Cognitive Approaches to Understanding the Challenge of Learning by Means of Computers and Personal Digital Assistants (PDAs)

Jocelyn M. Wishart
University of Bristol, UK

INTRODUCTION

Increased motivation amongst pupils has been readily observed in schools when they are allowed to use computers and other forms of information and communications technology (ICT) (Cox, 1997; Denning, 1997; Wishart & Blease, 1999). In fact, Denning (1997) reports almost universal enthusiasm amongst students for the use of ICT to support their work in schools. That enthusiasm has been seen to double or triple amongst primary school students given a personal digital assistant (PDA) of their own (Whyley, 2006). These handheld devices are small computers that can be used both off- and online via wireless or mobile phone signals. Many psychologists (Light, 1997; Loftus & Loftus, 1983) have used behaviorist theories originating from the work of Thorndike (1898) to describe positive extrinsic reinforcements generated by or associated with the use of computer software. For instance, children find the use of a computer rewarding; they get nearly immediate feedback from the programs on their efforts, which often includes entertaining sound effects, graphics and animations. Therefore, they are more likely to take up opportunities to use ICT in and outside of lessons. What is more, as described by Loftus and Loftus (1983), these rewards arrive in the variable ratio schedule of reinforcement which Skinner (1938) believes is the most compelling.

However, behaviorist theories do not help us understand the processes of learning, that is, what happens between stimulus and response. Other, more recent motivational theories focus on explaining engagement with ICT through cognition rather than extrinsic reinforcements and include controlling the software and hardware, intrinsic rewards (challenge, visual complexity), graphical and epistemological curiosity.

BACKGROUND

The importance of a perception of control and/or autonomy to pupil learning has been justified theoretically by psychologists studying the links between motivation and learning. Byrnes (1996) notes the way in which students can become intrinsically motivated when they have control over their environment, set challenges for themselves and satisfy their curiosities. He cites research by Stipek (1993) where researchers found that future competence will follow successes particularly if students believe they controlled the success.

Byrnes also discusses the role of self-efficacy, linking the agency beliefs (beliefs that enable individuals to personally control successes) proposed by Skinner, Chapman, & Baltes (1988) to the idea of intrinsic motivation. Control or choice within the learning environment will motivate pupils and so engender success, this in itself will, therefore, lead to further motivation.

Indeed, in his early work Papert (1980) advocated the idea of the user controlling the computer, versus the computer controlling the user. He built this concept into the development and use of LOGO, a programming language designed for education, in preference to the drill and practice software typically used. Papert (1980) also attached importance to the concept of the learner "owning" the problem making the activity of constructing personally meaningful. This sense of increased engagement of the learner controlling their learning by means of information technology has been noted for a while but not yet investigated on a large scale. However, it has been recently identified by the Kaleidoscope group (a European Network of Excellence) as contributing to one of the Big Issues in Mobile Learning (Sharples, 2006).

In their study of the role of computers in the learning process, Underwood and Underwood (1990) emphasise the idea that if the learner is in control or in charge of their learning they will respond to and appreciate their

independence and so will learn. In a later review of the use of databases in classroom practice Underwood (1994) returned to this idea, this time linking valued learning experiences with ICT to the ways in which students take responsibility for the learning outcome and how new technologies could support a move to more independent approaches to learning. Today we are seeing even quite young children in the schools, such as those participating in the Learning2Go project in Wolverhampton, UK who are controlling their PDAs in and outside school with ease (Whyley, et. al., 2006). The teachers in this project are reporting that these students are doing more work independently at home and bringing into school more information gathered outside school than before they were given the mobile devices.

In fact using software to provide an open learning environment encouraging student autonomy and choice has been seen as good practice in ICT teaching in the United Kingdom for a number of years now (NCET/ NAACE, 1994).

The idea of empowerment and its relationship to the learning process is further discussed by Davis, Desforges, Jessel, Somekh, Taylor, & Vaughan, (1997) where they argue that the degree of autonomy that secondary school pupils had over the pace and content of their learning with ICT was directly related to an increase in the quality of learning itself.

In the Kaleidoscope Big Issues in Mobile Learning report, Jones (2006) described the importance of empowerment, or control, as a feature of the relationship of users with their mobile devices. In particular, she noted the relationship between control and the strength of association between the use of mobile devices and informal learning. Learners often find their informal learning activities more motivating than learning in formal settings such as schools because they have the freedom to define tasks and relate activities to their own goals and control over their goals. There are now many examples of PDAs being used to support informal learning within the UK. These include Caerus in the University of Birmingham's botanical gardens, the Tate gallery in London, Mobile Bristol and the Queen's Square riots.

It therefore appears that the key motivator of ICT is its ability to provide different levels of challenge for pupils of all abilities that invites them to take control of the software and respond. For example, ICT can be used both to provide differentiation by task with pupils running the same educational program but at different levels and by outcome with pupils using an applications package to produce a more or a less complex piece of work. Suitably chosen or content free software provides appropriate challenges for different levels of ability enabling most students to master the task and achieve their goals.

The importance of other cognitive, intrinsic rewards within software, such as challenge and complexity, was first described by Malone (1981a & b) in his analysis of what makes video games so involving for the player. He considers that the challenge of an educational software program is made up of a number of goals which vary during the program thus maintaining uncertainty within the user as to whether they will achieve them. When computer games of the 1970s were assessed by American schoolchildren, the presence of a clear goal produced the highest correlation with popularity. This was closely followed by whether the game kept a score which also provides further challenge. Malone adds that complexity created by the use of graphics and sound motivates the computer user through evoking curiosity to explore the software. Pupils using a multimedia application whether on a desk top or a handheld PDA can be seen to be satisfying this visual or sensory curiosity to see what images and sounds there, are as well as following up their epistemological curiosity to know more about a topic.

MAIN FOCUS INVESTIGATION OF COMPUTERS AND PERSONAL DIGITAL ASSISTANTS

The importance of cognition in theoretically underpinning the use of computers in education and training was tested empirically by Wishart (1990). She investigated the effects of the three cognitive factors; user control, challenge and visual complexity on motivation to use, and learning from, an educational computer game. The game itself was intended for use by young children, written for the BBC micro and illustrated how to get out of a house fire safely. 300 primary school students played different versions of the game which had been constructed to provide user control of movement through the house, challenge through scoring points and visual complexity through use of graphic effects in different combinations. Control through user choice