Computers and Children's Learning

Evaluate the significance of working with computers for children's learning in the classroom

The role of technology in childhood education is a controversial topic, and both parents and educators have concerns about the potential benefits or harm to young children. Critics contend that technology in schools wastes time, money and childhood itself by speeding up the pace and cutting down on essential learning experiences (Cordes & Miller, 2000; Healy, 1998). Proponents suggest that children should have the advantages that new technologies can offer. There is also some concern that modern technology is not being used in the best ways, or obtaining the expected results (Healy, 1998). This essay will review the considerations for technology use in childhood education and will address the question of whether computers can replace more traditional teaching methods.

Both critics and proponents of computers in the classroom agree on the importance of the early years in a child's physical, social-emotional, language, and cognitive development. Perhaps the area of development most researched in relation to computer use has been that of cognitive development and the question of how modern technology is affecting children's minds. Are computers being used to enhance and hasten cognitive development, or are they detracting from and inhibiting intellectual growth in some way? Can technology support the specific needs of children or does it take away from essential developmental experiences?

Knowledge of children's development and studies of children and technology use can guide understanding and inform decisions. Recent research on brain development has focused attention on the capabilities of young children, the stages and styles of learning, social-emotional development, and successful educational practice. Such research has argued that children lack knowledge and experience, but not reasoning ability and that the appropriate stimuli, such as close interaction with caring adults and engaging hands-on activities, enhance the brain's development (Healy, 1998). A study by the National Research Council (Bransford, Brown & Cocking, 1999) states that "early learning is assisted by the supportive context of the family and the social environment, through the kinds of activities in which adults engage with children".

The influence of Piaget's and Vygotsky's constructivist theories are evident in this recent research and it is in considering their models of development that we can make some assessment about the significance of working with computers for children's learning.

Much research has attempted to apply the developmental theories of Piaget to children's computer usage. In considering the Piagetian tasks of classifying and categorisation, Healy (1999) has made some interesting observations about computers and cognitive development. She maintains that a child sorting groceries in the kitchen is developing skills and grasping abstract concepts (the difference between fruit and vegetables, household products and food, the different ways to sort these items, etc.). This three-dimensional, physical experience is qualitatively different from that of a child who is playing a categorisation game on a computer. Whilst both may be helpful, too much substitution of icons for 'touch and feel' physical learning leaves something essential out of the developmental equation. Healy also asserts that spontaneous play and games with older children and adults are far more likely to enhance the brain development of children than time spent on computers, thus supporting the views of Vygotsky and Bruner in terms of peer interaction and scaffolding. Indeed, she states that "the best results from all technology use for children come accompanied by a skilled adult coach who adds language, empathy and flexibility."

Other research points to a list of possible positive effects of computer use. These include "the relatively more abstract or complex proposed cognitive outcomes (that) include increases in creative thinking, problem solving skills, decision making abilities, the understanding of cause and effect relationships, and the ability to engage in Piaget's 'symbolic representation'" (Goodwin & Goodwin, 1986). Others have cited the benefits to memory that come from computer use. Hohman (1990) states that "opportunities for developing children's memory skills can also be found in computer memory activities", and he believes that the sorts of representational tasks that computers require aid children in encoding experiences into their memories and actually remembering them. Indeed, the early use of computers to aid instruction was based on the work of behaviourists such as Skinner, with computers providing drill and practise on previously learned skills, and the stimulus-response interaction between student and technology was the dominant paradigm.

However, Goodwin and Goodwin (1986) take the opposite view, that others have "discussed this area of concern in terms of Piagetian stages and indicated that children need to be at the concrete operations stage before they are ready to use computers…. Some of the specific skills that are considered necessary for computer use (not usually demonstrated by pre-operational children) are basic arithmetic skills, sequencing ability, and memory and mnemonic skills".

Perhaps the most influential of those attempting to apply Piaget's theories to children's computer usage was Papert, who saw in the computer the possibility for radically subverting the traditional methods of education. He believed that children as learners have a natural curiosity to construct meaning of their world and he saw the educational system as too structured, stifling this natural curiosity. He maintained that the means by which children were being taught relegated them to a role of passive recipients of teaching and, as such, they were not motivated to construct any learning for themselves. His desire to have children become motivated learners, critical thinkers and problem-solvers was to be achieved through educational reform - providing the learner with the necessary tools to participate and to take ownership of the learning process. According to Papert, the computer was the appropriate tool to achieve this reform, and he helped to design Logo, a programming language for children with many powerful features, including 'turtle graphics'. Papert claimed that Logo could benefit children's thinking and encourage exploration within an environment, so offering them a key to understanding. The turtle serves as an 'object to think with' and Logo provided an environment, which Papert called 'Mathland', where speaking the language of mathematics becomes second nature (Papert, 1980). Papert's claims for Logo are not restricted to mathematics and he maintains that the act of programming the computer helps to develop skills, such as that of breaking down problems into manageable units, which can then be applied to other situations.

There has been much research around Papert's claims for the cognitive benefits of Logo. Hughes (1990) asserts that programming in Logo does not in itself result in enhanced problem-solving capabilities, but cognitive gains are more likely to be observed when the experience is carefully structured by the teacher. Whilst most evaluations of the impact of Logo has focused on individual cognitive skills, it is has become apparent that working with Logo opens up possibilities for social interaction (Clements and Nastasi, 1988). Similarly, studies by Mevarech et al (1991), Blaye (1998) and Light & Glachan (1985) have indicated that children work better in pairs (peer facilitation) in all types of learning, whether with computers or not. Perhaps then peer facilitation is one of the best ways of learning, with both children in the same ZDP, and a teacher available to scaffold if need be?

