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Sineath, Bythel June

THE RELATIONSHIP BETWEEN EDUCATION AS LIBERATION AND COMPUTING

The University of North Carolina at Greensboro ED.D. 1986

THE RELATIONSHIP BETWEEN EDUCATION AS LIBERATION AND COMPUTING

by

Bythel J. Sineath

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Approved by

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APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at the University of North Carolina at Greensboro.

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The purpose of this study was to inquire into the relationship between education as liberation and computing. The first phase was an examination of foundational aspects of the concept of education as liberation. Major theoretical aspects related to education as liberation include Marcusian false consciousness, Pinarian constitutive rules of reality formation, the communal relationship among students and teacher, the responsibility of the teacher in bringing critical perspective to the relationship, and praxis. The second phase involved an inquiry into foundational computing concepts such as the Turing machine, the Lovelace model of computing, and the artificial intelligence programming concepts of heuristics and emergence. The next phase of the study was an analysis of the relationship between computer concepts and education as liberation. There were four foundational aspects found in the relationship between computing and education as liberation. They are the aspects of creativity, a psychology of control, the seeming paradox between these two, and cultural emergence. This analysis was also used as a critical perspective through which to accomplish a textual analysis of an instructional software package which introduces operational computing concepts. The textual analysis revealed a strong orientation toward control in the software examined with little or no concern for the liberation model.

The central recommendation for computer education more likely to promote liberation is for students to become more aware of the human

dimensions of knowledge creation. Pedagogically, this would mean an emphasis on teaching about programming. Further recommendations for additional research are included.

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Within a more personal sense I wish to acknowledge and express appreciation to David Purpel for his patience, friendship, and for being my mentor. I wish to thank Fritz Mengert especially for his earlier, and long enduring encouragement, and introducing me to exciting and challenging ideas and perspectives. To Svi Shapiro I wish to express my deep respect and admiration for one of my own generation whose life is living proof of praxis. Yes, I know the work is difficult, but I agree that it is also important. To Gwendolyn Loy I say a special thanks for words of advice and unwavering support which made this dissertation and other important things possible in my life. I thank Patty Dalton for much needed technical support but also for that insightful ability to sooth a sometimes fragile ego. To my wife, Alice, I appreciate her moral support, but also her role as devil's advocate which has helped clarify my own beliefs and character.

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CHAPTER I

INTRODUCTION

The phenomenon of the microchip revolution is potentially beneficial or harmful to society. The revolution has occurred because dramatic increases in computing power have been placed at the disposal of significant numbers of people in our society. Any person who drives a fairly recent vintage automobile is indirectly in contact with the computing device under his or her car hood just as any person using a touchmatic microwave oven first operates a computing device in the microwave to control the oven. As these devices become even simpler to operate, it is a certainty that an extremely high percentage of the population will become directly involved with computers of some type. It is of vital importance to assess what this revolution means to individuals as well as to society.

The impact this revolution is having encourages expressions of valid fears since dramatic technological and/or philosophical changes inherently result in difficult societal as well as individual adjustments. There are obvious historical examples of great change resulting in emotional and physical pain as individuals are hurt economically when their skills become obsolete. With the discovery and use of gunpowder it is a certainty that knights suffered great mental anguish upon discovery that non-knightlike individuals could reduce their influence and power as well as themselves into

lumbering heaps of useless metal. There always exists at least two sides to every issue but human suffering still remains human suffering whether it be by the "good guys" or the "bad guys." Fear is felt by people because of the apparent economic ramifications resulting from the microchip revolution; however, there exist other equally important considerations associated with this revolution.

There was a story reported by the news media concerning an individual who had spent time in jail because a local police agency had accessed a name similar to hers through a national computer crime network. Even though evidence suggested she was not the criminal in question, police believed the computer printout above what the physical evidence proclaimed. It may be argued that this was an instance in which the computer system was not truly efficient, but this is not the crucial issue. What does this incident proclaim about the view some people have of humanity and its relationship with computing systems and devices? We should ask ourselves if we want to translate computing power into power over human beings. Do we wish to place more faith in a device which calculates rapidly than in our own powers of reason and observation? If people place more faith in a calculator than they place in themselves, in whose hands are they placing their destinies? Some individuals believe "education" plays a major role in helping people make decisions which effect answers to questions such as these.

