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ABSTRACT

Patterns of occurrence and type of computer use, major, gender, and computer anxiety were analyzed for teacher education students. Over a 4-year period beginning in the fall semester of 1986, 914 teacher education students provided data for this study while they were enrolled in a mandatory computer awareness module. All of the subjects were education majors with the following concentrations: English; science; social studies; elementary education; mathematics; special education; and physical education. In addition to providing data for the study, the students responded to a computer anxiety instrument--a modified version of Spielberger's Self-Evaluation Questionnaire. Males (n=277) had significantly lower levels of computer anxiety than did females (n=637). Almost half of the students had no previous computer experience, and many were highly apprehensive toward computers. Mathematics education and science education majors were significantly less anxious toward computers than were students with other majors. Students in all seven majors had very little experience in running content-area software. Across the 4 years studied, there was a lower percentage of no prior computer experience and a higher percentage of previous use of content area software and word processing, spread sheet, or data base software. Three implications for teacher education are highlighted: (1) course designers should recognize that many students have no prior experience with computers; (2) practical uses of content area software and managerial types of software should be the focus for areas other than mathematics education; and (3) computer instruction should be driven by the student's major. Four tables contain study data. (SLD)

Teacher Education Students and Computers: Gender, Major, Use, Occurrence, and Anxiety

by

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One of the most pervasive patterns involving computers and education is the consistent increase in their use and availability in public schooling. Wright (1984), for example, reported that, in 1982, 38 percent of the schools had computers; on the other hand, Ordvansky (1988) reported that 91 percent of the schools had computers in 1988. Webb (1984) found that the median ratio between student and computer in 1983 was 100 to 1, whereas Ordvansky reported a more promising figure of 30 to 1 in 1988, with over half of the schools having that median ratio. Such figures have implications for teacher education: (a) teacher preparation programs must make serious efforts to train prospective teachers so that they can effectively use computers in their future instruction; and, (b) the increase of computer experience of in-coming teacher education students should affect the kinds of training and information offered as part of their undergraduate experience.

According to Carey and Gall (1986) and Goor (1980), uses of computers in pre-collegiate schooling center on (a) computer literacy, (b) remediation, (c) learning enrichment, and (d) challenge use. Goor reports that computer literacy is the most-often taught use (85 percent), followed by learning enrichment (72 percent), challenge use (64 percent), and remediation (45 percent). Although computer literacy is the most predominant use that is typically delivered through a special course, other uses such as learning enrichment and remediation apply to different subject-matter areas. The implications are that a significant portion of computer use is not restricted to one or two areas and that all content-area teachers should be prepared to use computers for remediation and learning enrichment.

Computer use can also be delineated by grade level. Typically (Noran & Estes, 1985) elementary use centers on CAI in mathematics and reading; junior high use centers on computer literacy; and high school use centers on computer science and CAI in mathematics, science, and vocational education. Such use can be further delineated by ability level: the two extreme ability groups--the talented and gifted and the learning disabled--are exposed to computers via federal funding of programs for these two student-populations. Noran and Estes have also reported that, of the different content areas, math and science seem to be the subjects in which computers are integrated in instruction the most. Given the information on grade and ability levels, certain guidelines for teacher training on the uses of computers can be established: (a) prospective teachers being prepared to teach at certain grade and of certain ability levels should have undergraduate training in computer uses in learning; and, (b) certain majors, such as math and science, probably have had greater experience with computers than such others as English Education, Special Education, and Elementary Education.

In addition to prior use, occurrence and type of computer exposure, and major, another factor affecting computer use is gender. According to Chen (1985), boys have more experience with computers than girls both at school and at home. Compared to girls, boys also have lower anxiety toward computers, more confidence and greater interest toward working with computers, and a greater regard for the respect computer competence brings them. Chen's findings have been supported, in part, by Muira (1986). Fuchs (1986) also found that boys have had more experience than girls, via formal courses, with computer application, BASIC programming, and other programming courses. The one area that girls excel in is the use of word-processing. Because females in teacher education programs typically outnumber males, gender may prove to be a significant factor in the creation of computer experiences for teacher education students.

The purpose of this study was to analyze patterns of teacher education students in terms of occurrence and type of computer use, major, gender, and computer anxiety over a four-year period.

