Beyond IT2000 – What we can learn from international experience

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Ireland is now at a critical junction as the IT2000 initiative draws to a close and the challenge facing us is to move the use of ICTs in the classroom onwards from the hands of those who have been termed the 'early adopters' to the 'late majority'. This paper is not a critical review of IT2000. Instead it argues that sufficient international research is now available to allow us to outline clear principles upon which future initiatives should be based. This paper is based on comparative international research on *Best Practice and Innovation in Learning* that was commissioned by the Lifelong Learning Group of Ireland's Information Society Commission. We examined hundreds of different initiatives and selected those that embodied best practice to underpin our work. The full report is available on-line at www.isc.ie and looks at learning in not just the formal education system but also in the community and the workplace. We argue that ubiquitous learning technologies, such as the Internet and lightweight laptops, have a key role to play in a flexible, broadly constructivist, learning paradigm where the focus is on *learning with technology, not learning about technology*.

ICTs and Learning

Much has been written about the advantages that Information and Communication Technologies can bring to learning: with the advent of the Internet, limitations of time and place are challenged; learning can take place asynchronously and one can potentially access an enormous diversity of materials and information. Motivation is key to learning and ICTs have a strong motivating power. The diversity and flexibility of ICTs also mean that different learning styles can be supported and the needs of second chance learners and of different social groups can be accommodated [Davis 1998, Jonassen *et al.* 1999, McCormick 1999, Maurer 1997, Somekh 1998, Tearle *et al.* 1998, Wade *et al.* 1998].

The use of ICTs is not without its critics. For example, Healy [1998] and Talbott [1997, 2000] recount many inappropriate uses of ICTs for learning and raise serious questions about the value for money that is accruing from the investment in ICT in education. Common problems they report are the poor pedagogical quality of many pieces of educational multimedia software, inappropriate lesson plans, the superficial nature of much of the content on the web, lack of appropriate teacher training and support, and the amount of teacher time taken up with computer maintenance and technical problems. Other reasons cited for poor learning outcomes are the lack of pedagogical support within educational software, learners' difficulties in using such systems [Bates 1995, Maurer 1997, Wade 1999], and the lack of innovative approaches to assessment in line with the pedagogy Boucher *et al* [1997].

Despite these criticisms and despite the fact that evaluating "effectiveness" in the area of education and learning is notoriously difficult a body of research is emerging

which indicates that ICT is of significant benefit when used appropriately. In particular ICT is good at supporting many of those features of learning argued for previously such as a constructivist approach to learning; support for self-motivated learners; flexibility in terms of when and how one learns; flexibility in assessment; problem oriented, and project based, learning dealing with real world scenarios.
Some sample success stories include the following.

- Evaluations on the use by US 5th grade students of the "Animalwatch Mathematics Tutor", which is designed to cater for the different learning styles, found that use of the Tutor increased student's performance, as measured by test scores. Of particular interest is that, while the Tutor is beneficial for all, it is particularly helpful for weaker student Wolf [2000].
- According to McCormick [1999] with appropriate multimedia training material, course completion times can be reduced by 33% with competency levels rising by up to 50%.
- Wireless, lightweight portable computers have been found to increase best practice in learning, not only with students in the classrooms but also throughout the building and after school. Research, Rockman *et al.* [1998], AM [2000] has indicated that laptops have a number of influences in the classroom including the following:
  - Laptop students use their computers more often resulting in more proficient students;
  - Laptop students write more and of higher quality;
  - Laptops increase access to research resources and so improve analytical skills;
  - Laptop students rely more on active learning strategies; and
  - Teachers spend less time lecturing and more time facilitating student self-motivated learning.

