Computer Experiences, Self-Efficacy and Knowledge of Students Entering a College of Agriculture

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Abstract

Students enrolled in AGED 1011 - Agriculture Freshmen Orientation (N = 84) during the fall 1999 semester were surveyed to determine their computer experiences, self-efficacy and knowledge. A majority of respondents reported owning a computer and having completed one or more computer courses. More than half of the students had received formal instruction in word processing, file management and spreadsheet use, while less than half had studied presentation graphics, Internet use, e-mail, databases or programming. Students had an average level of computer self-efficacy, with a majority rating their skills in word processing, e-mail, Internet use, and file management as average or above. Conversely, a majority rated their skills in spreadsheets, presentation graphics, databases, and programming as below average. Scores on a computer knowledge exam were low, with the mean percentage of correct responses being 39.7%. Scores were highest on the Internet and general knowledge sections of the exam and lowest on the spreadsheet, database and programming sections. A substantial positive relationship ($r = .65$) existed between computer self-efficacy and computer knowledge. Based on these results, implementation of a required computer applications course with a test-out option was recommended.

Introduction

Computers play an important and ever increasing role in agriculture (Odell, 1994). In a follow-up study of Pennsylvania State University agriculture graduates, respondents rated computer skills as slightly more important to job success than technical agriculture skills (Radhakrishna and Bruening, 1994). Thus, university agriculture programs must ensure that their graduates are competent in computer use (Langlinas, 1994).

In a study conducted for the College of Agriculture and Life Sciences at Cornell University, Davis (1997) found that over 80% of employers rated computer skills as either an important or very important factor considered in making employment decisions. The employers rated skills in using word processing, spreadsheet, database, and presentation graphics programs as the most important computer abilities needed by prospective employees. Similar results were found in an agricultural employer study conducted for the University of Nebraska (Andelt et al., 1997).

Bekkum and Miller (1994) surveyed the deans of 71 land-grant colleges of agriculture to determine the strategies used to ensure that graduates were proficient in computer use. Of the 59 deans responding, 26 (44.1%) reported a college-wide computer requirement. An additional 20 (33.9%) deans reported that some departments within their colleges had specific computer course requirements. All deans reported that computer application courses were available to their students. Bekkum and Miller also asked the deans to indicate likely changes in computer requirements for agriculture students. Eleven (18.6%) deans believed that, in the future, less time would be required for basic computer skill development, since students would have developed these skills before entering college. According to Kieffer (1995), the assumption that students enter college possessing basic computer skills is common among university faculty and administrators.

Despite such optimism, just how common is computer use among pre-college students? According to the most recent data from the National Center for Education Statistics (1999), in 1996, 65.5 % of 11th grade students reported using computers at school once a week or less. Only seven states require students to complete a computer literacy course in order to graduate from high school

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(National Center for Education Statistics, 1997). In these seven states, the most common computer literacy requirement is a single semester course. Additionally, many colleges and universities do not include computer coursework as a requirement for admission.

Computer self-efficacy (CSE) has been defined as an individual's level of confidence in his or her ability to successfully complete computer tasks (Kinzie et al., 1994). According to Karsten and Ross (1998), persons with higher levels of CSE are more likely to use computers, exhibit greater persistence in completing new or difficult computer tasks, and have higher levels of computer skill. Karsten and Ross also found a positive relationship between CSE and student achievement in undergraduate computer applications courses.

Computer skills are important to both success in college (Kieffer, 1995) and to success in agricultural careers (Andelt et al., 1997; Radhakrishna and Bruening, 1994;). Yet, the college of agriculture in which this study was conducted has no computer education requirement, is located in a university which does not require a computer course for admission or graduation, and is in a state with no computer requirement for high school graduation. Previous research (Johnson et al., 1999a, 1999b) found that students enrolled in introductory agriculture courses at this university had low levels of computer knowledge. Donaldson et al. (1999) recommended continued research to assess the computer skills of undergraduate students in the agricultural sciences.

