Information Technology in Pre-service Teacher Education within a New Zealand College of Education

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Education
at Massey University

Anthony Neil Hunt
2000

Abstract

This thesis examines the use of Information Technology (IT) by lecturers and pre-service student teachers at the Auckland College of Education to provide a basis for future development of policy and programmes.

The concept of IT is examined and the term defined in terms of a broad range of artefacts, knowledge and skills which includes the use of computers, but also other technologies for handling and storing information. Information skills are also identified as being an important component of IT. The development of IT use in pre-service teacher education is examined in New Zealand, and for comparison in the United Kingdom, the U.S.A. and Australia. The survey demonstrates that the place of IT in pre-service teacher education was originally ignored by education authorities in those countries in favour of in-service teacher education, but in recent years has has become the subject of official concern and, overseas, action. The establishment of goals and standards for pre-service IT teacher education is one reflection of this concern in a number of countries.

The literature indicates a number of issues that need to be addressed if pre-service teacher education institutions are to successfully prepare teachers to work in IT-enhanced schools. These include the development of teacher education programmes which integrate IT and emphasise its pedagogical use, the provision of adequate IT teaching experience for student teachers, the provision of resources and staff development for teacher educators.

A survey of lecturers, first and final year primary student teachers, and graduating secondary student teachers indicates that, while all groups have a high degree of access to computers and many have basis skills in using software, the use of computers and other information technologies within the College curriculum is

limited. All groups believe that skills in using IT are important for beginning teachers but most lecturers do not model its use or teach its use in schools. Students have limited experience in using IT during practicum sessions, and lecturers, themselves, have limited practical experience of IT in education. The importance of strategies indicated by the literature for improving this aspect of pre-service teacher education is supported by the findings of the research. The various factors identified as influencing pre-service teacher education are summarised in a model which draws attention to the different sites in which students develop a range of skills, knowledge and attitudes, all of which affect their understanding and capacity to use IT in their teaching roles.

In the light of these findings, and the absence of any previous New Zealand research in this area, the study identifies areas where there is a need for further research. It is argued that such research is urgently needed in view of growing concern at the ineffectiveness of pre-service teacher education in this area.

Acknowledgments

I would like to acknowledge the support of the administration, teaching staff and students of the Auckland College of Education during this research and the contribution of Rudi Petersen in entering the data..

In addition, it would not have been possible without the support of my family who enabled it be completed, and Bryan Tuck who taught me about reality and whose advice and support was inestimable.

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CHAPTER 1

Review of the Literature

Introduction

In this chapter the meaning of the term "information technology" (IT) is discussed and its place in schooling is examined. The literature on the development of pre-service teacher education in New Zealand, and for comparison in Britain, the United States and Australia. is surveyed. Major issues arising in this literature are highlighted and research on these examined in greater depth. The consequent place of IT in teacher education is considered with particular emphasis on the ways in which teacher educators in New Zealand have responded to the needs of pre-service student teachers. It is argued that in New Zealand we have little knowledge about the effectiveness of pre-service IT teacher education, and of the needs of teacher educators and pre-service student teachers. The proposed research addresses this gap in our knowledge and understanding.

Information Technology

The use of the term "information technology" in New Zealand education is relatively recent and its application to education has been surrounded by a considerable degree of confusion (Brown, 1997b). Most authors use the term without giving any definition. A broad definition may be taken to include techniques involving the use of a wide range of information handling and processing equipment and techniques from the ancient to the modern, but today it is generally used to refer to those that involve computer-based information. "Instructional Technology" (also abbreviated to "IT") (Gentry, 1995) and "Educational Technology" (Brownell, 1997; Bruce, 1999) are terms used by many American and British authors in similar contexts to

describe an approach to teaching and learning which often involves the use of computers and other electronic equipment, though the emphasis here is usually on the design of systems for education and training (Gentry, 1995). The term "New Educational Technologies" has been used similarly, but to emphasise the use of computer-based technology for education. Some authors prefer to use the phrase "new information technologies" to make explicit this restriction to information which is handled electronically (Brown, 1997b). This narrower view is reflected in definitions such as that offered by the British Department of Education and Science:

> *I.T. may be defined as the technology associated with the handling of information: its storage, processing and transmission in a variety of forms by electronic means, and its use in controlling the operation of machines and other devices. (Department of Education and Science, 1989a, p.1)*

The term appears to have been used more widely in relation to the computer industry than in education. In the United Kingdom the term has been used for about two decades as a general term covering computer related activities in schools (Davis, 1992, p.8) but in New Zealand the term was less commonly used until the late 1990s. In the United States "information technology" is seldom used in educational writing and "technology" is used alone to describe what seems to be exclusively the use of computers. However, the term "technology" in New Zealand (and U.K.) education has developed a different connotation through the development of *technology education* as a major element of the school curriculum.

Technology was introduced to the official curriculum in N.Z. with the 1993 national curriculum framework (Ministry of Education, 1993). This replaced former subjects with seven Essential Learning Areas, of which Technology was one, and introduced eight Essential Learning Skills – Communication Skills, Numeracy Skills, Information Skills, Problem-solving Skills, Self-management and Competitive

Skills, Social and Co-operative Skills, Physical Skills, Work and Study Skills – which were intended to be developed across the learning areas.

The description of these Essential Skills indicated that the use of computers was an integral part of, particularly, Communication and Information skills areas. Unfortunately no specific guidelines were given for evaluating these or guidance offered on developing them. The intention was that each separate curriculum document for the Essential Learning Areas would deal with appropriate aspects of the Skills.

Within the learning area of Technology students are expected to achieve objectives through working in a selection of different Technological Areas, one of which is Information and Communication Technology. Initially many teachers assumed that "technology" in the curriculum was synonymous with "computers" and five years after the publication of the detailed technology curriculum document (Ministry of Education, 1995) there is still considerable misunderstanding about the difference between the use of computers, or information technology, across the curriculum, and meeting the specific goals of the technology curriculum through Information and Communication Technology

The development of the Technology curriculum led to an intensified examination within education of the nature of "technology" as it is currently understood, and this has implications for our understanding of the nature of information technology, both within the technology curriculum and within the Essential Skills. Whereas technology was once seen as applied science it is now recognised as being a distinct activity concerned with finding solutions to practical problems which confront human beings – in areas such as medicine, engineering, agriculture and providing food, shelter and clothing. Moreover, we can now see that "technology" has three

layers of meaning: *artefacts* or physical apparatus & equipment, *human activities* involving the application of techniques, and *knowledge.* (see, for example, MacKenzie & Wajcman, 1985, p.3; Ministry of Research, 1991, p.14).

This recognition of three distinct aspects to technology means that we now recognise that Information Technology must include, for example, not just computer equipment and software (the "artefacts") but the knowledge and skills that are required to use these artefacts to solve problems. At the same time there has been an increasing awareness of the importance of learners developing "Information Skills" to enable them to cope with the "explosion" of published information which computer technology has facilitated.

There is also a growing appreciation that information technology cannot comprise computers alone. This has occurred through an appreciation of the growing inter-relationship between computers and telecommunications, particularly through the rapid development of the Internet as a communication medium and source of information, and the process of "technological convergence" whereby older technologies, such as telephone, facsimile, video and audio, are digitised and managed by computers. Technological developments in these areas, coupled with the increasing power, performance and storage capabilities of microcomputers, have led to more ways in which computers themselves can be used, affordably, in education. At the same time the use of older technologies has been enhanced in ways that make them more accessible and more sophisticated.

In response to these changes there has been a trend for the use of the term "information and communication technology" (ICT) in education, particularly in Britain and New Zealand. In New Zealand the term was first used officially to describe cross-curricular uses of IT in the document (Ministry of Education, 1998)

published at the end of 1998 which set out to provide a strategy for meeting "the technological challenges of the future" (p.5). The document adds confusion by describing ICT as a combination of "information technology" and "communication technology", defining the first as "the items of equipment (hardware) and computer programs (software) that allow us to access, retrieve, store, organise, manipulate, and present information by electronic means" (p.5) and the latter as "telecommunications equipment through which information can be sought and accessed" (p.5). As seen above this shows a very limited understanding of what is now implied by "technology", as promulgated in the Ministry's own technology curriculum document (Ministry of Education, 1995). It also seems that most authors who use the term "information and communication technology" are using it in the sense of a single concept which seeks to emphasise the importance of communication as an aspect of I.T., rather than a concept divisible into two separate parts: information and communication are "inextricably linked" (Brown, 1997b, p.252). In addition, this definition, ignores the human and cognitive aspects of communication.

The document continues to describe the term "information literacy" as "the combination of skills and understandings our students will need in order to fully contribute as members of society in the information age" (p.5) and argues that these skills can be grouped into "the practicalities of using ICT – both hardware and software – appropriately and skilfully" and "the competencies involved in using ICT, including such skills as research, communication, problem-solving, and information management". It goes on to warn that these "are not new areas. Such skills should not be practised only within the domain of information and communication technology."

Information Literacy is a diffuse and fluid concept. It has been described (Doyle, 1994) as,

> *"The ability to access, evaluate, and use information from a variety of resources, to recognise when information is needed, and to know how to learn."*

However, Gavin Brown (1997a) refers to sixty definitions uncovered by his research and Langford (1998) charts its development and variations, concluding that "information literacy appears to be defined depending on what part of the elephant one is experiencing". A consensus about the importance and the outcomes of information literacy does seem to emerge and the Ministry of Education statement appears to be in agreement with Langford's conclusion that, "It is not library skills, nor is it computer skills, nor even information problem-solving skills, but all of these are necessary *enhancers* of information literacy". What can be questioned, however, in the Ministry's statement is whether the "practicalities of using ICT" can be separated from "the competencies involved in using ICT", and whether ICT is a "domain" in which these skills can be practised, in any case. The first assertion seems to result from an unjustifiably limited view of what constitutes a "technology", and the second from the unnecessary confusion introduced in the curriculum framework between ICT as an area of study and as an enabler of study.

Although the phrase "information and communication technology" is now widely used in the literature and in official publications, it is the author's opinion that it offers no advantage over plain "information technology", for communication of information is an essential component of any "manipulation" or "presentation". For that reason this study uses the shorter phrase and takes as its definition the following:

> *a complex of artefacts, environments or systems involving information, together with techniques and knowledge for solving human problems through storage, manipulation and communication of that information.*

What is of greater importance than the exact wording of this definition is the implication that IT is more than just the use of computers, that knowledge and skills

are an important component of IT and that its purpose is to meet human needs, resulting in many different forms of solution. Although this definition can equally involve computers or quill pens, semaphore or satellites, it is also understood that in general we are considering processes that involve electronic storage and manipulation of information.

IT in schools

In the early years of microcomputer use in schools, the use of the computer in schools across the world was dominated by the concept of "Computer Awareness". The New Zealand Department of Education produced course materials for teachers which emphasised the history of computers and their uses in the community. Practical work in schools with computers was aimed at giving an understanding of how the computer could be programmed. Teacher education courses were also usually predicated on the need for teachers to be "aware" of the computer and able to use some of the simple software then available, also including their share of basic programming. Lacking any really useful application software, teachers were encouraged to create their own small programs and many did so. The well-known British software author Mike Matson has described how he created the program *Granny's Garden* for this reason (Hunt, 1989) and marketed it commercially, but initially very little software of this kind was used in schools.

Some teachers saw the potential of the computer as a means of teaching or enhancing learning. A range of, usually unsophisticated, curriculum oriented software became available, much of it written by the same teachers who were developing their own programming skills and enthusiasm. Teacher education courses reflected this trend by considering the educational principles behind software, which were largely behaviourist, criteria for evaluating software and often the process of

creating software using such authoring languages as PILOT. In 1989 the IEA study of computers in education (Nightingale & Chamberlain, 1991) found that,

> *"During pre-service training, all primary and most secondary trainees received a few hours of compulsory training at the 'user' level. ... Typically, the topics covered in a course were programming languages (all teachers colleges offered courses in LOGO, and three colleges offered courses in other programming languages); computers and computer systems, application of drill and practice programs, overviews of existing software, integration of software into existing lessons, organisational aspects and applications of simulation and tool software"* (p.19).

A deviation from this trend was provided by the development of Logo. A group of teachers and teacher educators were influenced by the work of Seymour Papert at the Massachusetts Institute of Technology, as described in his book *Mindstorms* (1980), and the growth of Logo as a programming language with a distinct educationally theoretical basis. This constructivist approach constituted almost a counter-culture which has persisted until the present day. Undoubtedly there have been many exciting outcomes for children's learning through the use of Logo, but it also became, in many cases, and particularly in secondary schools, just another vehicle for delivering "computer awareness" – an alternative to the BASIC programming language with pictures and a more complex syntax. Logo did, however, become an important component of many teacher education courses, though it is difficult to know to what extent teachers' practice was informed by its philosophical foundations. Certainly, however, a number of teacher educators found in Logo a justification for considering the computer seriously as an educational instrument.

The next stage was the approach to computers as a "tool", or "just a tool", a misleading phrase which Bigum (1987) argues misrepresents the capacity for tools to shape our thinking. The microcomputer had taken a serious place in business with the development of word-processors, spreadsheets and database software and

teachers began exploring the use of these in the classroom. Again, teacher educators saw this as providing something unique and the potential to use the computer to do things that could not be done by old methods. They were also content-free and able to be applied in a number of areas of the curriculum. Of these, the first and most powerful was the word-processor and this has continued to be the major application used in schools (Brown, 1995). Teacher education courses tended to vacillate between developing the skills of using the software and considering the theoretical and practical issues of using it in the classroom.

In recent years we have seen a new phase emerge in which the emphasis in educational computing has moved from the software to the information handling processes which the hardware and software enable. This has been characterised by an emphasis on the use of multimedia information sources, authoring of multimedia and the use of the Internet as an information source and communication medium. In teacher education this has been reflected in the courses offered to students with an emphasis on developing information skills and examining a wider range of computer-based texts, particularly visual language.

An associated dimension has been a renewed interest in information technology as a medium of learning by teachers themselves. Previously in teacher education there was a tendency to view computer-based learning and teaching with pedagogical suspicion. The development of computer-mediated communication and World-Wide Web-based courses and information sources has given information technology a new credence in the eyes of many teacher educators. This worldwide trend throughout the whole tertiary education sector has been reflected in a number of courses for teachers in New Zealand where computer-based technology has played a major or supporting role.

One effect of this use of the computer for course delivery has been to require teachers or teachers-in-training to develop a different relationship with the computer which may have a profound effect on their attitudes towards, and skills with, computers, far beyond that achieved by a generation of courses about computers in education.

This change in the emphasis of school computer use has coincided with a growth of teachers' interest in Information Skills and the concept of Information Literacy. Information skills are based on library, research and study skills, which have been taught in schools for a long time. Much concern has been expressed, however, that children did not develop information literacy, and that a large gap existed between theory and practice, with teachers often unaware of the difficulties that children experienced in carrying out effective research (Moore, 1995). It is argued that the need for such skills has been increased by the development of computer technology and modern communications, and it is argued from a number of perspectives that it is important for children to learn to manage information. These arguments include the economic-vocational need for higher order skills to provide flexibility in a changing world, the need for effective citizenship in a complex society and personal skills for more effective learning (see Brown, 1997a, p.2-3).

A major proponent of information skills education in New Zealand has been Gwen Gawith whose writing, particularly *Action Learning* (1988), and courses for teachers, helped to establish "action learning" as an influential approach to resource-based learning in schools. Gawith developed a six-stage information processing framework appropriate for classroom use (see Gawith, 1999, p.4), which she based on the nine-stage framework of Ann Irving and Michael Marland (Marland, 1981). A similar model, Michael Eisenberg's Big Six, has become popular in the USA (Eisenberg & Berkowitz, 1990). Through the promotion of Apple Computer Inc, the methods of

Lane Clark at River Oaks School in Canada have been highly influential both in the USA and in New Zealand. These schemes provide teachers with guidance in developing information skills within the context of the curriculum, rather than separately.

The new New Zealand Curriculum Framework (Ministry of Education, 1993), for the first time gave a clear indication that such skills had an important place in the curriculum, although it gave no detailed guidance for teachers. This has been progressively incorporated into curriculum documents for the Essential Learning Areas. Gavin Brown (Brown, 1997a) has examined the first of these in the light of the Information Skills objectives and finds that the Science, Social Studies and English statements are consistent with the nature of information literacy. In late 1998 the Ministry of Education published its Information and Communications Technology strategy (Ministry of Education, 1998) which specified the relationship between IT, the Essential Skills, Technology and other Essential Learning Areas of the curriculum.

As a result of these developments, IT is now accepted as an important aspect of the curriculum while there is increasing understanding of the importance of the cognitive skills required to make effective use of IT artefacts.

IT in pre-service teacher education in UK, USA, Australia and New Zealand

In their 1996 survey of IT and teacher education Willis and Mehlinger (1996) report:

> *"Much of the literature on information technology and teacher education could be summarised in one sentence: Most pre-service teachers know very little about effective use of technology in education and leaders believe there is a pressing need to increase substantially the amount and quality of instruction teachers receive about technology. The idea may be expressed aggressively, assertively, or in more subtle forms, but the virtually universal conclusion is*

> *that teacher education, particularly pre-service, is not preparing educators to work in a technology enriched classroom."* (p. 978)

This section surveys the historical development of pre-service teacher education in IT within the education systems of the United Kingdom, the United States of America and Australia, which are closely related to that of New Zealand.

United Kingdom

In other education systems with which New Zealand has close links there has been frustration at lack of governmental support. A consideration in some detail of the UK experience is of interest because of the many similarities to the New Zealand situation. Political pressures in Britain have tended to foster lack of government intervention in teacher education, as will be shown to have occurred in New Zealand. However, following an initial period of inaction, there has been a much greater degree of government interest in the area of IT education for trainee teachers.

In 1988 British teacher educators complained to a government working party that, "although the initial teacher education sector has been a major contributor to the development of educational computing, national support for this sector has been characterised as 'too little, too late'." (Information Technology in Teacher Education, 1989, p.2) The British government had been early, however, in setting criteria for courses to ensure that IT was an integral part of teacher education, following a 1983 white paper, *Teaching Quality*. The criteria, amongst others, set out for the approval of courses stated that "Students should experience a wide range of teaching and learning methods and be given ample opportunity to discuss and assess them. They should also acquire understanding and experience of the contribution of new technologies to all aspects of children's learning." (cited in Council for Educational Technology, 1984, p.1). In this 1984 booklet, the Council for

Educational Technology made recommendations to teacher training institutions about knowledge and skills for teachers, resources and methods of teaching.

The results of these courses appear to have been far from satisfactory, however, in enabling students to become confident in using IT themselves and a report by the inspectorate in 1988 expressed strong concerns about the adequacy of even the good courses (see Davis, 1992, p.11; Willis & Mehlinger, 1996, p.1011). They were concerned at the tendency to focus on technical aspects of IT rather than educational and curricular aspects. They believed that a large number of institutions had tried to move prematurely to models in which IT was integrated into the curriculum, and had then abandoned them in favour of stand-alone programmes.

At the same time Britain was establishing its first national curriculum for schools, which placed great emphasis on IT. An expert group to investigate IT in teacher education was set up and produced its report in 1989. One of its recommendations was rapidly accepted, to make IT capability of students part of the criteria for teacher accreditation (Department of Education and Science, 1989b). Part of the response to this was the INitial Teacher Education and New Technology project (INTENT) which ran from 1990 to 1992 in England and Wales and the similar SPRITE (Support and Promote Information technology in Teacher Education) project in Scotland. INTENT used an inter-institutional project team designed to provide support for teacher educators integrated with research into the human and institutional factors affecting that change. Support was provided by a national coordinator and one Staff Development Tutor on the faculty of each institution. Close involvement of a colleague with senior management responsibility was also an important feature. (Somekh et al., 1992).

The previous general competencies required of teachers were replaced in 1996 by detailed standards for trainees seeking Qualified Teacher status. The national initial teacher training curriculum, which came into effect from September 1998, specifies in detail the curriculum to be followed in institutions that offer pre-service teaching courses. A separate curriculum is provided for teaching the use of Information and Communications Technology within subject teaching. The document notes the special nature of this curriculum because "It is concerned with the ways in which Information and Communications Technology (ICT) can be used effectively in the teaching of other subjects in the pupils' National Curriculum" (Teacher Training Agency, 1996).

A framework of competencies which was developed in 1992 by three IT and educational technology organisations in the U.K. placed pre-service teacher education ("Initial Teacher Training", or "ITT") within a developmental framework of three stages of increasing technical competence (Davis & Tearle, 1998). The framework was closely tied to the National Curriculum and reflected the introduction of heavily school-based ITT. It was holistic, recognising the importance of context in the use of IT in schools, and made no specific reference to any particular type of technology. The framework was further developed (NCET, 1995 cited in Davis & Tearle, 1998) for use by practising teachers.

The United Kingdom ICT teacher training curriculum document (Teacher Training Agency, 1996) is much more complex because it actually describes a curriculum for teacher education. The first section specifies in detail the teaching and assessment methods that are required. The second section sets out the knowledge, understanding and skills that are expected of all trainees by the end of their course, with the requirement that training agencies will audit these. The list is extremely comprehensive and is specified in terms of demonstrable competencies for

individual students. There is recognition that the curriculum does not include everything that needs to be taught, particularly in relation to specific subjects, and that it may not be necessary to teach everything if students can demonstrate mastery without course work.

The competencies specified in this scheme are evidence of a much broader interpretation of IT (ICT) than the US NCATE standards (described below), covering traditional forms of ICT such as television, video and tape-recording, and including cognitive aspects and information skills. There is a much greater emphasis on pedagogical competency and a requirement that students will carry out practical work in schools. Awareness of health and safety, ethical and legal issues are also included.

United States

Because of the greater size and federal structure of the United States of America the situation there is more diverse than in the UK. Willis and Mehlinger (1996, p.1008) comment that, despite many state and national initiatives on IT in schools, there have been a limited number focused on teacher education. Activity has largely been limited to the internal work by individual schools of education.

A decade ago Niess (1990) carried out a project to investigate what computer competencies were needed by teachers and compared the results of her survey with one carried out in 1984 (Moore, 1984). She noted that the change in statements of competencies over the six years reflected a change from teachers' having *knowledge* of computing to their *using* that knowledge in the classroom. At all class levels her panel believed that teachers should integrate applications of the computer into their teaching. Fisher (Fisher, 1997) carried out a survey of elementary, middle and secondary teachers in Colorado asking them to rate ten competencies for pre-service

teachers. All groups ranked highest the competency, "Develop instructional methods that utilize technology to enhance students' skills, hands-on experiences, learning strategies and higher thinking skills" ahead of skill in using hardware and software which was rated third overall. The second rated item was also concerned with classroom teaching. The next four items were concerned with the selection and use of appropriate media and the last three items with issues that are more theoretical and with leadership roles.

A recent American study (Scheffler & Logan, 1999) sought to update Niess' and Moore's studies, using a panel of experts to develop 67 computer competencies important for teachers, which were then ranked by over 400 technology coordinators, teacher educators and teachers. This research showed that making computers an integral part of the curriculum had the greatest importance for teachers. Of the 34 competencies rated as important or higher, 26 were of the group classified by the researchers as "competencies unique to education". The most highly rated functional competency was "Utilise a word processor to prepare lesson plans, class notes, correspondence, course syllabi and other written documents" (ranked 8th) and the next, the highest ranked "general" competency was "Use operating system software and utility software that accompany the computer to initialise disks, load, run, save and copy programs" (12th). The growing use of the Internet (23rd) and electronic mail (24th) at the time of the study was also reflected in the competencies. The authors expressed surprise at the importance placed on keyboarding, which had also been placed highly in Niess' study. Niess found a large degree of content alignment with the NCATE standards (described below).

As discussed above, early trends in IT within teacher education were for courses that emphasised the use of the computer itself. Northrupp and Little, in an example which

is not isolated, as late as 1996 were proposing a set of "benchmarks" for pre-service teacher education in the USA which began with the...

> *"Ability to operate a microcomputer system to include powering up the computer, installing programs, accessing programs in other drives (such as CD-ROM in drive d:/), saving files to diskette, and deleting files with the context of a Macintosh, Windows and DOS-based system..."(Northrup & Little, 1996, p 218).*

Such functional objectives are, perhaps, an inevitable outcome of the kind of separate IT course which had developed in teacher education programmes, and the origins of such courses within Computer Science. This is understandable when course structures have been in existence for many years and it is seen as undesirable to displace other course material. Courses in IT have been seen as additional to an already complete, and probably over-full, programme of pre-service teacher education.

A number of states have established IT requirements for teachers to be certificated. A 1996 study (Hirumi & Grau IV, 1996) found that of the 50 states, 21 had standards available, four had standards under review and a further 9 had standards planned or in progress. Eleven states had no requirements but recommended prospective teachers to take computer courses, leaving 10 states with no standards at all. The authors found little consensus in the content of the standards, however. The most common proficiency, which was to demonstrate basic operations of a computer, was only specified by 78% of states with standards. The second most common (61%) related to knowledge of issues related to computer technology and its impact on society. A similar study in 1999 (Milken Exchange, 1999) found that only 15 states required pre-service teachers to meet technology-related requirements in order to receive their initial teaching credentials. 7 states were in the process of implementing such requirements and information from 2 states was not available.

Wiebe and Taylor (1997) contend that until recently "only the most innovative teacher education programs required students seeking their initial credentialing to be computer literate" (p. 5). Despite some states introducing requirements in this area for credentialing, few beginning teachers throughout the country were affected. A federal report from the federal Office of Technology Assessment (OTA) (1995) drew attention to shortcomings in pre-service teacher education, and the American Association of Colleges of Teacher Education (AACTE) surveyed its member institutions to assess the situation. They reported that institutions were generally well equipped, but students were not expected to use IT in their studies (Persichitte, Tharp & Caffarella, 1997 cited in Moursund & Bielefeldt, 1999, p.8).

Because the US government has little constitutional power to impose educational practice on states the major national action to deal with this situation came from the the National Council for the Accreditation of Teacher education (NCATE), the most prominent accreditation agency for teacher education programmes. In collaboration with the International Society for Technology in Education (ISTE) they formed an alliance in 1989 to establish IT requirements for teacher education courses (International Society for Technology in Education, 1997). Standards were adopted in 1992 and 1993 for courses providing specific computer and technology endorsements. These standards were re-examined and the revised standards approved in 1996.

The first statement of these standards is of the foundation requirements for professional studies culminating in the educational computing and technology literacy endorsement for all candidates seeking initial certification or endorsements in teacher education programmes. The are divided into three groups of requirements that are defined as...

