

Information and Communication Technology in Schools

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Abstract

Information and Communication Technologies (ICT) can support learning in a number of ways. It can facilitate communication, increase access to information, provide greater access to learning for students with special educational needs, model and simulate a range of scientific phenomena, and generally motivate students, develop problem solving capabilities and aid deeper understanding. For students with special educational needs, the computer can provide access to learning in new ways and which for many were previously inaccessible.

However for all this to happen teachers need to be aware of the potential of ICT for learning and experienced in the use of the technology for teaching. The idea that teachers are fountains of knowledge and that children are empty vessels waiting to be filled with the knowledge and wisdom of their teacher is untenable in the information age. The amount of knowledge available and the breadth and depth of it are far beyond the realms of most teachers, as is their control of learners' access to it. The teacher's role within an ICT-rich environment must necessarily change to help students learn in the best way they can by recognising different learners' needs, and support students in to making choices about how and where they access new knowledge. To ensure that teachers use the technology in appropriate ways, the different roles a computer can play in the classroom need to be considered together with how the teacher develops teaching strategies that support each role.

Older technologies also have a part to play in the ICT environment: we need to remain mindful of the relative merits of all resources and to consider their appropriateness in different situations.

Introduction

There is constant reference by Government and schools in developed countries to the belief that there is a real lack of research-based evidence to support the positive effects of information and communications technology (ICT). However a recent review and a critique of more than 100 research studies on evidence of learning and the learning potential of educational software (Mumtaz, 2000) found evidence that:

- Using the Internet has far-reaching effects. As well as facilitating communication, it develops skills of searching, interpreting and organising information often defined as "network literacy". Communication through email improves students, writing skills as they take more care in grammar, spelling, punctuation and conveying meaning to an audience which isn't their teacher
- ICT enables pupils with reading difficulties to find different ways in to the curriculum, and raises the status of visual and aural literacies to the level of literacy acquisition through text.
- ICT makes the invisible visible, and, for example, shows chemical reactions not possible in the school laboratory. Dynamic images and animation aid understanding of abstract concepts and enables visualisation of processes either too small or too fast to be seen in real life;

- ICT support differentiation providing enrichment and extension for able pupils, and support and motivation for weaker pupils. Additionally it allows independent learning at an individual pace, facilitates repetition and can improve teacher/pupil interaction, and better "pupil contact".
- ICT provides motivation and variety, generating enthusiasm, interest and involvement, maintaining attention and enjoyment, and supports the development of novel ways to present difficult ideas.
- Thinking skills and problem solving strategies are enhanced when using ICT, and challenging tasks and a responsive environment enhances students' sense of competence.

Learning with ICT

All forms of learning are enhanced by ICT. There is strong evidence that talking books encourage reluctant readers and numeracy skills can be improved through novel drill and practice games that take the drudgery and boredom out of reinforcement activities. There are also opportunities for students to use real data that makes tasks more authentic and realistic, rather than data that is contrived to make calculation easier. Problem solving situations readily lend themselves to ICT and students can learn to develop skills such as being systematic, logical and deductive through engaging with carefully selected computer based tasks and scenarios.

While computers can offer learners models and simulations of real world events, there is also a need for opportunities to have some real rather than virtual experiences. Science practicals, for example, have a place in demonstrating the importance of control, accuracy, error limits, and attention to detail, as well as providing students with hands-on experience of appropriate ways of measuring, observing, and controlling variables. Unless learners experience these phenomena first hand, their understanding of the ways in which computer modelled experiments might be set up in reality will be limited. Teachers need to be on hand to support and supervise such practical activity, to set up these experiments in meaningful contexts, and to help learners relate their experiences to computer based simulations.

However some activities can take longer or be more difficult with a computer. Young children have poor keyboarding skills so typing words can be time consuming until keyboarding skills and co-ordination improve. Reading long screeds of text on a computer screen is also a waste of expensive resource and is rarely as easy as reading from a printed document.