Objectives

This study was conducted to determine the computer experiences, self-efficacy and knowledge of undergraduate students entering a college of agriculture. The specific objectives of the study were to:

1. Determine demographic characteristics and computer-related experiences of entering agriculture students enrolled in AGED 1011, Agriculture Freshman Orientation;

2. Determine the computer self-efficacy of entering agriculture students enrolled in AGED 1011, Agriculture Freshman Orientation;

3. Determine the computer knowledge of entering agriculture students enrolled in AGED 1011, Agriculture Freshman Orientation; and

4. Determine the relationship between demographic characteristics, computer-related experiences, computer self-efficacy, and computer knowledge for entering agriculture students enrolled in AGED 1011, Agriculture Freshman Orientation.

Methods

This census study was conducted using a descriptive-correlational design (Ary et al., 1990). The population consisted of students enrolled in five sections of AGED 1011 (Agriculture Freshman Orientation) during the fall 1999 semester ($\underline{N}$ = 84). This course was selected because all students enrolled were either entering freshmen, or transfer students having completed fewer than 24 semester credit hours. All 84 students provided usable responses for a 100% response rate. Since a random sample of students was not studied, the findings of this study should not be generalized beyond these respondents. However, the present study, along with previous research (Johnson et al, 1999a, 1999b), does provide essential information for both local decision-making and further research of a more generalizable nature.

Data were collected by student responses to the "Computer Experiences and Knowledge Inventory" (CEKI). The CEKI was developed by the researchers and consisted of three parts. Part One contained 21 items related to respondent demographics and previous computer experiences. Part Two was composed of eight Likert-type items requiring respondents to assess their self-perceived level of skill (1 = "no skill"; 5 = "high skill") in specific areas of computer use. Part Three consisted of 35 multiple choice items (with 5 response options, including a "Do not know" option) designed to measure computer knowledge in the areas of: general computer knowledge (six items), Internet use (five items), word processing (eight items), file management (five items), spreadsheets (six items), databases (three items), and BASIC computer programming (two items). All items in Part Three were written so as to be answerable by persons familiar with common operating systems and application programs. In other words, the items were not software specific. Appendix A contains sample items from the exam portion of the CEKI.

The CEKI was evaluated by a panel of five experts with experience in teaching introductory computer applications courses to college agriculture students and was judged to possess face and content validity. The instrument was pilot-tested with six high school seniors participating in an on-campus agricultural internship program during summer 1998. The participants reported no difficulty in interpreting the instructions or items contained in the CEKI.

Pilot-test reliability estimates were .90 (coefficient alpha) for Part 2, and .79 (KR-20) for Part Three of the instrument. For this study, reliabilities of .89 (coefficient alpha) and .78 (KR-20) were estimated for Parts Two and Three, respectively. The reliability of Part One of the CEKI was not assessed, since, according to Salant and Dillman (1994), responses to non-sensitive, demographic items are subject to little measurement error.

Results

The typical student was an 18-year-old (87%) freshman (98%) male (55%). The ages of the entering students ranged from 17 to 43 years. The respondents reported high school graduating class sizes ranging from 18 to 800 students (Mdn = 120). Slightly over one-half (51%) of the respondents reported that they had earned a high school grade average of "A-minus" or higher.

The most commonly reported majors were poultry science (23%), horticulture/turf management (18%), and agricultural education, communication and technology (15%). The smallest percentages of students were either majoring in plant protection and pest management or were undeclared, each accounting for 4% of students. All agriculture majors were represented and the percentages closely approximated the distribution of majors for all students entering the College during the fall 1999 semester. The respondents reported a variety of computer experiences. Slightly over three-fourths (77%) had completed at least one computer course, with 52% having completed two or more courses. Over 50% of the students had received formal instruction in word processing, file management and spreadsheet use, while fewer than 50% had received instruction in presentation graphics, Internet use, e-mail, databases or computer programming (Figure 1).

