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Computers in the Schools: Intended and Unintended Consequences

Laurence Wayne Prochner

A Thesis

in

The Department

of

Education

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of the Arts at
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ABSTRACT

Computers in the Schools: Intended and Unintended Consequences

Laurence Wayne Prochner

This thesis addresses the issue of computer use in schools. Arguments posed by Papert (1980) and Weizenbaum (1976) are outlined with the intent to indicate how concepts such as educational ideology and hidden curriculum can contribute to a more comprehensive statement on the role of the computer in the educational process. Papert's educational philosophy is examined as an example of an argument for the increased use of computers in schools. Weizenbaum's polemic is set in counterpoint to Papert's viewpoint. In Papert's view, the child programs the computer. In contrast, Weizenbaum suggests that the computer is a machine that manipulates language. Weizenbaum's argument is elaborated by drawing on concepts from social theorists (Blumer, 1986; Mead, 1934; Garfinkel, 1967; Schutz in Wagner, 1970), to argue that if the computer manipulates symbols, it may play a role in language development and therefore socialization. Further, it will be argued that an educational ideology (Persell, 1977; Weber, 1946) may constitute the hidden curriculum or the unintentional message of the computer. It is suggested that norms, attitudes, and values that support the dominant culture are learned in addition to explicit learning goals. Scientific rationality and gender role stereotyping are introduced as two examples of the transmission of education ideology through computers. Any secondary effects that the computer has on children may be the result of this implicit learning.

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COMPUTERS IN THE SCHOOLS: INTENDED AND UNINTENDED CONSEQUENCES

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CHAPTER I

INTRODUCTION

The problem statement of this theoretical thesis is; what secondary effect does computer use have on children? The question is the result of an attempt to develop a more comprehensive view of the impact of the computer in schools, one that takes into consideration both intended and unintended learning. Perkins (1985), for example, asks the question, ''what difference will they (computers) really make'' (p.11)? Perkins describes increased efficiency as the straightforward or first-order effect of using computers. A study of the possible second-order effects, taking into account the social context of the computer, is the goal of this thesis.

Papert (1980) suggests that a second-order effect of learning computer programming is an increase in problem-solving skills. This may or may not be true. However, Perkins argues that whether or not opportunities to learn problem solving are taken by a student, something is being learned. In a similar manner, this thesis will attempt to describe some deeper repercussions of computer use by drawing on concepts such as hidden curriculum and educational ideology.

Chapters two and three describe the second-order effects of computers from two perspectives, those of Seymour Papert and Joseph Weizenbaum. In chapter two Papert's philosophy of education, as described in his book, Mindstorms: Children, Computers and Powerful Ideas (1980), is outlined. Papert's concept of computer-based education (Logo) [1] was selected as an example of an intended or explicit curriculum for two reasons. First, Logo is relatively popular in the early grades. According to a recent survey of American schools by Becker, (1987) Logo is used twice as often as all other programming languages combined in kindergarten to grade three (p.154). The recent introduction of LogoWriter (1985), a new version of Logo currently being marketed in schools across the United States and Canada, may further increase Logo's use. It is being taught, however, in the absence of research support for Papert's claim for the pedagogical superiority of Logo-based learning environments. The use of Logo in the schools is therefore an issue that is both current and and unresolved.

The second reason for selecting Logo is that it is meant to be taken seriously as a model for education and not just computer education. Logo is presented by Papert (1980) as an ''object-to-think-with'' that cuts across the whole curriculum (p.11). Logo can therefore be critiqued as an approach to education as well as a programming language.

Chapter two begins by describing Logo's connection with Piaget and the field of artificial intelligence. The development of generalizable problem solving skills is then described as the explicit goal or specified second-order effect of Logo. The chapter ends with the question of what is missing from Papert's theory of education? That is to say, what are other possible second-order effects of a computer-based education such as that described by Papert?

Weizenbaum provides one possible answer. Like Papert, Weizenbaum is a computer scientist at the Massachusetts Institute of Technology. However, for the past decade Weizenbaum has been a dissenting voice among computer scientists. Chapter three outlines Weizenbaum's argument as presented in his book, Computer Power and Human Reason: From Judgement to Calculation (1976). Weizenbaum suggests that the second-order effect of computer use is to limit and not expand human thought.

Both Weizenbaum and Papert therefore view the computer as a powerful tool for changing the way we think. However, as Weizenbaum (in Rosenthal, 1985) notes, each looks at different sides of the same issue. Both describe what they interpret to be the first and second-order effects of computer use. The effects are in fact the same, but Papert and Weizenbaum attribute a different meaning to them. That is to say, the computer increases efficiency (the first-order effect) and using the computer promotes computational thought (the second-order effect). However, while Papert views such thought as liberating and powerful, Weizenbaum interprets it as restrictive and even imperialistic (Weizenbaum in Rosenthal, 1985, p. 11).

Chapter three draws on Weizenbaum's view of computational thought to discuss the possible influence of the computer on human language and our view of ourselves. Sociological concepts from Mead (1934) and Schutz (1970) are used to set the issue in a broader social context through a detailed discussion of the socialization process. The concepts - reflexivity, generalized other, and intersubjectivity - are explained in light of Weizenbaum's main argument.

Chapter four builds on the sociological theory and links the issue back to schools and computers by introducing the concepts of educational ideology and hidden curriculum. The promotion of scientific rationality and a focus on efficiency, the first-order effects of computers, are described as a means of inhibiting ideological change. The chapter closes by examining a specific example of computer use, word processing, and its possible impact on both writing and the computer user. Word processing is used as an example because it is an application of computers that appears neutral. That is to say, the first- and second-order effects of using computers for writing are generally regarded as a greater efficiency, and an increased motivation and interest in writing. In the discussion of word processing, alternative interpretations of both first- and second-order effects are suggested.

The final chapter extends the critique beyond a single example to suggest a general framework for examining unintended learning in computer use. Three practical ways of studying the relationship between school and society are presented; a focus on knowledge form, content and classroom social relations [2]. Examples of how each focus may be applied to the computer in the school are given.

A central concern in the thesis is the potential of the computer to affect or control parts of our lives. Daiute (1985) and Turkle (1984) provide two examples of how the issue of computers and control can be expressed. Daiute (1985) suggests that control should be viewed in relation to communication. Those who perceive computers as controlling believe the technology will ultimately control communication between humans, thereby limiting our freedom, creativity and autonomy (Daiute, p.17). Daiute suggests that such control is largely a myth. In her view, possessing knowledge about computers allows the user to control the technology.

Turkle (1984) perceives the issue of control differently. In her study of computer users, Turkle found that the computer was often regarded as a world unto itself. Mastery over a computer program or an electronic game was therefore interpreted as a personal and psychological victory. As Turkle comments;

> I found that for them (personal computer owners) the computer is important not just for what it does but for how it makes you feel. It is described as a machine that lets you see yourself differently, as in control, as ''smart enough to do science,'' as more fully participant in the future. (p.20)

Within this thesis, control is considered as it relates to computers in schools, in terms of social control through the unintended learning associated with computer use. By using concepts such as educational ideology and hidden curriculum it is intended to show how the form and content of the computer can effect learning. The thesis does not represent an argument either for or against the use of computers in schools. It does, however, recommend a well researched and cautious approach to the educational use of a powerful technology.

Woodill (1986) used the metaphor of ''the two edged sword'' to describe the potential of the computer to effect our personal and social lives. That is to say, the strength of the computer, for example, its ability to increase efficiency, is accompanied by a limitation, the promotion of scientific rationality to the exclusion of other modes of thinking. Examples of the ''computer as two edged sword'' can also be found in schools. For instance, educational software may increase the efficient use of a teacher's time, but such curriculum packages may also contribute to the deskilling of teachers. A consideration of the two edged effect of computers, and not a technical knowledge of the use of computers as Daiute (1985) suggested, may enable the computer user to gain control over the technology and appropriate it for his or her own purposes.

Weizenbaum (in Wieckert, 1983) notes that

> very often with technology and, particularly with high technology, it turns out after the thing becomes mature, that side effects are very much more important than the main intended effect. (p.19)

Weizenbaum continues by stating that the side effects of computer use are rarely studied. As Salomon and Gardner (1986) point out, though, it is necessary to examine the side- or second-order effects before computers become completely pervasive in schools (p.13).

Postman (1985) agrees that we rarely ask the question of how technology affects us. He concludes that when we do ask the question we focus on the content of the medium and not the form. For example, Postman suggests that although television is influencing the school curriculum, the character or form of television ''is not included as part of what is studied'' (p.154).

According to Postman, then, educators have failed to develop a critical and reflective approach to the use of electronic communication media in the classroom. As a result television has effected our view of ourselves. Postman suggests that

> television has achieved the status of ''meta-medium'' - an instrument that directs not only our knowledge of the world, but our knowledge of [ways of knowing] as well. . . . At the same time, television has achieved the status of 'myth', as Roland Barthes uses the word. He means by myth a way of understanding the world that is not problematic, that we are not fully conscious of, that seems, in a word, natural. A myth is a way of thinking so deeply embedded in our consciousness that it is invisible. (p.79)

Similarly, computers and computational thinking may become taken for granted if we avoid a critical examination of their effects. Research on computers in schools can learn from the mistakes of television research by adopting a more comprehensive approach - one which considers the computer in its social and ideological context.