Within my experience as a teacher and administrator in public education, I have encountered the idea of schools as factories and students as the raw materials which are molded into finished products.

Do we face a similar danger with the advent of the microchip revolution as well? Will we plan ahead this time and recognize the pitfalls inherent within the limitations of computing power? This is related to education as a humanizing process, or liberation, and is truly one of the central issues our society should be examining.

Two concepts to remain aware of when examining these questions are that computers are part of our society and that society exists within that paradoxical framework of the collective individual. Individuals abdicate portions of their individuality by conforming to society's order so that they can secure freedom for the remaining portions. Society punishes those of us that disturb its order, e.g., maybe even removing all freedoms, and often it is necessary to conform in some acts if we are to obtain freedoms in other areas.

Individuals are educated as to what are socially acceptable freedoms through various agencies and traditions. This educational process is inclusive of all with which we come into contact, e.g., family, friends, associates, the electronic as well as the print media, word of mouth, the formal educational institutions, and the hidden curriculum within all of these. All knowledge we acquire from these influences affects our beings to varying degrees. We often decry the specialization of human beings into fields of endeavor and simultaneously speak of studying the educational process as if it were a process unto itself and happened only within the confines of classroom walls. There is indeed a rich history of influences outside the classroom from which to draw upon as our thinking and believing about computers is shaped.

The recent hullabaloo in the media concerning computers has been only the piercing point against the backdrop of a rich computer history and mythology. Within my generation alone there has been Robbie the Robot, a friendly all serving friend, and the more sophisticated but deranged Hal of Clark's 2001: A Space Odyssey. In print there exists Asimov's robotic series which includes I Robot and The Caves of Steel within which the Three Laws of Robotics express some men's desire for service by machines, and at the same time what can go wrong with good intentions.

Within these concepts lie what some people feel is the highest aspirations of computers: artifical intelligence. There exists the work of Minsky, Papert, Simon and others, whose efforts deal with the harsh realities of bringing forth fruit in this area, but who dream the dreams of dreamers nevertheless. By sharing their visions with the more artistically inclined, their dreams have been transformed into movies and novels, and these dreams have taken various visionary forms, such as Robbie and Hal. These visions have taken on folklore qualities as Mankind's dreams have led the pursuit toward the future and shaped it, for good or bad.

One step toward uncovering the expectations and beliefs concerning computers this inclusive educational process has provided is to inquire as to what is being presented concerning computing power in the formal educational process. In order to understand the impact of the past on the present, it is helpful to understand the current dreams for our future.

For those who doubt the esoteric implications of the microchip revolution and the potentially inherent societal changes, let us examine what some of the revolutionary dreamers are envisioning. On the immediate horizon there are four areas of expansion encompassed by the microchip revolution which when converged should bring into debate the basic philosophical questions of what it means to be human. The four areas are memory size, multiprocessing, telecommunications, and input/output capabilities.

About forty years ago with the beginnings of the modern computer age, in order to acquire a few K or kilobytes of processing memory, i.e., a computer with the capacity of retaining a few thousand characters of written text, a cumbersome, and by today's standards crude computer the size of several classrooms, requiring enormous electrical power and a monstrous cooling system was necessary. The cost was in the millions of dollars and well out of the reach of all but the wealthiest of institutions. In the mid seventies, to place 4K or 16K of memory on a desktop was a great revolutionary advance. Today, IBM, a leading microcomputer manufacturer routinely places 640K, or a computer which can retain about 250 double spaced type-written sheets of information, on the desktop of any person who can afford paying well under $5000. Within this package is included permanent memory storage of up to 20 megabytes of information, or about 8000 double-spaced type-written sheets of information. This has been available for a few years now. Within the past year announcements have been made that have revolutionized an already revolutionary industry. Announcements have been made of a memory

scheme which will allow eight megabytes of RAM on a desktop computer and provide a gigabyte, or a 1000 million bytes (characters), of permanent memory storage. Memory capability problems are resolved from past restrictions, and memory capacity is growing by leaps and bounds.