A majority (71%) of students reported owning a computer, with almost all (97%) being IBM® or IBM-compatible machines. Nearly all (98%) respondents reported using various versions of the Windows® operating system. Despite their previous computer study and computer ownership, less than one-half (48%) of the respondents reported having ever completed a course (other than a computer course) where computer use was required.

The respondents rated their own level of skill in each of eight areas of computer use on a 5-point Likert-type scale. As shown in Table 1, the respondents felt they had the highest levels of skill in word processing, electronic mail, Internet use, and file management, with over 80% of the respondents rating their skills as average, above

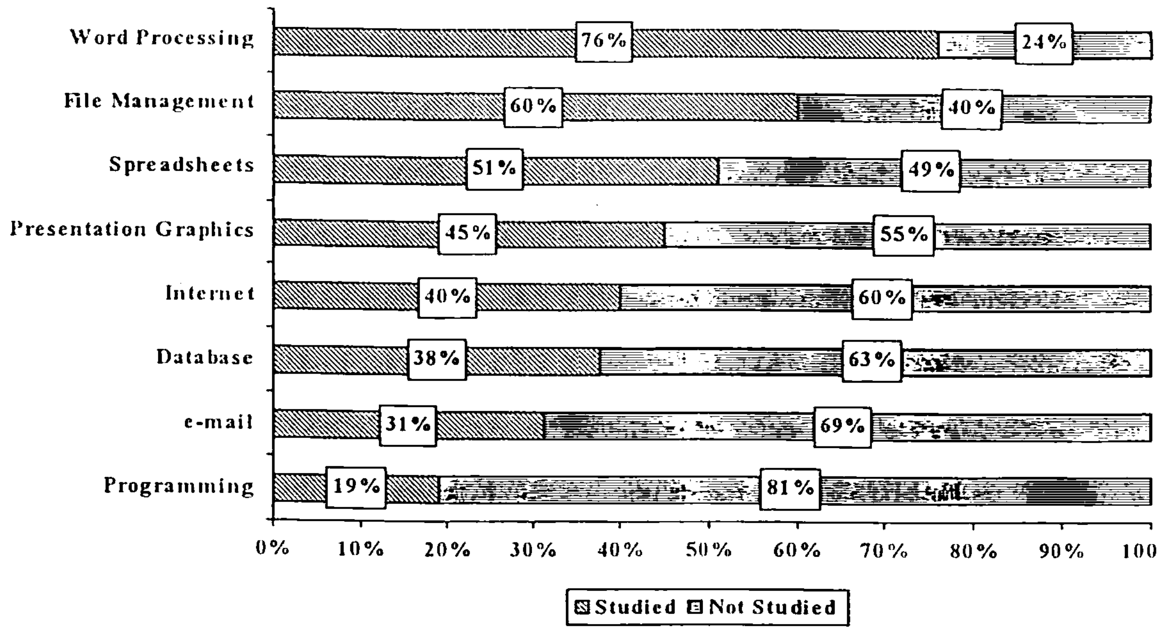

Figure 1. Percent of respondents having studied selected computer topics (N = 84).

average or high. Conversely, more than 50% of the respondents rated their levels of skill in spreadsheets, presentation graphics, databases, and computer programming as none or below average. Less than 20% of the respondents rated their skills as above average or high in any of these four areas.

Responses to the eight individual items reported in Table 1 were summed and averaged to arrive at a composite measure of computer self-efficacy (CSE) for each respondent (coefficient alpha = .89). The distribution of scores for the variable CSE was slightly positively skewed (skewness = .26) with a mean of 2.78 (SD = .78) and a median of 2.62.

Table 1. Self-perceived levels of skill in selected areas of computer use (N = 84).