CHAPTER II

PAPERT'S EDUCATIONAL PHILOSOPHY: A DESCRIPTION OF THE INTENDED MESSAGE

Logo was coauthored and popularized by mathematician and computer scientist, Seymour Papert. As described in Papert's (1980) book, Mindstorms: Children, Computers and Powerful Ideas, Logo is both a computer programming language and an educational philosophy. As a philosophy of education Logo blends principles from the field of artificial intelligence with the cognitive epistemology of Jean Piaget.

Logo and Piaget

Piaget (1950), in his stage theory of intellectual development, maintains that cognitive structures are formed as a child engages in active exploration of his or her world. The four genetically based stages identified by Piaget are sensorimotor, preoperations, concrete operations, and formal operations. Stage progression is universal and roughly age related, and the stages develop in an invariant order. Piaget's concept of the child as an active learner and builder of his or her own cognitive structures is the guiding principle in Papert's learning theory. As formulated by Papert (1980), ''Piagetian learning'' is a process in which children ''learn without being taught'' (p.7). A Piagetian curriculum, then, is learning without a curriculum (p.31). Papert contrasts this kind of learning - ''the natural, spontaneous learning of people in interaction with their environment'' - with ''the curriculum-driven learning characteristic of traditional schools'' (p.156).

Papert readily admits that his interpretation of Piaget's theory is unorthodox (p.31, 217). While Piaget (1970) urged that ''new methods of education make every effort to present the subject to be taught in forms assimilable to children of different ages in accord with their mental structures'' (p.153), Papert focuses on what Piaget referred to as ''the American question'', that is, how can cognitive development be accelerated.

Papert (1980) reworks Piaget's theory by maintaining that the more sophisticated cognitive structures identified by Piaget can be attained if intellectual problems are made personal and concrete (p.7, 175). Moreover, he suggests that it may be possible to develop new structures beyond those identified by Piaget (p.161). Papert's primary interest, then, is ''in intellectual structures that could develop as opposed to those that actually at present do develop in the child'' (p.161). In Papert's view, all that is necessary to achieve such a goal is a suitably rich and stimulating environment, for example, a Logo based ''microworld''.

Logo and Artificial Intelligence

Papert's other major influence is found in the concepts of a specialized area of computer science called artificial intelligence. Papert defines artificial intelligence in what he refers to as both the narrow and the broad sense. The narrow sense of artificial intelligence is primarily a concern for the technical aspects of building an ''intelligent'' machine. In the first instance, then, artificial intelligence is no more than ''a branch of advanced engineering'' (Papert, 1980, p. 157). However, artificial intelligence is also a philosophy in that it represents a particular approach to ideas of intelligence as well as engineering. Artificial intelligence in the broad sense is therefore concerned with exploring computational theories of human intelligence and human learning, and applying them to machine intelligence and learning and vice versa.

In summary, Papert describes the source of ''Logo's roots'' as the theory of Piaget and ideas from the field of artificial intelligence (pp. 156-176). However, while Logo as pedagogy is embedded in revisionist Piagetian theory, Piaget is in turn embedded in artificial intelligence. Piaget did not formulate a theory of education but rather one of the naturalistic, genetically based development of intelligence. Papert, however, is not concerned with describing intellectual growth but with changing the nature of intelligence through educational intervention.

In Papert's view, the aim of artificial intelligence is ''to give concrete form to ideas about thinking that previously might have seemed abstract, even metaphysical'' (p.157-158). If children are given access to these concrete ideas, through the procedures involved in computer programming, they can build their own theory of knowledge based on computational ideas. Papert refers to this kind of thinking as procedural logic (Papert, however, uses a variety of terms to refer to procedural logic). If the structure of what is learned is made concrete, Papert suggests that internal intellectual structures will in turn be stimulated. The child in interaction with Papert's prepared environment or ''mathworld'' will therefore develop new structures, beyond the four naturalistic stages described by Piaget, based on the computational model of artificial intelligence.

Logo and Problem Solving Skills

Papert therefore suggests that by using the computer model to think about thinking, the abstract is made personal (p.21). Clements (1985) describes the process as one in which ''children can create their own problems and then 'stand back' and watch themselves, as embodied in the computer program, solve the problem'' (p.63). As a result of using the procedural thinking demanded by the computer language, the child forms ''powerful ideas'' - that is to say, ideas that a child can use, that are general and transferable, intelligible, and personal (Papert, 1980, p. 76). The educator's role is to create an environment that will effectively foster procedural thinking and powerful ideas. The natural learning that takes place within Papert's Piagetian curriculum is directed and controlled by the educator. Moreover, the learning is limited by the computer language itself. In order to make his claim that children in a Logo environment learn without being taught, Papert employs a narrow definition of what it means to teach.

Papert's view of the role of the computer in education is not without its critics. Indeed, that his learning theory has provoked considerable discussion is a significant contribution of the Logo philosophy. According to Davy

(1984), ''the virtue of Papert's work is that it is not trivial. It impinges on fundamental questions of education, psychology, philosophy, and epistemology'' (p.449). However, research on Logo has tended to take a more limited point of view. The twenty year history of research on Logo is largely divided into those who make claims for its success (Gorman & Bourne, 1983; Horton & Ryba, 1986), and those who challenge its effectiveness (Pea & Kurland, 1984a, 1984b; Pea, Kurland & Hawkins, 1985). Success is typically measured in accordance with Papert's (1980) own claim for learning with Logo; that is, computer programming is considered to be a generalizable problem solving model with the potential to influence ''how people think even when they are far removed from the computer'' (p.4). Subsequently, research on Logo has been directed at either investigating the claim for a transfer of problem solving skills, or studying whether problem solving skills are learned at all.

In their review of research on Logo, Krasnor and Mitterer (1984) conclude that ''the entire LOGO literature merits considerable criticism from an experimental point of view'' (p.137). They categorize the existing literature as consisting primarily of testimonials, curriculum guides, manuals and anecdotal evidence (p.135). Moreover, Ginther and Williamson (1985) comment that experimental research supporting Papert's (1980) claims has tended to select dependent measures that seem to ''have no direct connection to the activities involved in learning Logo'' (p.76).

However, the point here is not whether Logo is successful in facilitating the transfer of problem solving skills but more significantly, with what else might be learned through a child's immersion in a carefully controlled, Logo based ''microworld''. In other words, the question is not whether Logo delivers what it promises, but if it delivers more.

Children using Logo may not learn generalizable problem solving skills, but they do learn more than just a programming language. For example, Ginter and Williamson (1985) suggest that Logo may have a greater influence in the personal-social realm than the logical-analytical. They list as examples, persistence in response to frustration, articulate communication, recognition of the need for assistance balanced with appropriate independence, cooperation and sharing of resources with peers, attention to detail and following directions (p.77). However, the effects of computer use on a learner may not all be as positive as Ginter and Williamson describe. The influence of the computer on the personal and social sphere, via second-order effects, is the focus of the following chapter. The role of computer use in the socialization process is explained by drawing on sociological concepts.

CHAPTER III

WEIZENBAUM: COMPUTERS, LANGUAGE AND SOCIALIZATION

A NOTE ON THE UNINTENDED MESSAGE

In this chapter Weizenbaum's critique of computers is examined with the goal of developing a more comprehensive view of the role of the computer in the school.

Computers and Socialization

The two central arguments in Weizenbaum's (1976) book, Computer Power and Human Reason: From Judgement to Calculation, are;

> 1. There are differences between humans and computers.
>
> 2. There are certain tasks which computers ought not be made to do, independent of whether computers can be made to do them. (p.x)

Weizenbaum formulated these seemingly self-evident statements as the result of public reaction to a language analysis computer program he wrote in the 1960's. The program, which Weizenbaum called ELIZA, was designed to mimic a Rogerian, non-directive counselling style in response to user input. Weizenbaum wrote ELIZA as an exercise in computer programming. Weizenbaum was ''shocked'' to discover that some psychiatrists were impressed with the therapeutic possibilities of the program, and advocated the use of ELIZA for use with actual clients. It seemed to Weizenbaum that professionals and public alike believed that the ELIZA program did not just process syntax, but also understood meaning. Weizenbaum concluded that with the invention of the microcomputer, the image of man as machine has been brought to a ''new level of plausibility'' (p.8). Weizenbaum contends, however, that computers are an inadequate model of the human mind in that they reinforce a primarily rationalistic view of the world.

Weizenbaum and Papert both acknowledge the power of the computer to influence our view of ourselves. Papert (1980), for example, states that ''the work on LOGO consists precisely of developing such forces in positive directions'' (p.26). As a result Papert has concentrated on the possibility of the computer to expand the human mind and contribute to the building of new cognitive structures. While Weizenbaum (in Rosenthal, 1985) agrees with Papert's view that the computer ''provides a powerful metaphor for thinking about thinking'' (p 11), he criticizes what he terms the ''imperialistic nature'' of computer influenced, rationalistic thinking.