> ***"1.1 Basic Computer/Technology Operations and Concepts***
> *Candidates will use computer systems to run software; to access, generate and manipulate data; and to publish results. They will also evaluate performance of hardware and software components of computer systems and apply basic troubleshooting strategies as needed."*
>
> ***"1.2 Personal and professional use of technology***
> *Candidates will apply tools for enhancing their own professional growth and productivity. They will use technology in communicating, collaborating, conducting research and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical and legal use of computer technology resources"*
>
> ***"1.3 Application of technology in instruction***
> *Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software applications and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations" (International Society for Technology in Education, 1997)*

In addition to these standards, NCATE had institutional standards with expectations of knowledge and use of technology:

> Candidates are expected to *"complete a sequence of courses and/or experiences to develop an understanding of the structure, skills, core concepts, ideas, values, facts, method of inquiry, and uses of technology for the subjects they plan to teach."*
>
> Professional studies for all teacher candidates were expected to include knowledge and experiences with *"educational technology including the use of computer and related technologies in instruction, assessment and professional productivity."*
>
> It is expected that *"faculty are knowledgeable about current practice related to the use of computers and technology and integrate them in their teaching and scholarship."*
>
> It is expected that *"higher-education faculty and candidates have training in and access top education-related electronic information, video resources, computer hardware, software, related technologies, and other similar*

> *resources," and "media, software, and materials collections are identifiable, relevant, accessible, and systematically reviewed to make acquisition decisions."*
>
> It is expected that *"facilities and equipment are functional and well maintained. They support computing, education communication, and educational and instructional technology at least at the level of other units in the institution." (NCATE, 1997a)*

These standards combine both functional and pedagogical capabilities, with a preponderance of functional statements. They are specified with a level of generality which enables them to be interpreted in a wide range of circumstances but the view of information technology that is taken here is highly weighted in terms of information processing and computing. It must also be remembered that these standards are designed for assessing teacher education *programmes* rather than individual students and thus the statements are not written as measurable criteria. These standards imply that students will be using IT in a variety of ways within their course work, and one statement requires that student teachers work directly with school students.

In 1997 the NCATE carried out a review of its response to IT (NCATE, 1997b). Its Task Force on Technology and Teacher Education proposed ways in which technology should "move from the periphery to the center in teacher preparation". Issues identified included insufficient understanding of IT amongst teacher education lecturers, lack of hardware and software, lack of IT knowledge and skill by lecturers, lack of technical support, teacher educators out of touch with what is happening in schools and few incentives for academic staff to become involved with IT. A number of the problems which they identified are perhaps particular to the USA, relating to the lack of status of teacher education programs within universities, and the lack of pedagogic understanding of staff outside the school or department of education.

However, the issues may not be unfamiliar to New Zealand educators. A number of recommendations were made, which included requiring each teacher education body to have a vision and plan for technology, to use modern communications technology in carrying out its functions, and NCATE making available exemplars of good practice to teacher education organisations.

A growing awareness of the needs of pre-service teacher education appears to have resulted in federal action, with a national Department of Education program called "Preparing Tomorrow's Teachers to Use Technology" (PTTT). The first round of contestable grants, totalling US$135 million, was announced in August 1999 (Thompson, 1999).

Perhaps indicative of the same awareness, a recent report on teacher education issued by the American Council on Education argues that American Universities must put greater effort and resources into teacher education (American Council on Education, 1999). One of the recommended actions is that, "Presidents should ensure that their teacher education programs have the equipment, facilities, and personnel necessary to educate future teachers in the uses of technology." The CEO forum, an industry-related pressure group for computers in education, in its 1999 report made its prime recommendation that "Schools of Education should prepare new teachers to integrate technology into the curriculum" (CEO Forum, 1999).

Australia

In Australia, concern about teacher education in IT at a national and state level seems to have been confined largely to in-service education, and notable work has been carried out at the state level, particularly in Victoria, in identifying IT capabilities for teachers. Throughout Australia there is widespread use of the term "learning technology" to specify the area of IT applied to learning in schools. The

Australian Council for Computers in Education (ACCE) issued a discussion document on *Teacher Learning Technology Competencies* (TLTC) in 1998 which was further revised in 1999 to include comments from stakeholders (Australian Council for Computers in Education, 1999a; Australian Council for Computers in Education, 1999b). They commented that "stakeholders raised the natural expectation that tertiary institutions training teachers need to extend their capability to produce teachers who are competent in the use of learning technology" (Part B p.11). It was noted that there was a problem for trainee teachers to practice IT skills in the classroom where schools or teachers had deficiencies in this area. Nevertheless, "personal competence and a positive attitude were seen as desirable attributes for graduating teachers." The ACCE recommended that teaching training institutions provide students with "opportunity to develop personal technology skills and an understanding of curriculum uses of learning technology" and "ensure" that they understand the global and community contexts. They were recommended to provide an opportunity for students to experience a "technological workplace" in the University itself. Encouragement was urged for Universities to place students in appropriate teaching practice schools, and documentation was recommended for graduating students describing their assessed learning technology competence. The tone of recommendation here contrasts markedly with British and American educators' calls for placing mandatory requirements on teacher education institutions.

Shortly after this discussion paper the Australian Commonwealth agency Education Network Australia (EdNA) released a discussion paper on *Improving teaching and learning in Australian schools through the use of information and communications technologies*. The lengthy report devotes three paragraphs to teacher education in which concerns are expressed that "Australia's pre-service teacher education

programs (sic) are locked into older paradigms of teaching and learning which do not adequately prepare students to make effective use of technologies when they go into schools" (Moran, Thompson, & Arthur, 1999, p.29). The report claimed that, although many teacher education programmes include units about learning technologies, few had integrated the technologies into their content and methods. Part of the reason was seen in resource and staffing constraints that resulted from education faculties having borne the brunt of university cutbacks.

Probably the most developed of state professional development programmes is that released by Victoria at the beginning of 1998 In common with other groups in Australia Education, Victoria has chosen to use the term "learning technologies" to describe the "integration of information technology (including both computer and communications technology) into teaching and learning. The range of technology tools in which teachers might develop skills includes other technologies such as video and digital cameras, scanners, graphics calculators, sensors, and probes. Learning technologies can also be used for school administration and professional development." (Pellegrino, 1998) The Victorian *Learning Technologies Teacher Capabilities Statement* (Education Victoria, 1998) identifies a set of IT capabilities, with an emphasis on curriculum and education, to be used as a basis for the State's in-service training but does not apply them to pre-service teacher education.

From these documents it would seem that in Australia the current situation of IT in teacher education is similar to that in Britain and the U.S. a decade earlier, with a growing appreciation of a problem but no systematic attempts to deal with it at a macro level. Strong parallels can also be found in the New Zealand situation.

New Zealand

In New Zealand there was initially little official support for IT in pre-service teacher education, particularly for primary school teachers, as there was no recognition of the relevance of computer use in the primary sector. When the curriculum of teacher training was controlled nationally by the Department of Education there were no requirements for meeting any objectives for education about educational computing.

Pre-service teacher education in IT began in 1978 and 1979 when the Secondary Teachers' College: Auckland (later to be part of the Auckland College of Education) received grants from the Department of Education to purchase microcomputers and develop programs and strategies for using them, while over the same period other New Zealand teachers' colleges purchased equipment at their own expense. The Ministry hosted a seminar on computers in teachers' colleges in 1982 (Department of Education, 1982) which made recommendations about courses for student teachers. It was proposed that all students would receive computer awareness education and that courses for teachers of secondary school Computer Awareness and Computer Studies should also be run. The Department took considerable time to consider recommendations made about facilities for teacher education and responded in 1984 with a circular to teachers' colleges announcing that no special allocation would be made, but that they might continue to purchase computers from their equipment grants, if they wished.

In 1988, in the new climate engendered by the changes to the administration of education heralded by the report *Tomorrow's Schools* (Lange, 1988), fourteen teacher educators met at Hamilton Teachers' College together with members of the Computers in Education Development Unit and other Department of Education officers to consider teacher education related to educational computing. They reported (Layton, 1988) on a set of principles to guide teacher education in this area

and a series of objectives for teacher education, as well as a large number of practical recommendations on such issues as in-service education, teacher support, staff development for teachers' colleges, resources and staffing. At the same time an organisation called Information Technology and Teacher Education (ITTE) was established to provide a means of sharing information and ideas and to coordinate activities between teachers' colleges (or colleges of education). This organisation was to prove largely ineffective, perhaps because of the mood of competition which was introduced into tertiary education at the time and difficulty in funding its intended activities.

The meeting endorsed two over-riding goals for pre-service teacher education, which were that every student should leave college:

> *(a) a confident and competent user of computers*
>
> *(b) disposed and able to provide children with the learning opportunities which computers can provide in the classroom. (Layton, 1988, p 5)*

Later in the same year the Association of Teachers' Colleges' Councils was presented with a paper by the principal of the Auckland College of Education, Dennis McGrath, which called on the Department of Education to provide resources to enable Colleges to achieve these goals (McGrath, 1988). The report pointed out that, apart from a one-off grant of $30,000 and a staffing allowance of 0.5 staff per college, which had been made in 1986, there had been no government finance allocated to teacher education in this area.

With the introduction of reforms to the education system in October 1989 and the replacement of the Department of Education by the Ministry of Education, teacher education institutions became bulk-funded with the expectation that they would be

responsible for finding resources from their grants for such initiatives. Similarly, no central responsibility was taken for setting the curriculums of the Colleges.

Continued representations on the matter of information technology in schools resulted in the setting up of a Consultative Committee under the chairmanship of Professor Philip Sallis. In its report (Ministry of Education, 1990) the Committee proposed policy goals for New Zealand education and made recommendation about training for teachers, funding for schools and National Curriculum objectives. The Report noted that, "At the present time it is not compulsory for teachers in training at all colleges to undertake a course in educational computing. Indeed under present staffing arrangements most colleges would be unable to offer courses to all trainees" (p. 25).

It picked up the goals for pre-service teacher education that had been enunciated two years earlier and commented that "College courses must therefore continue to focus upon basic training in the use of equipment until student teachers come into college with a better background in information technology. In addition, colleges need to provide courses which focus more on educational issues" (p. 7). It is interesting, however, that the main need was seen to be in upskilling student teachers in the techniques of using computer equipment.

A major attempt to provide consistency throughout the country has been the work by the New Zealand Qualifications Authority to establish a set of unit standards for teacher education. The standards that were initially developed in 1994 included two standards that specifically related to computer use:

> *"**Works with students: Creates learning opportunities***
> *Prepare and select computer activities as support in learning programmes."*
>
> *"**Works with students: Facilitates learning***

> *Facilitate learning through using computer activities as support in learning programmes."*

Within each standard were a number of elements that are intended to represent the actions required of a teacher, though experienced teachers may be forgiven if they find it difficult to recognise within these elements and their accompanying performance criteria the rich interactions and strategic thinking that occur in the classroom.

The unit standards, however, acted only as a guide for teacher education institutions, and with pre-service teacher education courses now being transformed from Diploma courses into Degree courses, the major unifying factor across the country is the requirements of the Teacher Registration Board which have nothing to say on the matter of information technology. In a green paper on teacher education, the Government has indicated that it wants pre-service teacher trainees to "acquire skills in the uses of information technology for aiding the teaching and learning process ...over and above the functional competences described by the Unit Standards" (Ministry of Education, 1997). It concludes that,

> *"To this end, information technology needs to be integrated into pre-service teacher training. Ideally, the information technology functional competence of beginning teachers should be practised and developed during the practicum as well as through the provider-based programmes."* (p. 31)

Pressure for action by the Ministry of Education on teacher education in IT has continued to come from a number of groups. A series of official reports acknowledged that this was an important area for teacher education. The government green paper on teacher education (Ministry of Education, 1997) placed emphasis on the needs for teachers to develop "a level of proficiency which allows them to lead work in this area effectively in the classroom", asserting that "information and communication technologies provide alternative routes to knowledge, directly

challenging the traditional role of teachers as conveyers of knowledge." In the same year, a report on the use of IT in New Zealand schools by the government education evaluation agency, the Education Review Office (1997) concluded that IT was of great importance for schools but "will only be successful if teachers are able to facilitate its use in the classroom" (section 4.3) and hence the role of teacher education was crucial. The Minister of Information Technology's Information Technology Advisory Group (ITAG) in its 1998 report on IT in schools (Butler & Zwimpfer, 1997) stressed the importance of teachers in bringing about effective use of IT in schools and applauded the recommendations of the green paper, and in a later report (Information Technology Advisory Group, 1998, May) went further to argue that contestable pre-service teacher education would result in training which was "more responsive to the needs of New Zealand schools and students".

In its 1998 report on definitions of quality teachers (Education Review Office, 1998), the ERO included a statement of professional knowledge specifically related to IT: "demonstrates willingness to extend skills in using information technology" and more general statements including IT relating to "knowledge of appropriate technology and resources" and the ability to use these in an "informed", "planned and relevant way". In the 1998 survey of schools carried out by the Information Technology Advisory Group (Sullivan, Allan, & Nicola, 1998) school principals reported that the two most important factors in reducing the value that their school derived from its investment in IT, after the cost of equipment, were lack of teacher knowledge of equipment and teacher understanding about the value of using IT. The quality of education received by student teachers continues to be a matter of official concern, as evidenced by the inclusion of Information and Communication Technology as one of the four curriculum areas specifically mentioned in the brief

for the 1999 Education Review Office investigation into teacher training (Education Review Office, 1999).

The Ministry's response to the need for teacher education has been entirely restricted to in-service teacher development initiatives, through contracts to provide school-based teacher development, funding of advisory services, staff development grants and the establishment of professional development schools. This corresponds to the ideological position taken by successive governments of an "open-market" approach to pre-service teacher education from competing suppliers. Some parallels may be seen in the British approach a decade earlier where, Davis reports, "little effort was directed at initial teacher education until recently, because it was felt that in-service training would have the fastest impact on the contemporary classroom" (1992, p.9-10). In that case she reports that, "Had initial education been supported from the start, rather than concentrating on in-service courses, then it is possible that the UK could have had a better trained workforce today." It would appear that lack of effective pre-service teacher education in this area will merely add to the pressing needs that are perceived for in-service teacher education. In the USA the National Council for Accreditation of Teacher Education observed, "Re-educating the existing teaching force will not be easy and will require extensive professional development over many years. The problem will be greatly compounded if those teachers entering the profession now and in the future have not been adequately prepared to use the new technology" (NCATE, 1997b). In New Zealand, there appears to be no indication, yet, that the government is prepared to direct any effort or resources at pre-service teacher education.

Issues in IT and teacher education

Goals & standards

Early courses in educational computing for student teachers, concentrated on the computer, and functional competence in operating a computer were relatively simple to evaluate. Where criteria were stated they typically appeared as a large number of statements related to trivial tasks involving manipulating hardware and software (for NZ examples, see Department of Education, 1982; Watts, 1990). In addition, they often had objectives that emphasised affective aspects of students' engagement with the technology. Words like "confidence" were used, and expectations of students knowledge and understanding of computers were often extremely limited. Little attempt was usually made to evaluate the degree of "confidence" in relation to classroom use of computers.

In recent years, following general calls for accountability in education, there has been a move towards the development of competency, or skill, frameworks for teachers. The NCATE accreditation standards in the USA, and the British National Curriculum for teacher education, described above, are leading examples of such frameworks. Similar frameworks have been variously used as a basis for in-service staff development and pre-service teacher education. Within all frameworks a balance needs to be struck between pedagogical skills, related to the specific requirements of teaching, and functional skills which may be similar to those required in other areas of employment. Another variable is the degree to which the frameworks include forms of Information Technology other than the use of computers.

An emphasis on functional objectives is a feature of competency frameworks developed outside education. The European Computer Driving Licence (ECDL) is

one such scheme, providing a standardised qualification across the European Community which is targeted at the broadest range of people who desire a widely recognised certificate of competence in using standard computer applications (British Computer Society, 1999). It has been suggested as providing a suitable curriculum for teachers but, although it might provide a useful demonstration of computer skills, would need supplementing by standards specific to teaching. A recent report of the National Research Council in the USA promotes an approach which they call "Fluency in Information Technology" ("FITness") (National Research Council, 1999). They argue that "fluency" is a better term than "literacy" because it implies an understanding of information technology that goes beyond technical competency and skills of limited life. This fluency is required in some degree by all citizens and has three components: intellectual *capabilities*, fundamental *concepts* and contemporary *skills*. It differs from many previous "computer literacy" moves in this recognition of the need for a theoretical understanding. The intention of the authors is to concentrate on incorporating this framework into tertiary education, including the education of teachers. "Fluency in Information Technology" may provide a framework for considering pre-service teacher education in a wider context, but it requires to be complemented by the specific pedagogical needs of teachers.

A different approach is that taken by the European Commission funded T3 (Telematics for Teacher Training) Project (1998), established to develop a core curriculum in telematics for teacher education (Davis & Tearle, 1998). Telematics is a term peculiar to Europe derived from *tele*communications, *tele*vision and infor*mat*ion technologies, referring to both information and communication technologies (Dillon, 1998) with a heavy emphasis on communication. The project established a framework for a core curriculum based on three aspects:

(a) pedagogical considerations, (b) networking and collaborative considerations and (c) technical considerations.

This framework is designed to be built on by institutions and governments in Europe to develop curriculums and materials for teacher education. The three aspects can be seen to bear similarities to the structure of the NCATE/ISTE standards in the USA but with an emphasis on functioning in networked learning environments. It also represents a framework of principles, rather than a specification of criteria. The field of study implied here is much broader and there is no reference to any particular technologies. While this framework has largely been applied to in-service teacher education, it would seem equally appropriate for pre-service education.

The frameworks described above are representative of attempts in a number of countries to ensure that beginning teachers have a degree of competence in using IT, as conceived in various education systems. Similar frameworks are also used as a basis for in-service training and on-going accreditation of teachers. It is possible to discern commonalities between these different frameworks and a study of a number of U.S. examples (Moore, Knuth, Borse, & Mitchell, 1999) yielded four major categories: (a) prerequisite technical skills, (b) technical skills, (c) instructional uses, and (d) professional roles. Different frameworks were found to emphasise different aspects and cover them in varying degrees of detail. The authors urge that teacher education programmes need to address them all adequately. They also draw attention to the need for authentic assessment practices, related to a vision of education and to classroom practice. There are similarities to the dimensions developed by Coughlin and Lemke (1999) for schools to assess their state of professional competency. They identify (a) core technical skills, (b) curriculum, learning and assessment, (c) professional practice, (d) classroom and instructional management and (e) administrative competencies.

Information Technology standards are part of a larger trend towards codification of standards in education and in many cases accompany moves by central governments to open up teacher training to a wider range of providers, necessitating clear accountability procedures. However, if they are expressed as sets of competencies, they suffer from the assumption that the complex intellectual work of a teacher can be atomised into a set of discrete, measurable behaviours; the final activity of the teacher must be much more than the sum of such parts. For teacher educators with an interest in IT they also become a two-edged sword, for on the one hand they provide an incentive for administrators to provide resources and course time, while on the other they can restrict and lead to an emphasis on easily measured, but trivial, outcomes.

Despite the impetus which standards may give to using IT in teacher education, these standards do not provide much certainty that beginning teachers will be successful *users* of IT, or even merely users. Wild and Oliver (1995) acknowledge that most IT programmes in teacher education are reported as being effective when they are assessed in terms of changes in skills, knowledge and/or attitudes, but they suggest that, "were the same programs to be assessed according to their influence on the uptake of IT use by student teachers and beginning teachers in teaching practice, then they might fare less well" (p 1091). The authors' evaluation studies indicate that "many IT programs would be found to be largely ineffective". If the goal of pre-service teacher education in IT is to ensure that beginning teachers use the technology and use it effectively, it may be necessary to base courses on an understanding of what influences teachers in using IT in the classroom.

This argument, although reflecting the reality of beginning teachers' reluctance to use IT, ignores the importance of a lack of direction within our schools. There are no doubt many teachers who, insecure in their own mathematical understanding and

knowledge, might be reluctant to teach mathematics, were it not an important and compulsory part of the curriculum. The place of IT in the New Zealand curriculum has never been explicitly formulated in the way that mathematics and other curriculum areas have been, and it has been up to individual schools to define how they will use it and to what ends. Even the recent national ICT Strategy (Ministry of Education, 1998) lacks clarity in guiding teachers. In this situation, it is not surprising that young teachers will give little emphasis to IT when there are so many other challenges facing them in the classroom.

There is an assumption implicit in the assessment schemes described above that teachers – and more specifically first year teachers – will need to use IT in a wide range of classroom activities across the curriculum. There is a further assumption that the possession of the listed skills is a necessary condition for achieving this goal. Alternative views of the most desirable basic needs for a beginning teacher are possible. To what extent can the beginning teacher be a master of all techniques, or should they aim for a subset? Is it possible that the use of IT is best learnt within the school context (particularly considering the wide range of types and degrees of provision of hardware and software between schools)? Wild and Oliver (1995) comment that:

> *"Student teachers will develop much of their teaching expertise only after they have graduated and begun teaching. It is therefore not necessarily desirable nor realistic to expect new graduates in education to be able to make use of IT in diverse and informed ways. However, a foundation for student teachers to build on should be provided. Much of this foundation has to be built during students' experiences on school placement" (teaching practice).* (p.1094)

It is useful to speculate on whether the approach of specifying explicit standards for beginning teachers will provide a model for future developments in New Zealand, particularly in the light of the 1999 Education Review Office (Education Review

Office, 1999) report which recommended to the government that consistent standards for graduates of teacher training be established, together with approved accountability methods, making particular mention of the national curriculum areas of ICT, English (literacy), science and mathematics (numeracy).

Attitudes & experience of student teachers to IT

Willis and Mehlinger (1996), in their study of IT in teacher education, comment that attitude studies have been the most prevalent research method in the field - not because of their value, but because of their convenience and ease of implementation. Such studies have, in general, indicated that student teachers are typically "somewhat anxious about computers, feel unprepared to use them, but want to learn about computers" (p. 980). Individual studies show a range of attitudes, however, and variations which can be related to age and experience.

Two aspects of student attitudes have been of major interest, the most common being confidence, or self-efficacy, in the use of computers, either in non-specific computer use or (less frequently) in classroom use of computers. The second area of interest has been in general dispositions towards computers and the place and purpose of IT in schools.

A recent Northern Ireland study, for example (Murphy & Greenwood, 1998) , only reports relative confidence between different groups. PGCE (postgraduate) students were found to have more confidence than BEd students in both non-specific use of computers and in teaching with computers. There was no effect of age on students' confidence though there was a sex difference with women significantly less confident than men. Similar sex differences have been found in other studies (for example, Handler & Pigott, 1995; McInerney, McInerney, & Sinclair, 1994; Sadera & Hargrave, 1999; Watson, 1997). Watson found that women made more negative

comments about their computer-related feelings and self-efficacy after completing a first year IT course. In Scotland (Simpson, Payne, Munro, & Lynch, 1998) around 80% of students graduating from both B.Ed. and PGCE courses were confident in their ability to integrate IT into their teaching, with secondary students slightly less confident than primary students.

An investigation into pre-service teachers (Sadera & Hargrave, 1999) showed that their preconceptions about the role of computers were naive (as categorised using a taxonomy for instructional use of computers) before taking an introductory instructional technology course, and these views were related to their computer proficiency, epistemological beliefs and attitudes towards computers. More sophisticated views were associated with greater perceived proficiency, lack of confusion about computers and beliefs that computers belonged in the classroom and were of value in the classroom.

Computer Anxiety is a term that has been used to describe negative affective reactions to the use of computers. Computer Anxiety has been related to low achievement in computer-related learning and thus one aim of many introductory courses in teacher education has been to reduce this anxiety. Evidence from one study (McInerney et al., 1994) supports the idea that increased experience gained in such courses can reduce anxiety. However other factors - sex, perceived competence, ownership of a computer and whether the student attended a single-sex or coeducational school - were found to affect computer anxiety in complex ways. The type of computer experience has also been shown to affect students' responses to computers (cited p.43). Programming experience generally, and the use of Logo compared with other programming languages, has been shown in different studies to be related to increases in confidence. Evaluation of computer tasks and comparing competency to others, rather than emphasising personal mastery, has been found to

increase anxiety. It has been suggested that women prefer an unstructured style of computer interaction.

Laffey and Musser (1998), in a study of students at the start of the pre-service teacher education, discovered high levels of anxiety about using computers. Investigating attitudes, they found, for example, that students considered computers as more or less relevant to different types of learning outcome and that many feared that computer use would interfere with student-teacher relationships. They viewed schools as resistant to change, but nevertheless recognised that increased use of computers was inevitable. The authors commented that, whereas many researchers and teacher educators believed computers had the potential to enrich classroom learning, students themselves did not have a rich enough experience of computer use in education to share these views. They believed that it was important for teacher educators to identify, and deal with, such attitudes, which go well beyond simply "computer anxiety".

Ropp (1999) used a battery of tests with pre-service student teachers to study their computer anxiety and also their attitudes towards computers and technology, technology proficiency, computer self-efficacy and computer-coping strategies. However, in this study, students were given the results of these tests and involved in discussion about them. Retesting later in their course indicated significant growth on three of the six tests. This approach to using psychometric tests to inform student reflection and assist their personal growth appears to be a useful technique for making positive use of knowledge about student attitudes to IT within courses.

Students have been found to have a wide range of prior IT experience on entry to teacher education, though courses in general do not appear to have made much allowance for this. Previous experiences, particularly recreational use, have been

found to correlate with positive student teacher attitudes to using computers (Hunt & Bohlin, 1993). Recent studies indicate that students' entry skills are steadily improving, which might be expected as computer use permeates businesses, universities and homes. A 1995 study in Britain (Liénard, 1995) showed an increase from 18% to 29% in personal ownership of computers amongst post graduate student teachers over a five year period, and those who owned or had easy access to a computer increased 44%. At the same time, there was a steady increase in the prior use at work, home or university. In the light of growing domestic computer sales we can expect increases to have continued during the past five years. A study by Simpson, Payne, Munro and Lynch (1998) found that 43% of students had access to a computer at home and, unlike Liénard's, this figure includes B.Ed. students.

The picture that emerges from this body of research is that of a complex set of circumstances that interact in affecting student teachers' readiness to use IT in their teaching. Prior experiences with computers, at home, in previous education and work, views of education and of technology, together with their personal sense of self-efficacy and locus of control are all found to influence response to teacher education courses in IT and the expectations of the curriculum. Gender seems to be also particularly closely related to these factors, and possibly age. In addition to these personal factors which affect the individual student the skills, knowledge and attitude of teacher educators and the nature of the courses that they provide must also be considered.

Skills and knowledge of lecturers

A developing theme in descriptive accounts is staff development amongst teacher educators. This literature has much in common with that on teacher development but recognises some of the particular issues in teacher education institutions. Very little

empirical research appears to have been done in this area, however, and most papers are descriptions of strategies adopted in different institutions.

One recent study which considered the skills and strategies adopted by teacher educators was the study by Simpson, Payne, Munro and Hughes (1999) carried out as part of a larger project to examine pre-service teacher education in ICT across Scotland. They found that most of the teacher educators expressed very positive attitudes towards IT and its use in teacher education but made surprisingly little use of it themselves, with most use made of fairly low level tasks such as word-processing (an average of 62% used this with confidence). Use of electronic communication was second in popularity (38%) with very few using information sources such as the World-Wide Web, CD-ROMs or bibliographic databases. In teaching, they seldom modelled the use of IT. A number *encouraged* students (70% encouraged the use of word-processors, 53% the WWW, 50% CD-ROMs and less for other applications) but very few *required* students to use IT (26% for word-processing was much the highest response). Very few covered pedagogical aspects of IT use in their courses (for example, "how to integrate ICT into the curriculum" was covered by 33%) though more *encouraged* students to consider the issues.

