The Detrimental Effects of Extensive Computer use in Education on the Development of Children.

The aim of this paper is to prove that the extensive implementation of computers in pre-high school education is having a detrimental effect on the development of children.

To clarify my aim the following definitions are offered. Computer is defined as "An automatic electronic device that rapidly performs complex mathematical and logical operations using information and instructions it receives, processes and stores (Scribner, 1986:206)." Pre-high school education is defined as any formal learning that is "attended before high school education, usually comprising grades one through eight (Scribner, 1986:456)." Development is defined as "the changes over time in structure, thought, or behaviour of a person as a result of both biological and environmental influences (Craig, Kermis and Digdon, 2001:528)." The definition of children is "developmental stages of boys or girls from birth until adolescence, or approximately 15 years of age (Craig, Kermis and Digdon, 2001:49])." Having defined the main concepts of the aim, the supporting arguments for the aim will be presented next.

The first argument I present to support my aim is that computer technology is ecological. Secondly, I argue that a computer is a tool, and to be effective it is necessary children understand what it is and how it works. Thirdly, I argue that computers work with an extremely restricted class of children's thoughts. The fourth argument presented to support my aim is, that computers are used in education in a way that is detrimental to

children's development. Finally, and most importantly, I argue that holistic development in children is not compatible with computer use.

To begin, the first argument advanced here is that all technologies are ecological (Postman, 1988:147). That is, their introduction sends ripples of change throughout the entire social system and through it, the individuals that comprise the system. Many of these changes are indirect. Usually, there are undesirable, eventually difficult to detect side effects. For example, the automobile added mobility to society, which was widely perceived as beneficial. It took some time before the problem of air pollution was recognized as a direct side effect of this increased mobility. It took even longer to see that the automobile also contributed greatly to the destruction of the inner city by fostering suburban sprawl and expressways that allowed wealthier workers to turn their backs on inner-city residential concerns. Similar collateral effects accompany every new technology that is adopted by society (Winner, 1993). This problem can be ameliorated by knowledge of the character of technologies and recognition of the need to look beyond their direct benefits. "This can only be successful if the basic operation of those technologies is understood (Winner, 1993:12)."

The normal response of children, when confronted with something that is not understood is to investigate the object until the child can associate the sensory perception to a concept that relates to his/her ideas with the observed world (Bronfenbrenner, 1995). Machines are becoming more and more complex and inscrutable. Facing an apparent impossibility of understanding of how they work the child's response has been not greater curiosity but apathy (Craig, Kermis and Digdon, 2001:421).

In addition to the preceding argument, I argue that a computer is a tool; it is advanced that for a tool to be effective it is necessary for children to understand what it is and how it works. Integrated circuits are impossible to internally examine, this broad scale opacity of our common tools presents society with a serious challenge. To accept the renunciation of the natural drive to understand how things work means accepting the diminishment of this essential human characteristic. This may have "negative influences on any areas that require curiosity and investigation, not only in relation to machines but also in personal and social relations (Craig, Kermis and Digdon, 2001:528)."

Computers have penetrated into every human activity because they replace or simulate a certain part of one's thinking. "It is necessary to teach what they are, how they may be used in general applications, how they may be well or badly employed and what beneficial and undesirable effects they can have on the individual and society (Monke and Setzer, 2000:14)." These influences can only be understood if one has some knowledge of the computer's internal structure, from the hardware and the logical points of view. This is a subject that educational systems should address, so that all young people can obtain a fundamental knowledge of how the computer operates both for us and on us. Unfortunately, the emphasis in educational systems is on using computers wherever and whenever software products can be employed effectively. Often, even effectiveness is not the primary determinant. Just the use of the computer itself is deemed justification enough for putting children at the keyboard. Before employing the computer we should carefully examine the effects of its use according to the developmental needs of various age groups (Monke and Setzer, 2000).

It is essential for proper implementation of computers in education to understand certain characteristics of computers, and to understand how children develop cognitively. Every person can imagine an appropriate age for beginning to learn how to drive cars. Knowing these tools (cars), and also the general characteristics of children, certainly nobody would say that they should learn to drive at age 7 or even 10. One expects that a driver have a certain degree of responsibility, maturity and motor coordination to drive in traffic. In the case of computers, age is not an obvious factor, because their operation does not produce physical disasters and requires very limited physical coordination, and then only when entering data (Monke and Setzer, 2000). This indicates that an understanding of the tool (computer) is necessary and can not be fully grasped before an approximate ideal age not only to learn about how they work, but an ideal age at which to begin using them.