Papert's micro-worlds, that is, Logo-based classrooms, are intended to be complete in themselves. Knowledge in a micro-world is ''stripped of complexity, is simple, graspable'' (Papert, 1980, p. 162), and broken up into ''mind-size'' bits (p.171). Weizenbaum, however, argues that the rationalistic world that is contained in a computer program captures only the smallest part of what it means to be human. Logo-based classrooms are therefore only partial worlds.

Nevertheless, the limited world contained in a computer program may contribute to the way we think about ourselves. In the following quotation, Weizenbaum (1976) offers an explanation of the role of computers in socialization.

> Man's tools, whatever their primary practical function, are necessarily also pedagogical instruments. They are then part of the stuff out of which man fashions his imaginative reconstruction of the world. It is within the intellectual and social world he himself creates that the individual prehearses and rehearses countless dramatic enactments of how the world might have been and what it might become. That world is the repository of his subjectivity. Therefore it is the stimulator of his consciousness and finally the constructor of the material world itself. It is this self-constructed world that the individual encounters as an apparently external force. But he contains it within himself; what confronts him is his own model of the universe, and, since he is part of it, his model of himself. (p.18)

Many of the concepts expressed in the above quotation from Weizenbaum are also found in the social theory of Mead (1934) and Schutz (in Wagner, 1970). The following review of the theory is intended to add to the understanding of the impact of the computer on socialization. Blumer (1969) identifies the three fundamental premises of Mead's sociology as;

1. Human beings act toward things on the basis of the meanings that the things have for them.

2. The meaning of such things is derived from or arises out of social interaction.

3. These meanings are handled in, and modified through, an interpretive process used by the person in dealing with the things he encounters. (p.2)

A key concept is ''reflexivity'', or what Blumer (1971) refers to as a ''mechanism of self interaction'' (p.12). That is to say, a concept of ''other'' develops when the self as subject becomes reflexive or relates to the self as object (Mead, 1934). The self indicates meanings to itself, but draws on the external world in order to construct those meanings. A concept of a ''generalized other'' comes as we assume shared attitudes with a variety of other individuals. The idea of a generalized other, which constitutes ''the attitude of the whole community'' (Mead, p. 154), leads to an understanding of our place in that community.

Socialization is therefore possible only through social communication. Through the theoretical construct of ''intersubjectivity'', Schutz sought to describe the experience of assuming the attitude of the other. In intersubjectivity,

> the meaning of an experience is established in retrospect, through interpretation. Subjective meaning is that meaning which a person ascribes to his own experience and actions. Objective meaning is that meaning imputed to the conduct of another person by an observer . . . . The interpretation of the conduct of another person consists in relating the observed conduct to an objective meaning context, consisting of pre-established generalized and typified constructions. (Wagner, 1970, p. 320).

An individual not only takes or assumes the attitudes of others to construct the self, but by using the same process also constructs his or her concept of society as a whole. As the organized society or generalized other represents a unity, it exerts a degree of control over the individuals who draw on it for meaning. Moreover, in Mead's (1934) view objects (including the computer) can be a part of the generalized other,

> in so far as an individual responds to those objects socially or in a social fashion (by means of a mechanism of thought, the internalized conversation of gestures) . . . . By taking the attitudes of which he becomes conscious of himself as an object or individual, and thus develops a self or personality. (p.154)

In sum, socialization is viewed as a process grounded in social communication with others, that is, language (verbal and nonverbal), actions and gestures. Socialization and the development of an idea of self is a cyclical and ongoing process which is based in part on our interpretations of how others see us. Further, the intersubjective, or that knowledge or set of attitudes which is common among individuals, is - in Schutz' terms - largely taken for granted unless it is called into question.

Although intersubjectivity is problematic, in our day to day contact with others, including our contact with children, it is treated as if it were not. That is to say, the child's point of view is often taken for granted. Indeed, the child's point of view in an adult-child interaction is problematic because of cultural differences in the experiential sense. Mackay (1974), for instance, contrasts teacher's and children's conceptions of classroom activities and testing materials. He stresses that children and teachers interpret the world by drawing on different 'cultures' or contexts. It is assumed, however, that test questions or classroom activities have the same meaning for both teachers and children. The 'correct answer' therefore ''depends on the child's correct identification of a frame of reference that corresponds to the frame of reference the test constructor had in mind'' (p.242). Roth (1974) also notes in his study of intelligence tests that although objects, words, and events do not hold the same meaning for children as for adults, the tests assume children and adults experience shared meanings.

Similarly, the interaction of a child and a computer program may be problematic. The message sent, that is, Papert's notion of ''mechanical thinking'', is assumed to be the primary message that is received. While such an assumption may or may not be correct, it is possible that an increased skill in procedural logic is not the only learning that occurs.

The Computer, Language, and Mind

Mead's social theory emphasized that language is the key to socialization. In a similar way Weizenbaum suggests that language is also the domain of the computer. Weizenbaum, for example, describes the computer as a ''symbol manipulator'' (p.74). The application of such concepts as ''intersubjectivity'' and ''socialization through language'' to the computer is a first step in making the computer problematic in education. Questions can be formulated regarding the role of the computer in socialization. For example, if we perceive the computer as an ''other'', as Turkle (1984) suggests, do we also assume the computer knows what we know? Does the cyclical process of intersubjectivity function within the child-computer relationship as it does between child and adult culture? A reciprocity of perspective may be taken for granted by a computer operator. Garfinkel's (1967) description of the cycle of intersubjectivity may be applicable to a computer user.

> The person assumes, assumes the (computer) assumes as well, and assumes that as he assumes it of the (computer), the (computer) assumes it of him, that a relationship of undoubted correspondence is the sanctioned relationship between the actual appearances of an object and the intended object that appears in a particular way. (p.50)

For example, terms drawn from computer culture - input/output, programming, systems breakdown, debugging -

have entered into everyday language. As Turkle (1984) notes, however, ''people are not just using computer jargon as a manner of speaking. Their language carries an implicit psychology that equates the processes that take place in people to those that take place in machines'' (p.17).

Although Papert is keenly aware of the potential effect of the computer on the user's perception of self, in his view the computer user remains firmly in control. Any changes in human language brought about by computer language are interpreted as having a positive effect. Papert (1980) writes that,

> In a computer-rich world, computer languages that simultaneously provide a means of control over the computer and offer new and powerful descriptive languages for thinking will undoubtedly be carried into the general culture. They will have a particular effect on our language for describing ourselves and our learning . . . . We look at programming as a source of descriptive devices, that is to say, as a means of strengthening language. (p.98)

By his suggestion that computer language will ''effect our language for describing ourselves'', Papert acknowledges the potential role of the computer in socialization. Indeed the role Papert gives the computer is that of ''a carrier of cultural 'germs' or 'seeds' whose intellectual products will not need technological support once they take root in an actively growing mind'' (p.9). Although computer thinking may become natural thinking, Papert does not view this as a reason for concern.

However, as Weizenbaum (1976) cautions, a model - for example the information processing model of the computer - should not be confused with what it is supposed to describe. Weizenbaum suggests that

> the aim of a model is, of course, precisely not to reproduce reality in all its complexity. It is rather to capture in a vivid, often formal way, what is essential to understanding some aspect of its structure or behavior. (p.149)

In Logo, however, the distinction between the model and real life structure is not always clear. For example, in reference to the field of artificial intelligence (AI), Papert (1980) begins by suggesting that

> the aim of AI is to give concrete form to ideas about thinking that previously might have seemed abstract, even metaphysical . . . We propose to teach AI to children so that they, too, can think more concretely about mental processes. (p.158)

He goes on to state that ''while psychologists use ideas from AI to build formal, scientific theories about mental processes, children use the same ideas in a more informal and personal way to think about themselves'' (p.158). The result may be - through the process of intersubjectivity described earlier - to concretize a model of thinking that represents only one aspect of human thought.

In Turkle's (1984) view, the relevant question in the debate over artificial intelligence is ''not whether machines will ever think like people, but whether people have always thought like machines'' (p.24). Piaget's hypothesized fourth stage of cognitive development (formal operations), for example, is similar to the computer-like logic described by Papert. Papert (1980, p. 21) realizes that the thinking of most adults is not characterized by this stage. That is to say, Piaget's fourth stage appears to be a theoretical construct rather than a naturalistic stage of cognitive development. However, Papert suggests that in a properly controlled environment, one in which procedural thinking is demanded, procedural thinking will be encouraged, and in time, become natural.

