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ABSTRACT

This study examined the effects of increased computing experience on the computer anxiety of 101 first year preservice teacher education students at a regional university in Australia. Three instruments measuring computer anxiety and attitudes--the Computer Anxiety Rating Scale (CARS), Attitudes Towards Computers Scale (ATCS), and Computer Thoughts Survey (CTS)--were administered to the students both prior to and at the completion of a computer training course. The results of these tests were compared to the test scores of a control group of students who did not complete the computer training course. Other variables measured in addition to completion of the computer training course were gender, single sex versus coeducational school type, age, and ownership of a personal computer. Analyses of the data indicate that increased computer experience generally lowers anxiety; computers will cause less anxiety when they are a source of self-directed exploration or diversion than when they are part of formal instruction; the issue of gender differences in computer anxiety is complex and unresolved; confidence may well be linked with computer ownership; the effect of school type appears to be more significant for males than females; student ethnicity showed trend level significance; and, due to the multiple variables, greater computer experience worsens anxiety for some individuals. Evidence from this study also gives further support to previous research that explains computer anxiety from a social learning perspective. (Contains 17 references.) (ALF)

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COMPUTER ANXIETY AND STUDENT TEACHERS
interrelationships between computer anxiety, demographic variables and an intervention strategy

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It is known that research into computing in Australian tertiary institutions has examined various student characteristics such as gender and computer experience. It appears that none has investigated student anxiety with regard to this technology . Furthermore, none has tested scientifically the assumption that increased computer experience per se will reduce anxiety and increase positive attitudes. This study, therefore, sought to examine the effects of increased computing experience on the computer anxiety of preservice teacher education students. This was assessed following a number of steps. Firstly, both prior to and at the completion of a computer training course, the computer anxiety and attitudes to computing of first year teacher education students were measured using three instruments which have been standardized on large populations and which have been demonstrated to have high reliability. The instruments are the Computer Anxiety Rating Scale (CARS), Attitudes Towards Computers Scale (ATCS), and Computer Thoughts Survey (CTS), (Rosen, Sears and Weil, 1987). A control group of students not completing the computer training course were surveyed with the same instruments at the beginning and end of the semester for comparison data. This paper reports on the initial analyses on the data using the CARS.

Method

Subjects

Subjects in this study were 101 (m=21, f=80) first year education students at a regional university. Fifty nine of the subjects were school leavers while forty two had been one or more years out of school before commencing University. Forty six of the subjects elected to take a compulsory course called Computers in Education during the first semester, while the other fifty five elected to do it in the second semester. Thirty five students had attended single sex high schools, twenty five were classified as of ethnic background, and forty three owned a personal computer. Sixty five of the students classified themselves as beginners in using computers while thirty six classified themselves as advanced.

Measures

The Computer Anxiety Rating Scale (Rosen, Sears & Weil, 1987) was used to evaluate levels of computer anxiety. In this instrument twenty statements reflect a variety of aspects and features of computer anxiety, including anxiety about the machines themselves, their role in society, computer programming, computer games, consumer use of computers, and future computer impact. Each statement was rated on a 5-point scale indicating how anxious the item expressed in the statement made the person feel "at this point in time" (1= not at all, 2= a little,

3 = a fair amount, 4 = much, and 5 = very much). Items comprising the scale are found in Table 1.

As well as the CARS, students were administered demographic questionnaires eliciting information on the following:

sex, age, ethnic background, ownership of PC, intentions to purchase PC, use of computers and associated computer linked equipment, attendance at single sex or coed school, and self-ranking of computer competence.

The intervention, Computers in Education, consisted of one hour of coursework per week for fourteen weeks. Coursework consisted of learning to use a word processor on IBM JX computers.

Procedures

All students were administered the CARS during the second week of their education course. The instrument was readministered during the second last week of their fourteen week course. Pretest and posttest forms were combined for each subject. Students with either the pre or post tests missing were excluded from the sample.