	Level of skill				
	None	Below average	Average	Above average	High
Computer area	%	%	%	%	%
Word processing	3.6	5.9	41.7	30.9	17.9
Electronic mail	5.9	10.7	44.0	20.2	19.0
Internet use	4.8	11.9	48.8	17.9	16.7
File management	4.8	15.5	42.9	25.0	11.9
Spreadsheets	19.3	32.5	32.5	13.2	2.4
Presentation graphics	19.0	38.1	25.0	8.3	9.5
Databases	27.4	33.3	29.8	7.1	2.4
Programming	58.3	23.8	11.9	5.9	0.0

The overall score on the 35-item exam portion of the CEKI ranged from 1 (2.8% correct) to 26 (74.3% correct), with a mean of 13.9 (39.7% correct), a standard deviation of 5.1, and a median of 13.0 (37.1% correct). As shown in Figure 2, 93% of the students scored 60% or less correct on the CEKI exam, with the greatest percentage scoring in the 21-40% correct range.

On the individual components of the CEKI exam, students scored the highest percentage of correct responses on the Internet and general knowledge sections and lowest on the computer programming section. Overall scores for the word processing, file management, spreadsheet, database, and programming sections were all less than 40% correct (Figure 3).

The final objective of this study was to determine the relationships between selected student demographic characteristics and computer-related experiences and computer self-efficacy and scores on the CEKI exam. Scatterplots were constructed and examined for each pair of variables in order to identify curvilinear relationships or outliers that might tend to distort the bivariate relationships. One outlier was found, as one entering student reported an age of 43 years, while no other student reported an age of more than 21 years. Thus, for this objective, relationships between age and computer self-efficacy and CEKI exam scores were reported both with the outlier's scores included and deleted (Borg and Gall, 1983). The conventions suggested by Davis (1971) were used to describe the magnitude of relationship between variables (.70 or higher = "very strong," .50 - .69 = "substantial," .30 - .49 = "moderate," .10 - .29 = "low," and .01 - .09 = "negligible").

As shown in Table 2, four computer-related experience variables had moderate positive correlations with computer self-efficacy. Having studied more computer topics (r = .40), owning a computer (r = .39), completing more computer courses (r = .31), and using a computer in non-computer courses (r = .30) were all associated with higher confidence in overall computer abilities. Further analysis indicated a very strong association (r = .75) between the number of computer courses completed and the number of computer topics studied. The dichotomous variable, having completed a computer course, had a negligible correlation (r = .08) with computer self-efficacy.

Table 2. Relationships between selected demographic characteristics and computer-related experiences and computer self-efficacy and CEKI exam scores.

		Correlation (r)	
Variable	n	CSE	CEKI exam score
Age	83[z] (82)[y]	-.27[z]* (-.09)[y]	-.27[z]* (-.10)[y]*
Gender[x]	83	-.06	-.11*
High school graduating class size	81	.07	.09
High school grade average	81	.08	.16*
Completed a computer course[w]	83	.08	.15*
Number of computer courses completed	83	.31**	.24*
Number of topics studied in computer courses	83	.40**	.31**
Completed course(s) requiring computer use[w]	81	.30**	.08
Own a computer[w]	82	.39**	.20*
Computer self-efficacy (CSE)	83	1.0	.65***

[z]Outlier included.

[y]Outlier deleted.

[x]Coded as female = 0 and male = 1.

[w]Coded as no = 0 and yes = 1.

* = low relationship, ** = moderate relationship, *** = substantial relationship (Davis, 1971).

Age was the only student demographic variable having a non-negligible association ($r = -.27$) with computer self-efficacy when all subjects were included in the analysis. However, when the outlier was deleted from the analysis, the relationship between age and computer self-efficacy was also negligible ($r = -.09$).