On the other hand, the answer to Turkle's question may be that human thinking is not well described by an information processing model. If we do not naturally 'think' like computers it is the computer user who must accommodate to the computer. Weizenbaum (1976) suggests, for example, that ''if people from outside the computer fields are to be able to interact significantly with computers, then either they must learn the computer's languages or it must learn theirs'' (p.183). Computer language - rigid and impoverished - is not like human language. ''Humans understand communications couched in natural languages (eg. English) that lack, by very far, the precision and unambiguousness of ordinary programming languages'' (p.183), or what Weizenbaum calls formal language. Because the computer can not understand meaning or know context, it will never be able to understand or learn human language (verbal and nonverbal), in the same way - as indicated previously - that children can not know adult culture or meaning. Mackay and Roth stressed that in order to develop interactional competence children must adjust to the conceptual framework of the teacher. Similarly, when children use computers they must adopt the coded and necessarily precise language of the computer. That is to say, that the user must accommodate the limitations of the computer. Roszak (1986) supports this conclusion in his remarks on Logo;

> (Papert) speaks of the child ''teaching the machine''. But it is unclear that in this respect LOGO is any different from other programming languages. True, students write the program, but they must do so on the machine's terms. They must stay within the machine's language and logic - or the machine will tell them, ''I don't know how to...''. (p.75)

In Mead's social theory - and as was expressed by Weizenbaum and Turkle - the meaning of objects in our world is taken to be socially created. Indeed, socialization refers to the process by which the external world (including the world of objects) comes to be subjectively known (Rafky, 1973, p. 50). It is important to note, however, that although the computer may be perceived as having a role in socialization, interaction with the software is illusory. Rather, the user enters into a relationship with a programmer who is in turn influenced by a particular ideology. It is the programmer who creates the learning context.

Weizenbaum suggests that ''the computer programmer . . . is a creator of universes for which he alone is the lawgiver'' (p.115). Control on this level is similar to the psychological control over the computer entity noted by Turkle (1984). However, the programmer is part of a social and ideological context. In Roszak's words, ''the essence of the machine is its software but the essence of the software is its philosophy'' (p.64). In order to set the computer in a larger social context, the following chapter will focus on how an educational ideology enters into interaction between the child and computer through the computer program, and from the organized society. The intent is to point to how the concepts of educational ideology and hidden curriculum, as unintended consequences, become an integral part of the socialization process through computer use in schools.

CHAPTER IV

THE COMPUTER, EDUCATIONAL IDEOLOGY AND THE HIDDEN CURRICULUM

The Social Construction of Reality

Apple (1979, 1982) contributes to the understanding of how meanings (at a micro level) are influenced by larger social structures (the macro level) in the schooling process. Apple suggests the use of the concept of the social construction of reality to analyze the above process. By social construction of reality he means how individuals, in the construction of their world, draw on the experience of others thereby creating their own life-world. Apple observes that we do not interact with a world that is neutral. Ideology, which is defined herein as ''a 'system' of ideas, beliefs, fundamental commitments, or values about social reality'' (Apple, 1982, p. 26), enters into our interpretations. The question remains, however, of how a relatively stable system of meanings becomes part of an individual's interpretation process via the computer. As

Apple notes;

> The general principle of the social construction of reality does not explain why certain social and cultural meanings and not others are distributed through schools; nor does it explain how the control of the knowledge preserving and producing powerful institutions may be linked to the ideological dominance of powerful groups in social collectivity. (p.27)

Persell (1977) analyzed the relationship between ideology and institutions such as schools by drawing on Weber's (1946) concept of a ''structure of dominance'' to indicate that ''people in positions of greater power and privilege do not retain these positions by accident, but use their superior resources to maintain themselves'' (p.6). The structure of dominance is maintained in part by educational institutions through the explicit and implicit teaching of ideas and concepts that make the existing structure seem natural. Thus, the discussion returns to the issue of the computer and implicit learning.

Unintended Consequences: Hidden Curriculum

A hidden curriculum most often refers to an implicit moral curriculum in schooling (Giroux & Purpel, 1983). Examples of principles of conduct and social norms that the hidden curriculum is assumed to teach are; ''independence, achievement, universalism, and specificity'' (Dreeben, 1988, p.44), and such values as respect for the teacher and good work habits. In general, hidden curriculum as a sociological concept, that is, as it is used in this thesis, refers to the social-control function of schooling (Vallance, 1983, p. 11). That is to say, it reflects an educational ideology that helps to maintain and legitimize the existing dominant culture.

Socialization is therefore influenced by the educational ideology which has been written into the computer program. As a result, certain norms, values and attitudes reflect those of the generalized other. In the case of computers in schools, legitimation may occur as a result of the meanings embedded in the computer software. As defined by Mead, interaction is the process whereby we create, through language, an identity of self and of others. In computer use, however, interaction is defined by a programmer. The programmer is in turn restricted by an educational ideology which supports the dominant culture.

The transmission of a particular philosophy or educational ideology may be considered to be part of the content of the computer's hidden curriculum and the socialization process. Implicit learning associated with computer use in schools may include:

1. The promotion of one mode of thinking, ie. scientific rationality, to the exclusion of others.

2. Gender role stereotyping.

3. The promotion of the computer as a mediator of social relations in the classroom (child-child and teacher-child).

4. The promotion of a traditional reward and punishment system in some educational software.

5. Conformity to hierarchical authority and preparation for the workplace.

Below scientific rationality and later gender role stereotyping are discussed to illustrate the transmission of education ideology through computers.

Scientific Rationality and Computers

Persell (1977) has cautioned that

> while rationality may offer a valuable approach to many problems, it should not be forgotten that rationality is a relative concept, that it may support the interests of certain groups . . . more that others, and that it may not be the best approach in all situations. (p.10)

Therefore, scientific rationality may help support existing social structures. Ellul (1964) described the potential of scientific ideology, or what he termed ''technique'', to repress creativity and social change. In Ellul's critique, technique is a way of thinking about the world based on logic and scientific rationality. The technical world view is concerned with efficiency and is focused on means as opposed to ends. Ellul argued that ''every intervention of technique is in effect, a reduction of facts, means and instruments to the schema of logic'' (p.79).

Similarly, Garfinkel refers to scientific rationality as a particular system of methods and practices that we use to build up our knowledge of ourselves and the world. Drawing on Schutz, Garfinkel (1967) makes a distinction between the ''practical theorist'' (''the attitude of everyday life'') and the ''scientific theorist'' (''the attitude of scientific theorizing''). Garfinkel lists fourteen behaviors or ''rationalities'' that can be seen as evidence of each of the two attitudes (see Table 1). Only four (11-14), however, are used by the scientific theorist [3]. The scientific rationalities rely on a different set of presuppositions than do the ''practical rationalities''. For example, as a methodology, scientific rationality seeks to isolate ideal characteristics of an object of study, and then construct a model based on the ideal. The model then exists as a relatively stable construct against which actual persons or the behavior of persons is judged as conforming or nonconforming.

By contrast, Garfinkel suggests that the practical

TABLE 1

A SUMMARY OF THE PROPOSITIONS RELATING THE RATIONALITIES TO THE CONDITIONS OF THEIR OCCURENCE

	For all actions that are governed by the rules of relevance of daily life can the rationalities occur IF			For all actions that are governed by the rules of relevance of scientific theorizing can the rationalities occur IF		
	Considered as an ideal standard of action?	Considered as an operative standard of action?	Considered as a property of actual practice?	Considered as an ideal standard of action?	Considered as an operative standard of action?	Considered as a property of actual practice?
1. Categorizing and comparing	Yes	Yes	Yes	Yes	Yes	Yes
2. Tolerable error	Yes	Yes	Yes	Yes	Yes	Yes
3. Search for "means"	Yes	Yes	Yes	Yes	Yes	Yes
4. Analysis of alternatives and consequences	Yes	Yes	Yes	Yes	Yes	Yes
5. Strategy	Yes	Yes	Yes	Yes	Yes	Yes
6. Concern for timing	Yes	Yes	Yes	Yes	Yes	Yes
7. Predictability	Yes	Yes	Yes	Yes	Yes	Yes
8. Rules of procedure	Yes	Yes	Yes	Yes	Yes	Yes
9. Choice	Yes	Yes	Yes	Yes	Yes	Yes
10. Grounds of choice	Yes	Yes	Yes	Yes	Yes	Yes
11. Compatibility of ends-means relationships with formal logic	No	No	No	Yes	Yes	Yes
12. Semantic clarity and distinctness	No	No	No	Yes	Yes	Yes
13. Clarity and distinctness "for its own sake"	No	No	No	Yes	Yes	Yes
14. Compatibility of the definition of a situation with scientific knowledge	No	No	No	Yes	Yes	Yes

"Yes" is to be read, "Is empirically possible either as a stable property and/or a *sanctionable* ideal."

"No" is to be read, "Is empirically possible only as an unstable property and/or an *unsanctionable* ideal." By this is meant that attempts to stabilize the feature or to compel adherence through systematic administration of rewards and punishments, are the operations required to multiply the anomic features of the interaction.

What these propositions state for the rationalities when considered singly, they state as well for the set of them taken in any combination.

Note: From Studies in Ethnomethodology by H. Garfinkel, 1967, Englewood Cliffs, NJ: Prentice-Hall (p.271).

• See Notes [3]

is ''not subject to such rigid restrictions regarding the use of propositions as legitimate grounds for further inference and action'' (p.281). This is precisely Papert's point in developing and promoting procedural logic and thinking, thus eliminating the practical rationalities which members draw on in everyday life. The interests of the scientific researcher (embodied by scientific rationalities) are similar to the interests of the computer-programmer, and the interests of everyday life (embodied by practical rationalities) are similar to the interests of the child as learner.