In Northern Ireland (Murphy & Greenwood, 1998) teacher educators were again found to make most use of word processing, but apparently at a higher level (80%). Use of e-mail (46%) and the Internet (41%) seem to be at a higher level, but this may represent the inclusion of all users rather than "confident" users. This study seems to be unique in comparing lecturer and students. Lecturers were found to be more confident in *general* computer use than students, whereas for confidence in using computers in *teaching* PGCE (but not B.Ed.) students were slightly more confident than lecturers. Younger lecturers were also significantly more confident than those over 45.

One USA college of education carried out a survey of faculty use of IT as the forerunner to strategic planning (Parker, 1997). This indicated that a large proportion (87%) of lecturers used word-processing in their preparation and somewhat fewer (68%) used computer-generated material in their teaching. A similar number reported that they required students to present computer generated material in all or most of their classes, which may simply refer to word-processed papers. On-line searches were used by a large number of lecturers for their own research with considerably fewer using spreadsheets or databases. Somewhat less than a half of staff used instructional software in their teaching but few required students to use it themselves, and no use was made of the Internet or e-mail in class. A study of colleges of education in Texas (Jolly, Davis, Strader, & Denton, 1999) found a general low level of use of IT by faculty with the exceptions being VCRs, word-processing, spreadsheets and presentation, for which responses were in the middle to high range. Lecturers indicated that these technologies were well enough established for them to feel comfortable with them. There was generally a low level of requirement for student teachers to use IT, except for word processing, presentation software, web-browsers and video-discs.

In considering their research evidence Simpson and her colleagues (1999) point to the nature of teaching staff in teacher education institutions. In Scotland, they are traditionally recruited from the ranks of "highly experienced school teachers of proven pedagogic and scholastic ability". Thus, they tend to be older and are argued to have responded to the introduction of IT by "recruiting it to support their long-established routines" rather than by radical change in their teaching (p. 258). Lecturers in New Zealand Colleges of Education in general have the same background. One study (Stetson & Bagwell, 1999) describes the problem as a double challenge for teacher educators: "how to integrate technology in the K-12 classroom

as well as their own" (p.147). The authors add that, "a large percentage of teacher education faculty have not spent extensive time in a K-12 classroom for several years, and in the information age ... that means a lifetime." Brownell (1997) cites further sources for evidence that most teacher educators in the USA have not had the opportunity for learning experiences with technology and lack personal expertise.

Cuban (1998) presents a different analysis of the problem. Discussing lecturers at Stanford University in general (not just in teacher education) he shows how most are heavy personal users of computers but few use computer-based approaches in their teaching, and that this situation has persisted for over a decade, despite provision of excellent resources and support. In a "high-tech" environment they remain, in Cuban's terms, "low-tech" teachers, as do most school teachers. He argues that this is not because of lack of skill or support but because lecturers and teachers value other elements of education - personal relationships and developing community values - and are reluctant to abandon tried methods for faddish ones. Such views from an eminent educational technologist need to be taken seriously, but there are vigorously countered by other scholars (see Andre, 1998 and other commentaries in the same journal issue). An important question is raised by Cuban's critique, however: is there a need for "high-tech" teachers, and what will they look like? It may be argued that teachers with appropriate knowledge and skills can still espouse the values described by Cuban while developing cognitive and pedagogical knowledge and skills that enable them to exploit IT to the benefit of their students' learning.

The evidence of most research described above gives an indication of a problem consistently referred to by authors. Willis and Mehlinger (1996) conclude that "the literature ... clearly points to another barrier, lack of expertise on the part of teacher educators. Providing encouragement, support, and training to teacher education faculty will be a prerequisite to any effort to move beyond stand-alone courses and

to diffuse technology throughout the teacher education curriculum" (p.1020). Somekh, in describing lessons learnt from the INTENT programme to develop the use of IT in English teacher education institutions includes staff development as a key factor, commenting that "staff development needs to be restated because it has been so startlingly neglected" (1998, p.19).

The location of IT in pre-service teacher education programmes

Integration or stand-alone courses?

Most teacher education programmes have traditionally included IT through an introductory computer course with an emphasis on the use of software and the mechanics of computer use. (Handler, 1993; Somekh et al., 1992). Recent literature, however, has been highly critical of this approach. This section examines some of the work that has led to a new conception of how IT should be included in pre-service teacher education.

Wild (1995), for example, proposes a framework to address the findings of his research into pre-service teacher education in IT, based on constructivist principles. The objectives are concerned with processes rather than knowledge or skills and the strategies identify characteristics of IT programs that have been found to be effective and related to a coherent theory of teaching and learning. Wild recommends that the content of courses be developed to emphasise the methodology of classroom IT use.

Once goals for teacher education in IT are selected, it is necessary to provide appropriate experiences to enable students to meet those goals. Even when providing skills checklists, the accreditation agencies referred to above, recognise that successful courses will need to pay attention to the method of teaching those skills. The UK teacher education curriculum recognises, for example, that, "it is expected

that many providers will integrate aspects of the section when designing courses" (Teacher Training Agency, 1996, introduction) and that, "Trainees must be given opportunities to practise" the methods and skills "in taught sessions and in the classroom" (, p.6). If we accept a wider definition of good teaching which recognises that the activity of teaching is an intellectual activity requiring a well developed philosophy and a capacity for critical reflection, as well as a wide knowledge of teaching, then the ways in which courses are designed must be of even greater importance. Two major issues are raised by the UK teacher training curriculum above: *integration* into the teacher training course and opportunity for students to gain *teaching experience* with IT. Willis and Mehlinger report that comparative surveys of teacher education programmes are rare (p. 981). Much published work appears to consist of descriptions of specific courses and innovations in teacher education. Many of these papers are highly specific, but a number of common themes and trends may be discerned. The most prevalent kind of description was discerned to be of "stand-alone" courses, but since their survey was published there has been a growing concern with integration of IT into other ("methods") courses.

In the past, the simplest apparent solution to educating pre-service teachers about IT has been to provide separate, specialist courses. Within the structure of tertiary education institutions, this has been the least problematic procedure to adopt. Willis & Mehlinger (1996) found that while large numbers of students in teacher education programmes were taking some coursework in IT, by and large this instruction was not tied to curriculum methods, field experience or practice teaching. Presenting IT as a series of skills to be learnt does not provide a useful model for students to apply in their own classrooms and ignores the reality of how they themselves learn. As Chris Bigum points out (1990) most teacher educators, themselves, learnt about computing, not through attending courses, but through sitting down with a task to do,

a manual and, possibly, access to somebody with more experience. Bigum's solution at Deakin University was to provide *no* computing courses, but 24-hour, open-access computer facilities with a technician, in which students developed their computing in the context of their academic work and supported by their colleagues. This method puts into practice the theories of situated cognition, described by Brown, et al (1987).

Wild (1996) draws attention to the global problem of low uptake of IT use by beginning teachers, a phenomenon for which the term "technology refusal" has been used. He sees a significant error in most of the courses that are provided for student teachers, where the emphasis is placed at the beginning on the skills of using computers. There is evidence that student teachers do not need formal courses in IT education, or personal computer skills, to make use of IT in their own teaching, and neither does the possession of computer skills ensure that student teachers use computers. He criticises traditional courses for ignoring individual needs of students and ignoring the importance of their constructing personal meanings of IT and education. The influence of general IT experiences and personal beliefs about teaching and learning may be far more potent than IT courses provided in pre-service teacher education.

An authentic context for developing educational computing is now being offered in many institutions. An increasing number of teacher education courses are being offered through distance education and open-learning methods (see for example, three examples in the New Zealand context: Anderson, 1998; Campbell, 1998; Delaney & Wenmoth, 1998) and making heavy use of information technologies. It seems likely that these students will be in a much better position to understand the power of IT and how it can be used in education, as well as developing their own skills. Students attending face-to-face traditional courses may be at a disadvantage in

this respect. Using IT within teacher education to make courses more effective may be the best way to empower students to make creative use of the technologies in their own teaching. It would, however, be giving students a misleading message if the only courses to employ IT were those in which IT was also the subject of the course, so it is important that IT permeates the teacher education curriculum as widely as possible.

Integration, sometimes referred to as *permeation*, *infusion* or *diffusion*, has been a major theme recurring over the past decade or more in the literature concerning IT in teacher education. There is a general agreement in theory that IT skills are of value in the context of learning within all areas of the curriculum. Weibe and Taylor (1997, p.8) indicate that the ISTE intends that their "Foundations will be achieved through a series of experiences within the professional education curriculum... It is critical that these experiences continue throughout the professional preparation. This includes modelling of technology integration within specific curricular and content areas... ." Robertson (1996b) identifies benefits from "permeation" as a result of providing greater relevance through meaningful contexts and making IT use seem to be normal practice, thus promoting its use by students. However, he warns that this is not enough "unless the IT activity is linked to the theory and pedagogy of its surroundings" (p.3). There is evidence that integration of IT throughout teacher education programmes actually does affect students. Handler (1993) found that there was a significant positive relationship between students' feeling prepared to use computers in their teaching and both having seen the computer used during their "methods" classes and having participating in computer use during their student teaching practice. Those who reported feeling prepared were also found to be significantly more likely to use computers in their first year of teaching. In a further study (Handler & Pigott, 1995), with larger numbers, a similar relationship was seen.

Teachers who felt prepared reported much higher use of computers in their pre-service instruction than those who felt unprepared, although it must also be noted that of the prepared students a much greater proportion took an introductory course on the use of computers and other technologies in education where one was offered. However, Dunn and Ridgway (Dunn & Ridgway, 1991b) found that students who had taken a course in computer studies or computer literacy were no more likely to use a computer in the classroom during their practicum than those who had not. Few students in Handler's (1995) study saw instructors modelling the use of technology and even fewer were required to incorporate IT into a lesson plan. After surveying graduates from several years' cohorts Topp (1996) reported many negative comments about the place of IT in their programme and that, overall, "these graduates did not feel adequately trained in college to use computer-related technology in their classrooms". About half of graduating Scottish teacher trainees (Simpson et al., 1998) surveyed found that the IT courses they had received were at about the right level and many believed that they had learned a great deal. Nevertheless, the most frequently identified area of dissatisfaction was that of the pedagogical use of IT in the classroom.

Integration can be deceptive: it is possible to split IT amongst a number of subject courses but still maintain its separateness. Using IT in curriculum classes is not necessary of value unless the IT is linked to the theory and pedagogy of its surroundings. When IT is integrated throughout a programme in this way it is important to maintain a *coherence* of students' experiences across individual components, and also ensure that there is *progression* as they move through the course (Robertson, 1997).

The general concept of "integration" in education is also problematic. A number of commentators have seen it as a process by which innovation becomes appropriated

to the ends of pre-existing educational practise. In New Zealand schools of recent years this has clearly been a difficulty with curriculum areas such as health and Taha Maori. There is a strong case to argue, however, that IT is different, having its dual nature as object of study and vehicle for study. The very nature of technologies is that they are available for wide use and amenable to adaptation. Nevertheless, for those who view IT, not just as a set of tools for learning, but as a new paradigm in learning, this is still a problem. Two distinct approaches to curriculum change are evident: those that see change as *transformation* and those that look for *incremental* change. Bigum (1993) discusses these approaches from a post-modern perspective and draws attention to the different discourses associated with each. Terms such as "integration", "improve" and "enhance" are typical of the latter viewpoint. A number of influential theorists of IT in education, however, espouse the transformative view of IT.

Semantically, the use of alternative terms, such as "permeation", may thus be desirable. "Integration" of IT as it is discussed in the context of teacher education, however can be seen as a method of ensuring that the skills and strategies associated with it are contextualised. Stand-alone courses may still be effective if classroom strategies, curriculum-based teaching and affective aspects are dealt with and, if organised appropriately, may still have a place in supporting and consolidating work elsewhere in students' pre-service education. As suggested by HM Inspectorate (cited in Willis & Mehlinger, 1996, p.1011) this may be a more appropriate approach at some stages in an institution's growth. Topp found that graduates with 2-4 years classroom experience who had *not* taken an introductory computer-specific course rated their preparation significantly lower than those who had completed the course. Watson's study of pre-service teachers in Australia (Watson, 1997) convinced her that there is still a need for skills-based IT education for these students, to deal with

the lack of competence which they perceived in themselves. However, there needs to be careful consideration of the way in which they are organised to deal with the wide range of student needs. One issue to consider is whether acquisition of skills needs to precede pedagogic use of IT or whether it should be dealt with in the context of classroom activities.

In their 1996 survey of the field Willis and Mehlinger report "relatively few efforts" (p.1001) to integrate technology across the teacher education curriculum but found those encouraging. Most involved efforts to work within existing course structures and most targeted specific courses within the curriculum. A scanning of the literature since then indicates that there has been a growing number of such initiatives reported. Levin & Buell (1999), for example, describe how IT content in a course was distributed throughout other pre-services courses over a two-year programme, while in another programme (Campbell & Warburton, 1999) Information Technology was timetabled separately but the instruction was blended into assignments or projects in a Language Arts course. Though establishing a separate IT course, another college (Brush, 1998) designed the objectives and activities to relate directly to classroom teaching and students' work in content areas with the intention of removing the stand-alone course when others had picked up the ideas. Projects for upskilling lecturers, to help them integrate IT in their teaching, are being established in a number of institutions (for example Haile & Payne, 1999; O'Bannon, Matthew, & Thomas, 1998; Parker, 1997; Sprague, Kopfman, & Dorsey, 1998).

A major USA national survey of IT in teacher education (Moursund & Bielefeldt, 1999) gives evidence for growing integration of IT. 31% of institutions reported that faculty modelled effective use of IT in more than half of courses and the mean was 26 to 50%; however, 36% reported staff using IT in a quarter or less of courses. One of the major findings of this study was that the integration factor – composed of

items that addressed graduates' classroom skills and the actual use of IT during training – correlated most strongly with other scores including skills of students in using applications. The number of hours spent by students on formal IT course work (particularly in IT-specific courses) was found to have very little relationship to scores which measured, among other things, the ability of students to use applications and to integrate technology into their own teaching. The number of hours of IT instruction integrated into other courses did, however, correlate with these scores. The authors comment that "the possibility remains that standalone IT courses are generally not an efficient way to help new teachers use technology in schools. ... If we want to encourage the use of technology as a tool for learning and problem solving, it makes sense that we would want teachers to model this activity for students at all levels and in all appropriate contexts" (p.23).

Teaching experience

Student teaching practice is the second major issue raised in the literature. As well as situating College-based learning about IT in the context of different subject areas there is a strong current flowing through work in this area demanding that IT experiences be embedded in the classroom experience of student teachers. IT is thus identified as an important component of the course, and students are given an opportunity to develop their competence. There are, however, major problems resulting from the attitudes of tutors, or associate teachers, and unfamiliar software and hardware. At present many studies indicate that there is considerable difficulty in ensuring that all student teachers are placed with classroom teachers who have the confidence and knowledge to model and support the kind of teaching which is required, while access to equipment is often an added problem.

Two British reports (Dunn & Ridgway, 1991a; Dunn & Ridgway, 1991b) studied the use of IT by one cohort of student teachers during their teaching practice sessions.

Although they found an increase in use of IT from the first teaching experience to the final one, they expressed concern that a significant proportion of students would leave college with no classroom experiences. Although those that had used computers on teaching practice reported increased confidence as a result, the quality of their use was doubtful and mostly peripheral to the planned class work. Those who did use computers in their first teaching experience reported no problems with lack of personal skills. Those who had done an optional computer studies course, in addition to their compulsory computer awareness course, expressed greater confidence in the classroom, but were no more likely to use a computer in the classroom than those who had not taken such a course. That personal expertise is not the major factor in determining whether students use computers in the classroom is also suggested by the findings of Monaghan (1993) and Wild (1995).

One approach to dealing with teaching experience involved bringing children into a college of education where students worked with them using IT within the context of a course in which the emphasis was changed from students' own personal skills to their professional use of IT in an educational setting (Bennett, Hamill, Naylor, & Pickford, 1997). A modest increase in personal confidence occurred, together with a shift in the focus of anxiety from personal skills to pedagogical skills. 73% of the students' cohort (of which the trial group was about 10%) was found to use IT during the school-based teaching experience. This figure is much higher than those reported by others, though not necessarily as a direct result of this experiment alone. Another innovative programme combined pre-service and inservice education, with lecturers and student teachers working in an American elementary school (Kamens, 2000). As a result, both student teachers and the cooperating teachers with whom they were paired developed understanding and confidence in using computers in the classroom.

An Australian study (Downes, 1993) found that students' use of computers increased over three teaching practice sessions, and became more closely related to class work, but still less than half of students used IT in the final practicum. Studies that are more recent still show a lack of student teacher experience of using IT in the classroom. Simpson and colleagues (Simpson et al., 1998) carried out a national survey of beginning and graduating student teachers in Scotland. Only around a third were found to have seen or used a range of ICT in the classroom, with the exception of text handling (for which the figure was still only just over half). Again, the quality of experiences was very variable and often poor. In Northern Ireland a survey of three teacher training institutions (Murphy & Greenwood, 1998) also found that computer use in school during teaching practice was low (24% of PGCE and 15% of B.Ed. students often used computers on teaching practice) and, for many students, non-existent (17% of PGCE and 34% of B.Ed. students had never used a computer on teaching experience).

Moursund and Bielefeldt (1999) found that low numbers of students routinely applied IT in their teaching practice and fewer students found that classroom teachers modelled IT use during their practicum. Almost half (47%) of institutions reported that half or less of students applied IT and 66% reported modelling for half or less of their students.

In both studies by Handler and Pigott referred to above (Handler, 1993; Handler & Pigott, 1995) students who felt prepared to use IT in their own teaching reported much more than students who felt unprepared, that they had observed the use of IT often or consistently. The percentages, however, for both groups were relatively small with around 45% and under 40% of the prepared students using computers in their teaching practice in the first and second study, respectively. Figures for observing use in schools were 59 and 51%.

First year teachers are in a good position to throw light on the effectiveness of their pre-service education and their experiences can illuminate the needs of those who follow them. In the USA, Strudler, McKinney, Jones and Quinn (1999) followed up two cohorts of beginning teachers, who reported that their student teaching practice had had minimal impact on their preparation to use computers in their own teaching. Both coursework and teaching experience lagged behind their preparation in other areas of the curriculum. The authors conclude that integrating IT into students' field experiences is the most critical need for preparing them to use it in their own teaching.

Ensuring that students obtain classroom experience in using IT is a complex problem. Preparation in college-based work may be a significant factor, as are the expectations placed on students. Bennett (cited in Bennett et al., 1997, p.298), for example, found that requiring a written evaluation of an IT activity on teaching practice increased the take-up rate to 100%.

There is a relationship between student teachers' confidence in using IT and their engagement with it on teaching experience (Handler, 1993; Handler & Pigott, 1995). It can be postulated that the degree of use of computers by students on teaching experience represents a measure of the effectiveness of other elements of their education in the use of IT. However, the facilities in the school, the school's policies on IT and the personal skills and attitude of the associate teacher must also be important factors and there has been little reported investigation of this. Rather than teaching student teachers, there actually appears to be an assumption on the part of many schools that students, during their teaching experience, are themselves able to introduce into the school new ideas and skills related to IT.

Resources

It is generally accepted that IT requires a high level of funding for equipment, software and support services. Not only is the initial outlay expensive, but equipment and software date rapidly. Many colleges of education throughout the world appear to have had difficulty in providing these resources and although many pre-service teacher education providers are part of larger tertiary education institutions, this has not always guaranteed adequate or suitable resources. Often teacher education demands different software, and equipment that is comparable to that used in schools. Facilities are required in teaching rooms, whereas other University departments may rely on multi-purpose computer laboratories and not expect students to have access to audio-visual production facilities. Recommendations on the facilities required now include local area networking within institutions and ready access to the Internet, with e-mail and voice-mail facilities and on-line library databases. It is generally agreed that lecturers should be able to use these from desktop computers within their offices, and preferably from home (Willis & Mehlinger, 1996).

Standards for the provision of computer facilities have often been included in the recommendations of official reports (eg Department of Education and Science, 1989b). In the USA the Office of Technology Assessment (1995) saw access to resources as a major barrier in teacher education, though it pointed out that technical support was usually greater than in schools. The report, by contrast, drew attention to a lack of *institutional support* for staff to use IT in terms of encouragement and rewards (through criteria for pay and promotion). Willis and Mehlinger, in their review of the literature commented that, "many elementary and secondary schools today are better equipped than the colleges of education from which they employ their teachers" (1996, p.1015) and compare this to the situation in medical colleges,

where it is accepted that the highest standard of equipment must be provided. Moursund and Bielefeldt (1999) however found that most American teacher education institutions reported having adequate or better IT facilities for staff and students, though about a third believed that their facilities limited their delivery of programmes. This may reflect an improvement in resource provision over a period of time and possibly the viewpoint of the senior staff and administrators who completed their questionnaire.

Researchers continue to comment on the need for resources. For example, Murphy and Greenwood (1998) identify student access to computers as one of the three major obstacles to integrating IT into UK teacher training. In the USA Stetson and Bagwell (1999) also include it in their list of three recommendations, commenting also that students need to have adequate facilities in classrooms during their practicum.

Need for further research on IT in New Zealand pre-service teacher education

Within New Zealand, the only published research in this area of teacher education is concerned with in-service staff development for practising teachers. There appears to be no published research that addresses the effectiveness of pre-service teacher education in this area, or the nature of students' or lecturers' experiences and beliefs.

Previous government action has been restricted to in-service teacher development in IT. The New Zealand government has only recently made clear its expectations of schools in respect to IT and ministerial statements have been made which imply that this must become a priority in pre-service teacher education. If the trends in the U.K. and the U.S.A. are followed here, as is beginning to occur in Australia, it is possible that New Zealand will establish national standards for teacher IT competency and

accreditation of pre-service teacher education programmes. It is also possible (though less likely) that government funding will be made available to develop pre-service programmes in IT as in the U.K. and the U.S.A. In these circumstances it is important that teacher educators in the area of IT begin to develop a better understanding of the way in which the situation in this country differs from, or is similar to, those elsewhere.

Within the Auckland College of Education, most student primary teachers at the time of this study were enrolled in the three-year Bachelor of Education (Teaching) programme. All first year students in the programme are required to complete a module in Information and Communication Technology (ICT), which is located at the Q5 level of the New Zealand Qualifications Framework, equivalent to most first-year university undergraduate papers. The module is conceived of as introducing students to the use of ICT in educational contexts within primary schools, rather than as a course in techniques of using these technologies, which are interpreted widely to include computer software, video and audio recording and print-based media. One aim of the module is to prepare students to use ICT within their subject-based modules. There is an emphasis on information literacy, based on the *Action Learning* model developed by Gawith (1988). During this module students are required to demonstrate an understanding of theoretical aspects, gained through reading, use of video, class discussions and reflection on practical class activities, and carry out a group project using ICT to research a topic and present a report to their class. At the time of this study the topic of the research was an aspect of ICT use in schools, and involved students in visits to schools to observe and interview teachers.

A further, optional, module called "Teaching And Learning with Information and Communication Technology" is available to students in their third year, which builds on students' increased classroom experience and concentrates of the theory and

practice of using IT in teaching. Because only two optional modules are included in the three-year course, this module is only taken by a small proportion of students.

Most secondary student teachers are enrolled for the Graduate Diploma in Teaching, which is a one-year programme. In addition, a smaller number of graduating students come from the three-year Bachelor of Physical Education programme. These programmes do not have a separate module in ICT and rely on the integration of aspects of IT into the specialist teaching subject modules. At present, the degree to which IT is included in these modules is severely limited. One of these specialist subjects is concerned with the teaching of ICT as a component of the Technology curriculum in New Zealand secondary schools.

The College has adopted draft entry and exit standards for IT and is seeking to integrate the use of IT into all modules as appropriate. Exit standards have been based on the USA NCATE accreditation standards and entry standards specify minimal competencies in computer use that students are expected to have on entry to their programmes. Students who enter the College unable to demonstrate these standards are offered some basic courses by the Student Learning support unit and expected to take personal steps to develop their own technical skills.

In the light of the need for pre-service teacher education programmes in New Zealand to face the issues raised in this chapter, there is a demonstrated need for some systematic study to be undertaken which can bring about greater understanding of the problems and issues within a New Zealand context, and for the development of approaches with a sound basis of theory and research. A valuable start to bringing about innovation within an organisation is to establish the current state of practice, to enable changes to be planned on the basis of sound baseline data. A paper by Parker

(1997) represents one example of a teacher-education institution adopting this approach to staff development in IT.

The current study is planned, therefore, to provide similar information for a college of education within New Zealand. It seeks to investigate:

- the current use of IT within College pre-service teacher education programmes
- the degrees of access of students and lecturers to computer equipment and services
- the knowledge and skills of students and lecturers in the use of IT
- the experience of lecturers and students in using IT in school classrooms
- lecturers' and students' beliefs about the importance of different aspects of IT for beginning teachers.

As an outcome of the study it is believed that wider aspects of IT use within the College will be illuminated and guidance gained for future research directions and for course development. Of wider significance, this should provide the first major documented study of information technology within New Zealand teacher education.

CHAPTER 2

The Method

The Participants

Four groups of participants were involved in the study. They were lecturers, first year primary teaching students, graduating primary teaching students, and graduating secondary teaching students. The term "primary student teacher" is used to cover students who are specialising in early-childhood teaching as well as those concentrating on the primary school level, since their courses are largely the same in learning outcomes and teaching methods, with the same modules available to both groups. All first year primary student teachers were enrolled in the three-year B.Ed.(Tchg) programme. The graduating primary students were a more diverse group containing some students from the four-year Dip.Tchg. program, which has been replaced by the degree programme. The secondary student teachers were largely completing the one-year Graduate Diploma in Teaching, but a small number were in the final year of the B.Ed.(PE) four-year course.

Tables 1 and 2 show the characteristics of the staff and groups of students who completed the questionnaires. Lecturers were asked to indicate the programmes within the College in which they taught; most teach in more than one. Only those lecturers who taught within the pre-service programmes answered the questions relating to use of IT within courses. A small number of lecturers who did not teach in these programmes completed the first part of the survey relating to personal skills and uses of IT.

Table 3 shows how these samples compare with the College population. The sample of lecturers was slightly under one half of all lecturers in the College and both sexes

appear to have been represented in proportions similar to their proportion in the whole group. The proportions of students sampled were somewhat less than those of staff, with a total of about 23% of first year primary students, about 31% of final year primary students and about 41% of secondary students.