Collaborative, as well as constructivist, approaches to learning support concepts of cognitive apprenticeship and anchored instruction by providing an authentic or real-life context for learning, incorporating a number of ill-defined tasks that include integrated activities across the different subject areas. Leveraging the power of ICT collaboration can facilitate co-operation across large distances and can include leading experts in the field of study. Classic examples of the use of ICTs to support this type of learning include the following:

- Over 4,500 schools, representing more than 250,000 students, from all 50 U.S. States and 7 Canadian Provinces, participated in the spring 2000 Journey North Program [http://www.learner.org/jnorth]. Students collected data about a dozen different migrations and signs of spring. The documentation of Journey North extends for four months each year; with live data collection taking place from February until June.
- The Programmable Brick extends LEGO based construction kits enabling children to build not only structures and mechanisms but also behaviours. The NCTE SIP project, co-ordinated by St. Patrick's College of Education, based upon this approach has proved to be one of the most innovative and successful of all the SIP projects.
- Researchers at the Institute for Media Technology in Jönköping, Sweden argue that "*because students are learning for real life and preparing to solve real complex problems in the future, the complexity of the world should be taken into account much more and much earlier than usually happens*." One project had a group of 12-year students build a toy, or micro, greenhouse from a variety of

materials ranging from cardboard to Lego. The environment within the greenhouse was continually monitored and controlled using a variety of technologies. In order to make the learning experience more real the process was then repeated on a larger scale with the goal of actually growing real produce for sale in the local market - a goal that was successfully achieved. The researchers strongly argue in favour of the use of technology to support such a constructivist learning project Milard [2000].

Curriculum and Assessment Issues

The Internet is rapidly developing. There are thousands of educational portals with information, resources and lesson plans freely available. Not only do learners have access to texts but also to graphics, video, audio, 3D models, software, as well as resources that depend on connectivity such as access to experts and other learners. The wide availability of learning material and resources combined with the changes in pedagogy discussed previously mean that the use of ICTs in any learning environment, and formal education in particular, must be seen as a curriculum issue rather than a mere technological one. Teachers need professional development to help them make appropriate use of the emerging learning materials and techniques while learners need to learn how to learn and to develop the range of high order thinking skills needed for the Information Age. These skills range from such basic ones as retrieving and imparting information to the creation of knowledge through analyzing and synthesizing information.

This is also the view adopted by a number of other Irish researchers and commentators. In a critique of the Ireland IT 2000 Strategy, Conway argues that: "*IT 2000's rationale for integrating ICTs is primarily focused on perceived economic outcomes*". He claims that: "*IT 2000 underestimates the curricular scope of computer literacy and although it is not a curriculum document the inattention to the curricular scope of ICT integration is problematic*" Conway [2000]. This is in contrast to the UK, which has had a national policy of integrating ICT in the subject curriculum since the early 1980s. As an example Ireland's new Junior Certificate Syllabus for Mathematics, that will be taught and first examined in June 2003, makes no mention of use of ICTs, while internationally ICTs are seen to be key to the further development of mathematics and science education. Galvin makes a similar argument stating that: "*a nation-wide, ICT initiative represents a curriculum intervention as well as a technical one. And successful curriculum intervention is notoriously difficult to achieve*."

A key aspect of curriculum intervention is that of assessment. Constructivist, open-ended group and project based collaborative learning as advocated earlier does not sit easily in those parts of the current formal education system which are exam focused. There is considerably greater flexibility in the primary and transition years and it should be no surprise that it is in these areas that much innovation is taking place.

Two other points are worth noting. Firstly as some resources are now only available on-line, ensuring equality of access becomes more important. Secondly, there is an urgent need to produce high quality learning materials specifically for the Irish context and Irish curriculum. The production of materials for minority languages is a problem which is explored further in Hegarty [2001].

Features of "ICT and Learning Plans" in other countries

A number of features of initiatives in other countries are worth noting.

Finland has one of the most comprehensive IT strategies. It is not just focussed on formal education but on all sectors and includes all citizens from the very young to the elderly. The initiative for large-scale assessment of ICT in Finnish education in 1998 came from the Parliament. The Finnish strategy highlights a new trend in innovation in learning that includes the learners in the strategy from the beginning. It acknowledges the students' information technology skills and intends to incorporate these in the curricula and practical operations of places of learning. Students will also assist in the preparation of teaching materials and are encouraged to participate through the awards of scholarships and fees. Competitions will be arranged with appropriate business sectors and awards distributed. Female students will be particularly encouraged to participate in information technology expert communities [http://www.minedu.fi/julkaisut/information/englishU/2/2.html].