If scientific rationality, as defined by Garfinkel, becomes a pervasive world-view, it may have a role in conserving a particular symbol system that in turn supports the existing social system. Technical rationality, through the process of the generalized other, may stabilize, limit and make less flexible our interpretive procedures. By interpretive procedures it is meant those properties which are essential properties of a practical theorist [4]. Gouldner (1976), for example, refers to a growing technological consciousness which ''repress(es) the ideological problem and inhibit(s) ideological creativity and adaptation'' (p.276) in terms of interpretive procedures.

Weizenbaum (1976) comments;

> The computer did arrive 'just in time'. But in time for what? In time to save - and save very nearly intact, indeed, to entrench and stabilize - social and political structures that otherwise might have been either radically renovated or allowed to totter under the demands that were sure to be made them. The computer, then, was made to conserve America's social and political institutions. (p.31)

In this view the computer will not revolutionize education but rather reinforce existing problems and inequalities.

Moreover, if knowledge is socially constructed, the distribution of knowledge becomes a powerful means of social control. Computers, in as much as they manipulate language and human symbols, may have a role in the formation and distribution of knowledge. Because computers demand one kind of 'right thinking' the knowledge that results is of a particular kind. It is, of course, precisely this characteristic that Papert wishes to exploit. Papert (1980) states that he has

> invented ways . . . to master the art of deliberately thinking like a computer, according, for example, to the stereotype of a computer program that proceeds in a step-by-step, literal, mechanical fashion. (p.27)

Papert continues by suggesting that mechanical thinking is appropriate and useful in some contexts. However, he does not describe situations in which mechanical thinking is not particularly useful, nor does he mention any alternative thinking strategies. This omission is a fundamental limitation and contradiction within the Logo philosophy.

For instance, a variety of strategies are used in the process of creativity in addition to scientific rationality (Gardner, 1983; Perkins, 1981). Creative ideas are not always arrived at in an efficient or purely rational manner. The most efficient means will not guarantee a creative result. De Bono's (1971) concept of lateral thinking, for example, relies on the ability to explore, sometimes, inefficiently, uncommon pathways and connections between ideas.

The following section draws on a specific example of computer use, word processing, to demonstrate how scientific rationality and efficiency may characterize the computer experience. The purpose of using a concrete example is to illustrate the subtle effect of the computer on a specific domain, and to draw attention to the necessity of adopting a more comprehensive view of computers in schools.

Computers and Writing

Computers and writing is used as an illustration of what computers can and can not do. Word processing is often viewed as a neutral use of computers. By neutral it is intended to mean that the computer as word processor is viewed primarily as a writing tool. Therefore, it is generally argued that although the computer may ease the chore of writing, the experience and craft of writing remain essentially unchanged.

Word processors, originally developed for business applications, are used in schools as a means of teaching writing. Many of the programs are intended for use in the primary grades. LogoWriter (1986), for example, recently released by Logo Computer Systems Inc. (LCSI), is specifically intended for children as young as five or six years of age. Other word processors, for example, Bank Street Writer (F.E. Smith, 1984) have been used with young children for several years [5]. However, the marketing strategies of LCSI, combined with a consumer familiarity with LOGO, may help LogoWriter and therefore word processors become even more commonplace in kindergarten and the early grades.

Nevertheless, the influence of the computer on writing via word processing software is a relatively unexplored research area. The research that has been done has tended to concentrate on the use of word processors to stimulate interest in writing in reluctant writers (see for eg. Rodriques, 1985; Smith & Gray, 1984). Word processing is usually regarded as an activity that has little effect on the user other than improving writing. For example, Sardello (1984), while a severe critic of teaching programming skills in schools, is not concerned about word processing. Sardello comments;

> computers used as technical devices to perform operations that are themselves technical are not included as threatening. . . . In the case of word processing, the imagination is set free to focus on the craft of writing itself. (p.631)

Word Processing and Intended Learning

Using a word processor does have the potential to increase the speed and precision of writing. An increase in writing efficiency is the explicit goal of word processing systems. Word processing programs, including those designed for use by children, possess certain characteristics designed to meet this goal. For example, most programs enable the user to delete letters, words, sentences or paragraphs with one or two keystrokes. Sections of the text can also be temporarily removed and retrieved to be inserted in a different location. A find-and-replace function allows the user to locate words or phrases in the text and replace any or all instances with a new word or phrase. In addition to these basic functions, the program <u>LogoWriter</u> enables the user to integrate graphics with text. Finally, in all programs the text or graphics can be stored on a magnetic disc to be worked on at a later time.

It is the 'fluid' nature of the text, then, that makes writing with a computer most obviously different from writing with a pencil or typewriter. This fluid quality may have the effect of helping a writer sustain ideas from draft to draft. Writing can therefore become more of a comparison process (Newman, 1984). Newman suggests that by using word processors writers ''become more willing to take risks, to be tentative about meaning for longer, to consider organization and word choices more freely than ever before'' (p.495). For example, by using the specialized feature, 'global search and replace', a writer can experiment with a word change throughout a document and change back to the original word without making either change permanent.

Hence, the increase in speed, efficiency, and precision that can occur when writing with a word processor is generally seen to have a positive effect. Similarly, word processors are viewed as an effective tool for teaching writing skills. For instance, Newman (1984) compared using word processors for learning about writing to drill and instruction writing programs. She concluded that in drill and instruction the software programmer ''decides what aspects of the process are to be practiced, what particular language will be used, how much repetition is necessary for mastery. None of the 'language' which gets produced is the student's language; it belongs to someone else'' (p.495). In word processing Newman suggests that the student owns or is in control of the language.

Word Processing and Unintended Learning

The emphasis on efficiency in word processing may have an effect on the actual craft of writing. There may be second-order effects of using a word processor that make both the experience of writing and the writing itself different. If the word processor as a tool changes writing, the question of ownership or control of language is less clear.

Howard Becker (1986) suggests that the difference between writing with and without a computer is often obscured or ignored by proponents of computers. According to Becker, books and magazine articles describing the benefits of computers are often guilty of certain 'lies' and deceptions. One lie is that it is possible to find a computer program to do exactly the same job you do without a a computer program. Becker counters this claim by arguing that using a computer for writing means giving up old ways and old habits. For example, to effectively use the computer Becker found himself ''learning to think modularly, learning to deal more than I ever did with small units of material I can put together and take apart in several ways to see how the result looks'' (p.161). In a more general sense, Weizenbaum (1976) notes that ''to say that the computer was initially used mainly to do things pretty much as they had always been done, except to do them more rapidly or, by some criteria, more efficiently, is not to distinguish it from other tools'' (p.32).

Another lie identified by Becker is that writing on the computer saves time. While this is true of some aspects of writing, for example, revision and editing, Becker suggests that the saved time is spent on new kinds of writing activities. Because certain activities are possible with a computer, they become part of computer-writing. Experimenting with a find-and-replace feature, inserting formatting commands, or searching for files on a disk, are all time consuming tasks specific to computer-writing. Hoot (1986) suggests that an advantage of word processors is that they enable a writer to focus on the content rather than the mechanics of writing. With word processing, however, the mechanics have simply changed. The mechanics of traditional writing listed by Hoot, erasing, letter formation and recopying (p.96), have been replaced by new mechanics such as keyboarding and manipulating floppy discs and electronic printers.

Becker also comments that ''in order to get the good out of your computer you will have to change your way of thinking very substantially and become more of a computernik than you dreamed of becoming, or wanted to become'' (p.158). In part, thinking like a computernik is simply using the procedures built into the software by the programmer. By making certain procedures available, the programmer makes them new writing procedures. In this way the programmer helps define the interaction between the computer and user and thereby the writing experience. The user must adopt the language and the style of the programmer who reflects the best and worst of technical culture. Becker suggests that

> the people who write word processing programs . . . seldom write any other kind of prose themselves. If they did they would be writers, not programmers. So the instructions that tell you how to use a program, written in the language of the programming, rather that the writing, trade, are often difficult for nonusers to follow. The computer says such things to you as 'ILLEGAL COMMAND' or 'ERROR-SLOT AND DRIVE OUT OF RANGE'. Until you get used to being talked to that way, you may not like it. (p.156)

Like it or not, however, in order to make efficient use of a word processing program, it is necessary to adopt the coded and telegraphic language of the programmer. For instance, in writing this page using the program <u>Apple Writer</u> (Lutus, 1984), a 'printer readable' code (a string of dots, letters, and numbers; .lm20, .pm0, .li0, .lm12, .li1, .pm5) must be inserted into the text every time a quotation is indented to insure that the 'hard copy' or printed out version looks right.

Word processing changes the experience of writing in several other ways. For example, writing with a computer is often a more public or shared experience than traditional writing. Reasons for this may be; (1) economic (financial restraints limit the number of computers purchased by a school and students are therefore paired on writing assignments); (2) pedagogical (pairing or cooperative writing is seen as having an educational benefit); or (3) related to the physical properties of the computer (a writer's words appear on the screen making them available for 'public' viewing).

Electronic networking with other computer users also makes writing a more public experience. For example, a student's writing may be sent via electronic mail to be read by other students thousands of miles away. Mehan, Miller-Souviney & Riel (1984) describe a computer-based writing program for elementary students that regularly incorporated electronic communication with students across the United States. The unseen 'other' working on a computer several thousand miles away acted as critic and coauthor.

