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Articles

Comparing Computer Usage by Students in Education Programs to Technology Education Majors

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Introduction

The 1990s have been an era of growth in computer usage for campuses across the United States. A national survey of information technology use in higher education indicated an increasing integration of computing related activities into college courses (Campus Computing Project, 2000). This survey reported that three-fifths of undergraduate courses utilized electronic mail and two-fifths made use of World Wide Web (WWW) resources. Parallel to this trend is the growing number of colleges and universities instituting requirements for student computer ownership ("Growing number of colleges require…," 2000). This article reported that many of the schools implementing the requirement did so to guarantee that all students had access to the same computing resources. Research by Brown (1999) indicated that at schools without a computer ownership requirement, only half the students are likely to own one.

National surveys of teacher education programs seem to show trends that are similar to other higher education programs (Moursund & Bielefeldt, 1999; Rosenthal, 1999). While some statistics are available for teacher education programs as a whole, little research has been done in this area that focuses on technology education. For example, does the strong emphasis on technology in general in technology education teacher preparation programs make it more likely that majors in these programs would own a computer (in the absence of required ownership) than, say, a social studies or mathematics pre-service teacher? Apart from the actual ownership of the computer, are students in other education majors likely to utilize their computers differently in the course of their studies? These become important questions when assessing whether different teacher education programs are meeting local and national mandates for computing literacy. While nearly all national teacher education organizations have called for some elements of computer competency, technology education has logically put computing and information technology literacy front and center (International Technology Education Association, 2000). Though this study focuses on a technology education program at a single institution, the

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researchers believe that it offers some fundamental findings to inform the field and can serve as a comparative baseline to the conduct of more comprehensive research.

The College of Education at North Carolina State University (NC State) has been consistently upgrading its technology infrastructure and integration of computing into the curriculum as a response to campus-wide and national trends as well as new technology competency requirements for current and future teachers (Technology Assessment Project, 1999). Though every faculty member in the College has a computer and four computer labs are available for both student use and instruction, there are still unanswered issues concerning reasonable expectations faculty members can make concerning student computer access and familiarity of different software tools when developing instructional materials for use by students.

In the Fall of 1999, the College of Education at NC State undertook a survey of its majors in all disciplines, including technology education, to gain an accurate look at many of these issues surrounding the use of computers and information technology. The researchers were not only interested in the level and type of computing activity going on in the college and within the technology education program, but also whether it was justifiable to treat all logical groupings of students as having equivalent access and experience with computing tools. The faculty and administration wanted to know if computing needs differed with respect to certain demographic elements such as gender, age, and ethnicity. The researchers identified three principal areas on which to focus the study. First was the extent to which students owned computers and how they used these computers for school, work, and leisure activities. For the purpose of the study, “work” was defined as receiving pay for using a computer. Second, the researchers wanted to find out the variability among majors in the use of computing tools such as e-mail, word processing, spread sheets, statistical analysis, presentation graphics, and technical graphics (i.e. CAD). Third was to compare technology education majors to other majors in their computer ownership and use.

Methodology

A survey instrument was designed to gather information on the computing issues of interest. Computer ownership was determined by asking whether the respondents owned their own computer and, if so, how old it was. The age of a computer can be roughly equated to its capability. Determining the age of the computer was thought to be a simpler and seemingly more reliable way to determine the capability of a computer than asking about specific features of the machine about which the responding students may not be knowledgeable (i.e., RAM, hard drive capacity, CPU model and speed, etc.).

The instrument also measured computer usage. Frequency and duration are the most common scales used to measure usage (Deane, Podd, & Henderson, 1998). Previous observations of student computer usage in the College revealed that the duration of individual sessions on the computer were highly variable. Therefore, frequency would not likely to give a good measure of usage. For that reason, duration was used as the operational definition of usage.

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The respondents were also asked to report on specific types of activities for which they used the computer. These computer-based applications were considered to reflect basic computer competencies. They included electronic mail, the World Wide Web (WWW), word processing, presentation graphics, databases and spreadsheets, and statistical analysis.

