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Why pre-service information technology programmes often do not make a difference to the teaching practices of education students

Martyn Wild
Edith Cowan University


Introduction
The gradual introduction and accumulative use of information technology (IT)1 in primary schools over the past 15 years is a significant educational innovation.  However, the success of this innovation has not been consistent nor particularly pervasive: research has shown that for these schools the integration of IT into the curriculum is still a goal rather than a reality (Jackson, 1987; Jackson, et al, 1988; Haywood and Norman, 1988; Prideaux 1989; Cox and Rhodes, 1989).  It is not so much that the technology has not been deployed successfully (Fowler, 1992), but rather that there are substantial variations in teacher uptake of this technology (Haywood and Norman, 1988; Somekh, 1989; Rhodes and Cox, 1990; Plomp, et al, 1990).

For Cox and Rhodes (1989), barriers to the IT innovation are similar to barriers to educational innovations in general and these are well documented (Stenhouse, 1975; Stenhouse, 1980; Bolam, 1975; Bolam, 1976; Fullan, 1982).  However, it is also recognised that the introduction and use of IT in schools is associated with further and perhaps unique problems (Haywood and Norman, 1988; Griffen, 1988).  The uniqueness of IT as an educational innovation may be characterised thus:
•    IT for schools is based not only on an educational ideology (i.e. having a specific epistemological, pedagogical and organisational basis) but also on the provision of hardware and software - that is, those adopting the innovation will be required to learn a new technology as well as new teaching programmes, methods and strategies associated with the technology; whilst those servicing the innovation will need to provide comparatively expensive hardware and technical skills as well as educational knowledge (Griffen, 1988).
•    IT has received a great deal of support in terms of funding from governments, particularly in terms of the introduction of hardware and software into schools, the direct funding of related in-service and in the funding of advisory and consultant teachers to support the use of these computers.
•    IT is a social phenomenon: its establishment in schools' curricula is paralleled by its integration into almost every aspect of work and play and this social phenomenon continues to

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grow.

- 'Genuine innovation begets incompetence. It de-skills teacher and pupil alike, suppressing acquired competencies and demanding the development of new ones' (Stenhouse, 1975, p 170). Simply because of the technical nature of IT this comment on innovation in general assumes a more immediate relevance to the educational adoption of IT.

- In applying attribution theory to the difficulties that teachers have in adopting the use of IT, Haywood and Norman isolated personal confidence and competence as the two major causes of teacher concern (Haywood and Norman, 1988). These concerns are inter-dependent (i.e. confidence inspires competence, competence promotes confidence) and may be expressed as: (i) a personal, subjective, lack of confidence in the use of the technology; (ii) a personal lack of confidence in a teacher's own ability to be able to use the technology competently.

From this it is clear that there are considerable societal and educational demands on teachers to use IT widely, both personally and as an integral part of the teaching-learning process. In the UK, where the government has legislated for the use of technology in primary schools (DES, 1989a; DES, 1989b; DES, 1990; DES, 1991), there are specific and further professional pressures. The widely recognised problem of equipping teachers with the skills and knowledge necessary to meet these demands is traditionally tackled in two ways: first by the provision of in-service programmes (Megarity, 1989; Wild, 1991) and secondly, by directly relating IT to programmes of initial teacher training (ITT)2 (HMI, 1988; Somekh, et al, 1992; Grunberg and Summers, 1992).

The nature and effectiveness of information technology in ITT
The delivery of IT courses in ITT ranges from discrete courses to a model of total permeation in which the technology is integrated into the subject specific and general education of students. Many institutions adopt a mixture of both approaches (Robinson, 1993, pp 74-75; HMI, 1988).

Traditionally, the effectiveness of ITT courses in IT is measured in terms of cognitive outcomes as well as changes in attitudes and confidence on the part of students. However, it is important that IT courses are also measured in terms of their success in influencing the uptake of IT by beginning teachers or by students on teaching practice3 (Wild, 1991; Oliver, in press). That is, IT course effectiveness needs to be assessed by measurement of students' transfer of cognitive skills4.