Table 1: Participants: Lecturers
Number of respondents (and proportion of sample) who responded to each category

Total		108 (100%)
Sex	Male	24 (22.2%)
	Female	71 (65.7%)
	No response	13 (12.0%)
Ethnicity	NZ European	77 (71.3%)
	Maori	8 (7.4%)
	Pacific Islands	6 (5.6%)
	Other	-
	No response	17 (15.7%)
Programmes taught	B.Ed.(Tchg)–ECE	14 (13.0%)
	B.Ed (Tchg)-Prim.	65 (60.6%)
	B.Ed. (PE)	5 (5.2%)
	Dip. Tchg. (Prim.)	27 (25.0%)
	G.Dip.Tchg (Sec.)	15 (13.9%)
	H./Ad. Dip.Tchg.	24 (22.2%)
	M.Ed.	17 (15.7%)
Total Teaching Experience (yrs)	Mean	24.0
	SD	8.8

Table 2: Participants: Students
Number of respondents (and proportion of sample) who responded to each category

		First Year Primary	Final Year Primary	Secondary Graduate
Total		92 (100%)	104 (100%)	80 (100%)
Sex	Male	12 (13.0%)	11 (10.6%)	17 (21.3%)
	Female	78 (84.8%)	82 (78.8%)	61 (76.3%)
	No response	2 (2.2%)	11 (10.6%)	2 (2.6%)
Ethnicity	NZ European	55 (59.8%)	56 (53.8%)	61 (76.3%)
	Maori	4 (4.3%)	11 (10.6%)	5 (6.3%)
	Pacific Islands	2 (2.2%)	6 (5.8%)	5 (6.3%)
	Other	6 (6.5%)	6 (5.8%)	4 (5.0%)
	No response	25 (27.2%)	25 (24.0%)	5 (6.3%)
Student	G. Dip Tchg (Sec)	-	-	75 (93.8%)
Programme	B.Ed.(Tchg)-ECE	2 (2.2%)	18 (17.3%)	-
	B.Ed (Tchg)-Prim.	88 (95.7%)	72 (69.2%)	-
	Dip.Tchg,	-	4 (3.8%)	-
	B.Ed. (PE)	-	-	3 (3.8%)
	No response	2 (2.2%)	10 (9.6%)	2 (2.6%)
Age	Under 20 yrs	37 (40.2%)	1 (1.0%)	-
	20-24 yrs	18 (19.6%)	39 (37.5%)	25 (31.3%)
	25-39 yrs	24 (26.1%)	37 (35.6%)	41 (51.3%)
	40-44 yrs	9 (9.8%)	8 (7.7%)	9 (11.3%)
	45-49 yrs	2 (2.2%)	6 (5.8%)	3 (3.8%)
	50 yrs or over	-	2 (1.9%)	-
	No Response	2 (2.2%)	11 (10.6%)	2 (2.6%)

Procedure

Two questionnaires, one for lecturers and one for students, were designed by the researcher in discussion with colleagues. The questionnaires contained as much

common material as possible, to aid analysis and provide for comparisons. To obtain information about staff and student skills and expectations a list of IT capabilities was compiled on the basis of the College's exit standards, the information skills model developed by Gawith (1988) and the author's knowledge of the range of IT skills used in the College and in schools.

Table 3: Comparison of sample with the population
Number of respondents in each group

	Total Population	Sample (% of total pop'n)
Staff		
Male	59	24 (40.7%)
Female	153	71 (43.6%)
No response		13
Total	222	108 (48.6%)
1st Year Primary Students		
Primary B.Ed.(Tchg)	248	88 (25.3%)
E.C.E. B.Ed.(Tchg)	49	2 (4.1%)
No response		2
Total	397	92 (23.2%)
Final Year Primary		
Primary B.Ed.(Tchg)	254	72 (28.3%)
ECE B.Ed.(Tchg)	38	18 (47.4%)
Dip. Tchg.	47	4 (8.5%)
Total	339	104 (30.7%)
Secondary		
Graduate Diploma of Teaching	173	75 (43.4%)
B.Ed. (PE)	23	3 (13.0%)
No response		2
Total	196	80 (40.8%)

The questionnaire was then submitted to a sample group of staff and students to complete and comment on. Based on the feedback from these testers a number of changes to the wording were made to clarify intentions and remove ambiguities as well as correct typographical errors. Copies of the final questionnaires are given as *Appendix 1* and *Appendix 2*.

Towards the end of the third term lecturer questionnaires were distributed through the internal mail system to all staff identified as having teaching roles, together with a description of the purpose of the research and a request for completed questionnaires to be returned within a three week time period. An item was also inserted in the weekly staff news-sheet to inform lecturers about the study and seek their assistance. All lecturers received a follow-up reminder note at the end of four weeks and a further reminder in the weekly news-sheet.

It was decided to distribute student questionnaires to first and final year primary students through randomly chosen classes in compulsory modules, which would ensure that all students had a chance of being chosen without duplication. Only one module was available in each of the first and final year courses and it was necessary to wait to administer the questionnaire until the classes met in the middle of the fourth term. Unfortunately, because of the limited number of sessions available to them, lecturers teaching the classes were unhappy with the proposal that students complete the questionnaires during class time. It was, therefore, agreed that the researcher would introduce the questionnaire and hand them out during the class and that students would complete them during their own time and return them to their lecturer or directly to a box set up in the foyer. After a fortnight lecturers of the classes to which the questionnaires had been distributed were approached personally and in writing and asked to remind their students about returning the questionnaires.

When the number of responses from the initial distribution of the questionnaire were found to be too low to ensure validity, other lecturers of first year and graduating students were asked to administer the questionnaire to their classes. A number did so during the last two weeks of the term, resulting in a significant number of additional completed forms. Although this did not meet the original sampling method, and students did not receive the same introduction from the researcher, it was believed that no significant bias was introduced by the manner of obtaining additional subjects.

Questionnaires for secondary students were administered at a "Director's Forum" in the third term, which the whole target group was required to attend. The researcher was able to explain the research and distribute questionnaires but, again, it was not possible for students to complete the questionnaire at the venue, and unfortunately, the attendance at this session proved to be exceptionally low. A number of questionnaires were returned following this meeting but questionnaires were handed to all other students by the Academic Registry as students completed their formalities at the end of the term. A significant number of these questionnaires were returned, but the total response rate was much lower than initially anticipated.

Analysis of data

The researcher created a spreadsheet on which data could be entered, and an assistant undertook the coding based on established criteria. Error checking was carried out through a process in which data was entered twice, on separate spreadsheets, and an automatic procedure identified on a third spreadsheet where differences existed. This allowed errors in entry to be corrected. Data from the separate spreadsheets for each group of respondents were then imported into the SPSS computer programme, where all data was combined into a single datafile for

analysis. Frequencies were measured and parametric statistical analyses were carried out on data in this file, as explained in Chapter 3.

Ethical issues

The nature of an anonymous questionnaire reduces the potential for ethical problems to be raised by this research. Plans for the study were presented to the College ethics committee, which reported that they did not need to give approval under such circumstances. To protect the anonymity of all participants questionnaires were not marked or differentiated in any way. Each questionnaire contained a written explanation of the project and the nature of the involvement of each respondent. Each person who received a questionnaire had a real choice in whether or not they completed and returned it. Once returned, questionnaires contained no information that could enable the respondent to be identified.

This approach made administration of the questionnaires very simple, but had undesirable consequences in the inability to follow up individuals who did not return questionnaires. Neither did it allow for clarification of responses or of the reasons for incomplete sections. This could have enabled a higher response rate of valid questionnaires to be achieved, or provided valuable additional data. For example, lecturers were not asked about their teaching subjects, because this would, in combination with other data, have made many easy to identify, but this information could have given insight into different approaches to IT .

CHAPTER 3

Results

Introduction

This chapter describes the results obtained from the analysis of questionnaires returned by lecturers and students (Appendix 1 and Appendix 2). Students were sampled from three separate groups: first-year primary and early childhood student teachers, final-year primary and early childhood teachers, and graduating secondary teachers who were predominantly studying for the Graduate Diploma in Teaching.

The response format for a large number of questions was a simple 'YES' or 'NO'. These responses were coded as '1' and '0' respectively. The mean of responses on such a scale is the proportion of respondents answering "YES". Parametric tests have been used throughout the analyses as it is assumed, following the Central Limit Theorem, that the distribution of means drawn from the underlying populations will be approximately normal, and it has also been assumed that the interval between response categories are approximately equal. Post-hoc analyses for significant differences between groups were carried out using the method of least significant difference (LSD) at a significance level of 0.05.

Use of Computers

Access and ownership

Within College: Over 90% of lecturers had exclusive access to a computer (see Table 4), with the typical lecturer reporting that they were using a computer for work related activities at least 8 or more hours a week (See Table 5). However, only slightly more than a third of lecturers reported using computers in their work with

students. Students, at the time of the study, did not have exclusive access to computers at College, but around half of the students reported using computers at College for College work outside of formal classes (see Table 6). A significant difference [$F(2,273) = 3.39$, $p = 0.035$] existed between the rates of use reported by first and third year primary trainees, with the latter group being heavier uses of the technology. The average first year student reported using College computers for less than 1 hour a month, whereas the average final year primary and secondary student used College computers between 1 and 4 hours a week (see Table 7).

Table 4: Proportions of lecturers using computers within College

Activity	Lecturers	
	Mean	SD
Have exclusive use of a computer provided at College	0.91	0.29
Have access to a shared computer at College	0.38	0.49
Use a computer in professional work at the College	0.96	0.19
Use a computer personally when working with students	0.37	0.48

Table 5: Frequency of different rates of College-related computer use by Lecturers

Rate of use	Total Use	At Home
1: Less than 1 hour a month	0 (0%)	3 (3%)
2: 1-3 hours a month	2 (2%)	14 (14%)
3: 1-4 hours a week	16 (16%)	43 (44%)
4: 5-7 hours a week	23 (22%)	18 (19%)
5: 8 or more hours a week	62 (60%)	19 (20%)

Table 6: Proportions of students using computers in the College outside of timetabled classes

Activity	First year primary		Final year primary		Secondary	
	Mean	SD	Mean	SD	Mean	SD
Use a College computer outside class for College work	0.36	0.48	0.51	0.50	0.49	0.50
Use a College computer outside class for any purpose	0.45	0.50	0.63	0.49	0.50	0.50

Table 7: Frequency of different rates of College computer use by students outside timetabled classes

Rate of use	First year primary		Final year primary		Secondary	
1: Less than 1 hour a month	10 (30%)		14 (26%)		9 (23%)	
2: 1-3 hours a month	10 (30%)		10 (19%)		8 (20%)	
3: 1-4 hours a week	6 (18%)		17 (32%)		15 (38%)	
4: 5-7 hours a week	5 (15%)		8 (15%)		5 (13%)	
5: 8 or more hours a week	2 (6%)		4 (8%)		3 (8%)	
	Mean	SD	Mean	SD	Mean	SD
	2.4[a]	0.8	2.6	1.2	2.6	1.2

[a] Response values: 1 = "less than 1 hour a month", 2 = "1-3 hours a month", 3 = "1-4 hours a week", 4 = "5-7 hours a week", 5 = "8 or more hours a week"

Outside College: A very high proportion (0.96) of lecturers and students (0.87 to 0.96) either owned a computer or had regular access to a computer outside College (see Table 8). First year primary students were significantly less likely to have access than either lecturers or final year primary students [$F(3,379) = 2.98$, $p = 0.032$].

A very high proportion (0.91) of the lecturers and students (0.91 to 0.96) with access to computers outside College used them for College-related work. The typical lecturer reported that they use a computer at home for work related purposes for 1 to 4 hours a week (see Table 9). A typical first year student uses their home computer for College-related work for about the same amount of time, whereas a typical final year primary or secondary student uses it for eight or more hours a week. Significant differences existed between mean ratings of rate of use [$F(3,355) = 7.65$, $p < 0.0005$]. Post hoc analysis (LSD, alpha = .05) indicates that final year primary students and secondary students each reported significantly more frequent use than both lecturers and first year primary students.

Table 8: Proportions of lecturers and students with access to computers outside College, using them for College work and for Internet or e-mail access

Activity	Lecturers		First year primary		Final year primary		Secondary	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Own a computer or have regular access to one outside College	0.96	0.19	0.87	0.34	0.96	0.19	0.91	0.28
Use a computer outside College for College work	0.91	0.29	0.91	0.28	0.96	0.19	0.96	0.19
Have a personal e-mail address	0.95	0.21	0.53	0.50	0.54	0.50	0.69	0.47
Access information using the Internet (excluding e-mail)	0.85	0.38	0.64	0.48	0.77	0.42	0.88	0.33

Table 9: Frequency of different rates of use of computers by lecturers and students outside College for College work

Rate of use	Lecturers		First year primary		Final year primary		Secondary	
1: Less than 1 hour a month	3 (3%)		1 (1%)		0 (8%)		1 (1%)	
2: 1-3 hours a month	14 (13%)		14 (15%)		8 (30%)		4 (5%)	
3: 1-4 hours a week	43 (44%)		34 (41%)		30 (30%)		21 (27%)	
4: 5-7 hours a week	18 (19%)		16 (19%)		29 (29%)		22 (28%)	
5: 8 or more hours a week	19 (20%)		19 (23%)		33 (33%)		30 (39%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	3.4[a]	1.1	3.5	1.0	3.9	1.0	4.0	1.1

[a] Response values: 1 = "less than 1 hour a month", 2 = "1-3 hours a month, 3 = "1-4 hours a week" 4 = "5-7 hours a week", 5 = "8 or more hours a week"

Use of Information Technology by lecturers

Lecturers indicated the forms of IT that they regularly used in their College work and their responses are summarised in Table 10. Almost all lecturers used word-processing and only slightly fewer used electronic communications. Sending and receiving fax messages was reported by about three-quarters of lecturers, though this probably involves very little personal expertise since within the College support staff are usually responsible for operating fax machines. Accessing information on the Internet was carried out by about 70% of lecturers and about a half used databases and played videotapes. All other seventeen uses were reported by fewer than half of the lecturers, and fourteen of these by fewer than a quarter.

Internet and electronic mail access

E-mail Access: A very large proportion (0.95) of staff, and a large proportion (0.69) of secondary students, replied that they had an e-mail accounts while slightly over

half primary students reported having personal e-mail accounts (see Table 8). There were significant differences between these groups' responses [$F(3,380) = 21.8$, $p < .0005$]. Post hoc comparisons (LSD, alpha = .05) showed that lecturers were significantly more likely to have accounts than all three groups of students and that secondary students were significantly more likely to have accounts than both groups of primary students.

Table 10: Proportions of lecturers using various forms of IT in their College work during a typical week.

Form of IT used	Mean	SD
Word processing	0.96	0.19
Communicating using e-mail or a bulletin-board	0.92	0.27
Sending or receiving fax	0.74	0.44
Accessing information on the Internet	0.68	0.47
Using existing databases (including library databases)	0.51	0.50
Playing video-tapes	0.50	0.50
Desk-top publishing	0.35	0.48
Playing audio recordings on tape or CD	0.34	0.48
Recording TV programmes on video-tape	0.30	0.46
Using presentation software (eg PowerPoint)	0.24	0.43
Finding information on a CD-ROM	0.22	0.41
Making sound recordings	0.21	0.41
Using a spreadsheet program	0.18	0.39
Graphic design	0.14	0.35
Recording with a video camera	0.13	0.34
Creating own databases	0.12	0.33
Creating or editing pictures using computer software	0.12	0.33
Using a digital camera	0.10	0.31
Using a graphics scanner	0.10	0.31
Creating World-Wide Web pages	0.09	0.29
Video editing	0.09	0.29
Editing sound recordings	0.06	0.23
Creating hyper-media presentations	0.05	0.21

A typical lecturer used their e-mail account more than 4 times a day while students typically did so between 1 and 4 times a week. Analysis of the mean reported rates of e-mail access (see Table 11) showed a significant difference between groups [$F(3,274) = 68.7$, $p < .0005$]. Post hoc comparisons (LSD, alpha = .05) found that lecturers were heavier users of e-mail than all three student groups.

Table 11: Frequency of different rates of use of accessing e-mail by lecturers and students

Rate of use	Lecturers	First year primary	Final year primary	Secondary
1: Less than once a week	1 (1%)	15 (31%)	12 (21%)	9 (16%)
2: 1-4 times a week	8 (8%)	18 (37%)	20 (36%)	19 (34%)
3: once a day	13 (13%)	13 (27%)	14 (25%)	16 (29%)
4: 2-4 times a day	35 (34%)	3 (6%)	8 (14%)	9 (16%)
5: more than 4 times a day	46 (45%)	0 (0%)	2 (4%)	2 (4%)

Mean	SD	Mean	SD	Mean	SD	Mean	SD
4.1[a]	1.0	2.1	0.9	2.4	1.1	2.6	1.1

[a] Response values: 1 = "Less than once a week", 2 = "1-4 times a week", 3 = "once a day", 4 = "2-4 times a day", 5 = "more than 4 times a day"

World-Wide Web Access: The proportion of students and staff using the Internet to find information, through means such as the World -Wide Web is set out in Table 8. There was, again, a significant difference between groups' responses [$F(3,379) = 6.21$, $p < .0005$]. First year primary students were shown by post hoc analysis (LSD, alpha = .05) to report significantly less use of the Internet for accessing information than the other three groups.

Lecturers typically used the Internet in this way 1 to 4 times a week whereas students typically did so less than once a week (see Table 12). There was, again, a significant difference between groups' mean reported rates of access [$F(3,297) = 4.40$, $p = 0.005$] and post hoc analysis (LSD, alpha = .05) showed that first year primary students reported significantly less frequent use of the Internet to access information than both lecturers and secondary students.

Table 12: Frequency of different rates of use of accessing the World Wide Web by lecturers and students

Rate of use	Lecturers		First year primary		Final year primary		Secondary	
1: Less than once a week	28 (31%)		39 (67%)		37 (47%)		24 (34%)	
2: 1-4 times a week	36 (40%)		8 (14%)		21 (27%)		19 (27%)	
3: once a day	12 (13%)		8 (14%)		13 (17%)		13 (19%)	
4: 2-4 times a day	6 (7%)		3 (5%)		5 (6%)		9 (13%)	
5: more than 4 times a day	8 (9%)		0 (0%)		3 (4%)		5 (7%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	2.2[a]	1.2	1.6	0.9	1.9	1.1	2.3	1.3

[a] Response values: 1 = "Less than once a week", 2 = "1-4 times a week", 3 = "once a day", 4 = "2-4 times a day", 5 = "more than 4 times a day"

Computers in teaching and learning

Lecturers and students were asked a number of questions seeking information on the extent to which they had used or observed the use of computers in teaching (see Table 13). Two of the questions were unique to lecturers: about half of the lecturers indicated that they had used computers in class as a lecturer, and about a quarter had observed students using computers during teaching practicum.

Both students and lecturers were asked to identify which of the remaining four categories they had experienced. Inspection of data suggests that final year primary students reported greatest experience in all categories and that in three of the categories lecturers had the least experience.

Table 13: Proportions of lecturers and students reporting experiences of using or observing computer use in teaching

Experience	Lecturers N =103		First year primary N = 91		Final year primary N = 94		Secondary N = 103	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Observed student teachers using computer-related activities on teaching experience.	0.24	0.43	N/A	N/A	N/A	N/A	N/A	N/A
Observed experienced teachers using computers as part of their classroom programme	0.59	0.49	0.69	0.46	0.72	0.45	0.53	0.50
Taught in a school where computers were used by pupils as part of the programme	0.57	0.50	0.79	0.41	0.86	0.35	0.81	0.39
Used computers as part of the classroom programme as a teacher in a school	0.52	0.50	0.37	0.49	0.59	0.50	0.48	0.50
Been a student on a course which used computers as part of the programme	0.40	0.49	0.53	0.50	0.66	0.48	0.49	0.50
Used computers as part of own teaching as a teacher educator	0.53	0.50	N/A	N/A	N/A	N/A	N/A	N/A

Secondary students reported significantly [$F(3,363) = 3.02$, $p = 0.03$] less experience of having observed experienced teachers using computers in the classroom than both groups of primary students. Lecturers were significantly less likely to have taught in a school using computers as part of the programme than all groups of students [$F(3,363) = 9.22$, $p < 0.0005$]. Both lecturers and secondary students reported

significantly less experience of having been a student on a course which used computers as part of the programme [$F(3,363) = 4.69$, $p = 0.003$] than final year primary students. There was a significant difference between groups' reported experiences in using computers as part of a classroom programme when teaching in a school [$F(3,363) = 2.98$, $p = 0.031$], with first year primary students reporting this less than both lecturers and final year primary students.

Student experiences of IT within the College

Information Technology used in course delivery: Students were asked to identify, on a 6-point scale, the proportion of modules in which their lecturers used various kinds of media in their teaching (see Table 14). Whiteboard or blackboard, printed handouts and the overhead projector were reported as most frequently used by their lecturers, on average in 75 to 100% of modules. Videotape recorders were used less frequently, and other information technologies hardly at all.

Significant differences between groups were found in four cases. First year primary students reported the use of the overhead projector [$F(2,261) = 3.52$, $p = 0.03$] and video recorder [$F(2,258) = 3.26$, $p = 0.04$] as significantly more frequent than both other groups. Secondary students reported significantly less frequent use of presentation software [$F(2,254) = 4.75$, $p = 0.01$] and electronic mail than both groups of primary students [$F(2,251) = 3.53$, $p = 0.03$] .

Information technology used by students in modules: Students were also asked to estimate, on a 6-point scale, the proportion of modules in which they had used different aspects of IT (see Table 15). Overall, the greatest use was made of word processing (with an average of between 50 and 75% of modules). Next greatest reported uses were of recording and presenting information, of locating information sources and using databases but, surprisingly, students reported that on average these

were used in less than half of their modules. Desk-top publishing, the use of the telephone, Internet and video, and designing research questions was reported on average for 10-25% of modules and students reported rarely being required to use the Internet, video or audio recording and editing, or equipment such as cameras and scanners.

Table 14: Means of Students' ratings of the proportion of modules in which various media were used by lecturers

Medium	First year Primary Students		Final Year Primary Students		Secondary Students		Overall	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Whiteboard or blackboard	4.99[a]	1.13	5.23	1.10	4.87	1.34	5.05	1.19
Printed handouts	4.70	1.26	5.11	1.06	4.90	1.32	4.91	1.22
Overhead projector	4.13	1.46	4.62	1.23	4.18	1.44	4.33	1.38
Video cassette recorder	2.35	1.36	2.80	1.55	2.27	1.58	2.49	1.51
Audio tape recorder or CD player	1.54	0.81	1.64	1.12	1.29	0.98	1.50	0.99
Presentation software on a computer	1.49	0.91	1.57	1.00	1.15	0.87	1.42	0.95
Electronic mail	1.32	0.80	1.25	0.89	1.00	0.68	1.20	0.81
World-Wide Web pages	1.28	0.63	1.52	1.01	1.27	0.86	1.36	0.86
Projector linked to a computer	1.38	0.80	1.34	0.92	1.17	0.86	1.30	0.86

[a] A scale value of 6 = about 100% of modules, 5 = about 75%, 4 = about 50%, 3 = about 25%, 2 = about 10%, 1 = less than 10%

One-way analysis of variance between the three groups of students shows significant differences between them (see Table 16). Secondary students report use of IT in significantly fewer modules than both groups of primary students for 18 of the aspects of IT, and 3 aspects significantly less than one of the groups of primary students. In one of these, use of presentation software, first year primary students reported greater use than both secondary and final year primary students. However, final year primary students reported greater use of databases than first year primary as well as secondary students.

Lecturers' expectations of students' using information technology: Lecturers were asked to state the number of pre-service modules in which they expected students to use aspects of information technology. These numbers were converted into a proportion by dividing by the number of pre-service modules taught by each lecturer (see Table 17). Almost all lecturers expected word processing to be used in their modules. Information handling skills of presenting information effectively, locating useful sources of information, note-taking and recording information and using databases (which includes library databases) were expected on average to be used in somewhat more than 60% of modules. Accessing information on the Internet, using the telephone and designing research questions were expected on average in around 40% of modules. Lecturers expected relatively few of their modules to require students to use data processing software (for example creating databases and using spreadsheets) or multimedia equipment and software (for example, playing or editing video and sound recordings, using scanners and digital cameras, using presentation software, creating multimedia or web pages).

Aspects of IT taught during modules: Lecturers were also asked to indicate whether or not they had personally taught these aspects during the pre-service modules that they taught (see Table 18). The only aspects taught by more than half of the lecturers were accessing information on the Internet (54%) and presenting information effectively (51%). Skills of designing research questions, locating useful sources of information, note-taking and recording information and designing learning activities which use IT were taught by over 40% of lecturers. Word processing, using classroom computer programmes and evaluating educational software were taught by slightly fewer lecturers.