Sample

As of the Fall of 1999, the College of Education (then called the College of Education and Psychology) had 1695 undergraduate and graduate majors. The instrument was mailed to a stratified, random sample of one third of these majors (565). Since several of the programs had small numbers of students, the stratification was by department rather than program. A second stratum was class level. Of the 565 surveys mailed, 23 were returned as undeliverable. A total of 190 surveys were returned by students, for an effective return of 35.1% of the original mailing.

A second survey instrument was developed that mirrored the college-wide instrument. This instrument was sent to majors in the technology education program after the college-wide assessment was completed. A total of 54 (63%) of the 86 technology education majors in the College responded to the survey. In order to compare between technology education majors and other education majors within the College, information on other undergraduate education-related majors was abstracted from the initial college-wide survey. Breaking down the College majors by class and area, 417 of the 1695 majors were in undergraduate teacher education programs. About one third of the total (139) of these undergraduate teacher education majors were part of the original survey sample. Of these, 111 were teacher education majors in areas other than technology education. Thirty-five (31.5%) of the 111 non-technology education majors in the initial survey sample had responded.

Findings

Table 1
Key Demographics Data by Major

	TED		Other Ed.	
Factor	*n*	%	*n*	%
Female	8	15.7	28	82.4
Male	43	84.3	7	17.6
White	40	80.0	30	88.2
Non-White	10	20.0	4	11.8
Full-time	50	98.0	30	85.7
Part-time	1	2.0	5	14.3

The instruments collected demographic data from the respondents. Table 1 shows the key demographic variables: gender, race, and student status (i.e. full-time or part-time). The majority of respondents from undergraduate technology education majors were white males attending college full-time. The majority of undergraduate respondents from other education majors within the college were white females attending college full-time. The majority of respondents were

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between ages 19-21. Among the technology education respondents, not one reported being 18 or younger, while 37% of other education majors responding were 18 or younger. Also, more technology education respondents reported being 22 or older (35.1%) than other education majors (22.9%) within the College. Figure 1 presents a synopsis of the age of the respondents.

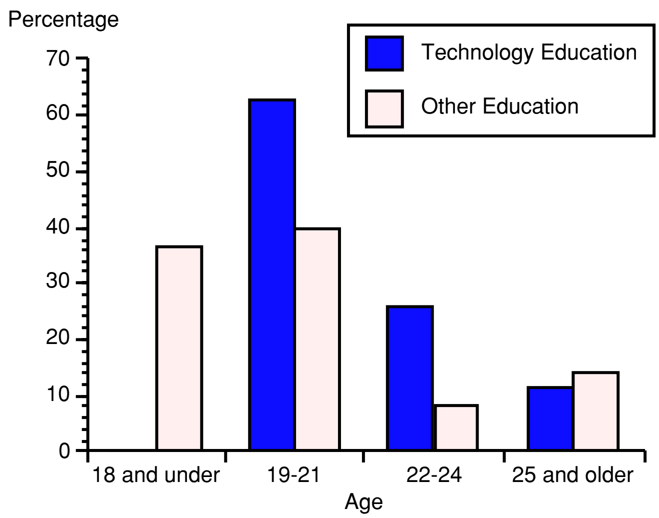

Figure 1. *Comparison of age between technology education and other majors.*

Overall, 87% percent of all education majors indicated they have a personal computer they own and use. Eighty four percent of technology education respondents own a personal computer, compared to 91% of the students from other education majors within the College. Most computers owned by both sets of respondents were between one and three years old. Figure 2 shows a comparison of the age of the computers among the respondents.

Computer ownership levels were analyzed to see if any significant difference or interaction existed relative to the variables of academic major, gender, or race. Using an ANOVA test (alpha = .05), no significant differences nor interactions were found.

Likewise, the researchers found no significant interaction between technology education majors as a group and those in other majors. No interaction was found between computer age and either gender or race. Also, no significant difference in computer age based on major, gender, or race was found. However, a significant positive correlation ($p < .0065$) was found between the age of student and the age of the computer for the total population that participated in the study.