The writing, then, occurred both with an audience and for an audience.

Using a word processor also means having to write in one place. Until computers become truly portable, the writer is restricted to working where the computer is located. A student is therefore limited to writing at a type of work-station. The result may be an effect - whether negative or positive - on a student's attitude toward writing.

Finally, in word processing text must be entered via a traditional typewriter-like keyboard. Keyboarding changes both the physical experience of writing and our understanding of what it means to 'write'. The traditional experience of writing, that is ''the making of letters or other symbols on a surface, especially with a pen or pencil on paper'' (Oxford, 1979, p.766), is replaced by depressing keys to make letters appear electronically on a video screen. Becker (1986), for example, pointedly describes his work as typing not writing.

The point here is not to grieve over the decline of the pen and pencil, but to emphasize that the physical properties of a writing tool change how - and perhaps what - we write. Daiute (1985) suggests that ''in general - writing has become more dynamic - more like talking and thinking - as writing tools have advanced'' (p.xiii). The greater labor of writing with a quill, ballpoint pen or typewriter increased the time interval between the idea in the mind and the idea on paper. Daiute also notes that with more ''static'' writing tools it is more difficult to change your mind. When writing with the computer, as in talking, it is much easier to make corrections or retract phrases.

A contentious issue related to text-entry is the necessity of teaching keyboarding skills to young children. Keyboarding instruction, which is primarily carried out through drill and practice and repetition, is time intensive. Wetzel (1985), in his study of keyboarding instruction, concluded that ''(it) cannot be integrated easily into the curriculum without replacing something'' (p.16). Using computers for writing with young children means having to devote a significant amount of class time to the instruction of touch-typing. Therefore, the efficient use of word processors requires reorganizing curriculum priorities and reallocating class time. Moreover, Hoot (1986) makes the point that this is being done before research has shown word processors to be developmentally or pedagogically justifiable for use by young children.

In sum, although there is a lack of research on just what the computer does to writing, it seems clear that word processing has the potential to substantially change how we write. That is to say, a number of second-order effects make computer-writing a different craft and different experience from that of writing with a pen or typewriter. Word processing is therefore a function of computers that only appears neutral.

The implication of writing with computers extends beyond the possibility of the emergence of a qualitatively different kind of writing. By changing writing, word processing may also effect the way we think. Recent theories on writing (Daiute, 1985; Emig, 1977; Flower, 1979; Flower & Hayes, 1981; Graves, 1983) suggest that writing is a form of thinking. Through the process of writing ideas become clear or are even discovered. Flower (1979), for example, suggests that ''effective writers do not simply express thought but transform it in certain complex but describable ways'' (p.19). In computer-based writing, however, words and even ideas are efficiently 'processed'.

Word processing may therefore effect our writing and our thinking. This critique of computer use is limited, however, in that it does not address the issue of social control. Mehan, Miller-Souviney and Riel (1985) maintain that in using a word processor the student is in control;

> (Word processing) subordinat(es) the mechanical details of writing (such as neat script and spelling) to the higher order goals of clear writing, fluency, and the flow of ideas. . . . (The computer) provides a medium that makes a new social organization for reading and writing possible. (p.512)

However, the view of Mehan et al is also incomplete in that it does not take into consideration the social context of the computer.

This chapter has outlined how the concept of hidden curriculum may be applied to the computer. It has drawn on concepts described in previous chapters - generalized other, reflexivity, intersubjectivity - to illustrate the possible secondary effects of computers in the schools. The computer programmer - who creates the context for learning - was described as being influenced by the educational ideology which supports the dominant culture. To illustrate the implicit learning associated with computer use Garfinkel's analysis of scientific and practical rationality was compared to the development of procedural logic as described by Papert. Word processing as am activity exemplifies the diminishing development of the use of taken for granted, practical methods in decision making (note Table 1: Rationalities 1-10). There are then, implicit, unintended implications of computer use in writing.

In the following chapter the computer and its relation to knowledge form, knowledge content and classroom social relations is examined.

CHAPTER V

TOWARD A MORE COMPREHENSIVE VIEW OF THE ROLE OF COMPUTERS IN SCHOOLS

Salomon and Gardner (1985) have suggested that holistic research should be conducted into the use of computers in education before the technology becomes ''completely pervasive in the educational environment'' (p.13). A few countries are delaying the introduction of computers in primary grades, for example, Japan and West Germany (''Japan, Germany'', 1986). The rationale used by West Germany for their cautionary approach is that because the technology is constantly changing, there is no value in learning computer skills that will be redundant in the near future. Even in high school, where computer science courses are offered, no programming is taught.

For the most part, however, computers are being used in schools before their effects and usefulness have been ascertained. There are an estimated 1.5 million microcomputers in schools in the United States (Naiman, 1987) compared with 96,500 in 1982 (Grant & Snyder, 1984). In the United States at least six states require by law that schools teach computer skills [6]. Also in the United States, several universities have made the purchase of a computer an entrance requirement [7].

In Canada no province has legislated that computer skills must be taught in schools, nor has any university required its students to purchase a computer (although it may be required within certain individual university departments, for example, a department of computer science). However, provinces are purchasing large numbers of computers for their schools at considerable cost (Innes, 1983). The province of Quebec instituted a plan in 1983 whereby approximately 50,000 computers would be placed in schools over a five year period (''Quebec Paying'', 1983) [8]. The controversial plan, costing a total of $150,000,000, was criticized at the time for being motivated by political rather than pedagogical considerations (''Quebec's School'', 1983). Despite a lack of software or appropriate teacher training (''Experts Cast'', 1983; Dubuc, 1983) computers have nevertheless become relatively common in Quebec schools. Moreover, computers are in Quebec schools before their effect or even their use has been determined.

The concern is that as computers become more and more commonplace in our lives we are losing our 'research window' into the effects of the technology.* Salomon and Gardner draw on the historical precedent of television research to demonstrate their point. They note that

> one regrettable feature of research on television is that relatively little quality work was carried out in the years before everyone had a television set; thus, the opportunity to look at relevant control groups and conditions was lost. (p.18)

Solomon and Gardner suggest several lessons that can be learned from television research, one of which is that the effects of instructional media can not be studied in isolated laboratory type settings.

> The social and educational context in which (computers) are embedded, and the specific ways in which they are used, need to be taken into consideration, for they affect the individual's experience of computer-afforded activities. The mind operates within a social and cultural context and reflects the qualities of that context. (p.18)

The relationship of the computer to the larger social structure, through an educational ideology, has been a focus of this thesis. An attempt was made to demonstrate that unintended as well as intended learning occurs through computer use. In this final chapter, practical applications of a theory of critique of the relationship between schools and society will be presented. Examples of how each critique may be applied to the computer in the school will be outlined.

Fitzclarence and Giroux isolate several approaches to the study of the relationship between the school and its social context that focus on the issue of knowledge and control. They refer to this type of critique as the ''new sociology of education'' (p.463). That is to say, it is an alternative critique to 'mainstream' theory in the sociology of education which has tended to focus on questions of knowledge management. The new sociology perceives school knowledge, as it is transmitted through both the hidden and explicit curriculums, as socially constructed and therefore problematic. By asking questions regarding the form and content of school curriculum, as well as the way in which the curriculum is delivered in the classroom, it is intended to emphasize the subjective nature of school knowledge and how it is socially distributed [9].

Focus on Knowledge Form

Curriculum Packaging and the Classroom Teacher

The first perspective identified by Fitzclarence and Giroux is a focus on the role of the form of the curriculum in promoting certain values and attitudes. If curricular materials contain an educational ideology, curriculum packaging becomes a form of social control. The emphasis moves away from the individual teacher to packaged and standardized materials. Drawing on a study of science curricula by Apple (1982), Fitzclarence and Giroux conclude that packaged materials have the effect of deskilling teachers.

> By dictating every aspect of the teaching process these curriculum packages reproduce a form of standardization and control that renders the teacher to the status of a mere technician implementing ideologies and interests constructed by people external to the lived experiences of his or her classroom and student interests. (Fitzclarence & Giroux, p. 471)

Educational software may be viewed as a new packaged curriculum. Although Papert argues that the Logo philosophy means learning without active teaching, the role of the teacher in a Logo classroom is simply supplanted by the packaged curriculum. Pea and Kurland (1984b) note that in Logo classrooms ''teachers are told not to teach, but are not told what to substitute for teaching'' (p.44). With LogoWriter, however, this is no longer a problem. In contrast to earlier versions of Logo, LogoWriter contains explicit directions for its use. In an introduction to LogoWriter at a recent conference on computers in education, Rosenbaum (1986) emphasized that there has been a significant gap between the vision of Logo as originally expressed by Papert and the reality of Logo as it has been used in the classroom [10].

Rosenbaum suggested four factors that have limited the success of Logo;

1. The absence of appropriate support materials.
2. A lack of integration with the rest of the curriculum.
3. Awkward technical aspects of the software.
4. The failure of the classroom teacher to effectively promote Papert's version of child centered learning.