Data Analyses

Initial analyses of the CARS instrument consisted of principal axis factor analysis using varimax rotation to establish the subscales of the instrument. Four clear factors emerged from the analysis accounting for 49.8% of the variance. The first factor, Learning About Computers Anxiety (LEARNANX) accounted for 30.4% of the variance. The second factor, Computer Equipment Anxiety (EQPANX) accounted for 11.7% of the variance. The third factor, Computer Message Anxiety (MESSANX) accounted for 5.1% of the variance and the fourth factor, Observing Computers Anxiety (OBANX) accounted for 2.7% of the variance. Mean scores were derived for each of the subjects on the items comprising each scale. Coefficient alpha estimates of reliability were computed for the entire scale and each of the subscales, these were the following: CARS, .90; LEARNANX, .79; MESSANX, .65; OBANX, .63; EQPANX, .75.

As one of the major tasks of the research was to examine the impact of an intervention program (Computers in Education course) on computer anxiety for those subjects who attended the course in relation to those who did not attend the course, an analysis-of-covariance design was used to control statistically any initial differences in the students which might have been present and which might confound the differences between the two groups of students. Five posttest variables (CARS, LEARNANX, EQPANX, MESSANX, AND OBANX) were separately analysed using an ANCOVA with the appropriate pretest as a covariate in each analysis. The independent variables considered in the analyses were sex, age, ethnic background, ownership of personal computer, computer experience, attendance at single sex or coed high school, and membership of intervention strategy.

Results

Computer experience

Forty three per cent of the subjects own a computer and forty one per cent intend purchasing a computer in the next five years. The following table indicates the levels of various types of computer experience within the group.

Table 1 Levels of experience in computer usage

EXPERIENCE	Never	1-2 times	3-5 times	6 or more times
Learned computer language	50	33	8	10
Used computer in job	59	11	8	23
Word processing	50	13	10	28
Computerized library card	23	24	12	42
Computerized library search	32	24	11	34
Computer games	3	9	13	76

Examination of the range of computer experiences of this sample may help account for the generally modest level of computer anxiety expressed. Intention of and actually owning a PC would appear to indicate a high level of interest in computing, or at least, an acceptance of the reality of computers in the workplace and especially in teaching. As professionals engaged in preparing the next generation for successful participation in a technological society the motivation of these teacher education trainees may well be greater than in other faculties of the University.

General levels of anxiety

Approximately 44% of the students expressed some general anxiety in the use of computers with 10% expressing considerable levels of anxiety. Of the subscales, LEARNANX and MESSANX revealed the highest levels of anxiety with 66% and 57% expressing some anxiety, respectively, while 22% and 16% expressed considerable levels of anxiety. The other two scales OBANX and EQPANX revealed very low levels of anxiety.

Computer anxiety rating scale (CARS)

The analysis of covariance on the Computer Anxiety Rating Scale reveals a main effect (approaching significance at the .05 level) for attendance at the Computers in Education course ($F=3.843$, $df=1/71$, $p=.054$). Those who attended the Computers in Education course were less anxious than those who did not (mean=1.7, SD=.542, n=46 and mean=2.006, SD=.592, n=55 respectively). One interaction term reached significance, sex by coed/single sex ($F=4.509$, $df=1/71$, $p=.037$), while another interaction term approached significance at the .05 level, own PC by computer competence. A comparison of simple main effects was made to examine the nature of the interaction effects using one way ANOVAS and Fisher's LSD. Where groups did not contain the same number of subjects (in this and other analyses) a Cochrans C test for the homogeneity of variances was performed, and where non-homogeneity of cell variances was indicated appropriate transformation of the scores using the harmonic mean was applied. No significant differences were found between the levels of sex and school type, however, the results suggest that males attending a single sex school were more anxious than males attending a coed school (1.88 and 1.72), while females attending a single sex school were less anxious than females attending a coed school (1.79 and 1.96). Furthermore, females who attended a coed school appeared to be more anxious than males who attended a coed school.

Significant differences were found between all levels of owning a PC and computer competence except for those describing themselves as beginners for whom owning a PC did not make any difference to level of anxiety. These students were more anxious than any other group. Conversely, advanced students (i.e., those with greater competence) who owned a computer were less anxious than those advanced students who did not own a computer.