Role of the teacher in ICT environments

Often children know more about computers than their teachers and have pursued an area of interest to a level at which they become more knowledgeable than their teacher. Therefore the idea that teachers are fountains of knowledge and that children are empty vessels waiting to be filled with the knowledge and wisdom of their teacher is untenable in the information age. The amount of knowledge available and the breadth and depth of it are far beyond the realms of most teachers, as is their control of learners' access to it. The teacher's role within an ICT-rich environment must necessarily change to help students learn in the best way they can by recognising different learners' needs, and support students in to making choices about how and where they access new knowledge. Instead of restricting access to information,

teachers need to encourage skills in which learners seek new information and consider and compare alternative viewpoints, question their sources, and make judgements about the validity and reliability of evidence and information presented to them from a range of sources.

The role of the teacher is therefore important in the learning process (see Selinger, in press). In another example, it has been demonstrated that children working together at a computer when given coaching by a teacher in exploratory talk, will ask each other task-focused questions; give reasons for statements and challenges; consider more than one possible position; draw opinions from all in the group; and reach agreement before acting. It also affects teachers' views of the learning process, with the technology playing a vital role in opening the minds of teachers to new ideas about children, learning and their own role in education. The teacher's role is changed from whole class to small group instruction; from a didactic approach to coaching with individuals or pairs; from working with and questioning the most able to working with all abilities and understanding their difficulties.

Teachers need to be more adaptable; more open to alternative teaching approaches, and the use of peer teaching, and adults other than teachers - such as experts in other domains. The access to and availability of information has expanded overwhelmingly since the inception of the Internet. Few expect primary teachers in particular to be completely conversant and have in depth knowledge of all aspects of National Curriculum subjects, especially as students can read well beyond the statutory demands, and ask questions that demand knowledge and understanding far beyond current expectations. The same is also true of secondary teachers whose field of specialism within their chosen subject will not cover all they have to teach. A history specialist may have in depth knowledge of British History but their knowledge of American History may only be superficial reflecting the specialism in their first degree course.

Information on the Internet vastly exceeds the amount of information available to students through school libraries and access to it is difficult to control. However the information on the Internet is vast and uncontrolled; it has been likened to a library where all the books have been thrown on the floor. Taking that analogy further, the books are mixed up with romantic novels lying side by side with reference books and the works of Shakespeare; advertising leaflets lie strewn around or are inserted in books; extremist materials like that given out at railway stations are also in the pile; and there are several library catalogues, all incomplete and with many duplicates. Teachers must help their students to pick their way through the pile; to make sense of what is there and to use the materials wisely.

Access to information in libraries has always been recommended to students from an early age (study skills), and especially at post-16 level so they could read around and beyond their subject, or undertake an in-depth study. Now with the advent of communication technologies, students can not only read around their subject, they can also be exposed to microworlds and simulations, computer generated models, video, graphics, images, audio lectures as well as electronic conversations with experts and others. Teacher control of new knowledge is weakened yet their role does not diminish; it changes to one of supporting learners to assimilate new information, to turn it into knowledge and understanding within a nurturing and supportive environment.

The role of the teacher is broadened beyond the classroom and the school. As school and home boundaries start to blur, the teacher's role will be to support learners through alternative means to traditional face to face experiences. Teachers will have to learn how to teach at a distance through virtual learning spaces: e-mail, web-based discussion forums, and computer conferencing systems. The skills of face to face teaching will have to be translated into an electronic environment where traditional cues like tone of voice, facial expressions and body language are lost. The benefits of virtual learning spaces are vast; they can bring learners together who may never have met; learners can be exposed to new voices and to new views and they can be presented with an authentic audience for their work. In addition some teachers will have to change their views of pedagogy since the nature of electronic collaboration will not always be between learners and their teachers in schools, but also between students and between students and adults other than teachers as stated earlier, as the constraints of distance are negated through virtual space. Teachers will have to deal with blurring of the classroom boundaries and for this to happen they will need to be made aware of the possibilities that can exist and the advantages to both teaching and learning.