Table 15: Mean Ratings by students of the proportion of modules in which they used various aspects of information technology

	Aspect of IT	First Year Primary Students		Final Year Primary Students		Secondary Students		Overall	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	Word processing	4.44[a]	1.77	5.00	1.42	4.84	1.78	4.76	1.67
2	Desk-top publishing	2.59	1.89	3.03	1.91	1.73	1.78	2.43	1.93
3	Using existing databases (including library databases)	2.93	1.74	3.64	1.64	2.77	1.95	3.12	1.81
4	Creating own databases	1.47	1.01	1.52	1.13	0.97	1.07	1.29	1.10
5	Creating or editing pictures using computer software	1.79	1.15	1.94	1.40	1.41	1.34	1.70	1.31
6	Statistical or other data analysis	1.62	1.20	1.53	1.03	1.28	1.10	1.46	1.11
7	Using a spreadsheet program	1.56	0.99	1.40	1.01	1.42	1.27	1.46	1.10
8	Using presentation software (eg PowerPoint)	1.79	1.18	1.42	0.72	1.15	1.00	1.45	1.02
9	Finding information on a CD-ROM	1.68	1.28	2.15	1.27	1.18	1.21	1.67	1.31
10	Creating hyper-media presentations	1.56	1.12	1.27	0.73	0.77	0.84	1.16	0.96
11	Communicating using e-mail or a bulletin-board	1.53	1.03	1.52	0.99	1.43	1.41	1.49	1.16
12	Accessing information on the Internet	1.91	1.34	2.25	1.30	2.29	1.76	2.15	1.48
13	Creating World-Wide Web pages	1.30	0.98	1.17	0.64	0.84	0.71	1.08	0.81
14	Video editing	1.62	1.12	1.51	0.70	0.82	0.73	1.31	0.94
15	Recording with a video camera	1.70	1.12	1.73	0.93	1.03	0.73	1.50	0.99
16	Recording TV programmes on video-tape	1.56	1.09	1.64	1.08	1.06	0.88	1.40	1.04
17	Playing video-tapes	2.16	1.40	2.30	1.45	1.72	1.40	2.06	1.43
18	Sending or receiving fax	1.64	1.15	1.54	0.97	1.05	0.85	1.40	1.02
19	Using a digital camera	1.44	1.04	1.23	0.73	0.89	0.75	1.18	0.89
20	Using a graphics scanner	1.47	1.02	1.42	1.09	0.94	0.81	1.25	1.00
21	Making sound recordings	1.45	1.01	1.37	0.68	0.91	0.72	1.23	0.85
22	Editing sound recordings	1.43	0.98	1.34	0.73	0.78	0.63	1.15	0.84
23	Playing audio recordings on tape or CD	1.67	1.30	1.84	1.24	1.16	1.07	1.54	1.23
24	Using classroom computer programmes designed for schools	1.62	1.10	1.69	1.10	1.24	1.19	1.51	1.15
25	Using the telephone	2.48	1.75	2.68	1.74	1.94	1.72	2.38	1.76
26	Locating useful sources of information	3.21	1.84	3.81	1.77	3.35	1.90	3.45	1.85
27	Presenting information effectively	3.66	1.89	3.80	1.77	3.49	2.11	3.65	1.93
28	Designing research questions	2.76	1.76	2.69	1.46	2.24	1.78	2.56	1.68
29	Note-taking and recording information	3.77	2.07	3.97	1.97	3.32	2.34	3.68	2.14
36	Using computer-based tutorials	1.41	1.20	1.46	0.93	0.99	0.95	1.26	1.05

[a] A scale value of 6 = about 100% of modules, 5 = about 75%, 4 = about 50%, 3 = about 25%, 2 = about 10%, 1 = less than 10%

Table 16: Differences between student groups' mean ratings of the proportion of modules in which they used various aspects of information technology

	Aspect of IT	Results of one-way ANOVA			Differences indicated by post hoc multiple comparison using the LSD method at 0.05 significance
		df	*F*	*p*	
1	Word processing		*NSD*		-
2	Desk-top publishing	2, 222	9.55	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
3	Using existing databases (including library databases)	2, 228	5.29	.006	Final year primary students report use in significantly *more* modules than both other groups.
4	Creating own databases	2,196	6.61	.004	Secondary students report use in significantly *fewer* modules than both groups of primary students.
5	Creating or editing pictures using computer software	2, 218	5.80	.034	Secondary students report use in significantly *fewer* modules than final year primary students.
6	Statistical or other data analysis		NSD		-
7	Using a spreadsheet program		NSD		-
8	Using presentation software (eg PowerPoint)	2, 226	8.11	.000	First year primary students report use in significantly *more* modules than both other groups.
9	Finding information on a CD-ROM	2, 231	12.03	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students. Final year primary students report use in significantly *more* modules than first year primary students.
10	Creating hyper-media presentations	2,198	13.72	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
11	Communicating using e-mail or a bulletin-board		NSD		-
12	Accessing information on the Internet		NSD		-
13	Creating World-Wide Web pages	2, 193	4.11	.002	Secondary students report use in significantly *fewer* modules than both groups of primary students.
14	Video editing	2, 228	19.10	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
15	Recording with a video camera	2, 245	14.43	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
16	Recording TV programmes on video-tape	2, 215	7.06	.001	Secondary students report use in significantly *fewer* modules than both groups of primary students.
17	Playing video-tapes	2, 231	3.61	.028	Secondary students report use in significantly *fewer* modules than final year primary students.
18	Sending or receiving fax	2, 222	7.72	.001	Secondary students report use in significantly *fewer* modules than both groups of primary students.
19	Using a digital camera	2, 225	8.35	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
20	Using a graphics scanner	2, 207	6.75	.001	Secondary students report use in significantly *fewer* modules than both groups of primary students.
21	Making sound recordings	2, 220	9.68	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
22	Editing sound recordings	2, 200	14.27	.000	Secondary students report use in significantly *fewer* modules than both groups of primary students.
23	Playing audio recordings on tape or CD	2, 213	9.36	.002	Secondary students report use in significantly *fewer* modules than both groups of primary students.
24	Using classroom computer programmes designed for schools	2, 218	3.46	.033	Secondary students report use in significantly *fewer* modules than both groups of primary students.
25	Using the telephone	2, 237	3.96	.020	Secondary students report use in significantly *fewer* modules than both final year primary students.
26	Locating useful sources of information		NSD		-
27	Presenting information effectively		NSD		-
28	Designing research questions		NSD		-
29	Note-taking and recording information		NSD		-
36	Using computer-based tutorials	2, 193	4.52	.012	Secondary students report use in significantly *fewer* modules than both groups of primary students.

Table 17: Proportion of modules in which lecturers expect students to use particular aspects of IT

	Aspect of IT	Proportion of modules for each lecturer	
		Mean	SD
1	Word processing	0.91	0.27
2	Desk-top publishing	0.18	0.38
3	Using existing databases (including library databases)	0.61	0.48
4	Creating own databases	0.07	0.22
5	Creating or editing pictures using computer software	0.18	0.37
6	Statistical or other data analysis	0.16	0.34
7	Using a spreadsheet program	0.12	0.30
8	Using presentation software (eg *PowerPoint*)	0.16	0.34
9	Finding information on a CD-ROM	0.30	0.43
10	Creating hyper-media presentations	0.11	0.29
11	Communicating using e-mail or a bulletin-board	0.21	0.39
12	Accessing information on the Internet	0.44	0.46
13	Creating World-Wide Web pages	0.02	0.12
14	Video editing	0.16	0.36
15	Recording with a video camera	0.20	0.37
16	Recording TV programmes on video-tape	0.16	0.36
17	Playing video-tapes	0.30	0.44
18	Sending or receiving fax	0.16	0.35
19	Using a digital camera	0.20	0.38
20	Using a graphics scanner	0.14	0.32
21	Making sound recordings	0.15	0.34
22	Editing sound recordings	0.12	0.31
23	Playing audio recordings on tape or CD	0.17	0.37
24	Using classroom computer programmes designed for schools	0.20	0.37
25	Using the telephone	0.42	0.49
26	Locating useful sources of information	0.63	0.47
27	Presenting information effectively	0.68	0.46
28	Designing research questions	0.38	0.45
29	Note-taking and recording information	0.61	0.48
30	Evaluating education software for classroom use	0.20	0.38
31	Designing learning activities which use IT	0.23	0.40
32	Understanding the use of IT to assist students with special needs	0.09	0.27
33	Understanding ethical and legal issues in using IT	0.21	0.39
34	Understanding theories of learning relating to IT use	0.20	0.37
35	Using IT for classroom record keeping	0.11	0.30
36	Using computer-based tutorials	0.07	0.24

Table 18: Proportion of lecturers teaching aspects of IT to students during pre-service courses

	Aspect	Mean	SD
1	Word processing	0.39	0.49
2	Desk-top publishing	0.20	0.40
3	Using existing databases (including library databases)	0.24	0.43
4	Creating own databases	0.22	0.42
5	Creating or editing pictures using computer software	0.29	0.46
6	Statistical or other data analysis	0.17	0.38
7	Using a spreadsheet program	0.24	0.43
8	Using presentation software (eg *PowerPoint*)	0.22	0.42
9	Finding information on a CD-ROM	0.37	0.49
10	Creating hyper-media presentations	0.17	0.38
11	Communicating using e-mail or a bulletin-board	0.29	0.46
12	Accessing information on the Internet	0.54	0.50
13	Creating World-Wide Web pages	0.05	0.22
14	Video editing	0.17	0.38
15	Recording with a video camera	0.32	0.47
16	Recording TV programmes on video-tape	0.10	0.30
17	Playing video-tapes	0.17	0.38
18	Sending or receiving fax	0.17	0.38
19	Using a digital camera	0.22	0.42
20	Using a graphics scanner	0.20	0.40
21	Making sound recordings	0.12	0.33
22	Editing sound recordings	0.07	0.26
23	Playing audio recordings on tape or CD	0.15	0.36
24	Using classroom computer programmes designed for schools	0.39	0.49
25	Using the telephone	0.15	0.36
26	Locating useful sources of information	0.46	0.50
27	Presenting information effectively	0.51	0.51
28	Designing research questions	0.49	0.51
29	Note-taking and recording information	0.44	0.50
30	Evaluating education software for classroom use	0.39	0.49
31	Designing learning activities which use IT	0.44	0.50
32	Understanding the use of IT to assist students with special needs	0.15	0.36
33	Understanding ethical and legal issues in using IT	0.34	0.48
34	Understanding theories of learning relating to IT use	0.34	0.48
35	Using IT for classroom record keeping	0.07	0.26
36	Using computer-based tutorials	0.10	0.30

Skills learnt by students: Students were asked to indicate, for most of the same aspects, whether they had learnt them during their course at college and whether they had learnt them elsewhere (see Table 19). It is clear from Table 19 that a greater number of students develop skills and knowledge outside college than during their courses. Notable exception for primary students are in using presentation software, video editing, understanding ethical and legal issues related to IT and using IT for classroom record keeping. All students indicated that most of their learning occurred at college for education-specific aspects: designing IT-based learning activities, understanding the use of IT to assist students with special needs and understanding theories of learning relating to IT use. The responses to this question also show that very large numbers of graduating students, as well as first year students, do not believe that they have developed many of the skills listed. Only word-processing and using the telephone stand out as being skills possessed by almost all students. In general, for most aspects, a smaller proportion of secondary students indicated that they had developed skills or knowledge than for final year primary students.

Table 20 summarises the differences between the numbers of students in the three groups who answered neither "at College" nor "elsewhere" for these questions. One-way analysis of variance indicates a number of significant differences between the groups' responses. Secondary students indicated having gained fewer skills. In comparison with both groups of primary students, fewer secondary students had gained skills in using presentation software, video editing, using a video camera, using a digital camera, editing sound recordings, understanding the use of IT to assist students with special needs and the telephone. The lack of skill in using the telephone is difficult to understand, except to assume that its inclusion in the list was confusing to respondents, since this is usually thought of as a trivial skill. Students may have assumed that something arcane was intended, or have been indicating a

lack of knowledge of voice mail, cell phones and similar systems. In comparison with the final year primary students, fewer secondary students were able to create hypermedia presentations, use class computer programs and playing sound recordings. Fewer secondary students than first year primary students understood theories of learning relating to IT use. The only skill that was possessed by significantly more secondary than primary students was statistical and other data analysis. Fewer first year primary students than final year primary students were able to make sound recordings and play sound recordings, but more first year students were able to use a digital camera and presentation software.

Table 19: Numbers of students who have learnt aspects of IT at College and elsewhere

	Aspect	First Year Primary Students			Final Year Primary Students			Secondary Students		
		At College	Elsewhere	Neither	At College	Elsewhere	Neither	At College	Elsewhere	Neither
1	Word processing	10 (11%)	79 (89%)	4 [a] (5%)	17 (19%)	82 (89%)	3 (3%)	6 (6%)	72 (90%)	4 (5%)
2	Desk-top publishing	6 (7%)	43 (48%)	42 (47%)	14 (15%)	50 (54%)	33 (36%)	10 (13%)	31 (39%)	40 (50%)
3	Using existing databases (including library databases)	39 (44%)	48 (54%)	15 (17%)	64 (70%)	34 (37%)	11 (12%)	30 (38%)	47 (60%)	12 (15%)
4	Creating own databases	3 (3%)	21 (24%)	64 (73%)	9 (10%)	29 (32%)	56 (61%)	5 (6%)	28 (35%)	47 (59%)
5	Creating or editing pictures using computer software	17 (19%)	45 (55%)	32 (36%)	21 (23%)	40 (44%)	38 (41%)	8 (10%)	41 (51%)	30 (38%)
6	Statistical or other data analysis	7 (8%)	36 (41%)	50 (56%)	13 (14%)	30 (33%)	53 (58%)	6 (8%)	48 (60%)	29 (36%)
7	Using a spreadsheet program	4 (4%)	57 (64%)	30 (34%)	11 (12%)	50 (54%)	35 (38%)	10 (13%)	52 (65%)	22 (28%)
8	Using presentation software (eg *PowerPoint*)	54 (61%)	27 (30%)	17 (19%)	43 (47%)	27 (30%)	31 (34%)	13 (16%)	31 (39%)	39 (49%)
9	Finding information on a CD-ROM	9 (10%)	60 (68%)	27 (30%)	28 (30%)	63 (69%)	16 (17%)	4 (5%)	53 (66%)	23 (29%)
10	Creating hyper-media presentations	13 (15%)	13 (15%)	65 (73%)	25 (27%)	13 (14%)	57 (62%)	6 (8%)	12 (15%)	62 (78%)
11	Communicating using e-mail or a bulletin-board	33 (37%)	54 (61%)	17 (19%)	35 (38%)	53 (58%)	17 (19%)	6 (8%)	59 (74%)	16 (20%)

Table 19 Continued

12	Accessing information on the Internet	23 (26%)	54 (61%)	18 (20%)	36 (39%)	59 (64%)	14 (15%)	11 (14%)	63 (79%)	11 (14%)
13	Creating World-Wide Web pages	4 (5%)	15 (17%)	70 (79%)	9 (10%)	12 (13%)	72 (78%)	6 (8%)	17 (21%)	57 (71%)
14	Video editing	35 (39%)	28 (31%)	31 (35%)	54 (59%)	17 (19%)	30 (33%)	5 (6%)	14 (18%)	59 (74%)
15	Recording with a video camera	34 (38%)	62 (70%)	8 (9%)	37 (40%)	65 (71%)	11 (12%)	16 (20%)	39 (49%)	27 (34%)
16	Recording TV programmes on video-tape	3 (3%)	70 (79%)	17 (19%)	8 (9%)	66 (72%)	20 (22%)	3 (4%)	58 (73%)	20 (25%)
17	Playing video-tapes	13 (15%)	72 (85%)	8 (8%)	13 (14%)	80 (87%)	8 (9%)	5 (6%)	63 (79%)	15 (19%)
18	Sending or receiving fax	9 (10%)	67 (75%)	19 (21%)	26 (28%)	62 (67%)	17 (19%)	2 (3%)	63 (79%)	14 (18%)
19	Using a digital camera	58 (65%)	23 (26%)	16 (18%)	33 (35%)	31 (34%)	38 (41%)	13 (16%)	25 (31%)	44 (55%)
20	Using a graphics scanner	17 (19%)	29 (33%)	46 (52%)	19 (21%)	37 (40%)	38 (41%)	8 (10%)	34 (43%)	40 (50%)
21	Making sound recordings	17 (19%)	36 (40%)	38 (43%)	26 (28%)	48 (52%)	26 (28%)	2 (3%)	37 (46%)	41 (51%)
22	Editing sound recordings	17 (19%)	21 (25%)	53 (60%)	27 (25%)	23 (25%)	45 (49%)	2 (3%)	17 (21%)	60 (75%)
23	Playing audio recordings on tape or CD	7 (8%)	60 (67%)	26 (29%)	17 (19%)	69 (75%)	15 (16%)	3 (4%)	51 (64%)	26 (33%)
24	Using classroom computer programmes designed for schools	23 (26%)	28 (32%)	40 (46%)	35 (38%)	33 (36%)	30 (33%)	19 (24%)	23 (29%)	43 (54%)
25	Using the telephone	9 (10%)	79 (89%)	6 (7%)	11 (12%)	86 (93%)	4 (4%)	1 (1%)	66 (83%)	12 (15%)
26	Locating useful sources of information	33 (37%)	63 (71%)	17 (19%)	37 (40%)	66 (72%)	20 (22%)	24 (30%)	60 (75%)	14 (18%)
27	Presenting information effectively	33 (37%)	64 (72%)	17 (19%)	41 (45%)	61 (66%)	17 (19%)	22 (28%)	57 (71%)	12 (15%)
28	Designing research questions	32 (36%)	47 (53%)	30 (34%)	51 (45%)	31 (34%)	22 (24%)	27 (34%)	42 (53%)	24 (30%)
29	Note-taking and recording information	33 (37%)	61 (69%)	16 (18%)	38 (41%)	61 (66%)	20 (22%)	12 (15%)	59 (74%)	15 (19%)
30	Evaluating education software for classroom use	16 (18%)	17 (19%)	60 (67%)	34 (37%)	16 (17%)	47 (51%)	19 (24%)	19 (24%)	47 (59%)
31	Designing learning activities which use IT	35 (39%)	13 (15%)	43 (48%)	46 (50%)	18 (20%)	35 (38%)	29 (36%)	19 (24%)	34 (43%)
32	Understanding the use of IT to assist Students with special needs	26 (29%)	18 (20%)	48 (54%)	35 (38%)	10 (11%)	49 (53%)	13 (16%)	12 (15%)	55 (69%)
33	Understanding ethical and legal issues in using IT	31 (35%)	12 (13%)	48 (54%)	40 (34%)	12 (13%)	46 (50%)	13 (16%)	24 (30%)	44 (55%)
34	Understanding theories of learning relating to IT use	45 (51%)	9 (10%)	37 (42%)	40 (44%)	4 (4%)	48 (52%)	16 (20%)	13 (16%)	52 (65%)
35	Using IT for classroom record keeping	21 (24%)	17 (19%)	54 (61%)	31 (34%)	19 (21%)	48 (52%)	12 (15%)	26 (33%)	44 (55%)
36	Using computer-based tutorials	14 (16%)	15 (17%)	62 (70%)	23 (25%)	15 (16%)	56 (61%)	7 (9%)	28 (35%)	48 (60%)

[a] The first two categories, "College" and "Elsewhere" are *not* exclusive: students could select one or both and were asked to select neither if they had not learnt the skill at all.

Table 20: Differences between the number of students in each group who had ***neither*** *developed skills at College nor elsewhere, as shown in Table 19*

	Aspect of IT	Results of one-way ANOVA			Differences indicated by post hoc multiple comparison using the LSD method at 0.05 significance
		df	*F*	*p*	
1	Word processing		*NSD*		-
2	Desk-top publishing		*NSD*		-
3	Using existing databases (including library databases)		*NSD*		-
4	Creating own databases		*NSD*		-
5	Creating or editing pictures using computer software		*NSD*		-
6	Statistical or other data analysis	2,256	4.36	.014	More secondary *had* developed skills than both primary groups
7	Using a spreadsheet program		*NSD*		
8	Using presentation software (eg PowerPoint)	2,256	9.44	.000	Fewer secondary *had* developed skills than both primary groups; fewer final year primary students had developed skills than first year.
9	Finding information on a CD-ROM		*NSD*		
10	Creating hyper-media presentations	2,256	3.33	.037	Fewer secondary *had* developed skills than final year primary students
11	Communicating using e-mail or a bulletin-board		*NSD*		-
12	Accessing information on the Internet		*NSD*		-
13	Creating World-Wide Web pages		*NSD*		
14	Video editing	2,256	22.45	.000	Fewer secondary *had* developed skills than both primary groups
15	Recording with a video camera	2,256	11.87	.000	Fewer secondary *had* developed skills than both primary groups
16	Recording TV programmes on video-tape		*NSD*		
17	Playing video-tapes		*NSD*		
18	Sending or receiving fax		*NSD*		
19	Using a digital camera	2,256	14.7	.000	Fewer secondary *had* developed skills than both primary groups; fewer final year primary students had developed skills than first year.
20	Using a graphics scanner		*NSD*		
21	Making sound recordings	2.256	5.47	.005	Fewer secondary *had* developed skills than final year primary students; More final year primary students had developed skills than first year
22	Editing sound recordings	2,256	7.34	.001	Fewer secondary *had* developed skills than both primary groups
23	Playing audio recordings on tape or CD	2,256	3.65	.027	Fewer secondary *had* developed skills than final year primary students; More final year primary students had developed skills than first year
24	Using classroom computer programmes designed for schools	2,256	4.53	.012	Fewer secondary *had* developed skills than final year primary students

Table 20: continued

25	Using the telephone	2,256	3.63	.028	Fewer secondary *had* developed skills than both primary groups
26	Locating useful sources of information		*NSD*		-
27	Presenting information effectively		*NSD*		-
28	Designing research questions		*NSD*		-
29	Note-taking and recording information		*NSD*		-
30	Evaluating education software for classroom use		*NSD*		-
31	Designing learning activities which use IT		*NSD*		-
32	Understanding the use of IT to assist Students with special needs	2,256	3.27	.040	Fewer secondary *had* developed skills than both primary groups
33	Understanding ethical and legal issues in using IT		*NSD*		-
34	Understanding theories of learning relating to IT use	2,256	5.43	.005	Fewer secondary *had* developed skills than first year primary
35	Using IT for classroom record keeping		*NSD*		-
36	Using computer-based tutorials		*NSD*		-

Confidence in using information technology

Both lecturers and students were asked to rate, on a five-point scale, their confidence in carrying out a number of specific tasks using a variety of forms of information technology (see Table 21). All groups rated using a word processor on average as the task in which they had most confidence ("very" confident on average for lecturers, final year primary and secondary students). Creating resources on the World-Wide Web was rated, on average, by all groups as the one in which they were least confident (mean ratings equivalent to "not at all" and "not particularly" confident).

Secondary students were significantly more confident than all other groups in the tasks involving word processing [$F(3,374) = 5.27$, $p = 0.001$], using spreadsheets [$F(3,376) = 6.51$, $p < .0005$] and down-loading files from the Internet [$F(3,373) = 4.91$, $p = 0.002$]. They were also more confident at creating World-Wide

Web resources than lecturers and final year primary students [$F(3,377) = 5.34$, $p = 0.001$].

Table 21: Mean ratings of confidence in using IT by lecturers and students.

Task	Lecturers		First year primary		Final year primary		Secondary	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Use a word processor to write handouts or essays which include tables and page numbers	4.02[a]	1.10	3.89	1.20	4.17	1.09	4.50	0.75
Use e-mail to send, receive and reply to messages and include attached files	3.99	1.13	3.18	1.45	3.22	1.37	3.56	1.49
Search for information on a particular topic on the World Wide Web of the Internet	3.17	1.22	3.03	1.29	3.58	1.18	3.79	1.20
Download files from the Internet to your computer	2.68	1.37	2.33	1.33	2.73	1.45	3.15	1.44
Locate references using the College library catalogue	3.04	1.47	3.65	1.21	3.84	1.27	3.70	1.23
Search for references using an electronic database such as AUSTROM or ERIC	2.94	1.32	2.39	1.24	3.29	1.35	3.09	1.32
Create and use a spreadsheet to store and analyse information about pupils	2.38	1.38	2.54	1.30	2.68	1.42	3.27	1.49
Use presentation software such as *PowerPoint* to create on-screen slides or OHP transparencies to support a talk or lecture	2.36	1.32	3.07	1.28	2.80	1.32	2.66	1.46
Create resources on the World Wide Web to provide information or support teaching	1.56	1.04	1.97	1.20	1.87	1.25	2.27	1.41
Set up a computer in a classroom and show children how to find information on a CD-ROM	2.53	1.54	2.93	1.31	3.23	1.36	2.96	1.43

[a] A scale value of 1 = "not at all" confident, 2 = "not particularly" confident, 3 = "Fairly" confident, 4 = "Very" confident, 5 = "Extremely" confident.

The e-mail task was the only one in which lecturers were significantly more confident than all three groups of students [$F(3,377) = 7.93$, $p < .0005$], whereas lecturers were less confident than all groups of students in using the College library

catalogue [$F(3,377) = 7.66$, $p < .0005$] and setting up a computer and demonstrating the use of a CD-ROM [$F(3,378) = 4.43$, $p = 0.004$]. Lecturers were also less confident in searching on the World-Wide Web than were final year primary and secondary students [$F(3,379) = 7.43$, $p < .0005$], as were first year primary students. Lecturers and secondary students were less confident at using presentation software such as *PowerPoint* than both groups of primary students [$F(3,376) = 4.81$, $p = 0.003$]. Lecturers were less confident than final year primary students in using electronic bibliographic databases [$F(3,375) = 58.13$, $p < 0.0005$] and less confident at creating World-Wide Web resources than first year primary students [$F(3,377) = 5.34$, $p = 0.001$].

First year primary students were less confident than final year students at downloading files over the Internet [$F(3,373) = 4.91$, $p = 0.002$], as well as using bibliographic databases and searching the World-Wide Web, as noted above.

Beliefs about the IT needs of the Beginning Teacher

Both students and lecturers were asked to rate, on a five-point scale, the importance of a range of information technology skills for a Beginning Teacher. Table 22 sets out the mean ratings of all respondents, with the significance tests set out in Table 23. It is obvious from Table 22 that lecturers and students regard all of the skills as important for the Beginning Teacher. Well over half have mean ratings equivalent to between "very important" and "essential". Word processing, "locating useful information sources" and "presenting information effectively" had an overall mean rating close to "essential" and seventeen others between "very important" and "essential".

Table 22: Mean rating of importance of IT skills for Beginning Teachers.