The third argument I present to support my aim is that, computers work with an extremely restricted class of children's thoughts, thoughts that do not have the same meaning to the machine that they represent to a child (to the machine they have no meaning at all). Computers process data, which consist of specific kinds of thoughts introduced into them. Through structural association one may couple two pieces of data, but what both mean and their relation to the real world, cannot be inserted into the machine (Bower, 1988). This symbolic manipulation of data characterizes computers as abstract machines, as mathematical machines. In fact, it is possible to describe with mathematics all data processing done by a computer. Programming a computer corresponds to elaborating purely mathematical thoughts. It is a process analogous to theorem proving. Although it is not so obvious, this is also the case when one uses any

software, as for example a word processor. To align a text vertically, one has to give the machine a command, punching some keys on the keyboard or selecting an icon with the 'mouse'. This activity is formal, always causing the same reaction by the machine. To execute some task through such a series of commands, one has to exercise exactly the same type of reasoning used in algebraic mathematics. To solve an algebraic equation, for example, one must work formally, logically, step-by-step, through a set of operations predefined by the algebraic system (Monke & Setzer, 2000). The only substantive things that set the computer user and the programmer apart from the mathematician are the type of symbolic language utilized in each case and the user's ability to get immediate feedback as the machine responds to each command (Bronfenbrenner, 1995).

The restrictive environment of computer use, whether exhibited through programming or the menu commands used in word processors, spreadsheets, and so on, are examples of what one calls formal language, a language with a strict syntax, which may be fully described in mathematical terms (Papert, 1980). The type of thinking necessary to program a computer or to use any software through written or iconic commands is of the same nature as the one used when doing symbolic logic. The computer's absolute demand that the student reduce decision by stringing together exact and unambiguous expressions requires that the child operate in a cognitive straightjacket. Software applications and programming that make this straightjacket more comfortable by varying degrees, does not mean that we can ignore their constricting effects on a child's cognitive processes (Bowers, 1988).

In addition to the preceding argument, it is advanced that, how computers are used in education is detrimental to children's development. The various uses of

computers in education may be classified into three broad categories. One form of using computers in educating children is “programmed instruction” introduced conceptually by B.F. Skinner in the early 1950s (Skinner, 1986). The computer presents a subject, often using sound and animation “unconditioned stimulus”. After this phase (sometimes in the midst of it), questions are posed to the student, and the answers lead to other topics of investigation or the repetition of previous ones that were not properly “conditioned”. This is a classic example of conditioning. In programmed instruction, the computer forces the same type of thinking as in any other application, because the commands given by the students also constitute a formal language, and the computer reacts always according to a rigid mathematical formula, based on nothing more personal than the students’ previous responses. Learning is here reduced to memorization and the capacity for solving problems directly related to the covered material; the program cannot take into account the level of maturity, creativity, and intuitive abilities of different users (Bower, 1988).

Another form of computer use in education is simulating experiments. Instead of observing and doing something real, either in a laboratory or in the field, students explore simulations on the computer screen. C.A. Bowers (1988) pointed out a number of cultural problems created by trying to reduce problem solving to mere data analysis. One aspect of this tendency is that the simulation, which is based on sophisticated mathematical models hidden from the user's view, gives the illusion of conforming to the real world, when in actuality it only conforms to the very limited contingencies anticipated by the programmer. It fosters a mechanical view of nature just as a political simulation fosters a mechanical, rational view of social relationships, also available to manipulation and control (Bower, 1988 and Talbot, 1995).

Finally, one may use computers as productivity tools, both within content areas and as an area of study for future use. This means teaching general software, such as word processors, electronic spreadsheets, graphic, database, and communication systems. Once again the child will encounter the problem of software requiring, the use of commands that constitute a formal language and that force a highly constricted, logical thinking (Talbot, 1995).

The use of the Internet for education deserves mention, it is the newest and touted as the most powerful tool for learning ever invented. What makes it so powerful is that it allows children to freely search for educational material or useful information, and allows communication with all sorts of people in different parts of the planet (electronic globalization) (Bronfenbrenner, 1995). However, the Internet does not provide a constructivist environment, one where the child or young person learns by doing and interacting socially and cognitievly. Objections to its use are: 1) the Internet has to be used through commands pertaining to a formal language, forcing the user to exercise the same type of logical-symbolic thinking and the use of a formal language inappropriate before high school, 2) the Internet reduces education to consuming information (Talbot, 1995). Certainly the informative part of education is extremely important, but not as crucial as the formative part (Monke and Setzer, 2000).

The final argument that supports the aim of this paper is, cognitive and social development in children is not compatible with computer use. Given that the activity of a computer programmer or of any software user is analogous to theorem proving in mathematics, it follows that the appropriate age to start using computers is the same one we consider appropriate for young people to start doing formal, algebraic theorem-

proving (Talbot, 1995). This ideal age can be surmised by reviewing the concepts of the development of children. One supporting concept is that of Bloom and Krathwohl (1956), that forwarded six categories of developmental abilities necessary for the acquisition of knowledge by children. This concept can be illustrated by asking six questions. Does the child have possess knowledge of facts and principles of the computer? 2. Comprehension of the computer, 3. Application of the rules principles as well as basic procedures used with computers, 4.