As Oliver (in press) suggests, evaluation of cognitive outcomes

alone from an IT course in ITT, is not sufficient to reflect either the higher order outcomes or to reflect students' attainment of all the course objectives (particularly where the course objectives describe transfer of cognitive skills).  There is also other evidence to suggest that cognitive outcomes, attitudes and confidence are, taken alone, not accurate indicators of students' or beginning teachers' eventual use of IT in classrooms (Downes, 1993, p 17; HMI, 1988; Handler and Marshall, 1992).

Factors influencing IT uptake by students and beginning teachers
The discussion below is principally in terms of the characteristics of IT courses at ITT level.  Research has shown that a myriad of interrelated factors are at play in determining the uptake of IT use by student and beginning teachers, only some of which are addressed by the majority of IT courses at ITT level (Wild, in press/b).  Such factors include those relating to the student or teacher (confidence, attitudes, experience, age, expertise), the teaching situation (organisational constraints, time investment, support structures, managerial frameworks, fabric of environment), remote players (peer pressures, influence of Headteacher) and resources (availability, quality, type, amount).  For a review of this research see Grunberg and Summers (1992).

Wild (1991), has provided a comprehensive study of factors that influence the uptake of IT by student teachers, highlighting the ordinary pressures of teaching practice and the lack of relevant school resources, hardware and software, as being reasons for a 'performance gap' (i.e. a gap between intention and practice5). Positive influences include the involvement of children in IT courses, appropriate software being owned by students, follow-up support by the supervising lecturer and role modelling by the supervising teacher.

Concurring with these findings, Russell (1992), reports that a negative influence on student teachers uptake of IT is a lack of IT use by supervising teachers; Downes (1993), suggests that students working with children as part of their course is an influential factor in IT uptake; Novak and Knowles (1991), suggest that student teachers are positively influenced by structured field experiences with IT; Diem (1989), attributes a lack of teaching methodology for classroom integration of IT as being a decisive factor in determining low IT up-take by students; whilst Davis' work (1992), leads him to outline three factors of influence: (i) providing student teachers on practice with specific responsibilities to use IT; (ii) students working with children in the training institution; (iii) students

observing teachers working with children in schools.

Interestingly, both Monaghan (1993, p 157), and Oliver (in press), suggest, respectively, that student teachers' and beginning teachers' uptake of IT is not dependent upon personal expertise in using a computer.  This is also consistent with Dunn and Ridgway's (1991b), findings for student teachers on their final teaching practice, where it was found that students who had taken a course in computer studies or computer literacy (i.e. a course aimed at the development of procedural, machine based, skills), were no more likely to use a computer in the classroom than those who had not.

For beginning teachers in particular, Oliver's findings (in press), suggest that IT training needs to build in a substantial component related to the methodology of classroom use of IT.  For student teachers, Monaghan's (1993), and Dunn and Ridgway's studies (1991a; 1991b), imply the same conclusions.

Wright's study (1993, pp 47-48), emphasises the importance of role modelling IT use by lecturing staff; this is supported by Gooler (1989), Davis (1992) and Handler (1993).  In particular, Handler (1993), outines the need for lecturing staff and teacher supervisors, together, to plan for a holistic student learning 'culture' that encompasses the entire student experience, including a discrete computer course, education methods course and a teaching practice component.  From a case-study of one institution, McDonald's (1993), work also reflects the importance to plan for a holistic approach to the question of IT training.

Downes, (1993), also considers that it is significant to correctly determine the point in their course when students should be trained in IT.  For example,  she suggests this should be early (i.e. during the first year) and that in particular, access to work with children should be provided for at a very early stage in the course.  Further, she maintains that use with children can and should precede students' personal use of IT.

These and other studies in this area carry loud and clear implications for IT course planning at ITT level: for example, it may be extrapolated that IT courses should emphasise the methodology of classroom use of IT at the expense of procedural and low-level cognitive skills6; that supervising lecturers and teachers need to model the use of IT widely; and that the strategy of providing student access to children plays a pivotal role in determining uptake of IT.  However, the majority of IT courses currently offered in programmes of ITT are not characterised in these ways (Handler, 1993; Carey, 1992; Wild, in press/b).  The remainder of this paper presents findings that indicate that such courses are not successful for the majority of

students who complete them.


