The State of Affairs of Teacher Education with Respect to Information and Communications Technology

PAUL KIRSCHNER
Open University of the Netherlands, Heerlen, Netherlands
MICHELLE SELINGER
Cisco Systems, Feltham, United Kingdom

ABSTRACT If the Internet is an information superhighway, then teachers just might be the road-kill on the asphalt of the information superhighway. Possibly, for the first time in history, students are more adept at using the tools necessary for acquiring and transmitting knowledge than are their teachers. Children everywhere are creating their own virtual communities through the use of new technologies. They make use of chat facilities (*MSN*®, *ICQ*®, etc.) to stay synchronously in touch with both old and new friends and email and short message services to stay in touch with them asynchronously. They take part in discussion groups, navigate through virtual worlds and assimilate new hardware and software as if it were second nature. In many ways they are light years ahead of their parents and teachers with respect to the possibilities of information and communications technology (ICT). As a result students are getting bored and frustrated and teachers are getting frustrated and distraught. To try to remedy this, the Inspectorate of Education of the Netherlands commissioned the Educational Technology Expertise Centre of the Open University of the Netherlands to lead an international study (quick-scan) on good/best practice with respect to the integration of ICT into the mental and physical toolbox of the aspirant teacher and to try to draw from this preliminary curricular benchmarks for teachers' colleges in the Netherlands. The quick-scan was carried out by a network of teacher training and ICT experts throughout the world. This special issue shows the reader the results of this quick-scan in terms of good practice and benchmarks for calibration and/or modelling of teacher training in ICT along with a number of pedagogical and policy repercussions of their adoption.

Introduction

While technology is not a panacea for all educational ills, today's technologies are essential tools of the teaching trade. To use these tools well, teachers need visions of the technologies' potential, opportunities

to apply them, training and just-in-time support, and time to experiment. Only then can teachers be informed and fearless in their use of new technologies. (Office of Technology Assessment for the US Congress, 1995)

Developing future teachers who know how to use modern learning technologies to improve student learning is a major challenge facing our nation's teacher preparation system. (Preparing Tomorrow's Teachers to Use Technology, 2002)

Information and communications technology (ICT) offers the potential to meet the learning needs of individual students; to promote equality of opportunity; to offer high-quality learning materials; and to increase self-efficacy and independence of learning amongst students of all ages. For the teaching profession, ICT is not only an essential tool for teachers in their daily work, but it also offers them opportunities for their own professional development. It can be used to encourage new ways of working as part of professional learning teams and it offers schools themselves the possibility of a faster route to establishing a meaningful role in the wider community, embracing learners of all ages, linking and networking to other educational establishments and bringing professionals together across a range of areas.

But all that glitters is apparently not gold. An ICT adviser for a large Local Education Authority in the United Kingdom (UK) reported that he had observed an increase in the use of ICT but it was just to be 'more of the same – we are seeing nothing transformational'. The same adviser added that he did not believe that learners had more autonomy; technology was not being used to give students a new way into learning, nor was there a change in pedagogical practice. Larry Cuban (1993), critical of the developments in the use of ICT in schools, believes teachers appropriate new technologies and incorporate them into their traditionally held views of teaching and learning. He argues that the overhead projector and video made very little impact on teaching styles, so why should computers be any different? But computers *are* substantially different from any previous technologies because multimedia and hypertext give students access to new ways of thinking through dynamic images, simulations and models, and the Internet provides access to a huge array of previously untapped information. Teachers must find ways of harnessing the power of the new technology. Their jobs will change but their role should become no less important, in the same way that public libraries and books did not make teachers redundant.

There is thus a growing tension between demands for radical change in educational priorities and processes and the expectations for teachers, especially with respect to the use of ICT in the teaching and learning process. Whether these priorities are determined locally or nationally, the teaching profession is having trouble adapting to these priorities at a pace that is fast enough to support the radical changes demanded. Teachers are increasingly on the front line in implementing policies designed to reap

educational benefits from investments in ICT. Innovations in the effectiveness of teacher recruitment, training and professional development have become key issues and will remain so.

In a survey of American teacher training institutions by the Milken Exchange on Educational Technology (1999), respondents revealed that teacher training students are not receiving systematic and prolonged technology training opportunities to use ICT. For example, at most institutions between 25 and 50% of faculty members in the school of education integrate information technology in their teaching … [and] only 25 to 50% of students frequently and systematically use ICT in their practice teaching.