Multiprocessing, or parallel processing, is technically different but results in much the same effects from a nontechnical viewpoint. It simply means that a computer can work toward solving many problems at the same time and is a form of divergent processing. Dare I say thinking? Inclusive within parallel processing is even more speed than we currently have available. This simply means that hundreds of items are routinely processed each second, and the faster computers process even more quickly. If you wanted to add one and two, it may take a computer a thousandth of a second to "recognize" the number one, another thousandth of a second to store it, another thousandth of a second to recognize the two, and so on and so forth with the total addition operation taking only 10/1000 of a second. It is important to note that this is a very simplified example and that the so called super computers operate at much, much greater speeds than portrayed in this example.

The third major area of advancement is in telecommunications. Already millions of users are in communication with the hundreds of professional and nonprofessional bulletin boards as well as national databases. Local area networks have been instituted on all major campuses in the nation, and these fit like a spider's web encompassing the nation when overlayed onto a continental map. Tied in to this

collegiate web at various points are additional webs sprouting from private as well as governmental sources.

Finally, and perhaps the most direct challenge which will force us to make decisions concerning what it is to be human in relation to the freedoms and the controls we institute for our society, are the dreams of those that envision new forms of contact between humans and computers.

In the early days humans communicated with computers by manually opening and closing switches. The keyboard via paper cards was the next improvement, and now most communications are accomplished through direct keyboard input. (Mandell, pp. 12-19) Fairly recently, the "mouse," which is a screen pointer, has been introduced. Also, voice activation and control has had limited success and is predicated as one of the next major breakthroughs for input/output communication. The technology for audio output has fairly well been perfected while voice input is in the infancy stages, although workable under controlled conditions. (Dologite, pp. 34-38)

Up to this point we have been discussing dreams that have been realized or partially realized and on the verge of completion. Obviously, computers are not in isolation from society. There have been various brain research projects which have implications for the future of mankind when viewed in conjunction with the microchip revolution. Currently biofeedback is being used for a variety of reasons. As Harry Stine notes in his article "The Bionic Brain," when this technology is combined with the research being accomplished with reading alpha/beta waves from the human brain and applied to computer

communications (input/output), vast new horizons can be dreamed about. (Stine cited in Davies, pp. 41-53) Within this combined technology alone it can be envisioned that an individual could become a telepresence by wearing a device as small as a hearing aid and control the input into a computer hidden in a desk, or wall, and see the results of his or her endeavors displayed on a monitor hanging on the office wall or from the desktop. If this extension is carried a step further, instead of only the monitor display being controlled, devices could be controlled within an environment of direct communication. Marvin Minksy has described and outlined the advantages to which telepresence could be used to the advantage of mankind, such as operating nuclear power plants, or mining in space. Just as Minksy states, it is important to note that many of the ideas described in his article "Telepresence" are derived from specific suggestions from Isaac Asimov, Robert Heinlein, Carl Sagan, Brian O'Leary, Edward Purcell, as well as other individuals. This is important since this list represents some of the most "imaginary minds" of present time. (Minksy cited in Davies, pp. 55-74)

Dreams even more amazing are possible. There are serious research efforts to help blind people see through direct electrical stimulation of the brain in which images are mirrored directly onto the human brain. This completes the circle of input/output between human and computer: results of almost direct communication between computer and the human brain. Although Minsky's telepresence focuses upon tactile feedback, I believe that the possibility of "mindpresence" will eventually emerge. The combining of telepresence

with mental control could further Man's physical capabilities much as current machinery does, with the exception that control over machinery would circumvent physical contact by substituting mental contact and control.