Nevertheless, Papert's contention was that the potential of the computer in aiding development lay not in it's use as a tool for teachers, but "on the contrary, it's potential lies in extending children's control over their own learning" (Light, 1987). Whist this may be true for older children, using technology to follow paths of learning they might not otherwise come to using a traditional print resource, can the same be said of pre-school and primary school children? Would not undirected exploration at these ages lead merely to frustration and failure because of the very young child's inability to think other than concretely? Certainly there is research that points in the opposite direction. Susan Haugland (1992) carried out studies in which children exposed to non-developmental software had significant losses in creativity, whilst children exposed to developmental software had significant gains in intelligence, non-verbal skills, structural knowledge, long-term memory and complex manual dexterity. There seems to be agreement, then, that for any computer software to have a positive influence on cognition and education, it needs to be developmentally appropriate, otherwise it is liable to cause damage.

In the areas of co-operative and collaborative learning, computers do appear to offer some advantages. At a practical level, students often work with more than one student at a computer owing to the limited number of computers available in the classroom. This practice can also find support at a theoretical level. Vygotsky (1978) argues that all higher psychological functions (e.g. perception, voluntary attention) have social origins. Specifically, he claims that adults and more capable peers mediate a child's experience. Many of the successful problem solving training studies have been influenced by the Vygotskyan notion of guided learning within a learner's zone of proximal development - a distance between what a child can do working alone and what he or she can accomplish with aid.

An important implication from Vygotsky's argument is that within a computer learning environment, there needs to be an increase of interaction between the teacher and the learner, as well as between learners. A corollary to this proposition is that if the intended outcome of such learning experience is the improvement of problem solving skills, then the focus of such interaction should be on the skills and processes involved with problem solving. For instance, learners could be encouraged to reflect on their problem solving experience and skills, and then share the experience with each other. More capable peers could be encouraged to assist the less capable ones initially, but gradually transfer the control of tasks to the less able learners (Day, Cordon & Kerwin, 1989).

If we view the computer as a medium, we can argue that it can enhance the very nature of how and what we communicate. It facilitates inter-subjectivity (communication between learners), and intra-subjectivity (communication between the learner and him/herself) (Vygotsky & Kozulin, 1996; Vygotsky & Vygotsky, 1980) Such communication is an essential part of learning. Teachers must communicate ideas and facts to students; students communicate with other students in social learning situations to develop answers to questions, to reflect on their understanding, and to concretise their ideas.

The effect of computers on children's physical and social development can also be significant, the amount of time and the types of activities that children engage in whilst using computers being key factors influencing whether technology has positive or negative results on their development. Reports warn that children can suffer repetitive-strain injuries and damage to vision from extended use of computers. Working with computers can be a socially isolating experience and affect the child's ability to interact with other human beings. Research has indicated that children spending substantial amounts of time on-line, communicating with strangers in multi-user domains and chat rooms, have been found to experience greater declines in social involvement and increases in their feelings of loneliness and depression. Similarly, exposure to violent computer games has been linked with increased aggression and antisocial behaviour. Again, these findings underline the importance of supervised use of computers, both in the classroom and at home, and the guidance of an adult to encourage children to use computers in appropriate ways.

Another socio-cultural concern around the use of computers in the classroom is that pre-existing patterns of social inequality may be worsened, particularly in terms of gender. It is feared that there is potential with educational computer technologies to place girls at a disadvantage to boys since girls tend to have a less favourable attitude to computer use than boys, and use such technology much less. However, whilst there is evidence that there are gender related differences in terms of attitudes, frequency of use and type of use of computers, these differences are not generally associated with performance on computer tasks. Indeed, a study by Underwood and Underwood (1990) suggests that girls perform just as well as boys when they engage with computer-based learning tasks and programming activities.

A number of explanations have been offered to explain gender differences, one of which proposing that they are linked to the issue of individual versus collaborative modes of working. Hoyles et al (1991) found that when computers are used individually, girls tend to find the experience isolating, thus reducing their performance. However, when the computer is associated with a collaborative model of working, girls are typically as eager as boys in their response and performance.

A study by Sherry Turkle (1984) has proposed that there may be differences in the cognitive styles of boys and girls that affect the way in which they relate to computers. Working with computers today requires formal analytical skills, which evidence suggests are masculine skills. If this were true, girls would need to be helped to overcome social conventions and to adopt approaches to computers using their own strengths and cognitive skills. It may also be significant that the metaphors and images used in the presentation of a task are more suited to boys than girls, and that context exerts a critical influence on cognitive performance and its relative difficulty for the different sexes.

Conclusion Technology is a tool that can provide another way for children to learn and make sense of their world. Computers can be used in developmentally appropriate ways that are beneficial to children, or they can be misused, just as any other materials can be misused. Furthermore, just as pencils do not replace crayons, but rather provide additional means of expression, computers do not replace other methods of learning, but add to the tools available to children to explore, create and communicate. When used appropriately by skilled teachers, technology can support and extend learning in valuable ways and can increase educational opportunities. The key is finding the balance and knowing how to align the elements of a healthy childhood with the unique capabilities offered by technology.

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