According to a survey in the US by Market Data Retrieval (1999) of 1st-year and 2nd-year teachers, approximately 50% of the respondents were required to integrate technology during their student teaching. On the university side, although faculty respondents had similar skills as students, only 25 to 50% of field experience supervisors could offer advice on how to integrate technology in the classroom.

On the other side of the coin, looking at learners' ICT experiences, a recent report by the Dutch Social and Cultural Planning Office (De Haan et al, 2002) determined that 97% of the high-school students questioned reported having a computer at home, 84% reported having an Internet connection at home, 80% had their own email address and 22% even had their own web site. They use their computers more at home than at school (16% of the students report not having access to a computer at school compared to only 3% reporting not having access at home) and if they report using computers at all at school, it is not usually in their lessons. For the required course on informatics, only 41% of the students reported using the computer at least *once* a month!

In another study examining students' views of ICT in school and the home (Mumtaz, 2001), their experiences at school was mostly inferior to their experiences at home. They described school use as boring and cited examples such as 'typing up from the board' as a use of ICT, adding weight to Cuban's perspective discussed above.

Given that schools are – despite these results – increasingly expected to integrate technology and provide increased access to students and teachers, these results reveal that the majority of teacher training students are graduating in an information age without proper guidance on how to use technology in the classroom. There is, thus, a GAP!

Despite this gap, there are institutions that are doing good work to train both tomorrow's and today's teachers to make good use of the possibilities offered to them. In this special issue, a team of top educators/researchers in the field of teacher education and ICT have joined forces to discern and analyse examples of good practice all over the world so as to arrive at some benchmarks for good teacher training.

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Setting

There is widespread agreement that ICT can play a key role in enhancing learning and teaching. Children everywhere are creating their own 'virtual communities' through the availability of new technologies. They make use of chat facilities (*MSN*®, *ICQ*®, etc.) to stay synchronously in touch with both old and new friends and email and short message services to stay in touch with each other asynchronously. In many ways they are miles ahead of their parents and teachers with respect to the possibilities of ICT. They also multitask – while text messaging, listening to music, surfing the Internet, and watching TV they are also doing their homework. Professor Wim Veen (2000) describes them as a new breed of humans, 'homo zappiens'. Not only is the lack of technology integration a problem, there is a lack of recognition or acknowledgement of their learning and lifestyles in schools:

> In the past 5 years a substantial base of computer and other technology has been installed in K-12 [i.e. compulsory education] classrooms. *The Teaching, Learning and Computer: 1998 National Survey* found that 90% of 87,000 schools nationwide had Internet access at the school level and almost 40% had access at the classroom level. In several national studies, the question of teachers' expertise in using computers in instructional settings has surfaced as the central issue in educational technology. Only 20% of teachers thought they could use technology in their classrooms, and only 15-20% of teachers regularly used advanced telecommunications in their classrooms or instructional planning. Only 15% had 9 or more hours of instruction in educational technology. (Beck et al, 1999)

As Niki Davis and Penni Tearle (1998) noted: 'many countries around the world are taking action to ensure that their educational systems are updated to permit equality of access and to ensure that the key ICT skills are developed in schools and other educational institutions ... It has become abundantly clear that the training of teachers in ICT skills and appropriate pedagogical approaches is essential.' 'Preparing teachers is perceived as the main critical success factor in deploying ICT in education' (Weets, 1997):

> The changes brought about by the technical and social mutations affects the education field ... [but] the characteristics of education today still correspond (at their best!) to what were the needs of the industrial system of the 60s and do not anticipate on the future needs of the information society. European educational systems and training organisations need therefore to transform the professionality [sic] of teachers and trainers. The FETICHE project will consider different types of users: the Final users (learners), the Intermediary users (teachers, trainers, and personnel of education and training institutions).

What are the new competencies required? What new functions emerge from the recombination of these competencies? How do they collaborate together? How are they linked to the previous traditional competencies?
They determined that with respect to ICT in teacher education:

> – There is no universally defined understanding of applicability of ICT for teacher education, either pre-service or ongoing, in-service.
> – The range of styles of incorporation of ICT into teacher training reflects dependence upon particular institutions or large-scale projects to provide an impetus and interpret the requirements of teachers in schools.
> – For in-service and continual professional development, some initiatives are led by large government initiatives; others depend upon teacher and classroom demand.
> – It is thought that this reactive rather than proactive situation has contributed to the relatively slow uptake of the use of ICT in schools.