As great or as terrible as this seems, there are dreams of even greater magnitude. At this time it is pertinent to caution the doubter that at one time there were many people forty years ago, perhaps the majority, that could not foresee the level of technological advancement which has been currently attained. If this brief outline of dreams and their attainment is not convincing that the microchip revolution is leading toward a redefinition or at the least a reconsideration of what it is to be human in our society, let us explore the more outlandish dreams of the dreamers.

Up to this point we have been considering computers as electronic digital devices which are composed of silicon, metals, and various other substances of an inorganic nature. As genetic and cellular research proceeds, our dreamers envision computing being based upon intracellular and intercellular chemical processes and controlled (programmed) via DNA structures. Kathleen McAuliffe in "Biochip Revolution" describes Kevin Ulmer's, John Wehrung's, Forrest Carter's, and James McAlear's varying research endeavors. (McAuliffe cited in Davies, pp. 89-101) Combining this research with the advances expected with immunological rejection suppression, which derives from heart transplant research of the 1960's, raises the possibilities of bringing computers from an external environment into a truly direct physical relationship with people's minds. One method of overcoming

the rejection syndrome is dissection, manipulation (DNA programming), and reimplantation of a person's own cell tissue. The communication and control of computers, as well as the processing, would be from cell to cell within individual's cranial areas as cellular masses capable of computing would be implanted, maybe even shortly after birth. Who would be in control, the computer as programmed by others, or the individual in whose head the mass was implanted? How much freedom will be allowed the individual in such a situation? How does this affect how we define ourselves within a human sense? Certainly, these advances are not going to be made next month, or even next year, and maybe these advances will never occur. There exists the possibility that advances will take a turn toward a direction which is not even presently being considered. What these visions should strikingly point out to us is that Man is inquisitive by nature within his current perspective and will continually strive for newness.

Computers may alter our culture much as another invention did during the twentieth century. Advances in and the impact of computer technology may be roughly compared to the technological marvels of the internal combustion engine which has taken its most noticeable form in the automobile. Although the first practical automobile was not produced until the middle of the nineteenth century, we only have to look around us today to determine the effects this device has had on our culture and society. Imagine what daily life would be like if the internal combustion engine suddenly vanished from the face of the earth. The shift in our habits would be far greater than just personal transportation since the manufacturing industry alone depends

upon the power of internal combustion to drive plants and to deliver goods to the market places of the world. Our society has become tremendously mobile because of this one invention alone. If all internal combustion engines ceased working today, many people would starve, others would not be able to arrive at work, and eventually nearly all of us would suffer the shortage of one good or another. This is only the physical impact this single invention has had on us and the world. Who are we, as a people and individually, as a result of the internal combustion revolution can also be asked of the microchip revolution. However, just as the automobile has provided us with a certain amount of personal mobility, goods, and services, and therefore power, it has also served as our master because of the dependency it promotes as a result of its pervasive influence into our lives through its incorporation into society's infrastructure. The oil embargo of the seventies demonstrates our servitude to the servant.

The microchip revolution presents us with similar challenges. It could be argued we are at a parallel point of development with microcomputers as it was with the automobile in the early twentieth century when the attitudes toward automobiles were changing from viewing automobiles as recreation to that of serious mass transportation. With the advent of the microchip revolution society is only beginning to use computers within a mass context. This shift should be planned for and options considered, but we first must understand from where in people's minds we begin since we have to know where we are if we are to know how to arrive at where we want to go. The basic questions extend even beyond this in that we must make

decisions as to where we wish to go. These are basic philosophical considerations concerning our cultural direction which must be addressed. One of the concerns which I have is if educators are even searching for answers, much less planning curriculum which addresses basic philosophical questions. When computers become as much a part of everyday life as has the internal combustion engine, will our freedoms be expanded or will the controls over our lives be clandestinely enhanced? The concepts and perspectives about computing with which we are educated will determine this to some degree. It is important to assess what the cultural perceptions about computers are if we are to enlighten ourselves about the microchip revolution and successfully deal with a force so powerful that it will alter our society.