The demographic characteristics of age [both with the outlier included (r = .-.27) and with the outlier deleted ($r = -.10$)] and gender ($r = -.11$: coded as female = 0; male = 1) had low negative correlations with CEKI exam scores. High school grade average had a low positive association ($r = .16$) with exam scores. Among the computer-related experience variables, completing a computer course ($r = .15$), the number of computer courses completed ($r = .24$), and owning a computer ($r = .20$) all had low positive correlations with exam scores. The best predictors of CEKI exam scores were the number of topics studied in computer courses ($r = .31$) and computer self-efficacy ($r = .65$)

Conclusions

The students participating in this study reported a variety of computer-related experiences. Slightly over three-fourths had completed one or more computer courses and nearly three-fourths owned a computer. However, over one-half of the students had not received formal instruction in presentation graphics, Internet use, databases, or computer programming. Between 24% and 49% of the respondents had not received formal instruction in word processing, file management, or spreadsheet use. Thus, it was concluded that these students had not completed a common core of formal educational experiences related to the most commonly used computer applications and tasks.

Slightly over one-half (52%) of the respondents reported that they had never completed a course (other than a computer use course) where computer use was required. When one considers the number of individual courses completed by the respondents, it becomes apparent that, despite rhetoric to the contrary, computer use is not a component of most courses at the pre-collegiate level.

Overall, a majority of the respondents perceived their skills in word processing, e-mail, Internet use, and file management as average or better. However, a minority of respondents, ranging from 9% to 20%, felt they had less than average skills in these areas. A majority of respondents felt they had below average or no skills in spreadsheets, presentation graphics, databases, and computer programming. The overall mean of 2.78 ($SD = .78$) for the composite variable, computer self-efficacy, was slightly below average (on a 1 to 5 scale). Based on these findings, it was concluded that many entering students lack confidence in their computer abilities.

The mean score on the 35-item exam section of the CEKI was 13.9 (39.7% correct). Nearly all (93%) students scored 60% or less on the CEKI exam, with most (49%) scoring in the 21-40% correct category. Students tended to score highest on the Internet and general knowledge sections of the exam, with mean scores of above 50% correct in these sections. The mean percentage of correct responses for each of the remaining five exam sections was less than 40%. Based on these findings, it was concluded that these entering students were deficient in all areas covered by the CEKI exam, especially in word processing, file management, spreadsheets, and databases. (Note: Although knowledge of computer programming was extremely low, the researchers concluded that this was not an essential area of knowledge for a majority of students or agricultural employees.)

A higher level of student interaction with computers, indicated by having completed more computer courses, studied more computer topics, used a computer in non-computer courses, and owning a computer, was positively associated with computer self-efficacy. While it seems reasonable that increased computer self-efficacy was the result of this higher level of computer interaction, no such cause and effect relationship can be established from these correlational results.

The best predictor (other than computer self-efficacy) of CEKI exam scores was the number of topics studied in computer courses. However, this variable was not a particularly robust predictor, explaining less than 10% of the variance in CEKI exam scores. No especially promising predictors of computer knowledge (except for computer self-efficacy) were identified as a result of this study.

A substantial positive correlation ($r = .65$) existed between computer self-efficacy and CEKI exam scores. Therefore, it appears that students are reasonably good judges of their own computer abilities. This finding, together with the overall low level of assessed computer knowledge, suggests that students may perceive a lack of need for computer knowledge in the courses completed prior to entering college.

Recommendations

The results of this study are congruent with the findings of previous research on the computer experiences, self-efficacy and knowledge of undergraduate agriculture students (Johnson et al., 1999a, 1999b). Given the nature and consistency of these results, the following actions are recommended in order to improve the computer skills of students entering this College.