The second part of the instrument assessed the number of hours each week the students spent using a computer for school, work, and leisure and the extent to which they used their own computer or one available elsewhere. As mentioned earlier, computer use for work meant that the students were being

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paid for the time they were using a computer. Figure 3 presents computer use by major.

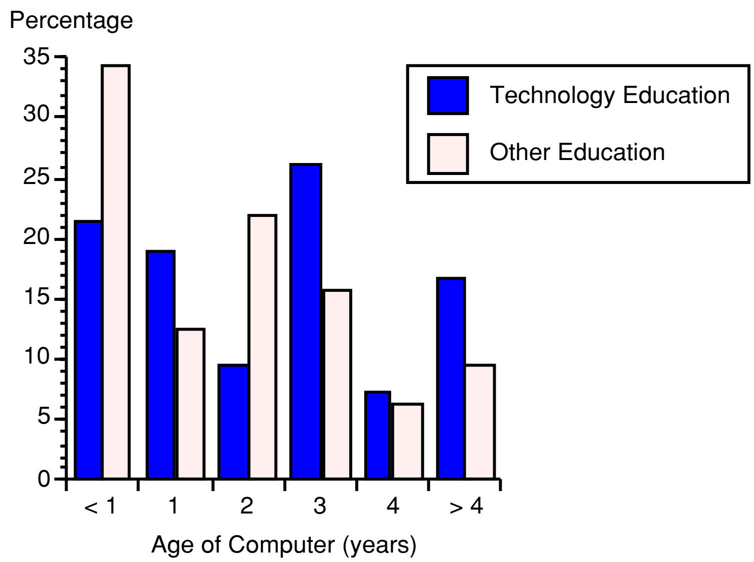

Figure 2. *Comparison of computer age between technology education and other majors.*

The second part of the instrument assessed the number of hours each week the students spent using a computer for school, work, and leisure and the extent to which they used their own computer or one available elsewhere. As mentioned earlier, computer use for work meant that the students were being paid for the time they were using a computer. Figure 3 presents computer use by major.

The researchers wanted to see if computing needs and time spent using a computer differed among class level (i.e. freshman, sophomore, junior, senior) and how much time, on average, students in each year classification spent at school, work, and, leisure computing activities. Table 2 shows the average (mean) hours spent per week by class level for each of the three computing activities for both technology and other education majors. Note that freshmen were not a part of the statistical analysis for this study since there were no freshman technology education majors.

The researchers compared differences in total computer use between major and class level using an ANOVA test (alpha = .05). No significant differences or interactions were found in total computer usage between major and the class level (e.g. sophomore, junior, senior). Likewise, there was no significant difference in total use by gender or race. Computer usage was then regrouped into the three component parts of school, work, and leisure and the ANOVA applied again. No significant interaction or difference was found based on major or class level for either school or work computer usage. Although there was no significant interaction in leisure usage by major nor class level, a significant

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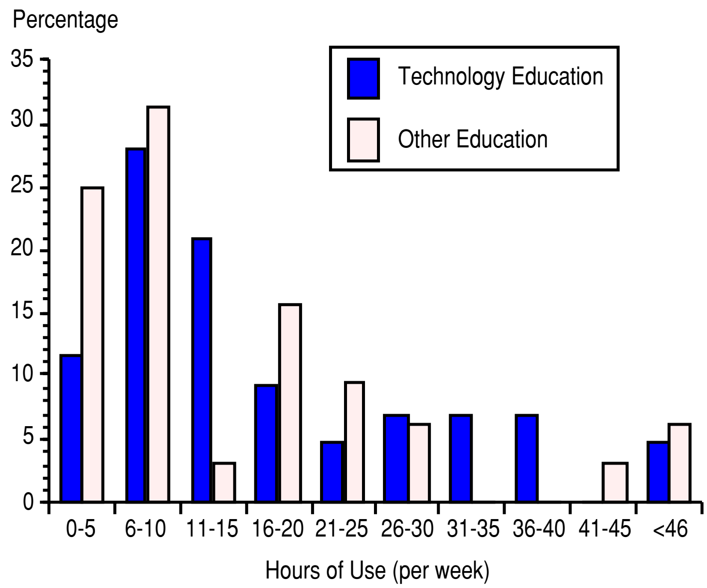

