ABSTRACT The concern that teachers are being inadequately prepared by their pre-service education to be confident and competent users of information technology remains, despite over a decade of computer availability in education systems. This paper examines the views of 234 pre-service teachers who experienced an information technology component in their teacher education course. It finds that many students have low computer self-efficacy and express negative feelings about information technology. These perceptions are gender and age related. It concludes that the need for information technology competency training remains important, but such programmes need to be specifically tailored to account for the wide range of experiences and attitudes of pre-service teachers.

Introduction

The need to provide information technology (IT) education for pre-service teachers has been well documented (for example Handler, 1993; Smith et al., 1994; McFarlane & Jared, 1994). This literature covers a range of issues relating to the pre-service IT education of teachers, including concerns “that students entering the [teacher training] course describe themselves as having low information technology skills” (McFarlane & Jared, 1994, p. 155) and “whether or not current pre-service teachers are being prepared to use technology in their teaching” (Handler, 1993, p. 147). In Queensland, Australia where the research for this paper was carried out, the state educational authority has been sufficiently concerned about the inadequacies of pre-service teacher training in IT that their recent policy document “Computers in Learning” (Department of Education, Queensland, 1995) stated specifically, “teacher graduates should acquire skills and
competencies in the effective use and application of computers during pre-service training”.

This article examines the views of 234 pre-service teachers who experienced an IT component in their teacher education course. It explores the role of gender and age in the self-perceived IT competency of these students, and their attitudes, use of technological concepts and their perceptions of their IT component experiences. Previous studies which investigated pre-service teachers’ experiences and feelings/attitudes include Summers (1988, 1990), Woodrow (1991), and Blackmore et al (1992). The importance of understanding student feelings/attitudes is encapsulated by Woodrow (1991) who says that, “awareness of student attitudes toward computers is a critical criterion in the evaluation of computer courses and in the development of computer-based curricula. Nowhere is this truer than in the training of teachers” (p. 165). Summers (1990) notes the importance of ongoing monitoring of students’ feelings and experiences in regard to IT because as he says, although these “are likely [emphasis in original] to change, we cannot be sure unless the situation is monitored” (p. 87). He further notes that, “the issue of gender differences is of particular concern” (p. 87) given that the majority of pre-service teachers are females.

Over the last five years, Australian schools have increasingly been experimenting with integrated models of learning with IT, specifically the use of note book type computers. Evaluations of these programs (Owen & Lambert, 1996; Ryan, 1991) have stressed the importance of all teachers having the appropriate IT skills and attitudes to facilitate such integrated models of learning. Other programs concerning IT and special needs students have also “confirmed that teachers have to be competent to manage students using computers as tools” (Cooper, 1996, p. 13).

However, the need for effective IT education does not necessarily translate into effective pre-service programs. Robinson (1995, p. 3), while celebrating the “interest and activity in information technology education for teachers” that warranted an increase in size and frequency of the Journal of Information Technology for Teacher Education, warns that “this does not mean that all is well with information technology in teacher education”. Wild (1995, p. 7) reflects a similar concern: “although 89% of all pre-service teacher education programmes in the United States provided some form of information technology education, only 29% of students (i.e. students following Education Majors) perceived themselves as prepared to teach with computers”.

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It is recognised that pre-service education is only one part of a teacher’s total professional development and that in-service education, peer provided tuition and self-instruction play important roles, particularly in the IT education of teachers (Sherwood, 1993, p. 169; Collis, 1994, p. 7). Increasingly in Australia the professional development of teachers is being taken up by professional organisations and the employing authorities. However, pre-service attitudes and experiences would seem to be important in determining the willingness and preparedness of teachers to avail themselves of these professional development opportunities, thereby increasing the likelihood of effective implementation of IT in classrooms.

**Gender**

Gender differences may have an important impact on teacher uptake of IT because, in Australia, women constitute 74% of primary teachers and 51% of secondary teachers and the profession is becoming increasingly female dominated (Townsend & Madden, 1994). Therefore their attitudes will be more widespread in the general education system. Also as Gill & Grint (1995, p. 3) say; “the cultural association between masculinity and technology in Western societies is hard to exaggerate”. Singh (1995, p. 84) observes that even quite young children have clear notions that computers are the domain of males. She records the conversation of eight and nine year old boys who clearly identify themselves as the only ones who understand the “high basics” of computers and identify only girls as not knowing the “low basics”. Singh notes that “the regulative discourse socially produced by this group of male students, to structure the norm of computer competency levels is a patriarchal discourse” (p. 85). The compounding effect of a predominantly female profession working with a male-perceived technology could be expected to be significant.