	Lecturers		First year primary		Final year primary		Secondary		All Groups	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
1. Word processing	4.79[a]	0.52	4.61	0.63	4.58	0.66	4.81	0.61	4.69	0.61
2. Desk-top publishing	3.73	1.05	3.87	1.03	4.04	0.91	3.38	1.20	3.76	1.07
3. Using existing databases (including library databases)	4.42	0.81	4.32	0.89	4.25	0.79	4.16	1.03	4.29	0.88
4. Creating own databases	3.40	1.04	3.23	1.17	3.34	1.20	3.01	1.15	3.24	1.15
5. Creating or editing pictures using computer software	3.00	0.96	3.67	1.04	3.36	1.11	2.76	1.15	3.22	1.12
6. Statistical or other data analysis	3.03	1.00	3.63	1.19	3.28	1.02	3.42	1.13	3.35	1.11
7. Using a spreadsheet program	3.52	1.05	3.66	1.14	3.38	1.10	3.57	1.15	3.54	1.11
8. Using presentation software (eg *PowerPoint*)	3.10	1.03	3.85	1.02	3.27	1.16	3.24	1.25	3.82	1.45
9. Finding information on a CD-ROM	4.15	0.92	4.29	0.81	4.18	0.84	3.81	1.16	4.11	0.95
10. Creating hyper-media presentations	2.92	1.19	3.45	1.19	3.03	1.22	2.57	1.28	3.00	1.25
11. Communicating using e-mail or a bulletin-board	4.38	0.81	4.04	0.93	3.80	0.99	3.98	1.09	4.03	0.98
12. Accessing information on the Internet	4.53	0.67	4.23	0.86	4.31	0.87	4.40	0.91	4.36	0.84
13. Creating World-Wide Web pages	2.66	1.21	3.17	1.33	2.88	1.27	2.72	1.27	2.86	1.28
14. Video editing	2.97	1.08	3.42	1.08	3.28	1.06	2.72	1.20	3.12	1.13
15. Recording with a video camera	3.78	1.08	3.75	1.01	3.87	1.07	3.40	1.18	3.71	1.10
16. Recording TV programmes on video-tape	3.94	1.10	3.78	1.05	3.81	1.02	4.04	1.04	3.89	1.05
17. Playing video-tapes	4.30	0.90	4.00	1.01	4.04	1.02	4.25	0.95	4.14	0.98
18. Sending or receiving fax	4.40	0.86	3.96	0.97	4.05	1.05	3.93	1.14	4.08	1.02
19. Using a digital camera	3.31	1.09	3.45	1.10	3.53	1.06	3.00	1.13	3.33	1.11
20. Using a graphics scanner	3.20	0.96	3.45	1.08	3.30	1.14	2.97	1.19	3.24	1.11
21. Making sound recordings	3.54	1.15	3.56	1.06	3.45	1.16	2.93	1.31	3.38	1.19
22. Editing sound recordings	3.21	1.14	3.43	1.02	3.32	1.15	2.58	1.25	3.14	1.18
23. Playing audio recordings on tape or CD	4.11	1.05	3.96	0.99	4.12	0.90	3.82	1.20	4.00	1.04
24. Using classroom computer programmes designed for schools	4.39	0.92	4.54	0.71	4.41	0.74	4.12	0.98	4.37	0.85
25. Using the telephone	4.72	0.63	4.52	0.93	4.46	0.91	4.08	0.94	4.54	0.87
26. Locating useful sources of information	4.76	0.54	4.73	0.59	4.54	0.76	4.73	0.58	4.69	0.63
27. Presenting information effectively	4.77	0.54	4.54	0.71	4.59	0.71	4.75	0.55	4.66	0.64
28. Designing research questions	4.02	1.05	4.19	1.08	3.80	1.22	4.14	1.11	4.03	1.13
29. Note-taking and recording information	4.63	0.69	4.53	0.87	4.29	1.05	4.49	0.94	4.48	0.91
30. Evaluating education software for classroom use	4.39	0.92	4.17	0.90	4.23	0.94	4.04	1.10	4.21	0.97
31. Designing learning activities which use IT	4.42	1.01	4.14	0.95	4.35	0.84	4.15	0.94	4.22	0.93
32. Understanding the use of IT to assist students with special needs	3.94	0.89	4.36	0.84	4.37	0.85	4.09	0.96	4.20	0.90
33. Understanding ethical and legal issues in using IT	4.19	0.86	4.19	0.93	4.26	0.98	3.96	1.04	4.15	0.96
34. Understanding theories of learning relating to IT use	4.21	0.98	4.05	1.02	4.04	1.10	3.78	1.11	4.02	1.06
35. Using IT for classroom record keeping	4.00	1.08	4.07	0.98	4.12	0.99	3.99	1.18	4.05	1.05
36. Using computer-based tutorials	3.08	1.06	3.51	1.15	3.34	1.18	3.45	1.34	3.36	1.19

[a] Scale value of 1 = Not important, 2 = Not very important, 3 = Important, 4 = Very important, 5 = Essential
Shaded cells are those with ratings of "Very important" or greater.

Table 23. Differences between groups' mean ratings of Beginning Teacher IT Skills

Skill	Results of one-way ANOVA			Differences indicated by post hoc multiple comparisons using LSD method at 0.05 significance
	df	F	*p*	
1. Word processing	3,325	3.20	.023	Lecturers and secondary students ascribe greater importance than both groups of primary students
2. Desk-top publishing	3, 269	4.86	.003	Secondary students ascribe less importance than both groups of primary students
3. Using existing databases (including library databases)	NS			
4. Creating own databases	NS			
5. Creating or editing pictures using computer software	3, 272	9.69	.000	Lecturers ascribe less importance than first year primary students Secondary students ascribe less importance than both groups of primary students
6. Statistical or other data analysis	3, 261	3.29	.021	Lecturers ascribe less importance than both first year primary students and secondary students
7. Using a spreadsheet program	NS			
8. Using presentation software (eg *PowerPoint*)	3, 281	6.48	.000	First year primary students ascribe greater importance than all three other groups
9. Finding information on a CD-ROM	3, 290	3.68	.013	Secondary students ascribe less importance than all three other groups
10. Creating hyper-media presentations	3, 218	4.76	.003	Lecturers ascribe less importance than first year primary students Secondary students ascribe less importance than both groups of primary students
11. Communicating using e-mail or a bulletin-board	3, 296	4.32	.003	Lecturers ascribe greater importance than all three groups of students
12. Accessing information on the Internet	NS			
13. Creating World-Wide Web pages	NS			
14. Video editing	3, 289	5.88	.001	Lecturers ascribe less importance than first year primary students Secondary students ascribe less importance than both groups of primary students
15. Recording with a video camera	NS			
16. Recording TV programmes on video-tape	NS			
17. Playing video-tapes	NS			
18. Sending or receiving fax	3, 303	3.25	.022	Lecturers ascribe greater importance than all three groups of students
19. Using a digital camera	3, 286	3.183	.024	Secondary students ascribe less importance than both groups of primary students
20. Using a graphics scanner	NS			
21. Making sound recordings	3, 283	4.51	.004	Secondary students ascribe less importance than all other groups.
22. Editing sound recordings	3, 272	7.61	.000	Secondary students ascribe less importance than all other groups.
23. Playing audio recordings on tape or CD	NS			

Table 23: continued

24. Using classroom computer programmes designed for schools	3, 276	3.20	.024	Secondary students ascribe less importance than both groups of primary students
25. Using the telephone	NS			
26. Locating useful sources of information	NS			
27. Presenting information effectively	NS			
28. Designing research questions	NS			
29. Note-taking and recording information	NS			
30. Evaluating education software for classroom use	NS			
31. Designing learning activities which use IT	NS			
32. Understanding the use of IT to assist students with special needs	3, 286	4.13	.007	Lecturers ascribe less importance than both groups of primary students
33. Understanding ethical and legal issues in using IT	NS			
34. Understanding theories of learning relating to IT use	NS			
35. Using IT for classroom record keeping	NS			
36. Using computer-based tutorials	NS			

There were significant differences between the perceptions of lecturers and students on the importance of about half of the skills. Lecturers rated communicating using e-mail and bulletin boards, and sending and receiving faxes as much more important than the students. Students on the other hand tended to rate such skills as creating and editing graphics, statistical analyses, creating hypermedia, editing videos, and using IT to assist students with special needs as more important skills than did lecturers. First year primary students rated presentation software as a more important skill than all other groups. Secondary students rated a number of skills as less important than both groups of primary students; these were desk-top publishing, graphics editing, creating hypermedia, video-editing, using a digital camera, using classroom computer programs. Secondary students also ascribed less importance than all other groups to finding information on a CD-ROM, making sound recordings and editing sound recordings. Word-processing was rated higher by lecturers and secondary students than by primary students.

Comparison between categories for aspects of IT grouped by function

Because the same aspects of Information Technology were used in rating importance for beginning teachers, and skills used by students in courses, expected by lecturers and taught by lecturers, it is possible to look for commonalities between responses in these different areas. It is also possible to group the different aspects according to themes that are shown in Table 24. On inspecting the ratings associated with these groups, some trends are discernible. Items from the group of Information Skills are rated most highly, with word processing, in importance for beginning teachers. Following word processing, items chosen from this group are those which are expected by lecturers in most modules and used by students in most modules. In general items of from the group of teaching-specific aspects rate highly below these on all four questions, while aspects related to creating sound recordings and video, multi-media presentations, multimedia processing and data processing tend to be rated low.

There are apparent differences between the proportions of modules in which students use aspects of IT and the proportions of modules in which lecturers expect these aspects to be used. In almost all cases students indicate that they use the aspects less than lecturers expect. For example, on average students report finding information on CD-ROM for less than 10% of modules (rating = 1.68) whereas lecturers expect this to happen on average in 30% of courses; students report using databases in less than 25% of courses (rating = 2.93) and lecturers expect this is 61% of courses. There are no aspects in which this situation is obviously reversed, and only a few in which the proportions are roughly equivalent (desk-top publishing, creating WWW pages, creating databases and using computer-based tutorials).

Table 24: Aspects of IT compared on four criteria, grouped by function

Group	Aspects	Mean Rating of importance for beginning teachers (by all groups)	Proportion of lecturers teaching to pre-service modules	Proportion of modules in which lecturers expect student will use	Students' mean rating of the proportion of modules in which they use (by all groups)
Print	Word processing	4.69[a]	0.39	0.91	4.76[b]
	Desk-top publishing	3.76	0.20	0.18	2.59
Information Skills	Locating useful sources of information	4.69	0.46	0.63	3.21
	Presenting information effectively	4.66	0.51	0.68	3.66
	Note-taking and recording information	4.48	0.44	0.61	3.77
	Accessing information on the Internet	4.36	0.54	0.44	1.91
	Using existing databases (including library databases)	4.29	0.24	0.61	2.93
	Finding information on a CD-ROM	4.11	0.37	0.30	1.68
	Designing research questions	4.03	0.49	0.38	2.76
Teaching-specific	Using classroom computer programs designed for schools	4.37	0.39	0.20	1.62
	Designing learning activities which use IT	4.22	0.44	0.23	N/A
	Evaluating educational software for classroom use	4.21	0.39	0.20	N/A
	Understanding the use of IT to assist students with special needs	4.20	0.15	0.09	N/A
	Understanding the ethical and legal issues in using IT	4.15	0.34	0.21	N/A
	Using IT for classroom record keeping	4.05	0.07	0.11	N/A
	Understanding theories of learning related to IT use	4.02	0.34	0.20	N/A
E-mail	Communicating using e-mail or a bulletin board	4.03	0.29	0.21	1.53
Telephone	Using the telephone	4.54	0.15	0.42	2.48
	Sending and receiving fax	4.08	0.17	0.16	1.54
Playing sound & video	Playing video tapes	4.14	0.17	0.30	2.16
	Playing audio recordings on tape or CD	4.00	0.15	0.17	1.67
Creating sound & video	Recording TV programmes on videotape	3.89	0.10	0.16	1.56
	Recording with a video camera	3.71	0.32	0.20	1.70
	Making sound recordings	3.38	0.12	0.15	1.45
	Editing sound recordings	3.14	0.07	0.12	1.45
	Video editing	3.12	0.17	0.16	1.62
Multi-media presentation	Using presentation software (eg *PowerPoint*)	3.82	0.22	0.16	1.79
	Creating hyper-media presentations	3.00	0.17	0.11	1.56
	Creating World Wide Web pages	2.86	0.05	0.02	1.30
Data processing	Using a spreadsheet program	3.54	0.24	0.12	1.56
	Statistical or other data analysis	3.35	0.17	0.16	1.62
	Creating own databases	3.24	0.22	0.07	1.47
Computer based training	Using computer based tutorials	3.36	0.10	0.07	1.41
Multi-media processing	Using a digital camera	3.33	0.22	0.20	1.44
	Using a graphics scanner	3.24	0.20	0.14	1.47
	Creating or editing pictures using computer software	3.22	0.29	0.18	1.79

[a] Scale value of 5 = Essential, 4 = Very important, 3 = Important, 2 = Not very important, 1 = Not important

[b] A scale value of 6 = about 100% of modules, 5 = about 75%, 4 = about 50%, 3 = about 25%, 2 = about 10%, 1 = less than 10%

CHAPTER 4

Discussion

Introduction

This chapter discusses the results in relation to the findings of other studies of lecturer and student experiences and competencies in using Information Technology (IT). The implications of these results are considered in the light of the growing body of international literature on pre-service teacher education in IT. Throughout this chapter the wide interpretation of Information Technology, which was developed in Chapter 1, is used. Information Technology is considered to include the use of equipment and development of information products, but also the understandings and techniques that are necessary to make use of information in its wide variety of forms. In particular, this is taken to include aspects of Information Literacy that contribute to learning and the effective use of information by learners and teachers.

College lecturers and IT

Lecturers' use of IT

Much of the literature characterises the majority of teacher educators in the UK and the USA as being relatively unskilled in the use of modern information technology and making little personal use of computers beyond word processing and, to a lesser extent, electronic communications using e-mail. In their teaching they are even less likely to deal with the practical and pedagogical issues of IT in schools except for modules which are specifically directed at IT and taught by enthusiastic specialists. One purpose of this study was to compare this view with the situation of educators within a New Zealand teacher education institution.

The picture that emerges from this study is of a group of lecturers with a high rate of computer ownership and high degree of access to computers at work, actively developing their computer skills at a variety of levels. Most use their computers at work fairly heavily and also use their home computers for College-related work. The uses that they report for these computers (Table 10) reflect those found in recent studies in Scotland and Northern Ireland (Murphy & Greenwood, 1998; Simpson et al., 1999) but the New Zealand lecturers were much heavier users. Most lecturers use computers for word-processing and electronic mail and these are the only applications in which, on average, they express themselves to be "very" confident or greater. As in the UK, sourcing information from the Internet was the next most common use. However, beyond these applications, which have become common in many homes, the use of computers is limited.

An explanation for the very high proportion of lecturers who use electronic mail and the Internet may lie in the development within the College during the two years prior to this study, of a new local area network which provides connections in every office with access to the Internet and an electronic mail system, together with technical support services. This has encouraged considerable activity within teaching departments to provide computers for lecturers and pressure on lecturers to communicate by e-mail. The provision of resources by the institution seems to have led to the development of staff skills and expectations. The result appears to be a culture in which the use of word-processing, e-mail and (to a lesser extent) the World-Wide Web have become normalised. Shortly before this survey, a new College Web site was established and a lecturer within each department given responsibility for developing pages. This may account for around a tenth of lecturers indicating that they used computers for creating web pages, and it would be interesting to observe how the creation and use of World-Wide Web pages is

reported in the future after a greater time for staff to gain experience with the techniques and an understanding of the use of a web site.

Student perceptions of the forms of IT used by their lecturers in teaching (Table 14) and lecturers' reports of their own use of IT (Table 10) indicates that teaching staff use computers largely for personal writing, research and communication with colleagues, rather than for work with students. Despite the importance which lecturers place on students' developing information processing skills (Table 22) and using them in coursework (Table 17) it is quite surprising that lecturers, on average, express themselves to be only "fairly" confident in locating references using the College library (computerised) catalogue. The use of other aspects of IT is limited in most cases to playing of videotapes.

Lecturers' modelling of IT use

In view of the widespread agreement, noted in the literature review, that the most effective method of educating student teachers in the application of IT to teaching is to integrate it across their curriculum, the findings of this study are concerning. The small range of applications used in class by lecturers and students, and the limited expectations of IT use by lecturers, suggests that there is little modelling by staff of the use of IT during pre-service teaching courses. The students' responses indicate that traditional media of white- or black-board, printed handouts and overhead projector are almost exclusively used in College courses (Table 14). These are convenient and appropriate presentation media and their use is entirely acceptable. However, to develop an IT-enriched curriculum, they need to be accompanied by the explicit encouragement of students in using a far wider range of aspects of information technology.

Lecturers' expectations of students in their courses are minimal, with the major exception being in the use of word-processing. The majority of lecturers expect students to use computers for written assignments and essays. This study did not investigate the degree to which this is explicitly required, encouraged or supported by lecturers, though around 40% of lecturers claimed to teach aspects of word-processing to students. In almost all cases lecturers' expectations of the small number of modules in which students will use different IT skills exceeds the number in which students say that they are used (Table 24). We may assume that lecturers' expectations are not clearly conveyed, that students do not have the competence to use these skills, or that they find they are able to complete the work adequately without them. This cannot be seen to be strong encouragement to use IT appropriately in suitable contexts.

It has been noted that new technologies are often initially employed in ways that reproduce traditional methods (see, for example Bigum, 1987). In their own academic work and course preparation lecturers are constantly writing, so that word-processing is an effective way of achieving traditional outcomes, enabling easier editing and more professional presentation. The same advantages are present for students using word processors, with the added benefit for lecturers in the legibility that it imparts to assignments. However, a number of authors have also drawn attention to the transformative nature of many technological innovations. Thus, the word processor, for example, can enable students to engage in the writing process in new ways which have important educational potential (Scrimshaw, 1993) through such processes as collaborative writing . Data obtained in this study indicates where information technology is being used, but gives no evidence about whether such qualitative differences are occurring. Indeed, the author's personal observations suggest that most use of information technology within the College is directed at

presenting information rather than at processing information and supporting learning.

Student teachers and IT

Students' use of IT

By the time they graduate, most students are computer users to some extent, with access to equipment at home, and making considerable use of it for their College work. Almost all use a word-processor and a large number are using electronic mail and the Internet. A large number of them, particularly secondary teaching students, indicate that their skills have been learnt outside the College (Table 19). A feature of students' responses is that a large proportion believe that they have developed information-handling skills. Skills in using computer software and hardware for multimedia work (using digital cameras and graphics scanners, graphics editing, creating presentations and creating World-Wide Web pages) and for data handling (using a spreadsheet program, creating databases, statistical and other data analysis), are relatively uncommon. Many leave College with little or no practical experience of using computers in the classroom (Table 13) while 38% of graduating primary students and 43% of secondary graduates indicate that they are not able to design learning activities which use IT (Table 19). Less than a half (48% of primary and 35% of secondary graduating students) reported understanding theories of learning related to IT use.

As might be expected, in most skill areas fewer first year primary students than graduating students claim competence, indicating a growth in skill over the three years of their courses. Some notable exceptions to this may reflect changes in the emphasis within the compulsory first year Information & Communication Technology module. Using presentation software and using a digital camera are two

activities that were more common in this course than previously and more first-year students than final year students report being able to use them (Table 19). That secondary students attribute less of their learning to their College courses no doubt reflects their shorter course and the fact that theirs is a post-graduate course to which they bring more prior experience and education. The provision of more specialised subject-based courses for secondary student teachers probably explains the lower reported levels of skill in practical use of multimedia equipment and software.

It is not unexpected that students develop a large number of their skills outside their College courses. Many of the skills dealt with in the questionnaire are commonly used in the home and other areas of daily life, as well as in other educational institutions that students may have attended. Some of these skills may be considered technically trivial, though their application for educational ends may be more challenging. Teaching does, however, require competency in some areas that are not part of students' general experience and greater numbers of students indicate having developed such skills at College.

That there are still large numbers of students who are not competent in various information technology skills poses a challenge for teacher educators to provide training that caters for the wide range of prior experiences. This survey also gives no evidence of the *degree* of competence that students have developed, or their ability to apply the various aspects of IT in their teaching. It is likely that, for many, the experience that they have developed outside College is insufficient to enable them to use IT effectively in the classroom. Students would be helped by a greater degree of authentic, meaningful learning (Brown et al., 1987) in the use of IT in education, and more chances to assess their own capability in realistic classroom settings. This cannot be provided by concentration on the technical skills of computer use, outside the context of academic work.

Teaching experience

The importance of students practising the use of IT within real classroom contexts, and the difficulty in achieving this, is emphasised in much of the literature cited in the literature review. Data obtained from the current study indicate that this is also a matter for concern within the College. A sizeable proportion of students (between 21 and 14 per cent across groups surveyed) reports *not* having teaching experience in schools where children were using computers as part of their school programme (Table 19). That even fewer observed the use of computers by experienced teachers adds to the problem. Still fewer students chose, or were able, to use computers in their own teaching during the practicum.

These results agree with those of Dunn and Ridgway (1991a; 1991b) in Britain and of Downes (1993) in Australia that student teaching experience in IT increases significantly over a number of practicum sessions, but remains low enough to cause concern. The proportion of students in this sample who reported using computers during teaching experience was considerably lower than those reported in Northern Ireland by Murphy and Greenwood (1998) who found 83% of graduate students and 66% of undergraduate students had used computers compared with 48% and 50% in this study. Simpson in Scotland (1998), however, found a smaller proportion with experience (around one third), while Handler and Pigott in the USA (1993; 1995) found a slightly smaller proportion (40 to 45%). Moursund and Bielefeldt (1999) indicate that around two-thirds of teacher education institutions in the USA report a proportion similar to, or smaller than, that found in this study. Additionally, although we have some idea from these studies of the number of students with no experience of using computers in teaching practice, there is little indication of the *quality* of use being experienced by those who do use computers.

The reasons for this lack of practice may be various, and are another area worthy of further investigation. A shortage of appropriate models for curriculum-related use is likely to be a major reason. Personal confidence and competence, reluctance and insecurity, or lack of encouragement and guidance from associate teachers and College lecturers may also be factors. However, personal competence in using computers may not be a major determining factor, as suggested by Wild (1995), Dunn and Ridgway (1991b) and Monaghan (1993). Wild argues that "pre-service IT programmes need to possess a substantial component related to the methodology of classroom use of IT" (p.10). It has been argued (Bennett et al., 1997) that moving the focus of IT education in pre-service teacher education to pedagogical concerns, and away from anxiety about technical knowledge and skills, is an important way to improve outcomes. If we expect students to be able to use IT effectively in their initial years of teaching, we must also develop strategies that enable them to do so with guidance during their student teaching practice. Formal, specific requirements and assessment of students' practicum work with IT (discussed by Bennett et al., 1997; Robertson, 1996a) may assist in achieving this. Working with children in the College environment (Bennett et al., 1997) and collaborative projects between schools and Colleges of Education (such as described by Kamens, 2000) offer a more innovative approach.

Comparison of secondary and primary students

There are differences between the preparedness of primary and secondary students for using IT in teaching. These are undoubtedly closely related to the different nature of the secondary students, who are largely graduates, the short-duration of the graduate programme, and the expectation that students are trained to teach in specialist curriculum areas. It may be argued that primary students received considerably more teaching relating to general pedagogical knowledge and will be in

a better position to apply this knowledge to the use of IT. Additionally, lecturers involved in the secondary teaching programme come largely from a secondary teaching background and the attitudes and experiences that they bring with them may reflect a different pedagogical culture which reinforces that which students experience during their practicum.

The secondary students participating in this survey had not taken part in a compulsory, cross-curricular module in Information & Communication Technology, as had the primary students. This is probably the reason why, for example, they had less confidence with presentation software than primary students. It may also explain why fewer secondary students had developed some IT skills related to teaching, multimedia and audiovisual media (Table 20) for, although taking a computing course does not ensure that students will use computers in the classroom (Dunn & Ridgway, 1991b), there is evidence that students who have taken such a course may feel more prepared to teach with computers (Handler & Pigott, 1995). In the absence of effective integration of IT across a student's course, a separate IT module may be necessary (as suggested by Robertson, 1996b) to give students a grounding in classroom-related IT skills.

In general, secondary students report less use of many aspects of IT than primary students. It is likely that some curriculum areas within the College, such as English language, Social Studies and Technology, may be heavier users of IT within their modules, so that primary students who experience all curriculum areas may have more opportunities to use IT within their courses. Primary teaching practice is traditionally more focussed on experiential, activity-based learning than secondary teaching, and the longer primary teacher education programme gives greater opportunity for a range of forms of IT to be introduced.

These experiences may be reflected in secondary students' perceptions of the importance of various IT applications. Their opinions of the skills needed by beginning teachers were in many ways more similar to lecturers' opinions that those of primary students. They saw skills in the use of multimedia computer applications, video and audio, and data gathering from CD-ROM as less important than did primary students. These views may reflect their personal lack of experience in these areas, the views of secondary lecturers, or a lack of experience of these aspects of IT in teaching practice schools.

Few studies have reported on students' technical skills, but Murphy and Greenwood (1998) found that PGCE (post-graduate) students were more confident than B.Ed. students in general computer use. To some extent this study supports this, with secondary student teachers more confident than final year primary student teachers in tasks involving word-processing, using spreadsheets, downloading files on the Internet and creating World Wide Web resources. However, they were less confident in using presentation software, and in the other five skills surveyed there was no significant difference.

It is of concern that secondary student teachers had significantly less experience observing the use of computers in schools and that less than half of them gained practical experience in this area themselves. It is possible that this reflects the practice of secondary schools, and practical difficulties of incorporating IT into classroom activities at that level. However, in view of the expectations being placed on schools and the needs of their pupils, it is even more important that graduates from pre-service teacher education courses have a wider range of teaching strategies available to them.

Course structure and design

Alternative teaching methods using IT

There is a growing trend for teacher education courses to be taught using flexible and distance methods that make heavy use of information technology, particularly telecommunications and the Internet.. To effectively carry out such teaching lecturers need to have an understanding of the pedagogical changes required and personal skills in using e-mail, the Internet and in multimedia authoring. From the results of this study it could be concluded that many lecturers in this College are in a position to begin to exploit new methods of teaching through their ready access to equipment (Table 1) and confidence in using word-processors and e-mail (Table 21). However, since use of other kinds of processes such as web-editing and using multimedia tools (Tables 7 and 11) is relatively low, it is obvious that considerable professional development is required before the staff will be able to make use of, for example, web-based teaching. Less than a half of lecturers report having experience of teaching or learning using computers (Table 13). From the author's personal experience, for example, only three lecturers have used software available in the College for providing web-based support for flexible course delivery; two of these have also used e-mail as a means of developing reflection within on-campus courses and a further three have used e-mail for some communication with off-campus students.

Information technology can provide powerful new techniques for instruction, but there is also growing evidence that it can support the establishment of cooperative learner-centred educational environments (Lai, 1992). The emphasis in such environments is on the "wider social, educational and physical contexts where students acquire cognitive, metacognitive and social skills, solve problems, make decisions, develop commitment to their academic goals, and construct knowledge

and meaning for themselves." (Rowe, 1995, p.30). Koschmann (1996) argues that this computer-supported cooperative learning (CSCL) represents a new paradigm in IT research. Such environments are seen as maximising the potential of IT to affect students' learning, but to establish such an environment requires us to go beyond seeing computers and other elements of IT as powerful aids for teaching and learning to considering the nature of the learning community itself. The beliefs of lecturers and students about learning, and the culture of the institution, become important factors in establishing an environment where the use of IT is effectively incorporated into teaching and learning. Creating such an environment within a pre-service teacher education institution would provide students with a strong model for IT use in learning, but requires considerable commitment and leadership within the staff.

Developing students' skills in teaching with IT

International literature expresses concern about the development of students' skills of using information technology in their teaching. Two major issues have been identified in the literature: integration of information technology into students' courses and the provision of experiences in which students can observe the effective use of information technology in schools and practise it themselves (see, for example Handler & Pigott, 1995; Murphy & Greenwood, 1998; O'Bannon et al., 1998; Office of Technology Assessment, 1995). The issue of teaching practice for student teachers has been discussed above. This section focuses on the aspects of IT use which should be included in the College-based component of their programme. There is a need for course organisation and policies which increase students' personal competencies in using computers and other IT equipment and also their ability to use these in their teaching.

Issues related to integration have been raised above in discussing lecturers' modelling of IT use in their teaching. On average, lecturers expected pedagogical aspects included in the questionnaire to be used by students in between 20 and 23% of their modules, with the exception of use with special needs students, and the use of IT in record-keeping for which the proportion was around half of this (Table 17). Between 34 and 44% of lecturers claimed to be teaching these aspects at some time, with the same exceptions (Table 18). Data does not allow an analysis of the curriculum areas in which this is happening, though we do know that, as well as curriculum modules, this proportion includes Information and Communication Technology modules which specifically emphasise these aspects. The evidence, therefore, suggests that there is no widespread integration of this important dimension of IT use into other modules.