Results

This paper describes an ITT course in IT operated at Edith Cowan University (ECU), WA, in 1992 and the uptake of IT use by students having completed this course, whilst on practice7 .  The results are descriptive and help characterise IT use by students on practice; they also indicate those characteristics worthy of further investigation.  It is suggested that the IT course under scrutiny is typical of many currently offered in programmes of ITT, providing currency and significance to the findings advanced here (Handler, 1993; Robinson, 1993; Carey, 1992; Somekh, et al, 1992; Wild, in press/b)8.

The survey  161 second year BA (Education) primary students replied to a questionnaire based on their experiences of one, two-week, teaching practice.  This practice was undertaken during their third semester (second year) of study9.  There is at present no mention of the use of IT in either the supervising teachers' or students' handbooks for any such practicums at ECU; nor is there any other expressed expectations that students will use IT during their practicums.  In this sense, any use of IT by these students whilst on practice could be classified as spontaneous.

The questionnaire was applied one week following the students' teaching practice.  All students undertook the IT course being examined here, during their second semester (first year).  That is, there was a gap of approximately, 12 weeks between undertaking the IT course and completing the practice (including a period of vacation).  The questionnaire was multi-faceted; this paper considers data generated for the following variables: student biography (experience); IT resource provision (type and amount of hardware and software resources; situation of hardware resources); IT usage (frequency of classroom and personal use; frequency of supervising teacher usage; type of classroom usage; initiation of usage; reasons for non-use).

The IT course  For the period of this research, primary students of the BA (Education), ECU (Churchlands campus), undertook one core unit for IT during the second semester of their first year of study.  This unit provided a total teaching time of 26 hours, spread over 13 weeks (i.e. 2 hours per week).  The objectives of this unit are primarily guided by a perceived need to provide students with personal skills to use IT.  The rationale is that acquisition of such skills necessarily precedes use of IT with children (i.e. classroom use of IT), (DCE, 1992; Rogers, 1992).  The methods used to achieve these objectives emphasise tuition of

students in procedural, low-level cognitive skills in the use of
hardware and software commonly found in WA primary schools.
Tuition is given in the form of exercises designed to facilitate
repeated practise of these skills.  A small amount of time is
given to instruction in classroom use of IT.  All teaching is
completed in the form of a lecture followed by skills workshop
(where students undertake completion of set exercises).
Evaluation of the unit objectives are two-fold: (i) marking of
completed exercises; (ii) an exam to test students' knowledge of
IT use (DCE, 1992; Rogers, 1992).

Students' experience in IT  Table 1 suggests that three-quarters
of the students have computer experience beyond that provided in
the IT course.  Given that these students undertook the IT course
early in their programme (i.e. second semester, first year), any
additional experience is likely to have been gained outside of
the BA (Education) programme and probably as part of school-based
courses or from positions in industry/business.  As such, this
experience might be expected to enhance students' procedural
skills in hardware and software use (i.e. students' personal


skills) rather than their knowledge of classroom use of IT.

Table 1   Students' IT experience other than that gained on the
course

|  | Count | Percent |
|---|---|---|
| Additional experience | 122 | 75.8 |
| No additional experience | 39 | 24.2 |

Students' access to IT resources  Almost 50% of students had
satisfactory access to a single computer for teaching purposes;
only 13% of students indicated that they did not have such
access.  Remaining students had access to more than one computer
(table 2).  These figures reflect the wide deployment of
technology throughout schools (Fowler, 1992; Oliver, in press10)
and that for a majority of students, access to hardware would not
be a factor inhibiting IT use during teaching practice11.  These
figures also compare to those in table 9, where only 11% of
students indicated that access to computers prevented them from
using IT on practice.