The classroom can become a metaphor for any learning space in which one or more knowledgeable others support the learner. Traditional modes of teaching and learning take place in a group or in a one-to-one situation in the same place, at the same time, in the classroom or lecture theatre, or in a teacher's study. The introduction of distance learning has enabled the learner to work alone or with others on a set of materials but without the opportunity to easily or quickly question the teacher or author of the materials about the content. Electronic communication can be through text, video and audio graphics and each occupies a new learning space: different place, same time, individual or group in an online chat, or more commonly in the context of this paper, different place, different time, group (conference) or individual (e-mail). The learning spaces are not mutually exclusive: the opportunities afforded by previous forms of distance learning are now enhanced through the additional spaces provided by new technologies and similarly face to face teaching can also be supported and extended.)

When designing any learning experience teachers will need to consider what it is they wish to achieve and then consider the most appropriate approaches to achieving their goals for the learners in question. Whether the technology chosen is face-to-face lessons, print-based distance learning or Web-based activities what is important is that they design the experience to make appropriate use of the characteristics of the chosen technology.

How ICT can support teachers

Crook (1996) explores a number of orientations to the technology or 'frameworks for change' that each serve as 'a focal point for arguments about the revolutionary potential of computers for teaching'.

Computer as tutor

One orientation is 'computer as tutor'; and he compares this with the transmission model of teaching or the 'stuffing in' of knowledge. Take for example Integrated Learning Systems (ILS) that are increasingly gaining popularity for teaching literacy and numeracy. This software coaches students in basic skills, assessing their performance on items and taking them to a higher level if they are succeeding or to more reinforcement if not. Often it is shortcomings in current educational practice that are cited as justification for using this technology. ILS is probably the most researched application of computers to teaching in the

UK, yet there is very little evidence to suggest the improvements in learning are substantial, and certainly do not justify the extensive investment that schools are making. However the systems can be shown to be of use when they are combined with teacher input, when pupils work collaboratively, and when work undertaken away from the machines is directly linked. Mcfarlane (1997) states that 'research supports the view that teachers play a key role in ILS'; their role in making the systems effective is crucial. ICT can also change teachers' views of teaching and learning: Underwood et al (1996) reported that teachers saw an ILS as a support tool for diagnosing weaknesses in pupil's understanding, and that an ILS proved to be a tool rather than a substitute for teachers. An understanding of students' learning and of appropriate pedagogies is needed to make informed judgements about how best to employ ILS; for which students it is most appropriate; and what related work will be needed to ensure the best possible learning gains are achieved. Facts learnt out of context need to be placed in a range of contexts so that students understand how to make use of their new knowledge. The teacher's role is to help students learn to make links between new knowledge and existing knowledge if new knowledge is to be of any value (see Skemp, 1976).

Computer as pupil

The next framework for change that Crook suggests is 'computer as pupil' and cites Papert's contribution to thinking in this area. 'The idea is to regard the computer as a tool which the learner may come to control - or 'teach' to do things' (Crook, 1996:80). Papert comments that some children experience learning French in USA schools, yet if they had been brought up in France this would not have been a problem; they would have learnt to speak French fluently. Therefore, as Crook points out, if one wants to learn French one goes to a French speaking country. The idea then is that students immerse themselves in microworlds. Logo is one such mathematical world in which children teach the machine to perform various functions - the computer acts as a pupil with the child as teacher. However the immersion in a microworld is not enough, some structures may need to be imposed on learners, to ensure that the meaning of what they are doing is clear. There has to be some purpose and motivation for engaging in the activity. Learners need their achievements to be located in broader frameworks of knowledge.

This framework does not make teachers redundant, it merely changes their role in which learners are encouraged to engage in purposeful and creative exploration - one that Papert (1993) describes as 'constructionist'. The goal of a constructionist teacher would be to teach 'in such a way as to produce the most learning for the least teaching' (p139).

Computer as resource

Crooks' third framework is the 'computer as resource' and cites the definition of Taylor and Laurillard (1995) as 'open access, self-directed learning from a large information source'. Learners in their interaction with the computer are active, and knowledge is discovered and negotiated. Computers can present information in ways in which teachers are unable; they can present information in multimedia formats allowing users to select and experience new knowledge in text, graphics, sounds or video; make use of hyperlink to link concepts together. It allows the learner to make choices about the medium through which they learn and present them with a wide range of hitherto unimaginable resources. However turning these experiences into meaningful knowledge and understanding relies on the support or 'scaffolding' of another. This other is usually a teacher who has some understanding of the learners' preferred learning styles and can help them make appropriate choices and decisions, can teach the learner to question the validity of new knowledge and help them to assimilate it

into exiting schema. However, it can also be a peer or group of peers; it could be another adult.