Design of the Study

Sample

Over a four-year period, 914 teacher education students participated in this study when enrolled in a required undergraduate educational psychology course. In year **one (beginning fall semester 1986), 215** students provided data. In year **two (beginning fall 1987) 247** students provided data. In year **three (beginning fall 1988), 211** students provided data. And, in year **four (beginning fall 1989) 241** students provided data. Although all majors provided data, only those in the following **seven majors** were included in the analysis due to having adequate representation: English Education, Special Education, Physical Education, Social Studies Education, Science Education, Elementary Education, and Mathematics Education (majors such as Art Education and Foreign Language Education often had only two to six students in any given year). The 914 students whose information is used in this study represented the seven majors listed above.

Procedures and Measures

All students provided data when they enrolled in a mandatory Computer Awareness Module. They furnished their gender, major, and prior computer use (**None** versus **Running Content-Area Software** [labeled CAI] versus **Using Word-Processing, Data Base, and/ or Spreadsheet Software** [labeled CMI] versus **Programming Languages**). The researchers coded the year in which they responded to the questionnaire. The students also responded to a **Computer Anxiety** instrument, a modified version of Spielberger's Self-Evaluation Questionnaire, a 20-item, 4-point, Likert scale.

Analysis of the Data

A 2 (Gender: Male, Female) X 7 (Major: English Education, Science Education, Social Studies Education, Elementary Education, Mathematics Education, Special Education, Physical Education) X 4 (Year: One, Two, Three, Four) X 4 (Prior Computer Experience: None, CAI, CMI, Programming) analysis of variance was conducted. The dependent measure was Computer Anxiety. Percentages were also calculated.

Results and Discussion

Gender, Year, Major, and Use all had significant main effects on computer anxiety. There was also a significant two-way interaction between Year and Major: $F(18,738) = 1.84, p = .02$. There were no other significant two-way, no three-way, and no four-way interactions.

Gender

Males (n = 277) had significantly lower computer anxiety than females (n = 637): $F(1,738) = 21.94$, $p = .0001$. The mean for males was 44.415 (sd = 11.552), whereas the mean for females was 47.871 (sd = 11.955). These findings are in line with those by Chen (1985) and Muira (1986).

Use

There were significant differences in computer anxiety across the four computer uses: (a) None, (b) Computer-Assisted Instruction (CAI), (c) Computer-Managed Instruction (CMI), and (d) Programming Languages ($F[3,738] = 110.31$, $p < .0001$). Of the 914 students, 409 reported no prior computer experience, whereas 113 reported CAI experience, 134 reported CMI-type experience, and 258 reported Programming experience. Based on *post hoc* tests to determine actual sources of effect, there were significant differences (a) between None and CAI, (b) between None and CMI, (c) between None and Programming, (d) between CAI and CMI, (e) between CAI and Programming, and (f) between CMI and Programming. The computer anxiety mean for those with no computer experience was 52.79 (sd = 10.782); for those with CAI experience, 49.478 (sd = 10.223); for those with CMI experience, 42.567 (sd = 8.577); and, for those with Programming experience, 38.415 (sd = 9.88).

These findings indicate that not only have almost half of the teacher education students had no computer experience but also they are highly apprehensive toward computers. Computer-course designers need to consider both this lack of experience and this high degree of anxiety. Somewhat promising is that relatively easy uses of computers such as running content-area software seem to reduce computer anxiety significantly. CMI-related uses such as word-processing reduce anxiety even more. Given the personally useful nature of word-processing (namely writing papers for classes), this type of use might be the most sensible of the three uses: it not only is something they can use throughout their training but also it (a) reduces computer anxiety and (b) is a use that they can easily teach their future students. Of the 134 students who reported CMI use, 109 were females. This finding supports Fuchs' (1986) contention that girls outnumber boys in the word-processing category.

Gender by Use

Although males in this sample had, on the average, lower anxiety than females, 47.2 percent of the males had no prior experience with computer whereas 43.6 percent of the females had no prior computer experience (see Table 1). This somewhat confusing finding--males having lower anxiety than females although a lower percentage of females had no prior computer experience than males--may be related to Chen's (1985) finding that boys typically have lower anxiety toward and greater confidence and interest in computer. Despite their lack of computer experience, they may perceive computers as male objects, "the way the male world has always claimed automobiles and weapons and motorcycles" (p. 7). This notion seems to be further supported by the lower percentage (43.6 percent) of females who had no prior computer experience. Both males and females (7.94 percent and 14.42 percent respectively) had little experience running content-area software which seems a little perplexing because, according to Noran and Estes (1985), the most frequent use of computers in pre-collegiate schooling is drill and practice which would tie in with remediation and learning enrichment. But, that finding may be explained by the type of student typically receiving much of that kind of instruction via computers--the learning disabled or students who usually do not go on the post-secondary education. A higher percentage of females (17.1 percent) had CMI experiences, mostly word-processing, than males (nine percent). This result may be due, as mentioned earlier, to word-processing being viewed as a female skill because of its close association with writing, a skill perceived as female oriented (Daly, 1986). A higher percentage of males had programming (34 percent) than did females (29 percent), which may help explain males' lower anxiety; programming was related to lower anxiety.