Table 2   Numbers of school computers to which students had
satisfactory access for teaching

|  | Count | Percent |
|---|---|---|
| None | 21 | 13.04 |
| 1 computer | 79 | 49.07 |
| 2 computers | 10 | 6.2 |

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3 computers     3     1.9
Over 3 computers     48    27.6
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Isolating the students who enjoyed satisfactory access to IT
resources, 94.9% (out of 79), indicated that such access was to a
computer situated in the individual classroom.  Upon further
consideration of data for students who considered that there was
no regular access to computer use for their children, 71.4% (out
of 21) of students indicated that their school computer resources
were situated outside of either their classroom or a central
computing facility.  It is possible that there is a correlation
between students' level of access to school computers and the
geographical position of those computers.

Table 3    Position of computers in the practice school12

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        Count       Percent
Classroom 87    54.04
Resource or computer room      51    31.68
Library   4     2.5
Elsewhere 14    8.7
None available 5     3.1
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Students' use of IT during practice  Table 5 indicates that a
very high percentage of students did not use IT on practice
(83%); and that correspondingly, only a small number used the
computer more than once during the practice (7.4%).  However,
these figures sit uncomfortably with those given in table 4,
where it is indicated that 72% of supervising teachers used IT at
least once during the period of the practice and that 38.5% used
IT almost everyday.  Handler (1993, p 152) and Davis, (1992),
both indicate a positive correlation between supervising teacher
use and student use of IT on practice; the descriptive data given
here may suggest that this correlation is itself dependent on a
range of other factors.

Table 4    Frequency of classroom use of IT by supervising
teachers

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        Count       Percent
Never     45    27.95
Once 26    16.15
Twice       25    15.5
Three times or more frequently      3     1.9
Almost everyday       62    38.5
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Table 5    Frequency of classroom use of IT by students

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|  | Count | Percent |
|---|---|---|
| Never | 133 | 82.6 |
| Once | 16 | 9.9 |
| Occasionally | 10 | 6.2 |
| Regularly | 2 | 1.2 |

The figures in table 6 suggest that most (i.e. 90.68%) students did not use IT for their personal use over the practice period (i.e. for preparation - creation of teaching resources, record keeping, etc.).  Those who did make personal use of IT (i.e. 9.32%) is even less than the corresponding number obtained by Downes (1993, p 24), for students who completed their first practicum13.

Table 6    Frequency of personal use of IT by students whilst on practice

|  | Count | Percent |
|---|---|---|
| Never | 146 | 90.68 |
| Once | 8 | 4.9 |
| Occasionally | 5 | 3.1 |
| Regularly | 2 | 1.2 |

Of the 28 students who made some use of IT for teaching during their practice (table 5), it was additionally possible to classify the type of classroom use of IT (table 7), and who initiated that use (table 8).  For table 8, students were asked to indicate what software they had used during their practicum. The software most commonly applied were games (17.39%; n=28), followed by word processing (15.52%; n=25), adventures (13.67%; n=22) and simulations (11.8%; n=19).  A preponderance of games usage is somewhat surprising, given the lack of attention to this software category on the IT course.  The relatively high ranking of word processing is to be more expected, given that a substantial component of the IT course is devoted to students acquiring personal skills in this software type (Rogers, 1992; DCE, 1992).  However, students' concentration on games software is reflected by Downes' findings (Downes, 1993, pp 26-28), where students observed on an initial practicum, used IT in their teaching for 'isolated activities' (Downes, 1993, p 26), (i.e. activities, such as games playing, not related specifically to the curriculum).

The type of software used by students on practice may also point to the pivotal importance of school based factors14 upon students' experiences in IT use.  These factors might include the availability of suitable software to the student (see table 9) and the person responsible for initiating students' classroom use of IT (table 8).