Research into gender differences in computing use and study is over a decade old. Such research focused on the willingness of girls to use computers and consistently showed that boys were more likely to undertake extracurricular activities involving computers, to use a computer at home or to take higher level computing subjects (Ware & Stuck, 1985; Lockheed 1985; Fish et al, 1986). It was suggested that the stereotypical male images of computing magazines (Ware & Stuck, 1985) and the mathematical associations of computing subjects (Davidson & Hartley, 1984; Hawkins, 1985) acted as deterrents for female involvement. Teacher attitudes reflected a belief that technology education was of greater importance for boys than for girls (Spear,
1985) although others noted that “the sex of a teacher is not a predictor of nonsexist practices” (Stasz et al, 1985, p. 162).

Later work reflects a similar picture. Clarke (1990) documents significant gender differences in overall computer use, course enrolments, programming and games and negligible difference in the use of computer applications. Clarke considers that explanations of this difference focus on sex-based differences in expected outcomes and that cultural understandings about competence: differences in the outcomes of computer experience; associations of computing with mathematics, technology and maleness; attitudes of parents and teachers; and preferences for sex segregation are the bases of differential expectations. Clarke & Teague (1994) include the nature of the workforce; the prevalence of male and female role models; stereotyping of computing careers; culturally specific factors; perceived gender differences in ability; attitudes to computing; the organisation of computing classes; approaches to assessment; and mentoring in a later commentary on the still prevalent under-representation of females in computer science classes. This under-representation is also recorded in recent research concerning women’s use of computer mediated communications. Dancer (1995, p. 67) records that only 9% of users of the computer mediated communication service CompuServe are women and only 4% of World Wide Web users are women, although other figures show that “34% of Internet users are women” and “gender parity narrowing at university-level Internet access points” to 41% of access by women (Business Women’s Network, 1995).

The above research, and the preponderance of female participants in the present research (73%), suggests that gender differences in the views of pre-service teachers could be significant and therefore the following research has emphasised gender distinctions. This is in keeping with Summers’s (1988, p. 189) recommendation that, in future, monitoring of student teachers’ IT experiences and feelings, “work on gender differences … would be particularly useful”.

The paper proceeds by discussion of the research process, an examination of the views of pre-service teachers under the categories of computer self-efficacy, attitudes and experiences and concludes by suggesting ways pre-service teacher IT programmes could be improved based on the findings of the research.
**Research Process**

The following data became available from a tutorial exercise on using electronic mail that was part of the compulsory IT component in the first-year programme of pre-service teachers at a large Australian university during 1994. The IT component included word-processing, library computerised systems as well as electronic mail. This component was the only exposure to IT indicated in the pre-service course design, but other IT experiences may have occurred incidental to other subjects or students may have taken elective subjects which specialised in the area.

The students were required to use the electronic mail system to provide survey information regarding age (<20, 20-29, >29), gender (female, male), course strand (Early Childhood, Secondary) and computer competence (novice, average, expert). The students were not provided with any definition of “competence” or of the standards “novice” “average” and “expert” so the methodology is not sensitive to differing interpretation of these terms by the students. The students were also required to respond, in free-response form, to the following message:

Write about two paragraphs (no more than 200 words) on your views of the computer systems that you have been using while at university. You might describe your feelings and views on their use, how helpful and how frustrating they have been etc.

The free-response message format is similar to that used in studies by Summers (1988, 1990) where students were asked to explain their “gut reaction” to computers. In the present study however, students were directed towards considering their university experience of computers and were given some prompts to direct their response. The free-response style was chosen in preference to survey techniques for this aspect of the research because it was considered to provide richer data. The decision to collect the data electronically rather than by the more conventional written technique was driven by the convenience factors of not having to interpret students’ often poor handwriting, having the data readily available for electronic data analysis and coincidentally providing a tutorial exercise that was meaningful for the students concerned. It was also believed that students’ feelings about computers would be more acute when they were actually involved with computers, thus eliciting a more powerful response and thereby providing richer data.