Figure 3. *Duration of computer use between technology education and other education majors.*

main effect ($p < .036$) was indicated for leisure usage by class level (F (3, 63) = 3.02). Post-hoc analysis showed that this was between seniors and the other years. The results of the ANOVA are reported in Table 3. This trend also revealed itself in a significant negative correlation between leisure usage and age ($r^2 = -.322$, $p < .0075$). No significant difference in leisure usage was found based on race or gender, nor was there any interaction with gender and class level or major.

Table 2
Average Hours Per Week Spent on Computing Activities

	Average Hours Per Week.		
Computing	Class Level	Tech. Ed	Other Ed
School	Sophomore	8.75	9.33
	Junior	8.50	5.25
	Senior	10.8	4.58
Work	Sophomore	3.57	1.83
	Junior	2.60	0.00
	Senior	2.27	1.66
Leisure	Sophomore	10.26	9.83
	Junior	7.75	1.50
	Senior	2.81	0.91

Seven computing areas were identified in the initial study as being regularly used within the College: e-mail, world wide web, word processing, databases/spreadsheets, statistics, presentation graphics, and technical

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graphics(CAD). This study compared the time per week that technology education majors spent in these seven areas compared to students in other majors. Table 4 shows the average number of hours each week technology education and other education majors spent in the seven computing areas selected for the study.

Table 3
ANOVA for Class Level - Leisure Usage

Test	SS	*df*	MS	*F*	*P*
Class Level	715.958	3	238.652	3.02	0.036
Error (Leisure Usage)	4980.004	63	79.047		

Using the ANOVA, no interaction or significant difference was found in the use of e-mail, the World Wide Web, or word processing by class level, major, or gender. Although no interaction was found for the hours spent each week using presentation graphics between class level and major, a significant main effect in use of presentation graphics was found between majors ($p < .0011$) with tech-

Table 4
Average Hours per Week Spent in Selected Computing Areas

Computing Area	Tech. Ed. Majors	Other Ed. Majors
E-mail	3.90	3.77
WWW	7.73	5.48
Word Processing	3.66	4.81
Presentation Graphics	2.24	0.25
Database/Spread Sheet	1.50	0.53
Statistics	0.12	0.32
Technical Graphics (CAD)	6.41	0.03

nology education majors using presentation graphics software more hours per week than other education majors (F (1, 63) = 11.73). See Table 5 for the results of the ANOVA. Though this two-way ANOVA did not reveal significance for class level, a one-way ANOVA on class level by itself did show a significant difference ($p < .0439$, F (3, 66) = 2.85). The results of the ANOVA are reported in Table 6. Seniors had significantly higher usage (m = 2.77) than freshmen (m = 0.42) and sophomores (m = 0.77) for this computing area.

Table 5
ANOVA Between Major and Class Level for Presentation Graphics Usage

Test	SS	*df*	MS	*F*	*p*
Major	66.561	1	66.561	11.73	0.0011
Class Level	29.837	3	9.945	1.75	0.1654
Class Level * Major	13.041	2	6.520	1.15	0.3235
Error (Pres Graphics Usage)	357.552	63	5.675		

No significant interactions or differences were found between majors or class level for database/spreadsheet, or statistics usage. Although, no interaction

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in CAD usage between major and class level was found, a significant main effect in CAD usage between technology education majors and other education majors ($p < .0001$, (F (1, 63) = 23.46) was found. See Table 7 for the results of this ANOVA. Also of note was the fact that seniors ($m = 7.26$) used CAD more than juniors ($m = 5.26$) who, in turn, used it more than sophomores did ($m = 2.14$).