Swedish educational policy for lifelong learning focuses upon higher order skills, that is finding, interpreting, evaluating and presenting information A holistic view is taken of knowledge with an emphasis on theme-based tuition rather than division into subjects. Teacher training colleges have the responsibility to ensure that new teachers have sufficient knowledge of new teaching approaches
[http://Knut.kks.se/english/ict/; http://www.skolverket.se/n/na.html].

As pointed out by the TAC [1997] report, a serious long-term sustained commitment is needed in the area as initial interest and enthusiasm "*often wanes over time, particularly in the case of exciting, timely, event-oriented projects, which may generate a degree of initial enthusiasm that is difficult to sustain over a protracted period*." This is particularly true in the Irish case as the use of ICT spreads from the early adopters to the late majority.

Much has been said in the literature about the changing role of the teacher, but national initiatives in Estonia emphasise an innovative role for students and learners. Students are encouraged to act as mentors and as mediators between students and teachers. Some Estonian schools required senior pupils to spend four hours a week mentoring and tutoring younger students.
[www.tiigrihype.ee/new/test/tiigrihype/timindex3.html].

Realistic Budgeting

A key point to recognise is that investment in hardware infrastructure alone is unlikely to yield dividends unless done as part of a larger exercise. At the core of this issue is not the fact that the effective lifespan of computers is short but that "*the purchase price of a computer system represents only 25% of the cost of its operation over the period of its useful life*" TAC [1997].

The full cost of running an information system can be broken down into a number of broad headings, including: computers; peripherals; network infrastructure; software;

support and maintenance; user training. Too often the hardware purchase price is assumed to be the major part of the investment.

Access to computers and the Internet must be free, or of minimal cost, and evaluation and dissemination of results, from a learning perspective, have to be built into programmes from the start.

Public-Private partnerships have a large role to play in funding ICTs in schools and this is a model that is being used extensively both internationally and locally as one component of the funding process. Care however must be exercised to ensure that the educational objectives are not dictated to by commercial concerns.

Training in Pedagogy

Perhaps the most expensive component in the cost of ICTs is training. In the case of teachers, user training constitutes not just basic literacy but sustained professional development in utilizing ICTs for pedagogical purposes. The current popularity of the ECDL program while having the advantage of helping students and teachers become ICT literate is no substitute for sustained high level courses in the pedagogical possibilities of ICT.

Another factor has to be taken into account, namely free time in which to plan and prepare for the integration of ICT into teaching. It is difficult for teachers to upgrade their ICT skills, receive training on how to incorporate ICT into their teaching, plan and prepare for that integration in an already busy schedule.

Technical Support

Technical support and administration of networks of computers is a severe problem. An all too frequent complaint from teachers is that machines do not work or cannot be connected to the Internet. Healy [1998] reports numerous cases of learning with ICT being severely handicapped by technical support issues resulting in wasted time and effort at best and negative learning experiences at worst. There are a number of reasons for this.

Firstly, managing a network of PCs is a non-trivial task that requires a sophisticated level of expertise. Secondly, technical support is too often ignored in the budgeting and planning of ICT facilities. Thirdly, much of the commonly used operating system software was designed for use by a single user and is somewhat inappropriate for a semi-hostile multi-user school environment.

A common approach to overcoming these problems is to assign the responsibility for technical support to an ICT co-ordinator. If the co-ordinator is a teacher he or she may have neither the expertise nor the time to carry the task out properly. On the other hand if the co-ordinator is a technologist (and these are hard to find in the current economic climate) they are unlikely to have the knowledge or skills to play an active teaching role.

Computers and Internet Access

Although the school computer lab is a common way of deploying scarce resources technical advances and research findings mean that an alternative model should now be promoted within schools. Integration into the curriculum is easier when computers are in the classroom rather than in a separate lab. It has been found that learning improved more with even a modest number of computers in the classroom than when computers were deployed in a dedicated lab Becker [2000]. Thus the focus should be on getting technology directly into the hands of the teachers and the learners.