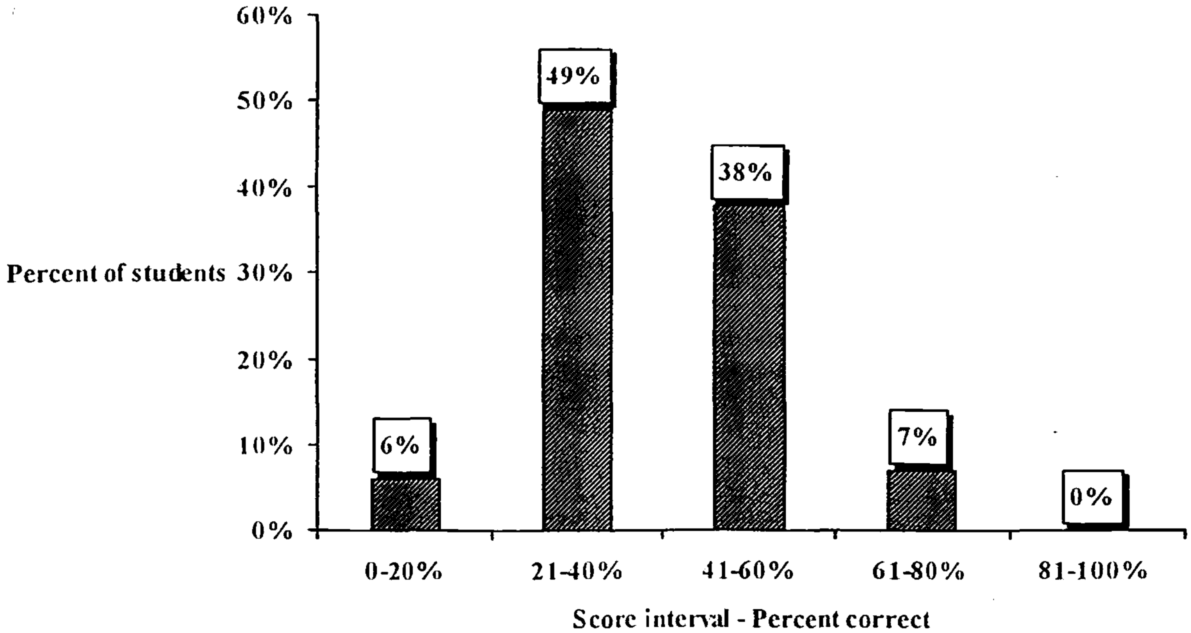

Figure 2. Distribution of grouped scores on the exam portion of the Computer Experiences and Knowledge Inventory (N = 84).

