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IMPACT OF IT ON SCIENCE EDUCATION

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Introduction

Since the early days of computer technology expectations for technology-enhanced science learning have been high. The potential for supporting and enabling learning through exploring simulations of scientific phenomena, modelling scientific processes, capturing and analysing data automatically and being able to access and communicate scientific information and expertise is high. Case studies across the globe have shown that IT can enable innovative classroom practices in science learning (Kozma, 2003). However, while science research has been transformed by computer technology, including the establishment of the new field of bioinformatics, the use of IT in science education has been patchy and limited. Major reasons for this include the nature of the science curriculum, availability of appropriate hardware and software and understanding of the pedagogical potential of the various types of IT and how to integrate their use effectively to support learning and teaching.

There is no basis for complacency in science education. Trends across the developed world show a drop in interest and take-up of science subjects (European Union, 2004; National Science Board, 2004; Osborne and Collins, 2001). Evidence suggests that children are interested in school science but to a lesser extent than in other subjects (Jenkins and Nelson, 2005). In recent research students complained that school science consisted of too much repetition, copying and note taking, with no time to discuss scientific ideas or their implications (Teaching and Learning Research Programme, 2006). This is of concern to science educators and governments and consequently several countries have recently undertaken radical rethinking of their science curricula. These developments have focused on the needs for science learning in the twenty-first century and have acknowledged a role, albeit not yet clearly defined, for IT.
The Use and Impact of IT on Science Learning in Schools

Research into the impact of IT use on learning has produced varying results (e.g. see the review by Kulik, 2003). Some studies have suggested that high levels of IT use may be linked to improved attainment in science (Becta, 2001; Harrison et al., 2002; Christmann et al., 1997). Furthermore the impact of IT use on attainment in science may be greater than that on other subjects (Christmann et al., 1997). Other studies have reported no clear differences in science attainment or achievement between classes making more use of IT and those using less (Alspaugh, 1999; Baggott La Velle et al., 2003). These analyses and surveys suggest that IT use could promote learning in science but provide no insight into how this may happen.

Evidence for How IT Enables Science Learning

Evidence for what might lie behind gains in attainment associated with IT use comes mainly from detailed studies of specific types of IT use often studied in experimental situations. Types of IT use that have been shown to promote science learning include simulations, modelling and data logging. Evidence for how these applications may enhance learning is discussed in the following sections. Other types of IT use such as multimedia and video authoring, web-searching and online project work have been less well-researched but their potential for supporting science learning will also be explored.

Learning with Simulations

Obvious benefits of using computer simulations in school science are to enable exploration of phenomena that are too difficult or dangerous to investigate experimentally, things too small or too large to be seen and things that happen too fast or too slow for direct observation. This broadens opportunities for science learning but also invites questions such as what range of phenomena should be explored in school science and in what level of detail?, to what extent should simulations replace experiments and fieldwork? and what additional learning affordances do simulations provide?

A first step in exploring these questions is to investigate how students learn from simulations. Some studies of the use of IT-based simulations have focused on one of the most difficult aspects of science teaching: promoting conceptual change and confronting specific alternative conceptions. It is well-established through extensive studies that children develop their own “naive theories” to explain the natural phenomena that they observe in the world around them and these alternative conceptions tend to persist despite schooling (Driver et al., 1985).

Research on children’s alternative conceptions provided part of the impetus for a movement, towards a constructivist approach to science pedagogy (e.g. Driver and Easley, 1978). More recently socio-cultural theories based on those of Vygotsky and others have been applied to science learning, and other pedagogical approaches have