ICT and special educational needs

ICT has become an invaluable tool for children with special educational needs. The British Educational Technology and Communications Agency (BECTa) have an inclusion web site (BECTa, 2000), which provides a good deal of information about how ICT can support pupils with a range of special educational needs:

- Supportive word processing with spell-checkers and speech feedback can support the development of literacy.
- Word banks with graphics clues can be presented either on screen or on an overlay keyboard, providing instant access to specialist vocabulary. By selecting whole-word, whole-phrase or even whole-sentence insertion, the writer can concentrate on content.
- Software designed to reinforce spelling, memory or numeracy work can be valuable if the exercises are chosen to link in with current class work.
- Information-handling programs with their emphasis on describing, classifying and analysing, provide opportunities for language development.
- For many learners, alternative methods of input to the computer such as switches, touch-screens, joysticks and trackerballs may provide easier access.
- Sending messages to the computer by a sound-activated switch can encourage children to vocalise. Using suitable software and blowing or speaking into the microphone, they can change the picture on the screen or create patterns in response to their voices.
- By pressing a switch attached to the computer learners can control what is shown on the screen, turning sounds on and off or changing pictures. In doing so they are gaining experience of cause and effect.
- Multimedia can present information in a variety of ways with graphics and sound as well as text. This creates opportunities for learning which are not dependent on the written word.
- A symbol processor links symbols to words, making written information more accessible and encouraging youngsters to write themselves from an overlay keyboard or an on-screen grid.

For those who are visually impaired or blind pupils, they can access the curriculum through alternative methods of reading and recording work. Printers and enlarging photocopiers can produce large-print versions of work materials and Braille-translation software can produce text and Braille versions. On screen pupils can work with larger font sizes than their peers or Braille keyboards, or use talking word processors yet still use the same material and do the same work. Many CD-ROMs have audio output too.

Hearing impaired pupils also benefit from ICT; email being one obvious example which gives them equality of access to communications

Multimedia technology can provide hearing-impaired pupils with access to information in a more immediate and visual form than was previously possible. The opportunity to create multimedia presentations can enable students to experiment with different methods of combining sound and vision. Where appropriate, the sound output can be linked to the

enhanced amplification used by the pupil. These sounds become more meaningful when heard in conjunction with moving images on screen. (http://www.becta.org.uk/inclusion/sen/technology/access_technology/hi.htm)

Children with poor motor skills can present work of equivalent quality to their peers as word processors make letter formation easier through the keyboard rather than a pencil, and data handling packages allow them to easily present tables and graphs. Overlay keyboards, trackerballs and joysticks, and predictive word processors are examples of devices that support learners with physical disabilities to use ICT effectively and enable them to take a full part in the life of the classroom.

'Low-tech' technologies

Too often the novelty value of new technologies leads us to neglect the older technologies like radio, television and audio and videocassettes, or even film loops and slides. These still have an important place within educational environments. The use of radio in the developing world has been shown to have a powerful effect (Skuse, 2000) in education through radio soaps, for example. The OLSET programme in South Africa has shown how radio can be used successfully to teach young children English and to model new pedagogy for outcomes-based education.

Finding innovative ways to combine old and new technology, exploiting the potential of both, and making decisions about the best medium to convey information and improve learning are of paramount importance in countries where resources are scarce. Technology must not be used for technology's sake.

Summary

ICT in education is here to stay. ICT is found in all sectors of the workplace in developed countries, and it is becoming increasingly used in the developing world. Children of today, at the very least, need to become aware of the potential of new technologies in all aspects of their lives. The benefits for learning are increasingly being demonstrated and teachers' roles in the information age ought to be both expanding and changing to embrace these resources and to harness their potential for the future of children in developing countries.

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