Rudolf Steiner introduced another relevant concept in 1919, when he created what became known as “Waldorf Education”. Although all developmental theories carry validity, Steiner consciously addressed the needs of children growing up in an increasingly technological environment, much like our own. According to Steiner the development of each human being may be divided into periods of approximately 7 years (Steiner, 1982). The Greek philosophers first acknowledged these divisions; Steiner deepened this knowledge and gave conceptual explanations and characterizations for the various periods. Steiner covered every aspect of life, providing a more holistic explanation of how the human life unfold, he advanced, that various stages continued to emerge through to adulthood.

According to Steiner, in the first 7-year period the child is individualizing the will and forming a physical base. Education should be based exclusively on contact with the physical environment, imitation, imagined fantasy and rhythm. He theorizes that any teaching through intellectual abstractions, as in reading (modern occidental letters and their composition into syllables constitute mere abstractions) goes against the child's natural characteristics, disturbing his or her development and producing harm that may

eventually manifest itself much later, in psychosocial or even physiological forms. In the schooling sense, present an environment conducive to playing and learning through doing, involving motor coordination, socialization, and observation of the environment without conceptual explanations, in an atmosphere full of love, nature, and natural objects (Steiner, 1982).

In the second 7-year period, the child enters school age. There existed a tradition, now almost lost, that children would begin formal schooling only when they were about 6 1/2 or 7, and it was at this age that they began to learn how to read. During this period, the child, who now controls the will to a great degree, begins to concentrate development on individualizing the feelings. The child of this period requires an education based on these concepts, being expressed through artistic aesthetics in any subject. Science learning should take place through observation and description of phenomena, not through abstract explanations. Mathematics should be presented as something interesting and humane, giving incentive to imagination with aesthetic feelings (Steiner, 1982).

In the third 7-year period, whose beginning is marked physically by puberty, the time of high school and university, a young person strongly individualizes his or her thoughts, and starts looking for a true world. At this time, teaching has to begin to be directed to 'pure' abstractions, models of reality or of concepts, eventually leading to work that is purely hypothetical in nature. The student looks to understand conceptually what is observed or studied. If during the second 7-year period one is to present phenomena and teach students how to describe them, in the third period one should begin to explain them through concepts. In this period, students should begin to prove theorems in mathematics, transforming it into pure symbolic manipulation, eventually without

immediate application (e.g., proving trigonometric identities) (Steiner, 1982 and Talbot, 1995).

Until the last century, mathematics was always motivated by applications (Kline, 1973: iv); it took humanity an enormous time span to reach the abstraction capacity necessary to become interested in 'pure' mathematics. It follows that children take some time to reach the necessary mental maturity to deal with the formalism and type of thinking involved in abstracts and mathematics. It is interesting to note that in many countries, 21 (the end of this 7-year period) is the age for a young person to become legally responsible. It is a recognition, that only at this age are all human capacities fully available, and the individual is able to control and be totally responsible for his or her actions (Steiner, 1982; Talbot, 1995 and Bronfenbrenner, 1995).

In conclusion, this paper supported my aim to prove that the extensive implementation of computers in pre-high school education is having a detrimental effect on the development of children.

The first argument I presented to support my aim is that computer technology is ecological and like all technology may have long reaching effects on children's emotional, psychological, spiritual, moral and social sensibilities. Fostering a mechanical, rational view of social relationships.

Secondly, I argued that a computer is a tool, and to be effective it is necessary children understand what it is and how it works. Just as a child's physical development is stunted when muscles are not exercised, the development of disciplined thinking is stunted when the computer relieves the child of the responsibility for planning and

organizing his/her thoughts before expressing them. It should be kept in mind that tools designed to aid the mature mind may hinder the maturation of the developing mind.

Thirdly, I supported my aim by arguing that computers work with an extremely restricted class of children's thoughts. It was demonstrated that early computer use and an emphasis on computer like thinking, is leading children's development to be dominated by the rigid, logical, algorithmic thinking, that is characteristic of computer interaction. This accelerated, but isolated intellectual development, brings a child's mental abilities to an adult level long before they have grown strong enough to restrain it and give it humane direction.

The fourth argument presented to support my aim was, that how computers are used in education is detrimental to children's development. Children need time for active, physical play; hands-on lessons of all kinds, especially in the arts; and direct experience of the natural world. The prevalent emphasis on technology is diverting us from the urgent social and liberal educational needs of children. A proper education requires attention to students from good teachers and active parents. It requires commitment to developmentally appropriate education and attention to the full range of children's needs; physical, emotional, and social, as well as cognitive.

Finally and most importantly I demonstrated that developmental stages in children are not compatible with computer use. Combining Steiner, Bloom and Krathwohl developmental concepts with the fact that computers are mathematical tools, forcing a purely abstract and mathematical type of thinking as well as use of symbolic formal language. Applying these concepts and properties of computers to proper educational goals we may surmise that they are unsuitable for extensive use by children in any form

before approximately age 15, or high school. Convincing arguments have been presented to prove the extensive implementation of computers in pre-high school education is having a detrimental effect on the development of children.

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