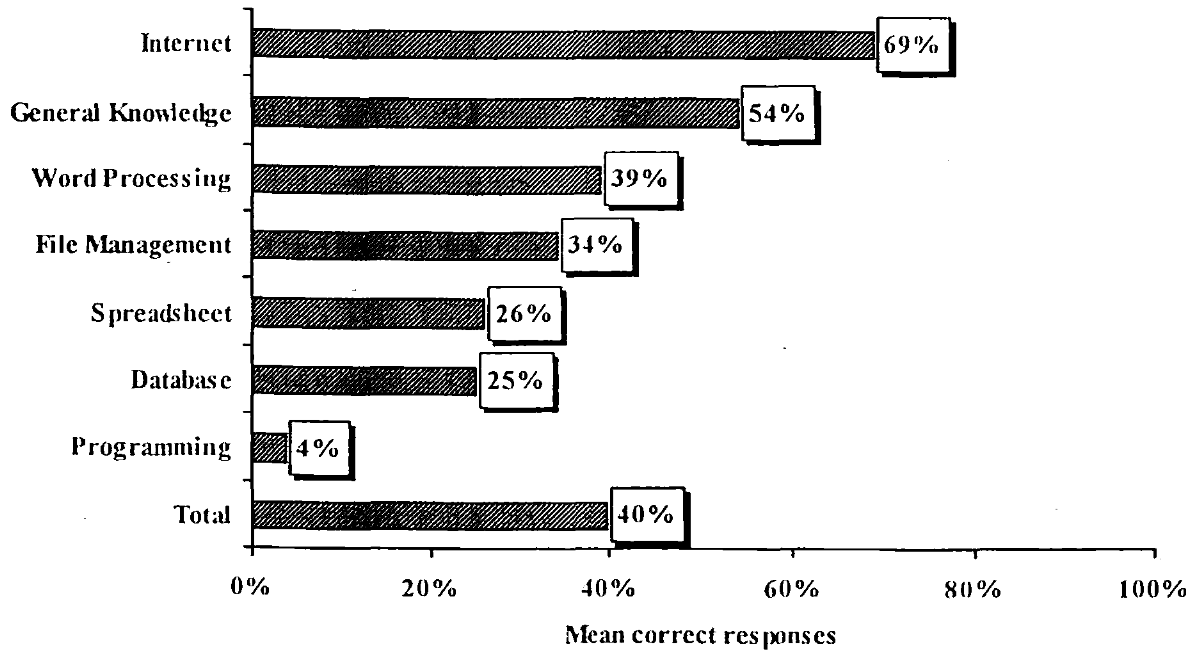

Figure 3. Mean scores on the Computer Experiences and Knowledge Inventory exam, by section and total (N = 84).

First, a computer applications course requirement should be established for all students entering the College. Students should be required to complete this course during their first year of enrollment. This course should emphasize hands-on learning experiences in the areas of word processing, file management, presentation graphics, spreadsheets, databases, e-mail and Internet use.

Second, because some students do appear to have an acceptable level of computer knowledge, a performance testing option should be available whereby students can test out of the introductory computer course requirement. Given the importance of computers in agriculture, students testing out of the introductory course should be encouraged to enroll in a more advanced computer course.

Third, deliberate efforts should be made to more fully integrate a variety of required computer activities into undergraduate agriculture courses. This required use should serve to increase the importance students place on the development of computer skills. Also, increasing required computer use should help prevent the decay that occurs when computer skills are not used in subsequent courses (Brown and Kester, 1993).

Finally, researchers and educators in other universities are encouraged to conduct similar studies. Such research will provide information necessary to make sound decisions concerning computer education courses and requirements in colleges of agriculture.

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Appendix A. Sample items from the exam section of the computer Experiences and Knowledge Inventory.

Exam section	Example item
General computer knowledge	2. Which of the following is an *output device*? A. Keyboard B. Printer[z] C. Mouse D. Light pen E. do not know
Internet use	10. Which of the following Internet addresses would most likely belong to a school? A. http://www.education.com B. http://www.maple.edu[z] C. http://www.consolidated.org D. http://www.highschool.sch E. Do not know
Word processing	12. After using a word processing program to type a 15-page term paper, a student realizes that he has mistakenly typed the word "their" instead of "there" throughout the entire paper. Which of the following would be the most ***efficient*** method of correcting this mistake? A. Use the ***Spell Checker*** tool B. Use the ***Find and Replace*** option[z] C. Use the ***Convert Case*** procedure D. Use the Copy and Paste *commands* *E. Do not know*
File management	21. In the file address **C:\MyDocs\Report.doc**, what is the file name? A. C: B. MyDocs C. Report[z] D. .doc E. Do not know
Spreadsheets	30. What result will be calculated if the following formula is entered into a spreadsheet? =(5+1*3)/(10-2*4) A. .56 B. 2 C. 4[z] D. 6 E. Do not know

Databases

31. The _____ procedure would be used to re-arrange database entries in alphabetical order by last name.

A. Alphabetize
B. Query
C. Sort[z]
D. Report
E. do not know

Programming

35. A computer program is to be written in BASIC. The computer is to prompt the user to enter two different numbers. After input, the computer should print a message telling whether the first or second number is larger. However, if the user enters two numbers that are equal, the computer should ask for a new try and start over.

Here is an incomplete program that one person wrote to complete this task:

```
100 PRINT "ENTER TWO DIFFERENT NUMBERS"
110 INPUT N1, N2
120 IF N1 > N2 THEN GOTO ____
130 IF N2>N1 THEN GOTO _____
140 PRINT "TRY AGAIN"
150 GOTO _____
160 PRINT "THE FIRST ID LARGER"
170 GOTO _____
180 PRINT "THE SECOND IS LARGER"
190 END
```

What number should go in the blank of line 130?

A. 100
B. 120
C. 160
D. 180[z]
E. Do not know

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[z]Most correct response.