The students were told that the information they provided would be used to evaluate the IT component and assist in its modification to better meet the students’ needs, as well as providing data for the
present study. Participation in the tutorial exercise was voluntary and no assessment weighting was attached to it. Students were aware that their identity was potentially obtainable from the address on their message, assuming that they had logged on to the electronic mail in their own name. The students undertook the task as part of their usual tutorial thus resulting in an almost 100% response rate for the cohort of students. A tutor was available in the computer laboratory to assist them with any difficulties they might have in using the electronic mail system. Tutors had been briefed by the IT component co-ordinator on the purpose of the exercise and the information that they were to make available to the students.

A representative response is:

When I first started at uni I was computer illiterate and found it very hard when asked to do assignments on the computers because I couldn’t use them. This semester through the extra computer tutorials it has helped a lot. There should be a course at the beginning of the year or the course because other people I know don’t know how to use them either. Computers are OK but I only use them if I have to, I’d rather use pen and paper or a type writer because they are not as complex and are much faster for people who can’t type or aren’t good with hi-tech machinery.

The students involved were from the Early Childhood (54 females, 1 male) and Secondary (116 females, 63 males) strands of the Bachelor of Education course. The age and gender ratios of the respondents are shown in Figure 1. As can be seen from this figure the female participants were, on average, younger than the males and 74% of participants were less than 20 years of age.

Figure 1. Age and gender ratios of respondents (n=234).
The students’ free-response messages were coded using an Open Coding method (Strauss & Corbin, 1990). The primary categories which emerged were: “computer self-efficacy”, which Makrakis (1993, p. 191) defines as, “general self-esteem or personal confidence in the ability to learn about or with computers and to perform well on computer-related tasks”; “attitudes” which involves personal feelings about computers; and “experiences” which relates to comments about the activities in the IT component of the students’ course. Sub categories of “positive” and “negative” were applied within each category. The categories used in this analysis which arose from the Open Coding method have similarities with analytical categories used in the studies of Blackmore et al (1992), Summers (1988, 1990), and Woodrow (1991).

The coding unit for the analysis was based on phrases reflecting a particular category. In this report these phrases are called “expressions” and are defined as “continuous words on a related topic”. As a rough guide to the frequency with which certain views were expressed, and as an indication of the emphasis on a particular topic, averages were calculated on the number of “expressions” of a particular category for the group of students. These averages were called Expressions Per Respondent (EPR). While these EPRs have been quantified they do not have significance in the statistical sense due to the unreliability of “expressions” as a unit of measure. They are however useful as a comparative tool. It is recognised that an individual student repeating the same idea multiple times could skew these figures but in reality this did not occur more than would reasonably suggest that this was a particularly important issue for the student. Including the multiplicity of references therefore, rather than a single indicator (such as percent), allows the depth of feeling about a particular issue to be gauged. Thus an EPR of 0.6 for example would indicate that this idea was expressed more frequently than one for which the EPR was 0.4; an EPR of greater than 1.0 represents a very high frequency of expression for that particular topic (either all students expressed this idea or most students expressed this idea with some students expressing the idea more than once); and an EPR of similar magnitude for both the positive and negative aspects of a particular category would indicate that positive and negative ideas were expressed with similar frequency by the respondents.
Views of Pre-service Teachers

This section of the article analyses the views of the pre-service teachers under the subheadings of “computer self-efficacy”, “attitudes” and “experiences”.

Computer Self-Efficacy

The students were asked to indicate their “computer competence” from a choice of novice, average or expert. Figure 2 shows the competency/gender ratios for the participants. It can be seen that the percentage of females who indicated that they were “novice” was higher than the percentage of males, and the percentage of males who indicated that they were “expert” is considerably higher than the percentage of females.

Figure 2. Self-perceived computer competency and gender ratios of the respondents (n=234).