In looking at the patterns of usage between applications, significant positive correlations were found between WWW usage and e-mail ($r^2 = .457$, $p < .0001$), as well as between WWW and CAD ($r^2 = .293$, p < .012). The study compared the age of the participants to see if age correlated with any of the seven computing areas. A significant negative correlation between age and E-mail use was found using the Spearman Correlation Coefficient procedure ($r^2 = -.355$, $p < .001$). Using this same test, positive correlations between age and presentation graphics ($r^2 = .337$, $p < .004$) and between age and CAD usage ($r^2 = .354$, $p < .002$) were also found.

Table 6
ANOVA Between Class Level and Presentation Graphics Usage

Test	*SS*	*df*	*MS*	*F*	*p*
Class Level	53.591	3	17.863	2.85	0.0439
Error (Pres Graphics Usage)	413.400	66	6.263		

Table 7
ANOVA Between Major and Class Level for CAD Usage

Test	SS	*df*	MS	*F*	*p*
Major	684.038	1	684.038	23.46	0.0001
Class Level	182.181	3	60.727	2.08	0.1114
Class Level * Major	79.675	2	39.837	1.37	0.2625
Error (CAD Usage)	1837.065	63	29.159		

Conclusions and Recommendations

The results of this study showed surprisingly similar trends in computer ownership and usage between technology and non-technology education majors. These similarities were maintained when the education majors were broken down based on gender or race. From the demographic data, it is clear that males continue to dominate technology teacher education at NC State. This is in contrast to a majority female population in the other education majors. At the same time, females tended to own and use computers at the same level as male students.

Interestingly, there was a considerably higher level of computer ownership among the respondents in this study compared to what Brown (1999) reported. Even though computer ownership was not required, a large majority of students in general owned computers and the proportion was even higher among technology education majors (though the difference was not significant). The lack of consistency between this study and the Brown study might be explained by socioeconomic differences between the two samples or by differences in support within the institutions. Understanding the barriers to ownership is

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important since ownership improves access to computer resources and this, in turn, influences the computing literacy of pre-service teachers (Kellenberger, 1997).

The age of the computer is related to what students can achieve with it and the extent to which their experience is positive. The computers that technology education majors used were, in general, older than those of non-majors. Older students tended to own older computers. This is likely due to the fact that students purchase a computer when they first enroll in the university and keep this computer until they graduate. The fact that technology education majors are often transfers from other majors may explain why they are older, on the average, than non-majors. Correspondingly, this likely would cause them to spend more years earning their degrees and thus might explain why their computers are older.

The age of a computer provides a relatively good benchmark to judge the readiness of the machine to run current software. Given the hardware demands of the latest graphics, CAD, and multimedia software that technology education majors are expected to use, these students are likely to be disadvantaged if their computer is more than two years old. A new computer ownership plan is being implemented by the College of Engineering at NC State that will have students lease computers and be able to trade them in after two years. A similar plan should be considered for technology education students.

This study revealed little difference in total computer usage between technology education majors and other majors within the College. Likewise, there was little difference in usage among class levels. While there seemed to be greater overall usage by technology education majors than by other education majors, and by sophomores compared to other class levels, these differences were not significant. Only when specific applications were analyzed did significant differences occur.

The fact that education majors in non-technical areas were making use of computers as much as technology education majors is indicative of the pervasiveness of computing activity in all curricular areas and in the work performed by students outside of school. On the other hand, it could be argued that the technology education program at NC State has failed to integrate computers to the extent that one would think, considering the nature of the of the discipline.