In their times many people have read about computers and viewed movies that have portrayed various conceptions of computers. Perhaps more people than I were influenced by popular movies concerning the topic, of course to varying degrees. However, today's generation is the initial generation to actually experience computers first hand on a wide scale. What results exist when the mythology of the past intersects with the experience of the present? What outcomes are expected for the future? Education has been one process through which we have shaped our destinies, and in order to shape our future, it will be necessary for educators to assess where we currently stand if we are to make beneficial decisions in regards to what beliefs we will educate with for the future. Whether the vision of the dreamers comes to pass or not, our perspective dictates our dreams and inherent

within our dreams lies what we perceive our definition of Man to be. Education is related to dreams and therefore culture. Computers are part of our culture as is the struggle for freedom. Within the field of education there also exist individuals who share the struggle for freedom. Since computers are increasingly becoming a major force within our culture, educators should exhibit concern as to the impact computers are having and will have on the struggle for freedom within the field of education and our culture. There are several key questions that must be addressed by educators concerned with the relationship between computers and education for liberation. What preparation for the microchip revolution do people have? What do people expect from computers? What "gifts" do people expect from computation? How much control are individuals willing to allow computers, and those that program and control computers, to have over their lives? What perceptions of computers do individuals possess, especially concerning the potentials of computers for liberation or control? I am interested in the messages being transmitted to the individual within the formal educational process which can translate into acceptable societal functions for computers. Whether computers will be used for liberation or control will depend in part upon individuals' perceptions of the relationship between the utility of computers and the meaning of liberation and control.

These issues relate to people's perceptions and knowledge concerning computers and what people see as the goals of freedom and liberation. People's perceptions of computers are closely intertwined with their knowledge of computers, and these two related areas

constitute their computer reality. Individuals' computer reality of course is intertwined with overall reality, and this makes it necessary to examine the construction of knowledge and reality.

Knowledge is an outgrowth of a specific perspective. At this early phase of the discussion, it is important to note that this is not a one-way street. If a person accepts knowledge from someone else, he or she also accepts the perspective inherent from which that knowledge was created, i.e., he or she accepts the constitutive rules that govern the composition of the knowledge.

Knowledge is constructed as a result of human beings using their creativity to order their environment so that they can understand the world in which they live. These acts of creation result in more than just new knowledge, i.e., "pieces" of information or facts. In fact, the creation of knowledge is reflective of a system of thought, for the very essence of a fact reflects the system of thought which gave it birth. As a result of this ordering of their environment, humans create their world, and themselves as well since they are also part of their world. It could be said that the knowledge we hold helps us to define or create ourselves. What is the knowledge concerning computers that we possess which helps us in defining ourselves?

Knowledge is the child of perspective and vice versa, i.e., the hermeneutic circle, since knowledge is derived from and ordered within a system from which we view and order the world in which we live. By involving ourselves in a system of knowledge, we adopt that specific system's perspective of reality, i.e., constitutive rules, as

we interpret our experiences via the perspective inherent in the system of knowledge.

This is not to say that a system of knowledge remains static once defined. Systems of knowledge are in constant review and change as a result of interaction with and manipulation by human creativity. By viewing the world through different knowledge lenses, it is possible to bring different perspectives of reality into our lives. The suggestion could be made that by possessing different perspectives, or knowledge, we indeed possess differing realities, i.e., different realities.

The inference is that One reality does not necessarily exist. The debate concerning Ultimate Reality versus Individual Reality is not really pertinent at this point in the discussion. What can be said with a measure of surety is that we function within an operational reality. Through changing knowledge bases we gain varying perspectives which allow us to order ourselves and our environment. It is not a question of whether with each change of perspective we come nearer to approaching Ultimate Reality or create new Individual Realities. It is a fact that with new perspectives we alter the reality under which we operate. It is very simply a matter of how we view ourselves and our world which results in the construction of changing knowledge and perspectives.