Table 1. Gender by Use Comparison

	None	CAI	CMI	Programming
Males	(n = 131) 47.3%	(n = 22) 7.9%	(n = 25) 9.0%	(n = 99) 35.7%
Females	(n = 278) 43.6%	(n = 91) 14.3%	(n = 109) 17.1%	(n = 159) 24.9%

Major

There were significant differences in computer anxiety across the seven majors: Special Education, Elementary Education, English Education, Social Studies Education, Science Education, Physical Education, and Mathematics Education ($F[6,738] = 7.92, p = .0001$). Based on *post hoc* tests, two majors were significantly different from the others: Math Education and Science Education majors were consistently less anxious toward computers than were those majoring in English Education, Elementary Education, Special Education, Social Studies Education, and Physical Education (see Table 2). Such findings support those of Noran and Estes (1985) who reported that computer use is typically found in math and science classes at the pre-collegiate level.

Table 2. Majors and Computer Anxiety Means (standard deviations in parentheses)

	Computer Anxiety
GROUP ONE[1]	
Elementary Education (n = 333)	49.05 (11.89)
English Education (n = 102)	47.64 (11.95)
Physical Education (n = 164)	47.59 (10.63)
Special Education (n = 53)	46.64 (13.37)
Social Studies (n = 75)	46.45 (11.40)
GROUP TWO	
Science Education (n = 99)	42.51 (11.34)
Mathematics Education (n = 88)	41.33 (11.97)

[1] There are significant differences in computer anxiety between those majors in Group One and those majors in Group Two.

Major by Use

Over half the students majoring in Special Education (50.94 percent) and Physical Education (55.49 percent) have had **no prior computer experience**. Almost half of the Elementary Education students have had no prior experience. Although only 41.2 percent of the English Education majors have had no prior experience, the three remaining majors had even lower percentages: Social Studies Education (38.67 percent), Science Education (39.39 percent), and Mathematics Education (22.73 percent). All seven majors had very little experience at **running content-area software,** ranging from 6.82 percent for Math Education majors to 16.17 percent for Elementary Education majors. Likewise, low percentages related to CMI uses exist for students in all seven majors with Science Education and Mathematics Education having the lowest (9.1 percent) and English Education majors having the highest (29.41 percent). In terms of programming, several majors had low percentages: Special Education (22.64 percent), Physical Education (18.29 percent), English Education (22.55 percent), and Elementary Education (20.36 percent). On the other hand, students majoring in the other areas had a much higher percentage of programming experience: Social Studies Education (38.67 percent), Science Education (42.42 percent), and Mathematics Education (61.36 percent).

Year

There were significant differences in computer anxiety across the four years: $F(3,738) = 4.15$, $p = .006$. Based on *post hoc* tests for sources of effect, it was found that there were significant differences (a) between Years One and Two, (b) between Years One and Three, and (c) between Years One and Four. It is interesting that those in Year One had significantly lower computer anxiety. Given the on-going influx of computers, it was believed that the results would be more favorable in the later years, which was not the case. One potential explanation is that, although there were decreases in the percentages of those with no prior computer use from Year One (50.2 percent) to Years Three (41.2 percent) and Four (32.8 percent), there were also decreases in the percentages of those with programming experience: Year One, 33.5 percent; Year Two, 28.3 percent; Year Three, 22.8 percent; and, Year Four, 28.2 percent. The significant shifts in prior use when factoring in Year are evident in CAI-use and CMI-use **between** Years One and Two **and** Years Three and Four: CAI--Years One (6 percent) and Two (4 percent) versus Years Three (18.5 percent) and Four (21.6 percent); CMI-- Years One (10.2 percent) and Two (13.3 percent) versus Years Three (17.5 percent) and Four (17.4 percent). When combining CAI and CMI for each year, the shifts are even more dramatic: Years One (16.2 percent) and Two (17.4 percent) versus Years Three (36 percent) and Four (39 percent). Although a lower percentage of students with no prior computer experience consistently occurred across the four years so did a lower percentage of students with programming background. The noticeable changes occurred for CAI and CMI. The explanation centers on the points that CAI and CMI uses increased and that CAI and CMI uses involved higher anxiety than programming experience (see Table 3). Despite the finding that those in Year One had significantly lower computer anxiety than those in Years Two, Three, and Four, the promising notion is that those in the later years had perhaps more useful prior experience: the increase in CAI indicates that content-area software was being used more and the increase in CMI indicates that word-processing was being used more. An important development is that computer use is not being limited to computer science programming or math classes.