Lightweight laptop computers combined with wireless local area network technology offer enormous potential and flexibility in meeting this objective. Technology has now developed to the point where certain high performance laptops are the size of an A4 page (when opened) and weigh no more than 3lbs. Wireless local area networks offer speeds of around 10 Mbps that is more than adequate for most applications. Wireless has further advantages: it avoids the overhead of extensive wiring; buildings can be networked with minimum disruption; wireless infrastructure can be moved between buildings, an important saving for schools going through building programs or undergoing renovations.

Internationally a number of different schemes and funding models are being used to put technology in the hands of learners and teachers.

Sweden is offering a free PC for teacher graduates in order to move the technology into teachers' hands. 60,000 teachers are expected to be targeted between 1999-2001 [http://www.skolverket.se/skolnet/english/index.html].

In the UK for example the TTA is offering a subsidy of Stg. £500 to teachers to buy their own computer. This initiative follows on from the "Multimedia Portables for Teachers Pilot" which showed that, once they have uninterrupted access, teachers are prepared to invest time outside school to build their own ICT skills.

> *Research figures for the scheme (where selected ICT-novice teachers were given their own portable computer) show a dramatic increase in the participant teachers' use of IT: over 90% successfully used CD-ROMs, 76% successfully used the Internet and 95% used the portable at home and at school for planning and delivering their teaching, BECTA [1998].*

Acadia University, one of the premier undergraduate colleges in Canada, has since 1996 been committed to providing students with the 'Acadia Advantage', a programme aimed at full integration of computers and technology into university life [http://www.acadiau.ca/advantage/]. All students and staff have laptop computers and the university is moving towards wireless networking. The way in which pervasive technology has been woven into the fabric of the learning environment to such good effect makes Acadia one of the best international examples of the use of ICT for learning.

Universal Access

As we put in place a new infrastructure, and develop new formats and genres for presenting information and communicating, it behoves us to do so in a fashion that maximises the opportunities for those suffering from various limitations, be they socio-economic, physical, or cultural, to participate. As a concrete example the US,

and other countries, have made it a legal requirement that all government sponsored web sites are accessible to the visually impaired.

The Role of the Information Czar

"*What is at stake during the next decade hinges on the capacity to innovate*" EU [2000b]

No investigation on the relationship between ICT and learning would be complete without some reference to the rate at which technology is developing. Planning for the use of ICTs for learning has to take into account the fact that, at least for the foreseeable future, ICTs will continue to develop very rapidly. With PCs and communication devices merging into new pervasive ICT devices it becomes all the more important that the use of ICTs in learning is both informed by sound educational principles and at the same time being open to the ever emerging new possibilities being presented by rapid technological development.

According to the Wall Street Journal of the 22nd of August 2000 "*Levi Strauss and Phillips next month will introduce the ICD+, a jacket that features a built-in cell phone, MP3 player, and headset. The jacket, which will retail for $900 at exclusive European boutiques, also includes remote and voice-activated controls.*" Whatever the future holds it seems unlikely that an educational model based an a single classroom in a school equipped with rows of PCs sharing a low-speed internet connection is appropriate for a class of teenagers wearing ICD+ designer jackets and carrying WAP phones!

An organisational model for this time of rapid technological development that is being adopted in many places is that of an Info Czar, defined as an individual who is primarily a "*strategic technology planner capable of the highest level of technological understanding while at the same time being grounded in the needs and objectives of the organisation*" Berghel [1999].

A Closing Word

The context in which much of the discussion about ICT in education takes place is that of the emerging "Information Age" and the need for life-long learning to allow people to adapt and change to a radically altered landscape. At an even more fundamental level the foundations upon which our Western education system, and society, has been built have been undermined. Christianity no longer provides an agreed basis on which to build a spiritual, moral and ethical value system. The principle of a liberal classical education in which the subjects taught were chosen for their perceived intellectual rigour and as a means to "*sharing of common values and the passing on of cultural heritage"* has been replaced by a system within which subjects are taught for their utility, whilst spirituality, morality and ethics are relegated to the role of an extra subject. Authors such as Noddings 1992], O Sullivan [1999], Sergiovanni [1992], and Starratt [1994] have written extensively on this topic. At a time when the use of ICTs is forcing us to re-examine many aspects of education it may be appropriate to bear in mind that the foundations upon which education has been built are to a large extent no longer present!

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