Use of a knowledge system, i.e., a certain perspective, to view the world can result in alteration of a person's conception of themselves and the world in which he or she lives. This results in a new or altered construction of operational reality. A person's

operational reality reflects his or her awareness of himself or herself and the world in which he or she exist. This results in an ever changing construct of reality through interaction of current perspective tested against systems of knowledge and experience. Man creates operational reality, but Man also defines and therefore creates himself in the process since he is part of his own construct of reality. (Freire cited in Beck, pp. 382-383)

The microchip revolution has become and is becoming even more of a major influence in our operational realities. How we view computers as well as the knowledge we possess about them will increasingly affect our world and the people in it. Of vital importance is the discovery of what we are being "educated" to believe to be true about computers so we can know into what image we are creating ourselves. Within a very broad sense THE ISSUE IS, what is the proper balance between freedom and control? Affecting this answer will be the answer to the question of what effect will the inherent limitations of computing power place on our conceptions of what it is to be human. The formation of culture is interactive and interdependent of course; therefore, an important aspect of this cycle is the educational process. Therefore, the question must be asked as to what are the computer concepts being taught or should be taught, and what is their relationship to other educational goals? To seek the answer to this question will help in defining the relationship between computing power and education, which is the major issue of this inquiry.

Since a student is influenced concerning the computer's potential for liberation during the act of training in computer operation, I

have examined software intended to introduce students to computer operation. I have chosen Exploring the IBM Personal Computer because this package is significant in more than one regard. Because of its depth, it is comprehensive in introducing operational concepts. IBM is a major computer producer, and because IBM sells this program, the concepts introduced in the program are experienced by a large portion of students trained on the IBM PC.

In the final section of this paper I have presented my overall reactions to the entire study which include conclusions and recommendations for further research and educational policy. The conclusive statement is synthetic by nature and brings into an integrated understanding the dialectic relationship between my experience and the research. "So, the problem initially is to get under one's exteriorized horizontal thinking to begin to sink toward the transcendental place, where the lower-level psychic workings, those psychic realms determined by conditioning and genetic code, are visible." (Pinar, p. 407)

This has been a journey of sorts which has led to one path which will divide into many, or possibly lead to a dead end eventually. Either way, it has been benefical in that it opens new possibilities and raises interesting questions. It has been part of an educational journey of expanding scope in which others are invited to join and to help steer its direction. To paraphrase: No man is more imprisoned than the one who believes he is free. This study deals with one aspect of this thought in relation to what kind of world we may have with the advent of the microchip revolution, and in another regard the

very nature of the research is a commentary on some version of truth which can be discovered or created.

CHAPTER II

THE CONCEPT OF EDUCATION AS LIBERATION

It is my view that many of the conflicts which exist within our educational system result from the inherent conflicts between the value of freedom and some of the principles upon which our technological system is based. These conflicts result not only in contradictory demands being placed upon our public educational system but also can lead to inner individual conflicts. This thesis deals with the issues generated by these conflicts within the context of our educational system. More particularly, it examines the relationship between education as liberation and computing.

I remember a rumor which was circulating for a time when I was in high school. It seems a student with a dubious reputation among many students, was called down by the principal for an infraction of gym rules. The rumor goes that while standing in the center of the basketball court the student responded to the principal's chastisement with a blow to the principal's jaw. The principal was an ex-marine and noted for his strength and "control" of himself, the faculty and the students. The story continued that the principal did not flinch from the student's attack and then decked the student with a single blow.

The principal called the student's father, and the father said the principal had done the right thing and the student would receive a

beating when he arrived home. What is most meaningful to me about this story is that the students, parent, and faculty identified with the principal's actions to such an extent that there was not one criticism of the reported actions by the principal. Seemingly, everyone identified with the authority figure. This attitude alluded to the dominant reality of the times which incorporated the idea that almost anything an authority figure did was the correct course of action. Although Vietnam, Watergate, the Civil Rights Movement, and other national experiences have affected how critically some of our fellow citizens perceive the actions of those in authority, there still remain obstacles to liberation.

One of the most serious roadblocks to liberation is the fact that people's consciousnesses are submerged by the reality of oppression. (Freire, p. 36) Associated with this submerged consciousness is the schooling process which supports its occurrence. Michael Apple provides further insight to the process. He agrees with Freire that in order for an individual to consciously create or redefine his reality it is inherent that he is aware of the possibility. Part of the hidden curriculum is the knowledge that this possibility does not exist since the hidden curriculum is tacit in its nature in this regard as well as all other regards in which it exists. (Apple cited in Pinar, p. 115). Liberation cannot take place until this realization of reality creation occurs.