These results are in keeping with Makrakis’ observation that there “is a tendency for females to be unsure of their own individual ability to use computers”. This gender difference in computer self-efficacy is also recorded by Clarke & Chambers (1989, p. 418) who note that the “more optimistic expectations of the men [in passing the course computing component] are consonant with the confidence of male computing students, but inconsistent with their slightly lower level of academic ability”. The present research made no attempt to evaluate the relative academic abilities of females and males, but in general the academic levels of male education students is not higher than those of female students. Perceived computer competency also varied with the age of the students; 24% of students younger than 20 years old classed themselves as novices while 45% of those over 29 classed
themselves this way. Similarly 6% of students younger than 20 years old classed themselves as experts, while no students over 29 classed themselves this way. This result would not be unexpected, given the higher probability of students in the younger age group having gained some computing experience during their school years.

Difference in computer self-efficacy is also recorded in the analysis of the free-response expressions considered to reflect this concept. Both positive and negative self-efficacy comments were noted and Expressions Per Respondent (EPRs) are shown in Table I.

<table>
<thead>
<tr>
<th>Self-efficacy EPRs</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>0.39</td>
<td>0.48</td>
</tr>
<tr>
<td>Males</td>
<td>0.28</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Table I. Gender differences in positive and negative Expressions Per Respondent (EPRs) for computer self-efficacy.

From Table I it can be seen that females make more negative statements (EPRs = 0.48) than positive ones (EPRs = 0.39) while males make more positive ones (EPRs = 0.28) than negative ones (EPRs = 0.17). The difference between the female and male negative EPRs is particularly marked (EPRs = 0.48 compared with EPRs = 0.17). When using positive self-efficacy expressions females often qualify their remarks and start from a premise of incompetence, for example:

- I’m starting to get the hang of it a little better
- I have improved slightly since we started.

Male positive self-efficacy expressions are more direct and start from a premise of competence:

- I have only experienced a few problems so far
- I have had little trouble understanding the work.

Even when acknowledging difficulty males convey a sense that this difficulty will be short lived:

- Still I’m sure that this will come with practice
- With a little patience and effort I will ... become the master of the system.

The negative self-efficacy expressions by females reflect what Makrakis (1993, p. 191) calls the “we can, I can’t paradox”. He describes this as the tendency “to feel that women as a group in general are as able as men in learning about computers” but that they experience personal difficulty:
Maybe it was just me
It has taken much longer for me to become confident
Everyone else seems to know a lot more about this than I do.

The few negative self-efficacy expressions made by males suggest that their attitudes are not the norm for their gender:

I’m not a natural when it comes to using computers
My knowledge concerning computers is quite pathetic.

Attitudes

Reinen & Plomp (1993, p. 353) found “that there are no great differences between female and male teachers on the different attitude scales”. These scales explored attitudes to the educational use of computers, social implications, the need for training and self-confidence. When attitudes are interpreted in light of personal feelings a different picture emerges (Figure 3) where females express more negative personal feelings than positive ones while males express more positive ones than negative. In a pattern similar to that for self-efficacy females expressed many more negative personal feelings than did males. This pattern is also recorded by Hattie & Fitzgerald (1987, p. 23) who found that “As many girls as boys enjoy using computers but many more girls than boys ardently dislike them.

Females were more likely to personalise their positive attitudes:

If you think of the computer as your friend and know that it can’t hurt you, then you start to feel better about the whole thing

and to express gratitude for the experience:

Personally I have found this part of the course very rewarding.
A repeated comment related to having an improved confidence with computers, such as:

- Now I feel more confident
- I know I feel confident about working on my own on these computers.

Males were much more likely to use positive feelings of fun and pleasure:

- Gee-whiz we had fun
- A pleasure to use.

They also were more likely to refer to the mechanical aspects of the computer:

- My fascination with the marvellous piece of technology
- My passion for the wonderous (sic) machine

and the concept of control in their positive feelings:

- My childhood fantasy of mastering the computer.

In expressing negative feelings females repeatedly used words like “confusing”, “daunting” and “frustrating” and reflected personal discomfort. For example:

- It is a bit scary at first to come to terms with this thing filled with microchips
- I have always been intimidated by computers
- You may call that laziness, but I call it being afraid, or maybe it is a lack of interest.

Words like “afraid”, “frightened” and “intimidated” appeared regularly and nearly every expression of negative feeling by females was an “I” statement. Males, on the other hand, often expressed their “negative feelings” in the impersonal. Such as:

- Time and frustration take their toll and may drive people to give up
- Students do naturally become frustrated with the computer workshops some of this is confusing.