And with respect to curriculum, teacher education and pedagogy, that:

> – Activity has been both fragmented and discontinuous. Curriculum development, teacher education and pedagogy have been perceived and treated as discrete and separate areas. Policy has inevitably been incoherent.
> – Serious attention must be paid to the question of teacher education which can underpin utilisation of ICT into all aspects of the pedagogy of a school. Integration will only come when the links between ICT, the curriculum and teachers' needs and professional development in schools are forged within such a framework. (FETICHE, 1996)

Things are not much different in the Netherlands, although the Government has invested a substantial sum in stimulation initiatives going back more than 25 years. In a nutshell, the Dutch Government's role in introducing information technology in education evolved over the course of three distinct phases (Van Deursen & Moonen, 1991): a pioneering phase (to 1984), a stimulation phase (1984-1988) and an expansion phase (1988-1992). After the expansion phase the policy themes moved from 'learning about information technology' to 'making use of information technology in the educational setting' (Kirschner et al, 1996). Many advances have been made, but the Netherlands is coping with the same types of problems that we see in the rest of the world:

> On the basis of visits by the Inspectorate for Education, it appears that colleges for teacher training are severely remiss with respect to the attention paid to ICT as a part of the educational toolkit of the aspiring teacher. (Educational Partnership, 2001)

Shortage of Teacher Knowledge
Impedes Application of ICT in the Class

Inadequate teacher expertise is the bottleneck in the application of ICT in education. The cause is an alarming situation in teacher education. The Inspectorate of Education is disappointed about ICT results in teachers' colleges:

> The Inspectorate comes to this hard conclusion based upon a number of recent reports. Teacher expertise stops at the level of basic skills. The attention, both qualitative as quantitative, paid to ICT in teacher education is not up to par and money for innovation is used for 'business as usual' ... Many teachers' colleges aren't busy equipping their students with ICT skills. Aspiring teachers also aren't learning about what is going on in elementary and secondary schools. (Automatiseringsgids, 2002)

What is Good Practice?

'Good practice' is a series of documented strategies and tactics employed by highly respected institutions trying to find an effective, efficient and satisfying solution for identified needs, through processing and/or prototyping, to a finished product (paraphrase of Arthur Andersen, 2000). These institutions are not 'top-of-the-class' in every area – such institutions do not exist – but due to the nature of competition and their drive for excellence, the profiled practices have been implemented and honed to help place their practitioners as examples of 'how it can be done'.

What are We Looking for?

In this special issue we see ICT as a core technology in the teacher training/learning setting (Collis & Moonen, 2001, also discuss ICT as complementary technology). A core technology refers to the main way of organising the learning experience; the component around which all other components are planned. In contrast, complementary technologies are optional, serving a valuable function but able to be compensated for via the core technology if so needed, or dropped altogether if not functioning or feasible.

Collis & Moonen also speak of the goals as learning how to use ICT and learning with ICT. In learning how to use ICT, the focus of teacher training is how to use such products in the classroom off-campus. Teachers face new roles with respect to using ICT and learn how to fulfil those roles. In learning with ICT, the presentation and distribution of instruction is primarily through 'web environments or systems offering an integrated

range of tools to support learning and communication' (Collis & Moonen, 2001). The synthesis of these two axes can be seen in Figure 1.

Core technology

| ICT use in the classroom as content focus of the teacher training | ICT use as core technology for participation |

Learning HOW to use ICT   Learning via ICT

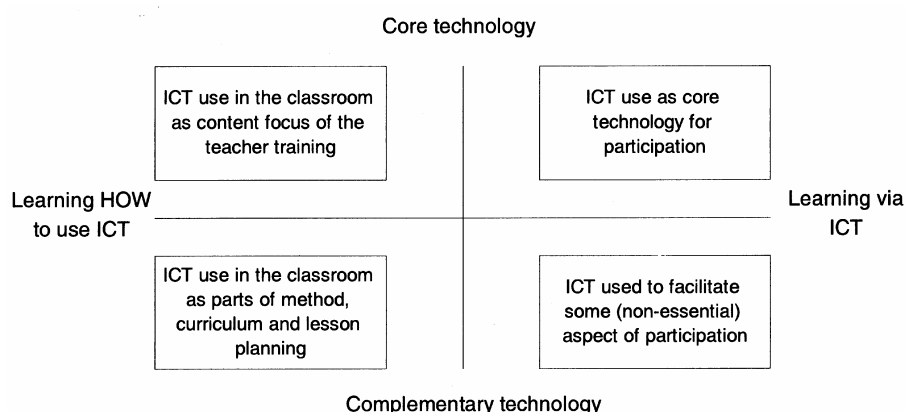| ICT use in the classroom as parts of method, curriculum and lesson planning | ICT used to facilitate some (non-essential) aspect of participation |

Complementary technology

Figure 1. Synthesis of axes.