Learning About Computers Anxiety (LEARNANX)

There were no significant main effects or interactions on this scale. However a main effect for student ethnicity approached significance (F=.078, df=1/71, p=.078) with Anglo students expressing less anxiety than ethnic students (mean=2.09, SD=.80, n=76 and mean=2.33, SD=.77, n=25 respectively). When all other variables were removed an ANCOVA with the pretest as a covariate showed a significant main effect for student ethnicity (F=3.999, df=1/98, p=.048).

Using computer equipment (EQPANX)

There were no significant main effects on this scale. A number of significant interactions were identified. Table 2 presents a summary of these interactions.

Table 2 Summary table of significant interactions on EQPANX scale

Source	df	MS	F	p
computer competence x sex	1	1.095	4.499	.037
computer competence x own PC	1	1.269	5.215	.025
computer competence x computing course	1	1.040	4.274	.042
school type x sex	1	1.662	6.831	.011
school type x age	1	1.201	4.936	.029
own pc x computing course	1	1.194	4.909	.030

A comparison of simple main effects was made to examine the nature of the interaction effects using one way ANOVAS and Fisher's LSD. For the sex and computer experience interaction, males who classified themselves as beginners were significantly more anxious than males who classified themselves as advanced (mean=1.63, SD=.53, n=10 and mean=1.05, SD=.101, n=11 respectively). On the other hand there appeared to be little difference in level of anxiety between females who described themselves as beginners and those who described themselves as advanced (mean=1.39, SD=.49, n=55 and mean=1.40, SD=.83, n=25 respectively). The results also indicate that males who described themselves as beginners were more anxious than females who described themselves as beginners (mean=1.63, SD=.53, n=10 and mean=1.39, SD=.49, n=55 respectively), and females who described themselves as advanced were more anxious than males who described themselves as advanced (mean=1.40, SD=.83, n=25 and mean=1.05, SD=.101, n=11 respectively).

A significant interaction was found between gender and school type. While males show greater anxiety from single sex schools, females show greater anxiety from coed schools. Furthermore, males from single sex schools were more anxious than females from single sex schools, while males from coed schools were less anxious than females from coed schools. For the owning a PC and computer competence interaction, students who classified themselves as advanced were less anxious than any of the other groups. There were no differences between beginners who owned or did not own a PC, but there was a highly significant difference between the advanced who did or did not (x=1.062, SD=.111; x=1.578, SD=1.00 p<.05). For the owning a PC and computing course interaction, those that did not own a PC and did not complete educational computing were significantly more anxious than each of the other three groups. Lastly, for the computer competence and the computing course interaction those who classifed themselves as advanced and who also completed the computing course were significantly less anxious than those who classifed themselves as beginners who did not complete the course. Although non significant, the direction of the other comparisons indicates that for both beginners and advanced students completing the computing course was associated with lower levels of anxiety.

Computer Message Anxiety (MESSANX)

The analysis of covariance reveals significant main effects for computer competence (F=7.813, df=1/71, p=.007) and completing the computing course (F=4.200, df=1/71, p=.044). There were no significant interaction effects on this scale. The results show that students who classified themselves as beginners were significantly more anxious on this scale than those students who classified themselves as advanced (mean=2.37 , SD=.677, n=65 and mean= 1.76, SD=.509, n=36, respectively) while those who completed the computing course were significantly less anxious than those who did not complete the course (mean=1.98, SD=.56, n=46 and mean=2.30, SD=.75, n=55, respectively).

Observing Computers Anxiety (OBANX)

The analysis of covariance reveals significant main effects for owning a PC (F=4.802, df=1/71, p=.032), computer competence (F=4.368, df=1/71, p=.040) and completing the computing course (F=4.619, df=1/71, p=.035). For the first main effect, those who owned a PC were significantly less anxious than those who did not own a PC (mean=1.29, SD=.42, n=43 and mean=1.59, SD=.69, n=58 respectively). For the main effect of computer competence those who classified themselves as beginners were significantly more anxious than those who classified themselves as advanced (mean=1.55, SD=.646, n=65 and mean=1.296, SD=.489, n=36 respectively) although this finding is complicated by the interaction of computer competence with sex. Finally, those students who completed the computing course were significantly less anxious than those who did not on this scale (mean=1.33, SD=.51, n=46 and mean=1.57, SD=.66, n=55 respectively).