Table 7   Type of classroom use of IT by students (% of total)

|                        | % of students | Rank |
|------------------------|---------------|------|
| Games                  | 17.39         | 1    |
| Word processing        | 15.52         | 2    |
| Educational adventures | 13.67         | 3    |
| Logo                   | 4.97          | 5    |
| Simulations            | 11.8          | 4    |
| Database (creating)    | 1.24          | 6    |
| Database (questioning) | 1.86          | 7    |
| Programming            | 1.86          | 7    |

Data was collected from those students who indicated they had used IT in their teaching (i.e. n=28: table 5), about the initiation of that use15.  In this context, it would appear that the supervising teacher was an important influence: in only 25% (n=7) of cases did students initiate any classroom use of IT; whereas in 57.14% of cases (n=16), it was the teacher who was responsible.  In broad terms, this pattern is reflected in Downes (1993, pp 27-28), although in her study, it was evident that students would be expected to develop over their ITT course and by a final practicum it could be expected that 50% of students would initiate their classroom IT activities.

Table 8   Initiation of students' classroom use of IT

|                     | Count | Percent |
|---------------------|-------|---------|
| Student             | 7     | 25.0    |
| Supervising teacher | 16    | 57.14   |
| Supervising lecturer| 3     | 10.71   |
| Headteacher         | 2     | 7.14    |

Students' non-usage of IT during practice  In table 2, 13% of students suggested that they had insufficient access to computers for classroom teaching; this is slightly higher than that given in table 9, where 11% of students indicated that a lack of access to computers was a reason for their not using IT during practice.  However, it would appear that insufficient access to suitable software was an important reason for students' non-use, whilst a lack of knowledge about classroom use, a lack of confidence in using computers in the classroom, difficulties in organisation and the negative influence of the supervising teacher were also relatively important factors in explaining students' non-use of IT in this survey.

It is suggested elsewhere, that there is not a clear relationship between the reasons for non-use of IT for either student teachers

(Wild, 1991), or teachers (Haywood and Norman, 1988), although there is reason to advance, tentatively, a possible correlation between confidence and competence (Haywood and Norman, 1988, p 41).  In terms of the results obtained here, it may be that students are expressing a lack of confidence in their knowledge to apply the computer to classroom teaching, rather than a lack of confidence in their personal IT skills (i.e. their ability to be able to use IT).

Table 9    Reasons why students did not use IT in teaching

| | Count | Percent | Rank |
|---|---|---|---|
| Insufficient access to a computer(s) | 18 | 11.18 | 7 |
| Insufficient access to a printer(s) | 9 | 5.59 | 8 |
| Insufficient access to suitable software | 94 | 58.38 | 1 |
| Lacked confidence to use computers in the classroom | 75 | 46.58 | 3 |
| Lacked knowledge about classroom use | 84 | 52.17 | 2 |
| Lacked personal skills to use computers | 30 | 18.6 | 6 |
| Too difficult to organise | 43 | 26.71 | 4 |
| Supervising teacher did not think it was a suitable activity | 41 | 25.47 | 5 |

Discussion
There are a number of prevalent points that might tentatively be drawn from the findings of this survey.  The IT course under scrutiny here is primarily intended to equip students with the skills to use IT, acknowledging a rationale that suggests personal skills in IT necessarily precede classroom use of IT. Furthermore, three-quarters of the students who completed the IT course had additional experience in IT, experience that is likely to have bolstered their personal skills in computer use (table 1).  However, 83% of students did not make any use of IT in their teaching whilst on practice and 91% did not make use of IT for personal work (such as teacher administration and preparation), (tables 5 and 6, respectively).  In addition, where students did record classroom use, games software was ranked as the most common type of IT activity (table 7).

From these results, the IT course can hardly be deemed a success for a majority of students.  In particular, these results also lend some weight to the views advanced by Downes (1993) and Oliver (in press), that personal use does not need to precede classroom use with children and, further, that equipping students with personal skills in IT is little guarantee that they will use IT in the classroom.

In identifying barriers to classroom use of IT, students do not
seem to indicate they suffered from a lack of personal skills;
however, they do suggest that they lacked knowledge about
classroom use and, in addition, lacked confidence to use
computers in the classroom (table 9).  This may be a variation on
the Haywood and Norman thesis, that IT confidence inspires IT
competence and that, in turn, IT competence promotes IT
confidence (Haywood and Norman, 1988).  In this case, it is
possible that the uptake of IT use in the classroom is undermined
by a lack of confidence to use IT in the classroom which is, in
turn, related to a lack of knowledge about classroom use of IT
(figure 1).  It is also important to consider that a majority of
students highlighted a lack of suitable software as a reason for
their non-use of IT in the classroom.

