECIDED	-0.83 (0.96)	-0.09 (0.79)	9.17 (455.8)	-0.16 (0.63)	-0.60 (0.66)
AGRIBUS	1.63 (1.15)	1.30 (0.83)	9.94 (294.2)	0.23 (0.49)	0.13 (0.49)
AG ECON	1.26 (1.19)	0.23 (0.66)	9.10 (300.4)	-0.14 (0.47)	-0.14 (0.47)
AG EDUCAT	-0.02 (1.27)	-0.55 (0.75)	-3.38 (2.22)	-0.26 (0.66)	0.07 (0.69)
AG JOURN	-1.69 (1.10)	-1.10 (0.85)	-5.73 (2.63)**	-0.02 (0.74)	-0.40 (0.75)
AG TECH	12.96 (287.1)	0.46 (0.75)	9.91 (384.1)	-0.31 (0.56)	-0.32 (0.56)
AGRONOMY	13.05 (252.4)	-0.47 (0.58)	-3.72 (1.96)*	-0.34 (0.51)	-0.43 (0.51)
BAKERY SCI	11.62 (825.4)	13.00 (926.6)	6.99 (1103)	-15.62 (1157)	-0.99 (1.27)
FEED SCI	12.35 (557.5)	13.63 (599.4)	8.81 (612.1)	0.14 (0.82)	0.39 (0.84)
FOOD SCI	11.45 (1560)	12.60 (1630)	-5.94 (1946)	15.76 (2009)	4.77(2003)
HORT	11.97 (276.3)	1.34 (0.88)	-1.97 (1.81)	-0.35 (0.53)	-0.15 (0.54)
HORT THER	-0.54 (2.34)	-2.38 (1.63)	7.11 (1197)	-14.85(1420)	15.62(1404)
MILL SCI	0.88 (1.22)	-0.26 (0.68)	-2.50 (1.92)	1.46 (0.69)**	-0.16 (0.54)
PARK RES	12.15 (1560)	13.02 (1630)	13.97 (1939)	15.32 (2009)	14.67(2003)
PREVET	0.49 (1.02)	-0.32 (0.60)	10.00 (308.4)	-0.98 (0.54)*	0.68 (0.54)
OTHER	12.18 (274.2)	0.98 (1.12)	8.79 (376.9)	0.44 (0.62)	-1.61(0.72)**
BUSINESS	0.10 (1.24)	-0.09 (0.92)	9.24 (611.4)	-0.49 (0.83)	-1.66 (1.15)
ENGINEER	13.92 (1043)	13.39 (1149)	-2.33 (1270)	15.27 (1419)	-0.34 (1.49)
ARTS SCI	12.29 (565.1)	0.20 (1.19)	-5.63 (2.55)**	-0.85 (0.97)	-1.44 (1.18)
Year in School:					
SOPH	-0.48 (0.65)	-0.37 (0.40)	2.33 (1.52)	-0.02 (0.31)	0.35 (0.31)
JUNIOR	-0.89 (0.76)	-0.24 (0.45)	13.12 (165.8)	-0.30 (0.35)	0.37 (0.36)
SENIOR	0.84 (1.19)	-0.44 (0.57)	-1.47 (1.25)	0.09 (0.45)	-0.09 (0.47)
Grades:					
EXAMS	-0.004 (0.04)	0.04 (0.02)*	0.17 (0.10)*	-0.02 (0.02)	-0.05(0.02)**
ASSIGNS	0.10 (0.04)***	-0.05 (0.03)**	-0.03 (0.06)	0.01 (0.02)	-0.002 (0.02)
QUIZZES	-0.05 (0.04)	-0.02 (0.03)	-0.10 (0.11)	0.01 (0.02)	0.06(0.02)***
-2 LOG L	152.338***	292.15*	73.83	415.808	417.01
% CONCORDANT	88.4	75.1	96.6	68.2	68.1

[1]Number of Observations=301. Standard errors in parentheses.
Significance levels: "***" = 0.01; "**" = 0.05; "*" = 0.1.