There was a significant interaction between sex and computer competence (F=4.738, df=1/71, p=.033) and between sex and type of school (F=16.590, df=1/71, p=.000). A comparison of simple main effects was made to examine the nature of the interaction effects using one way ANOVAS and Fisher's LSD. Analyses showed that male beginners were significantly more anxious than any of the other three groups. The results also indicate that female beginners were more anxious than female advanced (mean=1.485, SD=.587, n=55 and mean=1.373, SD=.564, n=25 respectively), and that female advanced are more anxious than male advanced (mean=1.373, SD=.564, n=25 and mean=1.121, SD=.168, n=11 respectively). For the sex by school type interaction, males who attended a single sex school were significantly more anxious than any of the other groups. The results also indicate that females who attended a coed school were more anxious than males who attended a coed school (mean=1.461, SD=.579, n=52 and mean=1.261, SD=.325, n=14 respectively). There appears to be little difference between females who attended a single sex or a coed school on this scale.

Discussion

The findings of the present study appear to support the arguments for increasing computer experience in order to lower anxiety in that those who completed the educational computing course were less anxious than those who did not. In addition, the subject's self-rated computer competence (that is, the range of computer applications they were familiar with) which would constitute additional computer "experience", appeared to be a significant variable which interacted with several others, viz., sex, PC ownership and completing educational computing. The complexities of these interactions, however, demonstrate the need for a more specific definition of "experience" to be derived with regard to computing than that which commonly occurs in the literature.

With regard to using computer equipment and observing others use computers, those male students who rated their competence as "advanced" were less anxious. Much of the research on gender differences in computing would support such a finding, that is, that males are advantaged by access to software that is male biased, and are socialised to be more technologically oriented

thereby gaining greater experience and confidence with computer technology than females. In line with this evidence, females in this study who considered themselves "beginners" would be expected to be the most anxious. However, male "beginners" were found to have the greatest anxiety on these items. One might hypothesise that the male subjects in the present study, primary teacher trainees, may be unrepresentative of males who generally enrol in other University faculties such as Business, Science or Computing. Qualitites that are associated with primary teaching include nurturance anbd care, characteristics of a stereotypically female sex-role identity. In Rosen, Sears and Weils' (1987) study, students identified as female in sex-role orientation, using Bem's (1974) scale, were more anxious than those with a male sex-role orientation. Winer and Bellando (1989) similarly found that psychology undergraduates, rated as "artistic" or "social" vocational-personality types according to Holland's (1985) model were more computer anxious, had lower interest and lower self-estimated competence in science and technology. Interestingly, in a very recent cross-cultural study of over 2,000 students from 18 countries, Weil and Rosen (personal communication, 1990) found that males were more anxious than females on the CARS scale overall.

The issue of female lack of confidence in technological areas has also been the focus of a number of studies. It has been demonstrated that many females transfer mathematics anxiety and negative attitudes toward mathematics to the computer (Collis, 1987). Furthermore, those with an externalised locus of control, more likely to be females (Dweck and Bush,1976), experience greater computer anxiety (Coovert and Goldstein,1987). Traditional socialisation of females has been argued as a major factor contributing to low perceptions of self-efficacy by females despite high achievement levels; mathematics and technology are perceived as male domains, therefore, interest and motivation to do well in these fields may well be limited, and low expectations of success to be self-fulfilling.

If confidence (or lack of anxiety) is not necessarily related to competence levels for females, as in the present study, how can one build self-efficacy expectations through computing experience as in the social learning model for remediating anxiety? Wilder, Mackie and Cooper (1985) found that confidence and perceived skill in computing for females was related to having knowledge of a programming language rather than merely experience with a range of computer applications, and that males were more likely than females to have such programming background at high school.

Thus, the nature of computing experiences must be a variable to consider in relation to questions of interest, self-efficacy perceptions and computer anxiety. It seems reasonable to assume that computers will cause less anxiety when they are a source of self-directed exploration or diversion than when they are part of formal instruction, especially when the latter is assessed.

Clearly, the issue of gender differences in computer anxiety is complex and unresolved as yet; generalisations, therefore, would be unwise.