This study demonstrates that students develop some valuable IT skills for teaching without explicit instruction within their College course (Table 19). It is, however, possible that some of this outside learning results from needs developed within the College programme. The author is also aware of external courses in using computer software organised by the College for students. It is not necessary, therefore, in planning the pre-service teacher education course, to rely exclusively on IT skill learning occurring within the College programme, and it would be sensible to take into account, and allow for, learning which, for many students, occurs outside. Wild (1996) has suggested that "it is likely that much of what occurs in this field in the near future will be undermined and perhaps rendered irrelevant by the experience of technology, for the student and beginning teacher, outside of pre-service IT courses; and for the child, outside of school" (p.140). It is possible that we are beginning to see this change occurring amongst the student population studied here. As significant numbers of students bring technical skills into their teacher education, part of the

burden of teaching basic technical skills may be lifted, but pressure in different areas will be created. Lecturers can no longer shelter behind a perceived imperative to teach skills of using software but will need to address clearly the classroom application of IT. At the same time equity will demand that provision is made for those students who have not developed the same technical fluency. Certainly, in the face of increased student sophistication in this area, teacher educators will need to be able to demonstrate both technical and pedagogical proficiency in using IT, at a level which, on the basis of this study and others, does not seem to be common today.

The importance of informal and non-formal learning in teacher education should not be undervalued. Student learning in this area may occur because of the infusion of IT into the home, workplace and the culture of young people. IT also provides a means for educational institutions to develop informal learning communities. The use of e-mail and the World Wide Web, for example, can provide a method for sharing ideas *through* IT, which itself provides a technology-rich context for learning *about* IT. Such methods are being increasingly used in distance and flexible learning and are also being introduced into on-campus learning.

On average, lecturers rated pedagogical aspects of IT as "very" important for beginning teachers. However, many lecturers' lack of personal experiences of using computers in the classroom, either as teachers or as students, must seriously hinder them in understanding the role of this technology in schools and in teaching student teachers to exploit its potential in their own teaching. Students and lecturers need to develop a clearer understanding of the capabilities that are needed to become successful teachers in schools, and this should be based on a sophisticated understanding of the role of IT in education. This survey shows that there is considerable agreement, at present, between the views of lecturers and the various groups of students on what IT skills are required by beginning teachers (Table 22). It

is not clear, however, whether these views are based on an adequate understanding of educational needs and theory. Lecturers report limited experience of using computers in school teaching, or of observing their use, and they were no more likely to have these experiences than their students. Students were, indeed, significantly more likely to have worked in schools where computers were used in teaching. It is reasonable to assume that students' views, particularly those of first year students, are influenced by lecturers, and their views in turn will be influenced by the technologies with which they are familiar. Hence, an agreement between groups is not likely to result from independent views so much as a shared culture, which is developed within the institution, and possibly the wider schooling community.

A tendency to value the application of IT with which respondents were personally more familiar can explain the greater importance placed by lecturers, by comparison with students, on e-mail, bulletin boards and faxes for beginning teachers. Students' rating of multimedia skills as more important is likely to be a result of their greater familiarity with these computer applications. This may result from exposure to them within the specialist IT component of their course and also from a greater contact with them at home and on teaching experience. The range of applications of this nature used in schools has increased in recent years, and many lecturers may not have much experience of them in the classroom.

If the aspects of IT used in this study are grouped according to common themes (See Table 24) it is seen that, together with Word-processing, elements from the group of *Information Skills* are consistently rated as the most important for beginning teachers by all groups of students and lecturers (Table 22). Pedagogical aspects, which are specific to teaching, together with using the telephone, are ranked next in importance for beginning teachers and in lecturers' expectations for student teachers. The

information skills are, similarly, those that lecturers expect students to use within their modules; they are the aspects which lecturers claim to teach most frequently (though only a half or fewer do so) (Table 18) and students agree that they are those which are used in the greatest number of modules (Table 15). Students' estimation of the proportion of modules in which they are used, however, is considerably less than the number in which lecturers expect them to be used.

These indications may be heartening to those who have been pushing for a greater emphasis on Information Literacy within teaching (for example Moore, 1995), but they raise issues that call for further investigation. Although these aspects of IT are rated higher than others, they are still far from universally incorporated into modules. It would be reasonable to assume that such activities as "locating useful sources of information", "note-taking and recording information" and "presenting information effectively" were part of student work in all modules. That they are recognised by students as occurring in less than half their modules may indicate that students are not explicitly aware of their own use of information skills, in which case it is unlikely that they will transfer these methods to their own teaching. However, an alternative explanation would be that students in many modules are not actively involved in activities that promote personal learning. That lecturers only expect these activities in around two-thirds or less of their modules demands further investigation.

Although the identification of discrete information skills is an approach that many teachers have found valuable for teaching students how to organise their research, it is important to recognise that such models as "action learning" may have limitations. Such heuristics may help students make their information-based activities more purposeful but they may disguise the complexity of the process. Moore (1995) points out that the process of research cannot be logically separated into discrete parts. Perhaps the use of such a framework can itself become a rote process which does not

involve strategic thinking and intentional learning. These concepts are widely discussed in the literature on cognitive learning (for example, Bereiter & Scardamalia, 1989; Pressley, Borkowski, & Schneider, 1987); Garner (1990) discusses why they often fail to be used. It is important for teachers to appreciate their role in developing an approach to teaching and learning which ultimately transcends the heuristics and recognises the complexity and context-dependent nature of learning (Perkins & Salomon, 1989; Sweller, 1991). This provides a strong argument for embedding skills use within a wide range of different contexts. Moore (1998) comments that it is essential that teacher education addresses these issues and "encourages student teachers to apply an information skills focus in practical work. Clearly, like information skills for children, this is not going to come about by osmosis. Teacher educators could be the most influential change agents is this, but little is known of their practical understanding of information literacy" (p. 92). Unfortunately, this study cannot provide evidence of that understanding. That lecturers and students expressed their belief in the importance of the skills, and claimed to possess them, cannot guarantee that they appreciate their complexity or are able to teach their strategic use.

Limitations of the study

It is important to acknowledge that this study has limitations in the information that it can provide about IT use within the College. This is partly inherent in the objectives of the research, which included providing a "snapshot" of selected aspects of Information Technology use within the institution, as a basis for future planning and investigation. In the process considerable emphasis has been placed on the "skills" involved in using various aspects of IT. The author contends that staff and student reporting of these skills and of their experiences contributes to an

understanding of the College's effectiveness in dealing with IT in its curriculum, and of the place of IT within the institutional culture. There is, however, a danger that this emphasis will obscure other important considerations that influence students' capacity to employ IT effectively in their teaching. Understanding of pedagogy and attitudes to IT use in schools, together with the degree of "computer anxiety", self-efficacy and coping strategies (Ropp, 1999), are amongst the important factors that may need to be considered.

Any survey relying on voluntary responses runs the risk of bias due to self-selection by respondents with strong interests. It is impossible to tell whether the staff and students who completed questionnaires in this study tended to be those with particular interests in the subject matter. The length of the questionnaires is likely to have been a factor in deterring those with minimal interest in the subject from completing and subsequently returning them. An appreciable number of student questionnaires were received with sections not completed. If, as seems most likely, students and staff with a particular interest in Information Technology were more likely to return the questionnaire, we would expect data obtained to *over-estimate* the degree of knowledge, activity and skill of the total population. Where low-levels of these have been noted in this study, the reality may be that they are even lower.

One of the problems in relying, as this study does, on self-reporting of skills is the lack of consistent interpretation of meanings. Aspects of IT use employed in the questionnaire were not tightly defined and we do not know how the phrases were interpreted by students and lecturers. It may be hypothesised that lecturers and students place value on the technical skills with which they are familiar (word-processing, telephone, fax and e-mail) and on generic skills which have been applied in using traditional media. The findings of this study cannot necessarily be taken to demonstrate that lecturers and students understand the application of these skills

within classrooms using new information technologies. Further research is necessary to establish their understandings of the pedagogy of using IT.

Summary

In this chapter lecturers have been shown to be heavy users of information technology in their personal, administrative and research roles but the degree to which they incorporate information technology into their teaching is found to be limited. Students are also found to use computers extensively though, as for lecturers, their use is largely in the common applications of word-processing, e-mail and Internet (World Wide Web) use, with fewer having developed skills in other areas which are valuable in the classroom. Students are shown to have limited experience in using information technology in their teaching and large numbers have little experience of pedagogical aspects within their College course. These findings have important consequences for the competence of graduates from the College's pre-service teacher education programmes and they are related to the themes of integration across programmes, provision of teaching experience which includes information technology, and the setting of goals for technical competence. Lecturers' limited competence with some aspects of information technology, and their understanding of its educational use, have important consequences for student teachers' learning to use information technology in their own teaching and also for the development of new modes of teaching and learning, which rely heavily on IT. Skills-based approaches to learning with IT have limitations, which result from their context-dependent nature and which are seldom recognised. It is, therefore, important that skills are integrated across the teacher education curriculum.

There is a tendency for statistical analysis to emphasise the generalities and reduce discussion to consideration of averages. It is worthwhile noting, therefore, that data

collected in this study also reveals wide diversity amongst the respondents in their knowledge of IT and experience in using it within education. Hence, any action which results from considering these results must also take into account the wide range of individual strengths and needs of lecturers and students within the College.

CHAPTER 5

Conclusion and Implications

Introduction

This chapter examines the implications of the research findings for the institution studied and for other pre-service teacher education organisations. The evidence gathered supports a number of proposals made by other workers in this area for improving the effectiveness of IT education for beginning teachers, and indicates needs for staff development. The implications of the findings for further research are also identified.

Implications for Teacher Education Practice

Pre-service teacher education programmes

The findings of this study provide support, within the New Zealand context, for the conclusions reached in Britain, the USA and Australia that most graduating student teachers have very little practical experience of using IT in the classroom, and many do not have theoretical knowledge in this area. This is despite large numbers of students having familiarity with computers and claiming competency in various aspects of IT. Researchers in those countries strongly recommend that a number of practices can have a crucial impact on this situation, including the integration (or "permeation" or "infusion") of IT use across the whole teacher education curriculum, establishing procedures to ensure that students get teaching experience using IT, and changing the emphasis within the pre-service course from developing skills in using hardware and software to developing an understanding of using IT in classroom teaching practice.

The evidence of this study indicates that at present integration is not taking place within the College and that students' opportunities to gain classroom experience are limited. This situation is not easily rectified, as the body of international literature attests, but it is important that the institution makes strong efforts to deal with them. Integration, which would ensure that students were given models of effective IT use within a wide range of contexts, is closely tied to issues of staff development, which are considered below. Enhanced teaching experience opportunities in IT are very much dependent on the skills of associate teachers and the policies in their schools, as well as the College's own procedures for allocating students to schools and setting teaching practice briefs.

Evidence from research, and common-sense, suggests that *requiring* students to undertake, and reflect on, work with IT during their practicum would increase the amount that is done. Although the quality of this experience may vary considerably depending on the school resources and the associate teacher's own expertise, there are indications that any successful experience will help to develop confidence and students' willingness to use IT in the future. Small scale teaching experience can also be arranged for students outside of major practicum sessions, by individual lecturers, to meet objectives within particular course modules. Other strategies that have been adopted successfully have involved school pupils coming into the College to work with student teachers. Indeed, the author has been involved in Diploma of Teaching courses (now defunct) within the College which have included this approach.

The third recommended measure concerns changing the emphasis for graduating students from technical IT capabilities to pedagogical IT capabilities. This is not to deny that students need skills in using equipment and software, but to recognise that possession of these skills may not be the crucial factor in beginning teachers'

readiness to use IT-based methods in their classrooms. There are clearly a number of interrelated elements which affect teachers' readiness to use IT, including their personal skills, confidence in handling IT, knowledge and understanding of IT use in teaching and learning and their prior classroom experience. Each of these may influence the others, so that personal skills may increase confidence and confidence may increase the willingness to use IT in the classroom; successful classroom experience may increase confidence and motivate the development of skills. Study of proficient computer-using teachers (Brown, 1995) has shown the important role that theory plays in making effective use of computers in teaching. This research indicates, however, that, despite general agreement about their importance amongst lecturers and students, theory and classroom application of IT are not accorded great importance in teaching. Putting greater emphasis on these areas seems to be essential in establishing a balance and helping students to be effective classroom teachers.

Many of the students have access to computers and have developed skills in using computer software and other IT tools (video, audio, fax, etc) independently of their teacher education. It is, therefore, important that College programmes both provide recognition for the learning that occurs outside them, and for the needs of students who do not have this advantage. Students may need guidance to identify how closely their outside experiences match with the needs of the classroom.

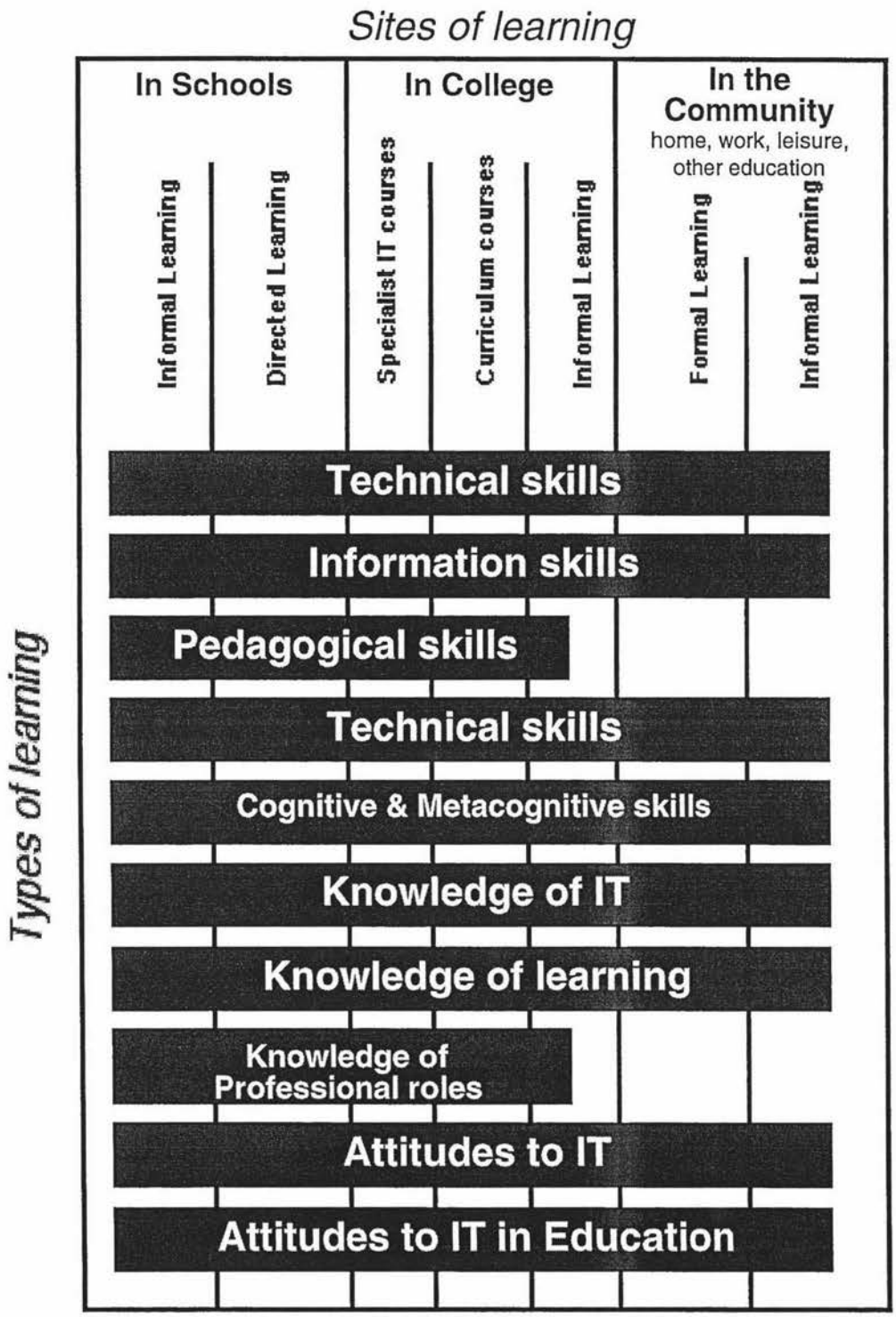
The approach to pre-service teacher education in IT in the past has been to provide specialist courses, a solution which closely fits traditional tertiary education curriculum models. Greater integration of IT into curriculum modules may not necessarily reduce the need for specialist modules, but the role of such modules may change. Within this College the compulsory introductory module in IT is already seen as an introduction to concepts of information literacy and issues related to the place of IT in education. Its role is to support students' personal use of IT and

prepare them for the use of IT within other curriculum areas. Technical skills are only learnt within this context. Developing the integration of IT across the pre-service curriculum will not make such a course redundant, and until effective integration occurs such a course may be essential to ensure that students gain basic knowledge and understanding of using IT in education.

The model of pre-service teacher education in IT that emerges from this study is one that recognises the diverse ways in which student teachers learn about IT. From the point of view of the College there are three sites for this learning: in the College, in schools and in the community (home, leisure, employment and other educational institutions). In each of these sites learning may be formal or informal. Across them, in varying degrees, students will develop their skills, knowledge and attitudes. Skills encompass the range of areas discussed above: technical skills of using hardware and software; information processing skills related to locating, retrieving, manipulating and presenting information; the cognitive and metacognitive skills associated with carrying out these processes thoughtfully and strategically so that learning occurs; and the pedagogical skills necessary to use IT effectively in teaching and teach children to use IT themselves. Figure 1 provides a diagrammatic representation of this model, which provides a basis for planning to ensure that teacher educators recognise the many components and the complexity of the task. They need to appreciate the context-dependent nature of much that is learnt, but also recognise that learning in one site can affect learning in another, both positively and negatively.

The author is aware that the College has established exit standards for students that do include both technical and pedagogical dimensions. What needs to be established is how these can be achieved through the pre-service teaching programme, and how they can be effectively monitored. Assessing students' practical skills and

Figure 1: A model for IT in pre-service teacher education



knowledge is easier to achieve than assessing their skills and knowledge of teaching with IT, with a resultant danger that undue emphasis will continue to be placed on the former.

To develop consistent monitoring of students' capability in using IT there is a need in the College to achieve a common understanding of graduating students' needs. Merely listing a comprehensive range of skills of the kind contained in this study has a real danger of missing the essence of the complex nature of the educational use of IT, as well as being short-lived as technology changes. Consultation beyond the College community, involving teachers in schools and academics with expertise in this area, could help to ensure that an appropriate framework was developed which related to the actualities of classroom practice. In terms of the structure proposed by Moore and colleagues (Moore et al., 1999) it is equally important to identify the "instructional uses" and professional roles associated with IT in the classroom as well as the technical skills.

At the same time, it is necessary to decide what are appropriate goals for pre-service teacher education. Brown (1995) draws attention to the small number of teachers in the early stages of their career who met the criteria in his study for proficient computer-using educators, despite the common perception that younger teachers are more innovative. This may result from deficiencies in pre-service teacher education, or indicate that a maturity of classroom experience is necessary for most teachers to be able to cope with the additional demands of using IT effectively. The latter conclusion will require a different approach to pre-service teacher education than the former. There is a plausible argument that beginning teachers lacking in the capability to teach with IT add unnecessarily to the burden of in-service staff development. Nevertheless, considering the worldwide problems in providing adequate pre-service education in IT, we must consider the possibility that it is an unrealistic goal to expect every graduating student teacher to be fully competent in this area. In addition, the demands of different hardware, software and approaches to the use of IT required by a variety of schools may be more effectively dealt with by

in-service teacher development. Suitable objectives, which satisfy the demands of schools, the realities of pre-service teacher education and the demands on beginning teachers, have not yet been established in New Zealand, and research on this is now clearly needed.

One conclusion that arises from this study is that there are a number of distinct differences between the knowledge and experiences of primary and secondary student teachers. The secondary students appear, in general, to be less familiar with many applications that are used in the classroom and to have less contact with computer use in schools, though having greater technical skills in some areas than primary students. Their views of the important skills for beginning teachers seem to indicate a narrower view of classroom pedagogy. An explanation for this may lie in the different nature of teaching practices in secondary schools; if this is not the case then we must assume that secondary student teachers are receiving an inadequate education for their future roles. There is a need for further investigation into actual and potential classroom uses of IT in New Zealand secondary schools, to inform the College's secondary programme. The question needs to be addressed concerning the extent to which this programme should, and can, attempt to promote IT practices that are not widely accepted in secondary schools.

At present, one strong opinion in the literature suggests that the only measure of success of teacher education in IT must be the number of students who actually employ the technology in their classrooms as beginning teachers. There are no reports in the literature of any research on beginning teacher use of IT in New Zealand, and an investigation into this would be a valuable way for the College to gain information about the success of its programmes in the area of IT.

Staff development

This study sought to develop a picture of IT use by lecturers. A very large number are regular users of computers, though for a limited range of purposes. Many are not using a wide range of aspects of IT in their work with students. If institutional goals are to be met, in developing students' abilities to use IT in their own teaching, and in widening the range of methods for flexible teaching and learning, then it will be important to enhance and extend the skills and knowledge of staff in this area. There is a need for ongoing staff development to achieve wider integration of IT into the curriculum, as described above, to provide more effective guidance for their students in using IT in their own classrooms and centres, and to enable lecturers to carry out their teaching and research more effectively.

Much of the widespread computer experience that this study documents appears to have been stimulated by the provision of resources - computers, network access to e-mail and the Internet and support services. It is useful to note the important role that this has played in developing a culture within the College in which staff accept the role of computers for communicating and regularly discuss computing techniques with colleagues. Further developments such as the provision of library databases online and the development of intranet services, may be expected to further expand this acceptance of, and familiarity with, IT. Administrators need to continually consider the value of strategically providing services and support, which have effects beyond the immediate practical outcomes through helping to establish a climate of IT acceptance and use.

Despite lecturers' beliefs that it is important for beginning teachers to have knowledge and understanding of the pedagogical use of IT, less than half teach these aspects and they expect them to be used in less than a quarter of the modules that they teach. An explanation may lie, partly, in lecturers' believing that these aspects

are dealt with in other modules, such as the compulsory first year Information and Communication Technology paper. In the light of lecturers' not using IT to any great extent in their own teaching, this may also indicate that they need to develop their own pedagogical IT knowledge. Staff development in this area may also increase the academic prestige associated with IT use. Unlike their American counterparts, however, New Zealand college of education lecturers, coming largely from a teaching background, can be expected to place value on pedagogical skills in general. In the USA great difficulty is experienced in addressing IT pedagogy, because of staff reluctance to engage with activities other than academic research (see, for example Office of Technology Assessment, 1995, p.191). In the College studied here teachers are exclusively taught by specialist education staff for whom pedagogy can be expected to have high values.

Nevertheless, effective education of beginning teachers to use IT provides a great challenge for teacher educators. As well as developing personal, technical skills, they need to become skilled at employing IT to achieve their goals in educating adults and competent in the techniques of using IT within school-level education. They also need to seek out, and work with, effective IT-using teachers within the schools, to ensure that student teachers can obtain school-based experience of IT-enhanced teaching and learning. Staff development in this areas for teacher educators thus becomes crucial.

There is a large and growing literature on IT staff development in schools. Despite differences in culture and organisation between schools and tertiary education institutions, it would be sensible for the College to take this body of knowledge into account when planning its own staff development. The work of Somekh and Davis (Davis, 1997; Somekh, 1998; Somekh, Whitby, & Coveney, 1997), in particular, bridges the gap, being based on work in both schools and higher education, while

writers on educational change, such as Fullan and Rogers (Fullan, 1982; Fullan & Stiegelbauer, 1991; Rogers, 1995), provide a theoretical basis. Based on her research, Somekh (1998) stresses the centrality of professional development in implementing change, as well as the importance of partnership and the development of shared meanings. This study has shown that there are clear expressions of shared belief in the importance of IT by lecturers and students within the College. These have the potential to provide a "critical mass" for change, but it is important to establish a degree of commonality in understanding what is meant by these statements: developing IT use involves bringing about cultural change.

McDougall and Squires (1997) developed a framework for IT professional development programmes in schools that recognises this, and which has equal value when applied to a teacher education institution. They proposed five foci for professional development: (a) skills with particular applications, (b) integration into existing curricula, (c) IT-related changes in curricula, (d) changes in the teacher's role and (e) under-pinning theories of education. There is a challenge for colleges of education to develop staff development programmes that incorporate all five of these foci.

This study has been based on a broad concept of *Information Technology* that includes a range of forms of information storage, retrieval and communication such as video and sound recording, telecommunications and computing, as well as the area often described as "information skills". As described in the literature review, a number of terms are applied to this area of study, with a wide range of definitions, resulting in considerable confusion amongst practitioners. Acceptance, or understanding, of the term "information technology" does not appear material to student and lecturer responses to the questionnaire, since individual items were specific in their reference to the various aspects considered. Nevertheless, agreement

on terminology and consistency in its use across the College would be beneficial in helping to build the shared understandings referred to above. In particular, the discussion must consider the role of the computer in relation to other information technologies, and the place of information literacy. There is much more information required about how children develop and use information skills and how teachers can enable them to become strategic users of information technology. A debate on these issues which continues at a national level may help in refining understandings and consistency between teacher education institutions.

Recommendations for further research

IT in pre-service teacher education in New Zealand is an area that has been under-researched in the past and, indeed, little discussed during the past decade. This study has highlighted a number of areas in which further research is needed.

This study has built up a broad picture of the use being made of IT by students and lecturers and of their experiences within the College; there has been a concentration on self reporting by participants of their own skills. To provide more information about the success of the College in educating students to become effective IT-using teachers there is a need for further study of the quality of these experiences and a more objective examination of their knowledge and skills. An understanding of the attitudes and pedagogical beliefs that underpin staff and student use of IT would be valuable in developing a deeper understanding of the processes at work. This may involve some survey work, but it is the author's belief that a case study approach would provide richer understandings. Much research evidence that is currently available, particularly from surveys, remains at a very general level. The complexity of IT use in education is now recognised and there is a need for specific details about current practice to inform future developments. There is also a need for teacher

educators to share their experiences in devising and implementing successful approaches to integrating IT within pre-service courses. Research in New Zealand needs to extend beyond this College to include other pre-service teacher education institutions across the country.

Research needs, also, to be extended beyond pre-service institutions to encompass longitudinal studies of beginning teachers' use of IT. As noted above, this provides an opportunity to gain feedback on the ultimate value of courses offered in pre-service teaching courses. Surveys of recent graduates would give global indications of course effectiveness, while in-depth case studies would help to throw some light on how these young teachers cope with the wide variety of conditions in different schools.

There is still considerable work that needs to be done to establish the appropriate curriculum for pre-service teacher education in IT. Our developing understanding of effective classroom practices which incorporate aspects of IT will have a significant impact on the content and approach of pre-service education, including the largely unexplored area of IT in early childhood education. Teacher educators from all curriculum specialities need to be more fully engaged in these studies to achieve maximum effect on the College programmes. It is also important for the College to involve outside practitioners in establishing appropriate goals for new teachers entering the profession.