A closer look at the differences in computing usage among major, class level, and type of activity might explain some of these findings. For both technology and other education majors, sophomores were clearly the heaviest users of computers. This difference was in large part due to the high amount of leisure time spent with the computer. Sophomores and juniors from all majors engaged in significantly more leisure activity than seniors. While the interaction was not significant, the drop-off of leisure time spent using a computer between the sophomore and junior year for non-technology education majors was much more precipitous than it was for technology education majors. What is unclear is whether this drop-off was due to changing curricular demands as students move through school or whether, in fact, it might be revealing a micro-generational

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change in lifestyle. That is, younger students tend to integrate the computer more fully into all aspects of their daily life, including their (self-defined) leisure activity. A significant negative correlation between leisure usage and age seems to support this latter theory. Another element of support for this notion comes from the significant negative correlation that was found between e-mail usage and age, since e-mail can be used for a wide range of non-academically-related activities.

Also of note, though not significant, is the reverse trend in use of the computer for school activities between technology education and other majors. While the amount of school-related activities increased between the sophomore and senior years for technology education majors, it dropped for other education majors. A closer look at the curriculum content of all the education programs might reveal the root of this differential trend. For example, the computer literacy instruction for all students could have been concentrated during the sophomore year.

When looking at specific types of software used by education majors, some interesting differences in usage emerged between technology and other education majors with respect to class level. Technology education majors used presentation graphics and CAD (computer-aided design) software significantly more than other education majors. This difference would be expected regarding CAD since it is such an integral part of a technology education curriculum. An explanation for the increased use of presentation graphics software among technology education majors is, however, is less obvious. Unlike CAD, presentation graphics software is meant to be used as a general communication tool. As such, one would expect to find similar use among virtually all majors. It appears that students in other majors should be given increased encouragement and opportunity to use presentation software as part of classroom assignments. Certainly presentation graphics software would be an essential element of computing literacy initiatives for pre-service teachers (e.g., Moursund & Bielefeldt, 1999). Clearly, the use of these software tools and their integration into assigned activities would be a significant influence to their use in the future by an aspiring teacher (Gibson & Nocente, 1998). Technology education does seem to be doing a better job in this area than the other teacher education programs at NC State University.

In addition to showing differential levels of usage between majors, the use of CAD and presentation graphics differed by class level. Seniors were more likely to use CAD and presentation graphics than were lower level students. Not surprisingly is a parallel, significant positive correlation between CAD and presentation graphics and age. In this instance the researchers were less inclined to point to the generational influence mentioned earlier as an explanation. Instead, the increased use was due to the fact that project-based activities and the presentation of their outcomes are more common in upper level courses at NC State and many other universities.

Looking at other application usage patterns, it is worth noting that technology education students seem to be making more use of the WWW, while other education majors were using word processing more. These differences

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were not significant, however. More important may be the synergistic use of Internet-based activities as shown in the significant correlation of WWW and e-mail usage for all education majors. Also significant is that e-mail and WWW usage is not significantly different between male and female students, regardless of major or class level. For those students who are connected to the Internet, these tools go hand in hand. Whether increased usage of Internet-based tools such as the WWW and e-mail is good or bad is highly dependent upon how individual instructors integrate these tools into their courses and how students apply them in the course of their studies. The Internet is a rich source of information exchange, but all information sources both electronic and paper-based must be used and evaluated based on their quality and their relevance to the academic tasks at hand.

The results of this study clearly indicate that computer ownership and computer usage was pervasive in the College of Education and Psychology in the Fall of 1999. This pervasiveness was independent of major, class level, gender, or race. The predominantly white male technology education majors did not differ from other majors in terms of their overall usage of computing resources. It was only in the more specific analyses that differences were found between technology education and other education majors. Overall it appears that differences in computing use may be due more to the age of the student than to their major or gender.

It is risky to generalize the results of this study beyond NC State University in the year 1999. Computers and their application by students continue to evolve at a rapid pace. Institutions of higher education differ dramatically from one another, as do the programs within them. What was found at NC State may not hold true in other technology education programs due to a myriad of factors that were not controlled in this study. However, the regular conduct of national surveys of technology education and other education programs are needed so that longitudinal trends can be observed. Such studies can be key elements in helping the technology education profession provide for the computing needs of its students and to set benchmarks for comparison. The computer has become a tool that is essential for all educators and this is especially true for technology education.

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