A comparison that reflects this trend--lower percentages of no prior computer experience and programming versus higher percentages of CAI and CMI use across the four years--might be helpful. Students whose majors were English Education, Social Studies Education, and Mathematics Education were compared. These three majors were chosen because we might expect word-processing to be used mostly in the English classroom; CAI use, in the Social Studies classroom; and, programming language instruction, in the Math classroom. As can be seen in Table 4, these expected trends occur when comparing each year with each use for each of the three majors.

Table 3. Percentage of Prior Computer Use and Computer Anxiety (in italics) Across the Four Years

	None	CAI	CMI	Programming
Year One	(n = 108)	(n = 13)	(n = 22)	(n = 72)
	50.2%	6.0%	10.2%	33.5%
	50.54	*46.61*	*43.91*	*36.09*
Year Two	(n = 135)	(n = 9)	(n = 33)	(n = 70)
	55.0%	4.0%	13.4%	28.3%
	52.51	*49.33*	*40.45*	*40.7*
Year Three	(n = 87)	(n = 39)	(n = 37)	(n = 48)
	41.2%	18.5%	17.5%	22.7%
	54.43	*47.1*	*44.29*	*38.85*
Year Four	(n = 79)	(n = 52)	(n = 42)	(n = 68)
	32.8%	21.6%	17.4%	28.2%
	54.53	*51.91*	*41.97*	*38.21*

Table 4. Major by Use Across Four Years (percentages are within-year)

	Year One	Year Two	Year Three	Year Four
English Education	(n = 26)	(n = 26)	(n = 22)	(n = 28)
None	53.9%	53.9%	36.4%	21.4%
CAI	3.8%	3.8%	9.1%	10.7%
CMI	15.4%	26.9%	40.9%	35.7%
Programming	26.9%	15.4%	13.6%	32.1%
Social Studies Education	(n = 17)	(n = 27)	(n = 13)	(n = 18)
None	41.2%	44.4%	38.5%	27.8%
CAI	0.0%	7.4%	30.8%	27.8%
CMI	5.9%	11.1%	7.6%	5.5%
Programming	52.9%	37.0%	23.1%	38.9%
Mathematics Education	(n = 22)	(n = 29)	(n = 15)	(n = 22)
None	40.9%	24.0%	6.7%	13.6%
CAI	0.0%	3.4%	13.3%	13.6%
CMI	0.0%	10.3%	13.3%	13.6%
Programming	59.1%	62.1%	66.67%	59.1%

The most significant shifts for English Education majors across the four years were a decrease in no prior computer experience and an increase in CMI-use (or word-processing). For Social Studies Education majors the significant shifts were a decrease in no prior computer use and an increase in CAI-use (or running content-area software). And, for Mathematics Education majors there was, likewise, a decrease in no prior computer use. Although programming consistently remained their highest-percentage use and considerably higher than the programming experience of the other two majors, there were increases in CAI and CMI usage.

Implications

Based on the data provided in this study, certain guidelines for developing computer-based training for prospective teachers become apparent. **First,** a large percentage of teacher education students have had no prior experience with computers, with the exception of Mathematics Education students; course designers should be prepared to start at step one. **Second,** the more practical uses of content-area software and managerial types of software are low and should be the curricular focus of such courses; an exception may be the Mathematics Education student who as the math teacher is expected to deliver programming instruction, but this expectation should not preclude their knowledge of remediation- or learning enrichment-based software as well as word-processing, data base, and spreadsheet programs. And, **third,** given significant differences in computer anxiety and prior computer use, computer instruction should be major-driven--that is, for example, English Education students should have a course designed specifically for them.

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