This is an area where cooperation between staff from a number of pre-service teacher education institutions, and the involvement of a wide range of other educational groups should be encouraged, to arrive at clearer national directions. It would also appear appropriate for the Ministry of Education to take a more prominent role in developing and supporting IT education for beginning teachers.

Information Technology is a multi-faceted endeavour that has had considerable impact on the way many people view the educational process. Many claims are made for its potential to change the practice of schooling, but its use in education is still developing and, largely, not well understood. Nevertheless, it plays a major part in national educational policies and rhetoric, and a great deal of emphasis has been placed on in-service teacher development to enable schools to benefit from IT. However, there has been a worldwide lag in recognition of the need for adequate pre-service teacher education in IT. In New Zealand there are signs of increasing concern for this aspect of teacher education being expressed within the Government and Ministry of Education.

In the light of this growing interest the present study is timely. It has illuminated the place of IT in the pre-service education provided by a large College of Education, and has indicated a number of areas for further research. A need has been demonstrated for the College to develop more effective strategies for embedding the use of IT into students' work across the curriculum, and enabling them to gain greater experience of its use within classroom contexts. It is likely that similar needs will be evident at other New Zealand teacher education institutions. IT in pre-service teacher education is a topic which has received little attention in New Zealand educational literature and this is an appropriate time to suggest that a body of knowledge must be rapidly developed on which to build practice, and that there are a number of important debates in which teacher educators need to engage.

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APPENDIX 1

Student Questionnaire

Information Technology in Teacher Education at Auckland College of Education

This survey about the use of Information Technology at ACE is being undertaken for the Teaching and Learning and Information Technology subcommittee of the Academic Board.

Information Technology (IT) can be understood in very broad terms. It is sometimes referred to as Information and Communications Technology. In this study I am concentrating on the use of electronic means of storing, manipulating and communicating information, particularly through the use of computers, but also including video and audio recording, telephone and facsimile machine, and the strategies and skills of analysis associated with these.

The purpose of this research is to provide a basis on which to plan staff development for lecturers and develop the use of IT within the pre-service teaching curriculum at ACE. It is intended to help me understand what ACE lecturers know about Information Technology, what experiences they have in using IT and what use they make of it in their work. This should be of assistance in enabling staff and students to get the greatest value from this technology in their courses at the College.

I will also be using the data as part of research for my M.Ed. thesis.

Randomly selected groups of first and third year pre-service teaching students are completing this questionnaire.

All lecturers are also being asked to complete a similar questionnaire about their experience with, and use of, Information Technology and their perceptions of the relative importance of different IT experiences for students.

All responses are *totally anonymous* and there is no way in which the you can be identified from the completed questionnaire.

A summary of the findings of the research will be made available to lecturers.

Thank you for your assistance in spending the time to complete this questionnaire.

If you have any questions concerning the study please do not hesitate to contact me at the Auckland College of Education (Telephone Extension 8656 or e-mail t.hunt@ace.ac.nz).

Tony Hunt
Educational Information Technology Adviser

[A] Your experience with Information Technology

Your use of computers for College work

To help me understand what experience you have with Computers and software, please tick the responses below which apply to you.

1 Do you use computers **within the College** for any **College work** *other than in class time.*

- Yes ☐ 1
- No ☐ 2

2 If you answered YES to Q.1, how, often *on average*, do you use a computer for this college work?

- less than one hour a month ☐ 1
- 1-3 hours a month ☐ 2
- 1-4 hours a week ☐ 3
- 5-7 hours a week ☐ 4
- more than 8 hours a week ☐ 5

3 Have you used College computers outside of timetabled classes?

- Yes ☐ 1
- No ☐ 2

4 If you answered YES to Q.3 please tick the place or places where you use the computer/s:

- Educational Computing Centre ☐ 1
- Technology Education rooms ☐ 2
- College Library ☐ 3
- Language rooms ☐ 4
- Maths Education rooms ☐ 5
- Science Education rooms ☐ 6
- Social Science Education rooms ☐ 7
- Health & PE rooms ☐ 8
- Arts Education Centre (include. Music) ☐ 9
- Te Puna Wananaga ☐ 10
- Other (please list below) ☐ 11

If you ticked OTHER, please write down the location of the computer or computers that you use

5 Do you own a computer or have the regular use of a computer outside College?

- Yes ☐ 1
- No ☐ 2

6 Do you use a computer **outside College** (eg, at home) for *College work* ?

- Yes ☐ 1
- No ☐ 2

7 If you answered YES to Q.6, how often *on average*, do you use a computer for this work outside College?

- less than one hour a month ☐ 1
- 1-3 hours a month ☐ 2
- 1-4 hours a week ☐ 3
- 5-7 hours a week ☐ 4
- more than 8 hours a week ☐ 5

9	Do you have a personal electronic-mail (e-mail) address?	Yes ☐	1
		No ☐	2
10	If you answered YES to Q.9, how often, on average, do you access your e-mail?	less than once a week ☐	11
		1-4 times a week ☐	2
		once a day ☐	3
		2-4 times a day ☐	4
		more than 4 times a day ☐	5
11	Do you access any information on the Internet or the World Wide, *not including* e-mail	Yes ☐	1
		No ☐	2
12	If you answered YES to Q.11, how often, during a typical week, would you use the Internet (other than accessing and sending e-mail)?	less than once a week ☐	1
		once or twice a week ☐	2
		between two and four hours a week ☐	3
		once a day ☐	4
		more than once a day ☐	5

Your confidence in using IT

We would like to gauge how confident you feel about successfully carrying out a number of IT-related tasks.

	Please tick in the appropriate column to indicate how confident you are in your ability to do the following...	Extremely	Very	Fairly	Not particularly	Not at all
13	Use a word processor to write handouts or essays which include tables and page numbers					
14	Use e-mail to send, receive and reply to messages and include attached files					
15	Search for information on a particular topic on the World Wide Web of the Internet					
16	Download files from the Internet to your computer					
17	Locate references using the ACE library catalogue					
18	Search for references using an electronic database such as AUSTROM or ERIC					
19	Create and use a spreadsheet to store and analyses information about pupils					
20	Use presentation software such as Power Point to create on-screen slides or OHP transparencies to support a talk or lecture					
21	Create resources on the World Wide Web to provide information or support teaching					
22	Set up a computer in a classroom and show children how to find information on a CD-ROM					

Your personal learning about computers

23 Please tick any of the ways in which you have learnt about using computers...

		Lri
Your pre-service teacher education programme [eg B.Ed.(Tchg), etc.] at ACE		1
Self tuition using self-instructional materials (books, tapes, videos, etc)		2
Self-tuition by use of manuals and trial and error		3
Higher and Advanced Diploma in teaching course/s at ACE		4
Higher and Advanced Diploma in teaching course/s at another College or ASTU		5
Course/s run by Information Studies Department at ACE		6
Short course/s or seminar/s at ACE		7
Staff development or training from an employer		8
Ministry of Education teacher development contract		9
University undergraduate course/s		10
University post-graduate course/s		11
Polytechnic course/s		12
School night class/es		13
Secondary school course/s		14
Private correspondence school course/s		15
Computer training organisation		16
One-to-one help from a friend or colleague		17
Information Technology Services (ITS) staff		18
Educational Computing Centre Staff		19
Other (please give details below)		

If you ticked OTHER, please give details here:

24 Review your answers to Q.23 and **circle** what for you has been the most valuable way of learning about computers.

[B] IT in Pre-Service Teaching Courses

Use of Information Technology by lecturers in your courses at ACE

We are interested in finding out what forms of IT are used in your pre-service teacher education programme at ACE. At one extreme the delivery of the course could be entirely via the Internet and all of your interaction with your lecturers by electronic means. At the other extreme a course may be classroom based with no use of IT whatsoever.

Think about the modules and courses that you have done *throughout your course to date*, and identify what IT was *typically* used during each course/module

25 How many modules/courses (usually a semester in a subject) have you taken at ACE? ☐

26 *In what percentage of these modules* were the following forms of IT used by the **lecturers** in the delivery of the course?

Indicate your answer by ticking the approximate percentage of modules using each type of IT.

	About 100%of modules	About 75% of module	About 50% of modules	About 25% of modules	About 10% of modules	Less than 10% of modules	
Whiteboard or blackboard							1
Printed handouts							2
Overhead projector							3
Video Cassette Recorder							4
Audio tape recorder or CD player							5
Presentation software on a computer (eg *PowerPoint*)							6
Electronic mail							7
WWW pages on the Internet							8
A projector linked to a computer							9

Others (please name):

Your personal use of Information Technology in your course at ACE

We would like to know what use you have made, personally, of Information Technology during your course at ACE so far.

Think about the modules and courses that you have done *throughout your course to date*, and identify what IT **you used** to do these modules

27 *In what percentage of these modules* did you use the following forms of IT?

Indicate your answer by ticking the approximate percentage of modules where you used each type of IT.

If you are *not familiar* with the form of IT *do not tick any column* alongside that use of IT.

	About 100%of modules	About 75% of module	About 50% of modules	About 25% of modules	About 10% of modules	Less than 10% of modules	ITU
Word processing							1
Desk-top publishing							2
Using existing databases (incl. library databases)							3
Creating their own databases							4
Creating or editing pictures using computers							5
Statistical or other data analysis							6
Using a spreadsheet program							7
Using presentation software (eg *PowerPoint)*							8
Finding information on CD-ROM							9
Creating hyper-media presentations							10
Communicating using e-mail or a bulletin board							11
Accessing information on the Internet							12
Creating World-Wide-Web pages							13
Video editing							14
Recording with a video camera							15
Recording TV programmes on videotape							16
Playing video-tapes							17
Sending or receiving fax							18
Using a digital camera							19
Using a graphics scanner							20
Making sound recording							21
Editing sound recordings							22
Playing audio recordings on tape or CD							23
Using classroom computer programs designed for schools							24
Using the telephone							25
Locating useful sources of information							26
Presenting information effectively							27
Designing research questions							28
Note-taking and recording information							29
Using computer-based tutorials							36

Continued on the next page ...

27 contd Please list any other IT skills that you have needed to successfully complete your course at ACE and estimate in what proportion of modules you needed these:

	About 100%of modules	About 75% of module	About 50% of modules	About 25% of modules	About 10% of modules	Less than 10% of modules

Your experience of computers used for teaching & learning

28 Please indicate if you have had of the following experiences that you have had:

	Yes	No	
I have observed experienced teachers using computers as part of their classroom programme.			EXP2
I have taught in a school where computers were used by pupils as part of the programme.			EXP3
I have used computers as part of my classroom programme as a student teacher or teacher in a school.			EXP4
I have been a student on a course which used computers as part of the programme.			EXP5

We are interested in knowing what IT skills you have learnt at ACE and what skills you have learnt elsewhere which could be useful to you in your teaching work.

29 Please indicate any IT skills that you have been *taught as part of your College course* or that you have learnt elsewhere, or taught yourself.

- Tick in the appropriate column for each skill.
- Tick in both columns if you have learnt at ACE **and** elsewhere.
- Leave both columns blank if you do not have the skill.

	Taught during ACE programme	Learnt elsewhere (or self-taught)	ITL
Word processing			1
Desk-top publishing			2
Using existing databases (including library databases)			3
Creating your own databases			4
Creating or editing pictures using computer software			5
Statistical or other data analysis			6
Using a spreadsheet program			7
Using presentation software (eg *PowerPoint)*			8
Finding information on CD-ROM			9
Creating hyper-media presentations			10
Communicating using e-mail or a bulletin board			11
Accessing information on the Internet			12
Creating World-Wide-Web pages			13
Video editing			14
Recording with a video camera			15
Recording TV programmes on videotape			16
Playing video-tapes			17
Sending or receiving fax			18
Using a digital camera			19
Using a graphics scanner			20
Making sound recording			21
Editing sound recordings			22
Playing audio recordings on tape or CD			23
Using classroom computer programs designed for schools			24
Using the telephone			25
Locating useful sources of information			26
Presenting information effectively			27
Designing research questions			28
Note-taking and recording information			29
Evaluating educational software for classroom use			30
Designing learning activities which use IT			31
Understanding use of IT to assist students with special needs			32
Understanding ethical and legal issues in using IT			33
Understanding theories of learning relating to IT use			34
Using IT for classroom record keeping			35
Using computer-based tutorials			36

We would like to find out what IT skills and knowledge you believe that **beginning teachers** require.

30 Please read each description of skill or knowledge and rate its importance for beginning teachers...

*If you are **not familiar** with a particular form of IT listed below, **please do not tick any** of the columns alongside that activity*

	Essential	Very Important	Important.	Not very important	Not important	BTX
Word processing						1
Desk-top publishing						2
Using existing databases (including library databases)						3
Creating their own databases						4
Creating or editing pictures using computer software						5
Statistical or other data analysis						6
Using a spreadsheet program						7
Using presentation software (eg *PowerPoint)*						8
Finding information on CD-ROM						9
Creating hyper-media presentations						10
Communicating using e-mail or a bulletin board						11
Accessing information on the Internet						12
Creating World-Wide-Web pages						13
Video editing						14
Recording with a video camera						15
Recording TV programmes on videotape						16
Playing video-tapes						17
Sending or receiving fax						18
Using a digital camera						19
Using a graphics scanner						20
Making sound recordings						21
Editing sound recordings						22
Playing audio recordings on tape or CD						23
Using classroom computer programs designed for schools						24
Using the telephone						25
Locating useful sources of information						26
Presenting information effectively						27
Designing research questions						28
Note-taking and recording information						29
Evaluating educational software for classroom use						30
Designing learning activities which use IT						31
Understanding use of IT to assist students with special needs						32
Understanding ethical and legal issues in using IT						33
Understanding theories of learning relating to IT use						34
Using IT for classroom record keeping						35
Using computer-based tutorials						36

31 There may be some other skills or knowledge related to IT (as defined on the front cover of this questionnaire) which you believe to be important for beginning teachers. If so it would be helpful if you could list them below and rate the importance that you attach to them

IT Skills or Knowledge	Essential	Very Important	Fairly Important.	Not very important	Not important

[C] Your Personal Background

32 Are you male or female?

Male ☐ 1
Female ☐ 2

33 What is your ethnic group? ☐ 33

34 What programmes are you enrolled in?

B.Ed. (Early Childhood) ☐ 1
B.Ed. (Primary) ☐ 2
B.Ed. (Physical Education) ☐ 3
B.Ed. (Food & Fabric technology) ☐ 4
Dip. Tchg (Primary) ☐ 5
Dip. Tchg (Secondary) ☐ 6
Other ☐ 7

If you ticked OTHER, please write down the programme/s here:

35 What year of your programme are you currently completing (1st, 2nd, 3rd... etc)? ☐

36 Please indicate your age at your last birthday.

Under 20 yrs ☐ 1
20-24 yrs ☐ 2
25-39 yrs ☐ 3
40-44 yrs ☐ 4
45-49 yrs ☐ 5
50 yrs or over ☐ 6

Thank your for your assistance in completing this questionnaire

APPENDIX 2

Lecturer Questionnaire

Information Technology in Teacher Education at Auckland College of Education

This survey about the use of Information Technology at ACE is being undertaken for the Teaching and Learning and Information Technology subcommittee of the Academic Board.

Information Technology (IT) can be understood in very broad terms. It is sometimes referred to as Information and Communications Technology. In this study I am concentrating on the use of electronic means of storing, manipulating and communicating information, particularly through the use of computers, but also including video and audio recording, telephone and facsimile machine, and the strategies and skills of analysis associated with these.

The purpose of this research is to provide a basis on which to plan staff development for lecturers and develop the use of IT within the pre-service teaching curriculum at ACE. It is intended to help me understand what ACE lecturers know about Information Technology, what experiences they have in using IT and what use they make of it in their work. This should be of assistance in enabling staff and students to get the greatest value from this technology in their courses at the College.

I will also be using the data as part of research for my M.Ed. thesis.

All lecturers are being asked to complete a questionnaire about their experience with, and use of, Information Technology and their perceptions of the relative importance of different IT experiences for students.

Randomly selected groups of first and third year pre-service teaching students are also completing a similar questionnaire.

All responses are *totally anonymous* and there is no way in which the you can be identified from the completed questionnaire.

A summary of the findings of the research will be made available to lecturers.

When you have completed this questionnaire, please return it to Tony Hunt's pigeon hole in A-block, or send it to him through the internal mail system.

Thank you for your assistance in spending the time to complete this questionnaire. I would be grateful if you were able to do this by 11 October.

If you have any questions concerning the study please do not hesitate to contact me at the Auckland College of Education (Telephone Extension 8656 or e-mail t.hunt@ace.ac.nz).

Your experience with Information Technology

Your use of computers for College work

To help me understand what experience you have with Computers and software, please tick the responses below which apply to you.

1	Do you use a computer in your professional work at ACE (course preparation, research or administration, communication)?	Yes ☐ No ☐	1
2	If you answered YES to Q.1, for *how many hours* would you use a computer for such College-related activity?	less than one hour a month ☐ 1-3 hours a month ☐ 1-4 hours a week ☐ 5-7 hours a week ☐ more than 8 hours a week ☐	2
3	Do you have the *exclusive* use of a computer or computers provided at College?	Yes ☐ No ☐	3
4	Do you have access to a computer or computers provided by the College which you *share* with one or more other staff?	Yes ☐ No ☐	4
5	Do you own a computer or have the regular use of a computer outside College?	Yes ☐ No ☐	5
6	Do you use a computer outside ACE (eg, at home) for *College work* (course preparation, research, administration, communication)?	Yes ☐ No ☐	6
7	If you answered YES to Q.6, for *how many hours* would you use the computer outside College for such College-related activity?	less than one hour a month ☐ 1-3 hours a month ☐ 1-4 hours a week ☐ 5-7 hours a week ☐ more than 8 hours a week ☐	7
8	Do you *personally* use a computer when working with students (ie during lectures, tutorials, classes, etc) eg for presentations, demonstrations, etc	Yes ☐ No ☐	8
9	Do you have a personal electronic-mail (e-mail) address?	Yes ☐ No ☐	9
10	If you answered YES to Q.9, how often, on average, do you access your e-mail?	less than once a week ☐ 1-4 times a week ☐ once a day ☐ 2-4 times a day ☐ more than 4 times a day ☐	10

11 Do you access any information on the Internet or the World Wide Web, *not including* e-mail

Yes ☐ 11
No ☐

12 If you answered YES to Q.11, how often, during a typical week, would you use the Internet (other than accessing and sending e-mail)?

less than once a week ☐ 12
once or twice a week ☐
between two and four hours a week ☐
once a day ☐
more than once a day ☐

Your confidence in using IT

We would like to gauge how confident you feel about successfully carrying out a number of IT-related tasks.

	Please tick in the appropriate column to indicate how confident you are in your ability to do the following...	Extremely	Very	Fairly	Not particularly	Not at all
13	Use a word processor to write handouts or essays which include tables and page numbers					
14	Use e-mail to send, receive and reply to messages and include attached files					
15	Search for information on a particular topic on the World Wide Web of the Internet					
16	Download files from the Internet to your computer					
17	Locate references using the ACE library catalogue					
18	Search for references using an electronic database such as AUSTROM or ERIC					
19	Create and use a spreadsheet to store and analyse information about pupils					
20	Use presentation software such as Power Point to create on-screen slides or OHP transparencies to support a talk or lecture					
21	Create resources on the World Wide Web to provide information or support teaching					
22	Set up a computer in a classroom and show children how to find information on a CD-ROM					

Your personal learning about computers

23 Please tick any of the ways in which you have learnt about using computers...

23

Your own pre-service teacher education (if you trained as a teacher)	☐	A
Self tuition using self-instructional materials (books, tapes, videos, etc)	☐	B
Self-tuition by use of manuals and trial and error	☐	C
Higher and Advanced Diploma in teaching course/s at ACE	☐	D
Higher and Advanced Diploma in teaching course/s at another College or ASTU	☐	E
Course/s run by Information Studies Department at ACE	☐	F
Short course/s or seminar/s at ACE	☐	G
Staff development or training from another employer	☐	H
Ministry of Education teacher development contract	☐	I
University undergraduate course/s	☐	J
University post-graduate course/s	☐	K
Polytechnic course/s	☐	L
School night class/es	☐	M
Secondary school course/s	☐	N
Private correspondence school course/s	☐	O
Computer training organisation	☐	P
One-to-one help from a friend or colleague	☐	Q
Information Technology Services (ITS) staff	☐	R
Educational Computing Centre Staff	☐	S
Other (please give details below)	☐	T

If you ticked OTHER, please give details here:

24

24 Review your answers to Q.23 and **circle** what for you has been the most valuable way of learning about computers.

---

25 Are there any areas of computer use in which you would like to develop your personal skills, which relate to your work at ACE in teaching, research or administration.

Yes ☐ No ☐ 25

26 If you answered YES to Q.25, please list below the skills or knowledge which you feel the need to develop: 26

27 If you answered YES to Q.25, please indicate below ways in which the College could help you to develop these skills or knowledge. 27

Your use of a range of Information Technology tools

In the table below, please tick any application or equipment which you use during a typical week in your work at ACE (teaching, research or administration):

28	**IT application**		28
	Word processing		A
	Desk-top publishing		B
	Using existing databases (including library databases)		C
	Creating your own databases		D
	Graphic design		E
	Statistical or other data analysis		F
	Using a spreadsheet program		G
	Using presentation software (eg *PowerPoint)*		H
	Finding information on CD-ROM		I
	Creating hyper-media presentations		J
	Communicating using e-mail or a bulletin board		K
	Accessing information on the Internet		L
	Creating World-Wide-Web pages		M
	Video editing		N
	Recording with a video camera		O
	Recording TV programmes on videotape		P
	Playing video-tapes		Q
	Sending or receiving fax		R
	Using a digital camera		S
	Using a graphics scanner		T
	Sound recording using a tape recorder		U
	Editing audio recordings		V
	Playing sound recordings on tape or CD		W
	Other (please give details below)		X

29 Please list any forms of Information Technology which you would like to use in your work, but do not use at present : 29

30 What things (if any) prevent you from making use of this Information Technology in your work? 30

Your experience of computers used for teaching & learning

31 Please indicate if you have had any of the following experiences:

	Yes	No
I have observed student teachers using computer-related activities on teaching experience		
I have observed experienced teachers using computers as part of their classroom programme.		
I have taught in a school where computers were used by pupils as part of the programme.		
I have used computers as part of my classroom programme as a teacher in a school.		
I have been a student on a course which used computers as part of the programme.		
I have used computers as part of my teaching (not administration or research) as a teacher educator.		

IT in Pre-Service Teaching Courses

You should only answer questions in this section if you teach any pre-service teacher education courses.

32 On how many modules of **pre-service** teacher education programmes will you have you taught this year. [ ] 32

33 On how many of those modules would you have expected students to use the following IT skills? Write the number of modules besides each skill. 33

Word processing	1
Desk-top publishing	2
Using existing databases (including library databases)	3
Creating their own databases	4
Designing or editing pictures using computer software	5
Statistical or other data analysis	6
Using a spreadsheet program	7
Using presentation software (eg *PowerPoint)*	8
Finding information on CD-ROM	9
Creating hyper-media presentations	10
Communicating using e-mail or a bulletin board	11
Accessing information on the Internet	12
Creating World-Wide-Web pages	13
Video editing	14
Recording with a video camera	15
Recording TV programmes on videotape	16
Playing video-tapes	17
Sending or receiving fax	18
Using a digital camera	19
Using a graphics scanner	20
Making sound recording	21
Editing sound recordings	22
Playing audio recordings on tape or CD	23
Using classroom computer programs designed for schools	24
Using the telephone	25
Locating useful sources of information	26
Presenting information effectively	27
Designing research questions	28
Note-taking and recording information	29
Evaluating educational software for classroom use	30
Designing learning activities which use IT	31
Understanding use of IT to assist students with special needs	32
Understanding ethical and legal issues in using IT	33
Understanding theories of learning relating to IT use	34
Using IT for classroom record keeping	35
Using computer-based tutorials	36
Other (please give details below)	37

34 Please tick any IT skills that you have taught to students during any pre-service teacher education module that you teach... 34

Word processing	☐	1
Desk-top publishing	☐	2
Using existing databases (including library databases)	☐	3
Creating their own databases	☐	4
Designing or editing pictures using computer software	☐	5
Statistical or other data analysis	☐	6
Using a spreadsheet program	☐	7
Using presentation software (eg *PowerPoint)*	☐	8
Finding information on CD-ROM	☐	9
Creating hyper-media presentations	☐	10
Communicating using e-mail or a bulletin board	☐	11
Accessing information on the Internet	☐	12
Creating World-Wide-Web pages	☐	13
Video editing	☐	14
Recording with a video camera	☐	15
Recording TV programmes on videotape	☐	16
Playing video-tapes	☐	17
Sending or receiving fax	☐	18
Using a digital camera	☐	19
Using a graphics scanner	☐	20
Making sound recording	☐	21
Editing sound recordings	☐	22
Playing audio recordings on tape or CD	☐	23
Using classroom computer programs designed for schools	☐	24
Using the telephone	☐	25
Locating useful sources of information	☐	26
Presenting information effectively	☐	27
Designing research questions	☐	28
Note-taking and recording information	☐	29
Evaluating educational software for classroom use	☐	30
Designing learning activities which use IT	☐	31
Understanding use of IT to assist students with special needs	☐	32
Understanding ethical and legal issues in using IT	☐	33
Understanding theories of learning relating to IT use	☐	34
Using IT for classroom record keeping	☐	35
Using computer-based tutorials	☐	36
Other (please give details below)	☐	37

35 I would like to find out what IT skills and knowledge you believe that beginning teachers require. Please read each description of skill or knowledge and rate its importance for beginning teachers...

If *you are **not familiar** with a particular form of IT listed below, **please do not tick any** of the columns alongside that activity*

	Essential	Very Important	Important.	Not very important	Not important	
						35
Word processing						1
Desk-top publishing						2
Using existing databases (including library databases)						3
Creating their own databases						4
Designing or editing pictures using computer software						5
Statistical or other data analysis						6
Using a spreadsheet program						7
Using presentation software (eg *PowerPoint)*						8
Finding information on CD-ROM						9
Creating hyper-media presentations						10
Communicating using e-mail or a bulletin board						11
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Creating World-Wide-Web pages						13
Video editing						14
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Playing video-tapes						17
Sending or receiving fax						18
Using a digital camera						19
Using a graphics scanner						20
Making sound recordings						21
Editing sound recordings						22
Playing audio recordings on tape or CD						23
Using classroom computer programs designed for schools						24
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Understanding use of IT to assist students with special needs						32
Understanding ethical and legal issues in using IT						33
Understanding theories of learning relating to IT use						34
Using IT for classroom record keeping						35
Using computer-based tutorials						36

36 There may be some other skills or knowledge related to IT (as defined on the front cover of this questionnaire) which you believe to be important for beginning teachers. If so it would be helpful if you could list them below and rate the importance that you attach to them

IT Skills or Knowledge	Essential	Very Important	Important.	Not very important	Not important	36

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