Burns and Hagerman (1989) found that different types of computer experiences may well affect self-concept and motivation viz a viz computers: Logo led to an increase in internal locus of control while a comparable programme which did not allow errors as part of the learning process led to an external locus of control. In addition to fostering an external locus of control, such "top down", "bug free", structured programming would not develop a sense of self-efficacy in individuals for whom this style of computer interaction was not preferred, if it were the only style valued by those who determine what constitutes "good programming" (Damarin, 1989).

Confidence may well be linked to computer ownership in that those "advanced" students in the present study who owned a PC had presumably gained competence through private experimentation in their own homes and therefore experienced the least anxiety. On the other hand, those "advanced" students who did not own a PC may have gained experience in other ways that did not dissipate anxiety, such as in high school computing classes. It was only those who rated their competence as "advanced" and who owned a PC that reported virtually no anxiety . Such findings corroborate those of earlier researchers,. For example, Miura (1987) reported that computer ownership by female college students contributed significantly to their perceived

self-efficacy while Levin and Gordon (1989) found that owning a PC had a stronger positive effect on attitudes towards computers than sex.

When compared with the "experience" gained from completing the word processing course, the ownership of one's own PC was more effective in reducing equipment anxiety, as would be expected. However, there was a significant main effect for the educational computing course on the CARS scale; those who completed the course did have lower anxiety than those who did not .

With regard to this issue of the relative merits of various computing experiences, Honeyman and White (1987) identified time as an important consideration; those with less initial experience needed an optimum period of time (in this case 30 contact hours with the machine) before any reduction of anxiety began in a semester long introductory computer applications course. Such findings would support those in the present study for lowest anxiety levels in "advanced" PC owners, i.e., students who had less need of time in which to gain proficiency compared with "beginners" (real or perceived).

The effect of school type appears to be more significant for males than for females in the present study. As the undergraduate population in teacher education is largely female, the shift from either single sex or coeducational high school to University would not be expected to make much impact on females in computing. For males, however, especially those who are less technologically oriented (Winer and Bellando, 1988) and less mechanically interested (Heinssen, Glass and Knight, 1987) as these male teacher trainees were likely to be, it could be expected that being in the minority at University and contradicting the male stereotype may well have been more keenly felt by those coming from a single sex high school. Thus, these males were more anxious on those scales that measured equipment anxiety and observing others using computers. Such an interpretation is in keeping with other research that found a significant decline in confidence for boys after a shift from single-sex to coeducational high school classes in mathematics (Rowe, 1988). It could be hypothesised, therefore, that these different school environments fostered the development of different perceptions of self-efficacy with computers.

The main effect of student ethnicity showed a trend towards significance ($p=.07$) on the scale LEARNANX, learning how to use a computer, with migrants showing greater anxiety than Anglo Australians. Chambers and Clarkes' (1987) findings of "cumulative disadvantage", vis a vis computing from particular group membership is pertinent here; females, low ability, low SES and ethnic students held less positive attitudes after increased experience with computers, and these attitudes were negatively compounded by multiple membership of groups, e.g., female ethnic student. Chambers and Clarke hypothesised that lack of prior computing experience (i.e., voluntary participation in out of class computing activities) relative to "advantaged" groups - male, high ability, high SES and Anglo, - was responsible for lowered confidence of the disadvantaged groups.

The evidence from this study gives further support to previous research that explains computer anxiety from a social learning perspective. Personal ownership of computers, familiarity with a variety of computer applications and participation in a University word processing course all reduced anxiety for first year teacher trainees. Furthermore, it could be argued that the association of computing with mathematics and the sex-typing of computing as a male activity interacted with the type of high school attended (single sex or coeducational) to affect the nature of computer experiences engaged in, attitudes toward computing, perceptions of self-efficacy and expectations of success associated with engaging in computing. Stereotypically gender differences, however, need to be moderated by considerations of individual variations in sex-role identification, locus of control orientation and vocational-personality type as well as sociological variables such as SES and ethnicity, which may impinge on access and participation in computing experiences.

A simplistic explanation, therefore, that increased computer experience alone will reduce computer anxiety would obviously not account for the complex interactions possible in the above individual and situational variables. In these interactions lies an explanation for the findings that for some individuals, greater computer experience in fact worsens anxiety.

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