We have chosen in our research to concentrate on ICT as a core technology, and thus on the upper two quadrants. The upper-left 'ICT use in the classroom as the content focus of the teacher training' refers to helping teachers gain competence with ICT, for example, with applications, specific educational software packages and the Internet. The upper-right quadrant relates to ICT (predominately web environments) as the tool used to support flexible learning for teachers, and particularly for specialist or postgraduate school-based or home-based study for teachers, just-in-time professional development including networking with other teachers, mentoring new teachers, and interregional or international collaboration. The on-line learning networks for teachers provided in many parts of the world are examples of teacher learning via ICT as a core technology.

Since we are dealing with the teacher learning and teacher training setting, we also have to determine what the level the goal competencies are at. There are, for example, three types of initial teacher education in the Netherlands:

o   teacher education for primary education (PABO: Pedagogic Academy for Basic Education): a 4-year course in higher vocational education at a teachers' college;
o   teacher education for lower secondary, vocational and adult education: a 4-year course in higher vocational education at a teachers' college;
o   teacher education for upper secondary education (the last 3 years of academic high school): a 1-year academic follow-up course after teacher education for lower secondary education or after university study in a specific subject area.

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Other countries follow predominantly similar paths, although in the UK there are very few undergraduate courses for secondary teachers, and it is an all-graduate profession.

At the end of this period, newly qualified teachers have a number of basic educational competencies that allow them to function adequately as a beginning teacher. In the Netherlands, this is defined as minimum quality norms for professional practice for teachers. These competencies are:

o directive with respect to policy for the educational curricula (programmes and examinations/certification) of the teachers' colleges;
o the starting point for the updating and upgrading of the competencies of practising teachers and as such can be directive for in-service training (in the UK this is called induction);
o the starting point for the evaluation of the competence of those who are not certified as teachers, but would like to receive this certification (Ministry of Education, Culture and Science, 1999).

For example, with respect to one of the competencies related to working with ICT and new media, the Dutch Government has determined that new teachers should be able to prepare, carry out and evaluate a few different educational situations that make use of ICT and multimedia (Ministry of Education, Culture and Science, 2000). Indicators for this competence are:

> ICT as aspect (aid for problem solving) and as medium (tool for the educational process); choose from one or more of the following 'tool-types': structured learning tasks via simulations, data sets, hypertext, cognitive tools, computer as tutee, video conferencing, distance education (email; tele-learning via intranet; Internet learning); multimedia (from transparencies and *PowerPoint*® to manipulable CD-ROM and virtual reality). (Ministry of Education, Culture and Science, 2000)

With respect to ICT, 'INTIME' (Integrating New Technologies Into the Methods of Education – an American project) differentiates between five levels of competencies, namely pre-novice, novice, apprentice, practitioner and expert. Table I illustrates the five levels for using technology resources and tools for science instruction and inquiry.

For this special issue we have chosen to focus on the challenges in achieving those competencies which need be gained at the end of the apprentice level/beginning of the practitioner level, as the competence level to be strived for.

Use computer and video systems (e.g. computers, videodisc players, video recorders, DVDs and cameras) for science instruction and inquiry

Pre-Novice	I am not aware of computer and video systems for science instruction and inquiry
Novice	I have read or heard about computer and video systems that may be used for science instruction and inquiry
Apprentice	I have used and evaluated computer/video equipment and media and any supporting materials appropriate for science instruction and inquiry in the grade level(s) that I will teach
Practitioner	I have designed authentic learning activities for diverse learners that integrate computer/video equipment and media and any supporting instructional materials with scientific inquiry in the classroom
Expert	I reflect upon and make educated decisions in determining the effectiveness of activities that require computer and video systems in addressing the needs of my students and whether they are consistent with current national science education initiatives

Table I. UNI pre-service teacher technology competencies: technology resources and tools for content areas (see http://www.intime.uni.edu/model/technology/comps3.html).

Structure of the Special Issue

This special issue details the project that was initiated by the Dutch Inspectorate through further analysis of the case studies in particular countries around the world. Each author, while gathering information from a range of sources to explore the very best practice in his or her region, has specific first-hand experience or involvement with teacher education programmes in a particular country and it is these that are further analysed to show how ICT in teacher training has evolved in line with government policy in each country and the demands of school, work and society. Additionally, the need for, the development and use of benchmarks is also discussed as well as the government perspective from the view of those that commissioned the study. Finally, the pedagogical aspects of ICT are considered and set within prevailing views of teaching and leaning.