Experiences

Also recorded were positive and negative comments made about the types of activities experienced by the students during their IT component. This data is shown in Table II. The strong positive response by both females (EPR =1.8) and males (EPR = 1.6) is particularly marked.

<table>
<thead>
<tr>
<th>IT activities EPRs</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>1.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Males</td>
<td>1.6</td>
<td>0.9</td>
</tr>
</tbody>
</table>
Table II. Gender differences in positive and negative Expressions Per Respondent (EPRs) for IT activities.

Examples of positive comments are:

- It is a good idea incorporating computers into the course to give novices a chance to become computer literate
- The extra computer tutorials have helped a lot
- Our guided experiences with computers has broadened my knowledge
- The staff and facilities are of a high standard
- It has been helpful to have hands on experience.

An analysis of positive and negative comments on the basis of perceived computing competence levels shows that different levels had different views of their IT experience (Figure 4). Average students would appear to have been the most positive about their IT experience and novice students the most negative.

Figure 4. Self-perceived computer competency level differences in positive and negative Expressions Per Respondent (EPRs) for IT activities.

Negative comments made by novice students particularly related to the intensity of the course, the spacing of the tutorials and the difficulty of getting help in the extra tutorials for novice computer users. Examples of these negative comments were:

- There were so many people in the extra classes it was hard to get help
- The idea of having computers every fortnight made it difficult to remember the information learnt
- I felt that handbooks should be distributed
- The time spent on the computers was not sufficient
- The course has been very intensified (sic)
- A student does not really have the free time to work on something that he/ she is not being examined on
- The entire technology facet of the course is unimaginatively presented.
Conclusion

Given the number of years that computers have been widely available in schools, teacher educators could have expected that by the mid 1990s their students would arrive at university with basic competencies in IT. This research shows that for many students this is not the case, or at least it is not the students’ perception of their own competence. However it is also apparent that this perception is age and gender related. This research demonstrates that females are far more likely than males to express negative feelings about IT and have lower computer self-efficacy. These findings suggest that pre-service IT education needs to be tailored to allow for different levels of perceived competence in new students and gender differences in the way students feel about IT.

Despite these difficulties for some students, in general the IT segment as experienced by these students was positively received and negative comments related mostly to problems with access to tutors and the intensity of the course rather than any desire to remove this segment of the course. It would seem therefore that students welcomed such preparation and many of them expressed comments that suggested that IT was essential to their university and professional lives.

What is evident from this research is there is still a need for skills-based IT education in pre-service teacher education programmes. The relative technological poverty of schools and the rapid rate of change in IT suggests that this will remain the situation at least in the near future. Pre-service education cannot hope to meet the IT needs of teachers for lengthy periods into their professional life but what it can do is provide entry teachers with sufficient basic skills to have the confidence and enthusiasm to seek in-service professional development. Just because the most common method for teachers to gain knowledge in IT is through self instruction or from others (Sherwood, 1993) does not mean that these are the preferred, or the most effective and efficient methods.

However, this research also shows that IT education programs need to be carefully devised to meet the rapidly changing needs of the students and to meet the diversity of needs within the student body. Wild (1995, p. 7) claims that the majority of teacher preparation programmes concerning IT are “constructed on weak and sometimes ill-defined premises” which is understandable given that most teacher
educators are themselves novice users of IT and the very short “shelf life” for IT related skills. This research has been based around a discrete IT skills program and does not attempt to consider the merits of integrated versus isolated approaches to IT skill acquisition. Without doubt any skill is more meaningful when learnt within an application and students must understand the educational uses for their IT skills. However any pre-service teacher program which does not provide a structure through which students can gain confidence and competence with IT would seem to limit the chance of any meaningful use of IT within the educational setting.

This paper has been preoccupied with the attitudes and experiences of pre-service teachers in the most basic IT training. It has made no attempt to grapple with more sophisticated issues such as Kenway’s plea that teachers need to be not only skilled but “informed and critical” users of the technology (Kenway, 1995, p. 57). However IT programmes in teacher education ideally will be designed with Kenway’s plea in mind while also addressing the issues noted in the present paper; that is the need to change attitudes and provide basic competencies while keeping in mind the different perceptions, abilities and experiences of students entering the programmes and the interrelationship of gender with these factors.

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References