LogoWriter (1986) is an attempt to rectify these weaknesses. The package is promoted as an improvement over earlier versions of Logo in that it includes guides for the integration of the software into all parts of the curriculum, and the teacher is given more direction in the use of the packaged materials. Lernon (1985) refers to the trend for teachers to be more directive in the use of Logo as ''Quasi Piagetian Learning''. The Logo philosophy of children teaching themselves has not proved practical or pedagogically justifiable. The consequence of implementing a writing program such as LogoWriter may be, as Fitzclarence and Giroux suggest, the transfer of primary educational decision-making from the teacher in the classroom to the designers of the packaged curriculum who are representatives of the dominant ideology. The problem of teacher training for this role is not considered.

Curriculum Packaging and the Business World

Curriculum packaging can also be studied in its relationship to the needs of the business world. For example, Apple Computer Inc., is focused on the threefold goals of improving educational computing, transforming education, and making Apple computers the standard in education (Reinhold, 1986, p.32). The difficulty is in balancing financial considerations against educational concerns.

A cyclical relationship has developed between computer businesses and computer education. A demand for educational software creates a demand for computer hardware and vice versa. Apple, IBM, Tandy/Radio Shack and Commodore are presently competing for an estimated 2.3 billion dollars that will be spent on computer hardware for schools in the United States over the next four years (Reinhold, 1986). The relationship between the school and business is secured by the dynamic nature of research and development in microcomputer technologies. Equipment purchased by schools a decade ago, at the beginning of the popularization of microcomputers, is now completely outdated. The initial purchase of hardware creates a need for more updated hardware, maintenance of the equipment, teacher training in the use of the new technology, and appropriate educational software packages. In addition, 'brands' of computers are generally incompatible, that is to say, Apple software can not be used on an IBM computer. Therefore, brand incompatibility serves to raise the cost and limit the usefulness of computers in schools. For example, in 1983 Quebec's ministry of education purchased large numbers of the French made Axel computer for which almost no educational software existed (Gazette, D'15,83). Efforts to produce software were initiated only after the machines were purchased.

The link between business and education is enhanced by sophisticated marketing strategies. For example, in order to use LogoWriter a school must purchase a package of curriculum materials through a system of site-licensing and subscriptions (''LogoWriter Materials'', 1986) designed to prevent illegal copying or 'bootlegging' (''Site-Licensing System'', 1986; ''Site-Licensing Has'', 1986). The site-license, which is purchased by an individual school ($630.00 to start and $99.00/year thereafter), enables the school to make as many copies of the LogoWriter master disk as may be desired. A 'Home Use Extension Option' ($199.00) is required if the school wishes to send a copy home with a child. The written material or 'documentation' can not be legally photocopied and must be purchased at an additional cost. The goal of LCSI is to licence LogoWriter in schools across North America (editorial comment in Papert, 1986, p.40). LCSI has already been successful in 'licensing' the state of Minnesota (LCSI, Yaesu, 1986). If this continues, schools will become increasingly dependent on a business corporation for an important part of their curriculum.

Focus on Knowledge Content

The second perspective is a focus on the content of the curriculum materials and the way in which the content may relate to the larger social and political context. Whereas a critique of curriculum form investigates how the curriculum is presented, a focus on content examines what is presented. A content analysis addresses such questions as; does the curriculum contain a class or gender based bias?; Who are the promoters of the material and what are their interests?

For instance, what are the possible interests of Papert in promoting the Logo philosophy and how might these interests influence the content of a Logo based curriculum? While educators have tended to focus on Papert's concepts of ''Piagetian Learning'', ''powerful ideas'' and ''learning without a curriculum'', Logo has its primary origins in the field of artificial intelligence (Papert, 1980, pp. 156-76). Indeed, Piaget is placed in the theoretical framework of artificial intelligence (p.157). Papert, as a computer scientist and mathematician, has an interest in promoting the information processing model that may or may not be shared by educators.

Bias is also present in the actual curriculum materials. For example, content analyses of drill and practice style educational software have revealed bias toward certain categories of users (Hawkins, 1985; Kiesler, Sproull & Eccles, 1983). Analyzing the content of curriculum materials designed to teach programming skills is less straightforward. For instance, in the discussion of curriculum form it was suggested that software such as LogoWriter is kind of curriculum packaging. However, it could be argued that teaching programming skills is not presenting a curriculum per se. Sardello (1984) adopts this position as he suggests that ''(Logo) eliminates content altogether and reduces all education to method; all things can be learned through the method of computer programming'' (p.633). The goal of Logo is to teach a way of thinking that transcends any specific subject area. The skills acquired through programming, for example, analyzing the problem, devising a plan and finding the 'bugs', are thought to be applicable to subject areas as diverse as music and algebra. The role of teachers is one of managers of a system and not any particular curriculum (Sardello, 1984, p.633).

Nevertheless, whether teaching programming is considered a curriculum or not, computer programming, as it seems to favor certain types of personalities, may contain an implicit user bias. Turkle (1984), for example, distinguished two kinds of computer users who she referred to as hard masters and soft masters. She describes hard mastery as ''the mastery of the planner, the engineer'', while soft mastery is ''the mastery of the artist: try this, wait for a response, try something else'' (pp.104-5). Hard mastery is similar to Papert's notion of computational logic. In contrast, soft mastery is more intuitive. Rather than systematically and logically debugging a program, a soft master will tend to experiment. Using this basic distinction in programming styles, Turkle suggests that ''girls tend to be soft masters, while the hard masters are overwhelmingly male'' (p.108).

Turkle is actually describing variations in styles of problem solving. In the interests of developing a critical pedagogy of the computer, the content of a curriculum such as Logo might be best defined in a limited manner as simply a computational approach to problem solving. Defined in this way the 'content' of Logo can be viewed as containing a gender based bias.

Focus on Classroom Social Relations

The third perspective focuses on the role of the social relations of the classroom, for example actions, language and teacher expectations, in promoting certain attitudes and values. The perspective assumes that a ''hidden curriculum of meaning functions through classroom social relations to legitimize the position and privileges of specific groups of students'' (Fitzclarence & Giroux, p. 471).

Classroom expectations may include those which influence how the computer is to be used for students of different social class or gender. Girls, for example, tend to use computers for word or data processing while boys use computers for programming (Lockheed, 1985).

Although the three focuses - content, form and social relations - appear in many ways to overlap, each reveals a different aspect of a given issue. For example, gender equity in computer use can be studied by focusing on the form of the curriculum materials, their content, or the social relations of the classroom [11]. The three perspectives are complimentary in that each adds to a more holistic understanding of the issue. Posed in terms of classroom social relations the question of gender equity is whether or not equality of opportunity, or equity of access to computers and computer skills exists in the schools. In this perspective, it is generally argued that if a gender based differential exists in access to computer skills, and knowledge about computers and associated information technologies is necessary for membership within the controlling superstructure, the existing male-dominated system will be maintained (Hawkins, 1985).

Gender associated differences in attitudes toward computers do seem to reflect stereotyped attitudes and expectations concerning women, mathematics and technology in general. Lockheed (1985) and others (Becker, 1985; Stasz, Shavelson & Stasz, 1985) argue that if such expectations are changed, for example, through the influence of the teacher in the classroom, equity in interest in computers and equal participation in computer use may be possible. For instance, Becker (1985) suggests that ''the presence of large numbers of women computer-using teachers as implicit role models for female students may be an important factor in any future decline of the association between gender and computer skills'' (pp. 147-148).

The limitation of a perspective focusing primarily on classroom social relations, is that the computer itself is seen primarily as a subjective medium. For instance, Lockheed (1985) describes the computer as similar to a Rorschach inkblot. What is missing from this view is a consideration of the influence of the content of the software and the form of the medium. Turkle (1980) has persuasively argued that the computer is more than a Rorschach, that is to say, it is a projective as well as a subjective medium. The issue of girls and computers is therefore more than one of gender-based difference in attitudes toward computer technology caused by stereotypes. If an ideology is written into educational software, the software itself legitimates the attitudes.

Hawkins (1985) suggests that in order to increase equity in the educational use of computers ''attention must be paid to software design'' as well as ''the organization of children's classroom experiences'' (p.178). Nevertheless, any attempt to reconstruct software is limited by the form or character of the medium. That is to say, the computer is limited in programmability to rationality and logic. The rationality of the computer may override any attempt to completely 'reform' software in a liberative sense. Lyman (1984) among others (Kiesler, Sproull & Eccles, 1983; Kolata, 1984), have criticized the biased form or character of computer software. Lyman suggests that all software ''contains a cybernetic model of knowledge derived from technical culture . . . it is embedded within an everyday male culture of aggressive image of control'' (p.87).

Therefore, even if a gender bias is removed from the content and use of software, the software should not be treated as a neutral educational tool. As discussed in the previous chapter word processing does not contain an obvious user bias. However, word processing programs, as all computer programs, are written using principles of scientific rationality. Because it is often overlooked and taken for granted, the character or form of the software and the educational ideology implicit in it may have the greatest influence on how we write, how we think, and ultimately, our view of ourselves.