Perspectives

The case studies of good practice are each approached from differing viewpoints. For the full list of practices, including descriptions and URLs, the reader is referred to the Appendix of this special issue. Selinger and Austin have examined the influence of government policy on the extent of permeation of teaching about the use of ICT in subject teaching in England and Northern Ireland. By comparing two approaches using a similar framework, the degree of autonomy left to teacher trainers is shown to be far greater in Northern Ireland than it is in England, although the results are very similar. Teachers are emerging from training as confident users of

ICT, albeit some feel frustrated by the lack of opportunity to use ICT during school placements. Government policy, however, has forged ahead with developments without allowing schools and teacher training establishments to be fully prepared. However, it could be said that waiting for the infrastructure to be in place might have delayed progress and the UK Government now prides itself in being a world leader in the deployment of ICT into schools. John Pearson writes about some of the approaches that have been taken to familiarise teachers with ICT in Australia and discusses the range of initiatives that have been developed since the mid-1990s. He sets out the range of policies, strategies and developments for teacher training in Australia in the different states. He suggests that teacher training has tended to focus more on learning *about* ICT and the time has come to place the emphasis in teacher education courses on learning *with* ICT.

Niki Davis sets her article in the context of diversity of good practice within the USA and compares the developments in the USA against an international backdrop. She concludes that despite some excellent programmes funded in particular through the US Department of Education's initiative 'Preparing Tomorrow's Teachers to use Technology', there is still considerable work needed to promote digital equity and social justice. Finland is another country in which policy documents have guided developments in the training of teachers to use ICT for teaching and learning, and Hannele Niemi describes the emergence of the use of ICT for the learning society. Finland is well known for its rapid emergence as a leading technological country and Niemi observes that there is now a trend towards using ICT 'more as a mindtool, moving towards more collaboration, interactivity and active learning, towards more integration of ICT in curricula and a better technical and pedagogical infrastructure', the direction suggested by Pearson. Kirschner and Wopereis focus on electronic networking technologies (conversation tools) as mindtools in communities of practice for teacher professional development. Examples of good practice from teacher training institutions in Europe illustrate how to prepare (aspirant) teachers for working with mindtools that enhance teacher professional development.

Benchmarking is becoming an acceptable and important methodology for identifying and catalysing good practice. In the article by Kirschner and Davis six benchmarks have been identified for the developments in pedagogical practices with ICT in both pre-service and in-service teacher training. Four of these benchmarks (competent users of ICT for personal uses, as a mindtool, as a tool for teaching, and mastering a range of educational paradigms which make use of ICT) are present in most programmes identified as models of good practice. However, understanding the policy frameworks that underlie the use of ICT for teaching and learning and understanding the range of assessment tools that make use of ICT are less prevalent.

The article by Boshuizen and Wopereis is based around the pedagogy of ICT within the four pillars of education described by the UNESCO Task Force (1998) on education for the twenty-first century: learning to know, learning to do, learning to live together and learning to be. They describe how ICT has broadened the privilege of access to knowledge to encompass the whole community and consider the implications these developments will have for education on raising new generations. They explain that teachers must learn and how and when to use the new tools that have been provided through ICT in order to prepare students for study, life and work in the twenty-first century. Teachers' awareness of the dangers and pitfalls of mass communications must be raised in order to further prepare their students. The implications for teacher education are vast as new and current teachers must be prepared for the speed of change and to develop their pedagogy accordingly. Boshuizen and Wopereis describe the best practices as those that are developed within a social constructivist framework. They conclude that there are no major differences between ICT training and training strategies in any other domain, and that these strategies should have two goals: the prevention of skills obsolescence and to keep abreast of emerging developments.

Finally, van den Dool and Kirschner reflect on the chances the presented benchmarks will have to become integrated within the teacher training programmes. They reflect on the concept of professional learning, organisational learning and how these two processes can be integrated and developed. They propose a framework for the actions of all actors involved in those processes: teacher training institutions, universities, research and development agencies, teacher trainers, students, in-service teachers, their pupils, and governments and society in general. Only purposeful and concerted action, collaborative experimenting and professional learning can effectuate the complete integration of ICT in the learning and teaching processes as a catalyst for implementing learning arrangements that fit the expectations of the twenty-first century and its youth.

Correspondence

Paul Kirschner, Open University of the Netherlands, PO Box 2960, DL-6401 Heerlen, Netherlands (paul.kirschner@ou.nl).

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