Figure 1  A model for interpreting use and non-use of IT in the
classroom (after Haywood and Norman, 1988)

The role of the supervising teacher is an interesting one.  It
seems that the supervising teacher was responsible for initiating
students' classroom use of IT in a majority of those cases where
students had used IT in their teaching (table 8).  Also, for a
quarter of the students it was indicated that the supervising
teacher's unfavourable advice was reason for their not using IT
in the classroom (table 9).  However, as a role model, her role
is less clear: in 72% of cases, the supervising teacher used IT
at least once during the period of the practice and for 39% of
students, their teachers used IT almost everyday (table 4).
Although others (e.g. Handler, 1993; Davis, 1992) consider there
is a strong correlation between supervising teacher use of IT and
students' classroom use of IT on practice, the indications from
this data is that there are other factors at play which influence
this correlation.

Conclusions
Undoubtedly, IT course design for ITT needs to address the
findings outlined above, as well as those reflected in current
literature in this area.  Indeed, there is a significant
convergence of findings from various studies of IT course
effectiveness at the level of ITT (Wild, in press/b; Somekh, et

al, 1992; Robinson 1993; Grunberg and Summers, 1992).

From this basis, the author has designed an experimental IT
course for first year undergraduate education students at Edith
Cowan University16 and is currently engaged in researching the
effectiveness of this course.  In terms of establishing

effectiveness, the author is particularly interested in identifying strategies that facilitate students' transfer of IT knowledge and skills.

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1 Information Technology (IT) is used in this paper, as it is commonly used in the literature, to denote 'computer education' and 'educational computing'.

2 Initial Teacher Training (ITT) is used in this paper, as it is commonly used in the literature, to denote 'pre-service education' of teachers.

3 Both teachers and student-teachers regard teaching practice as a very significant component of their training likely to impact on later professional practice (Wild, in press/a) and for this reason is an important point of measurement for students' transfer of IT skills.

4 In this sense, DeCorte (1990, pp 78-79), maintains explicit teaching for transfer needs to be one instructional strategy within IT course design.

5 This performance gap compares to the 'technology use gaps' identified by Handler in her study of beginning teachers (Handler, 1993, p 151).

6 Often referred to in the literature as 'personal skills'.

7  This is only one aspect of the results of evaluation studies currently being conducted by the author into the effectiveness of IT courses at ITT level; see, Wild, in print/a; Wild, in print/b.

8 'Typically, teacher education programs include a single required introductory computer course...These introductory courses generally introduce some tool or applications software, provide an opportunity to evaluate computer aided instruction (CAI) software and perhaps include an introduction to programming, usually BASIC or LOGO...Moreover, the focus is often on the mechanics of computer use rather than on ways to design curricular applications that take advantage of the power of computer technology to bring changes into the classroom and the curriculum' (Handler, 1993, p 148).

9 This practice was the third of five practicums undertaken over three years of the ITT programme.

10 'Western Australian schools have traditionally had a very high ratio of computers to students.  A number of government and Ministry of Education initiatives have seen large purchases of school computing resources...' (Oliver, in press).

11 Cf. Downes, (1993, p 29), where it was evident that a lack of IT resource provision was a significant barrier to students' use of IT with children.

12 Where students may have found multiple access to computers at more than one location, they were asked to determine the location of computer(s) that gained more use during their time at the school.

13  Downes (1993, p 24), found that 17% of students used IT for personal use during the period of their first practicum.

14 Those partially or wholly outside the influence of the IT course.

15 This data was collected using an open-ended question that probed students' perceptions as to who had initiated their IT use in the classroom.  Where students had indicated they had used IT more than once (i.e. 10 students used IT occasionally and 2

regularly: table 5), they were asked to indicate who had initiated use for each occasion.  If a student indicated that

they had initiated use on any of these occasions, this was
entered as the prevailing response.
16 This course is the subject of another paper: Wild, in press/b.