In summary, this chapter has outlined how existing critical approaches for studying the relationship between school and society can be applied to the role of the computer in the classroom. An examination of the computer in relation to knowledge form, content, and classroom social relations reveals that there are unintended implications of computer use. Gender role stereotyping, for example, is supported by the form and content of computer software, and by teacher expectations and classroom practices and procedures.

CHAPTER VI

CONCLUSIONS

It has been argued that the computer may have a role in language development and therefore socialization. Concepts such as educational ideology and hidden curriculum were used to develop an alternative framework in which to study the role of the computer in the educational process. The computer was depicted as a powerful, but not neutral, teaching medium. It was suggested that norms, attitudes, and values that support the dominant culture are learned in addition to explicit learning goals. Scientific rationality and gender role stereotyping were introduced as two examples of the transmission of education ideology through computers.

The concept of scientific rationality, as defined by Garfinkel, was also used to emphasize that an uncritical use of the computer in the schools has the potential to reinforce and stabilize inequalities that exist within society, in that it limits our interpretive procedures. Word processing was discussed in detail to underscore that computer use is an activity that only appears neutral. Finally, the ability of the computer to influence classroom knowledge on three levels - knowledge form, content, and classroom social relations - was described. The example of gender stereotyping was used to further illustrate the implicit learning associated with computer use in schools.

The important point is that meanings and the way they are arrived at and transmitted is not an obvious process. Intersubjectivity is problematic in all social interaction - and it is particularly problematic between children and adults. Nevertheless, the assumption is made that children and adults share the same meanings and interpretations. However, such an assumption does not take into consideration the differences between the adult's and the child's frames of reference. That is to say, adult and child cultures are distinct, but it is assumed that meanings are shared by all. Mackay (1974) and Roth (1974) note that teachers also take the child's point of view for granted. The result is that in order to be successful in school, children must adopt the teacher's frame of reference, which in turn is based on an educational ideology (see, for instance, Persell, 1977).

Similarly, educational ideology is transmitted through computer software by a programmer. Because, as Weizenbaum stresses, the computer can not 'know' human language, children must adopt the frame of reference or context of the computer and thereby the computer programmer. The formal language of the computer is based on a scientific rationality similar to that described by Garfinkel (1967); the steps in the solution of a problem are compatible with the rules of formal logic, the elements or steps within the problem are semantically clear and distinct, the clarification of constructs is the main task or the first priority of the project, and the steps within the problem are compatible with scientific knowledge and presuppositions. Scientific rationality is in turn related to Papert's (1980) concept of procedural logic in which children learn to think in a ''step-by-step, literal, mechanical fashion'' (p.27). There is nothing essentially 'wrong' in using the rationalities that characterize the scientific theorist. However, by focusing exclusively on the four scientific rationalities we restrict our choices and limit the number of meanings we can draw on.

Finally, Papert's insistence on the distinctiveness of procedural logic avoids the question of whether there really is such a thing as scientific rationality, so that scientists - just as the ordinary person - must use the practical rationalities. Garfinkel states that the scientific rationalities ''occur as stable properties of actions and as sanctionable ideals only in the case of actions governed by the attitude of scientific theorizing'' (p.270). However, Becker (1987), drawing on Rorty (1979, 1982), notes that the scientific rationalities do not reflect how scientific theorizing and investigation actually takes place.

> Real science proceeds by violating, in some measure, all the positivist rules in the name of getting some science done; cutting corners, appealing to authority, inserting personal opinion in place of certified knowledge all over the place. (Becker, p.26)

No science, then, is completely free of the interpretive procedures or 'rules of thumb' that characterize the attitude of everyday life. If scientific rationality or procedural thinking are not the usual strategies of either everyday or scientific theorizing, the value of Papert's Logo based classrooms (that is to say, the value as formulated by Papert) is questionable. Although research is inconclusive, word processing and gender role stereotyping were used as examples simply to indicate that scientific rationality and procedural logic are important concepts to be further investigated through research.

It is important to note that a child's individual history and personal choices effect his or her computing experience. Solomon and Gardner (1985) suggest that

> rather than assuming that the technology controls or affects performance and cognitions of learners in any deterministic way, lessons from past research on television suggest that individuals mold their own experiences by the traits and goals they bring to the encounter, the way they apprehend the technology and the situation, and the particular volitional choices they make. In so doing, learners, particularly when given interactive opportunities with computers, are likely to affect the way these opportunities are going to affect them. (p.16)

Nevertheless, control - through unintended learning - remains an issue that must be considered. As Persell (1977) notes, determinism does not have to mean the exertion of total and inevitable control. It can also be understood as ''setting limits'' and ''exerting pressures'' (p.7). Therefore, while a child does have input in forming his or her meaning of the computing experience, it is input within the limits and boundaries of an educational ideology. A critical pedagogy of the computer - one which considers its social, cultural, and ideological context - may enable a child to appropriate the technology for his or her purposes.

An important limitation of the critique outlined in this thesis is that it can be perceived as providing description without prescription. A valid criticism of the new sociology of education is that it has been primarily concerned with describing problems and not with suggesting ways to rectify problem situations [12].

It seems clear that computers are not going to go away. Indeed, this thesis is not an argument for or against computers, but rather a proposal for the adoption of a critical pedagogy of computers in the schools. Therefore, the question must be raised of what would constitute a responsible use of computers in schools? Is it enough, for example, for teachers and children to simply be aware of the limitations of the computer and its possible effects on users? Perhaps, as Postman (1985) suggests in reference to television, the character or what I have referred to as the form of the technology, should be made a part of what is studied. Acknowledging the computer's restrictive and limited character may be a start to recognizing the true potential of the computer in education. That is to say, the computer would then be free from the role of being all things to all people in all situations. A cautionary approach to computer use may include as its presuppositions;

1. Computers are not a neutral tool.
2. Computers are used differently by different children.
3. Computers are used differently by different aged children.
4. Scientific rationality is only one dimension of human cognition.

Research which begins with a consideration of the computer's restrictive character may yield results that point to specific uses of the computer that are developmentally and pedagogically justifiable. Future research could also be directed at investigating the meaning children assign to the computer. In Papert's educational philosophy, the intended curriculum or message sent is the development of procedural thinking skills. Analysis of a specific, defined aspect of the hidden curriculum – focusing and the curriculum form, content, or classroom social relations – may provide insight into both the message received and the unintended message.

Notes

1. For the sake of consistency, Logo will be written in the lower case throughout the thesis with the exception of an author's use of upper case in a direct quotation, journal article or book title.

2. Based on the three ways of studying the hidden curriculum described by Fitzclarence & Giroux, (1984).

3. Garfinkel (1967) identifies the four scientific rationalities as;

   a) Compatibility of ends-means relationships with principles of formal logic. By this Garfinkel means that a problem is arranged in such a way that the steps are compatible with the rules of formal logic.

   b) Semantic clarity and distinctness. Meaning a concern for the clarity of the definition of a situation. The elements or steps within the problem are therefore semantically clear and distinct.

   c) Clarity and distinctness 'for its own sake'. Meaning that clarification of constructs (of the body of knowledge, rules of the investigation, interpretive procedures) is the main task or the first priority of the project.

   d) Compatibility of the definition of a situation with scientific knowledge. Meaning all the steps within the problem are compatible with scientific knowledge and presuppositions. Anomalies or discrepancies are accommodated to fit the accepted body of scientific knowledge.

4. Cicourel (1974, pp.40-41) lists and describes the characteristics of several interpretive procedures or 'rules of thumb' used in everyday situations.

   a) Participants in social interaction 'understand' more than what is actually made explicit.

   b) Participants 'make sense' of an interaction by supplying meanings even if the interaction is not clear at a particular point in time.

   c) Participants supply missing information by drawing on what they already know about a particular situation.

   d) Participants delay judgement of each other's 'doubtful' statements assuming that details regarding discrepancies will be supplied later.

5. Other examples of word processors intended for young users are Snoopy Writer, Random House Inc., and Talking Screen Textwriter, TSTP, Computing Adventures Ltd..

6. The six states that require computer instruction in schools by law are Florida, Rhode Island, Virginia, the District of Columbia, Indiana and South Dakota (Christen & Gladstone, 1984).

7. For example, Carnegie Mellon University, Pittsburgh, PA. (Friedrich, 1983), and Drexel University, Philadelphia, PA. (Osgood, 1987).

8. The goal of the 'five year plan' for the introduction of computers in Quebec schools was changed from 50,000 to a total of 26,000 or an average of 8 per school. ('Quebec's Computer', 1985).

9. See for instance, Apple, 1979; Persell, 1976; Young, 1971.

10. With reference to an article by Lernon (1985)

11. Gender equity in computer use is the focus of increasing attention. Most studies tend to focus on bias in software content or classroom social relations. See for example, Becker, 1985; Fetler, 1985; Hawkins, 1985; Hess & Miura, 1985; Linn, 1985; Kiesler, Sproull & Eccles, 1983; Lockheed & Frakt, 1984; Mandinach & Corno, 1985; Naiman, 1982; Stasz, Shavelson & Stasz, 1985; Ware & Stuck, 1985; Wilder, Mackie & Cooper, 1985.

12. See Karabel & Halsey (1977) for a critique of the contributions of the 'new' sociology of education.

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