What is of imminent priority if curriculum is to be created and instituted is the discovery of the constitutive (Apple cited in Pinar, p. 127) rules of current curriculum which govern the dominant reality

of schools in society. It is important to discover the foundations of current curriculum if it is to be changed into a more desirable form, or if it is to be dismantled altogether and a new curriculum substituted. Apple states that constitutive rules are the rules of thinking and the rules of language. James Macdonald notes that these constitutive rules affect not only students within schools and persons within societies but curriculum workers also. (Macdonald cited in Pinar, p. 11) Constitutive rules "provide basic ways of defining situations." They may be thought of as the "rules of the game." (Apple cited in Pinar, p. 127) Indeed, they are the definition of the game and are often thought to be the only game in town so to speak.

We flatten reality when we allow these definitions to be made for us, and this is often the case with curriculum workers in regards to curriculum theories. By accepting the constitutive rules inherent within the educational context, we flatten reality in regards to what education should and ought to be. If curriculum workers are to be successful, it is necessary to identify the constitutive rules within the educational and societal contexts and create new language within which thinking occurs. Indeed, I believe creation of new language is action which provides new ways for reflection, and this is a prime example of praxis in process. The identification of constitutive rules is a necessity for new language to emerge according to Apple, if liberation from current reality and the resulting schooling system and its effects are to occur. (Apple cited in Pinar, p. 126) This is a necessity if we are to liberate ourselves from the constitutive rules

of current reality and the resulting schooling system and its effects by choosing, creating, and/or changing constitutive rules. If the constitutive rules of current reality are not discovered, any new creation of language will only reflect current constitutive rules since the "new" language would not reflect a consciousness, i.e., and the possiblity of change, of the constitutive rules which governed its birth.

School as a Controlling Institution

William Pinar has contributed his insight toward detailing conditions which he regards as resulting conditions of the constitutive rules of the current schooling process. There exist two reasons for detailing Pinar's insights concerning the schooling process. Firstly, it is beneficial to understand the existing concerns about the current schooling process since this thesis concerns education. Secondly, it is beneficial to some understanding of what constitutive rules are and what their effects are if concrete examples are used. Pinar offers something in both regards.

A sense of "success" within schools requires a certain measure of concentration upon teacher-directed topics and upon the teacher. Students may escape from the sheer boredom of the classroom through fantasy life which results in daydreaming and nonsuccess; or, if students concentrate well, they become one dimensional through their years of concentration and impoverish their imaginary abilities. Therefore, one of the results is an overactive imagination, or in the case of the "successful" student the diminution of fantasy or imaginary abilities. The capacity to create the world involves the

capacity for imagination. Diminishing this capacity reduces the possibility of liberation for the "successful" student.

Within the schools, models of behavior and models of how to perceive reality are continually displayed for student emulation. In order to model oneself after someone a student has to become dissatisfied with himself or herself. Within the modeling process students are urged to play at being other than themselves, and in order to be successful at this, they have to internalize the aspects of the model. "They are not themselves; quite literally, they are out of their minds; they are mad." (Pinar, p. 365)

Pinar states that the schooling process encourages students to transfer the dependency they have upon their parents to a dependency upon the teacher. As this dependency becomes more inclusive, the students' development of autonomy is arrested. This results in students becoming things for educators to use, which is a dehumanizing context within which to spend a substantial number of development years.

The criticism bestowed upon students by teachers and other important individuals within the schooling process can result in a loss of self-love. Since it is impossible to be "perfect" there is always room within the schooling process for criticism. A student's sense of worth, i.e., his love for himself, depends upon the attitudes of others to a great degree. The criticism of others within the failure of being perfect can result in a loss of this self-love. A sense of self-worth is a prerequisite for a person to have the confidence to become active in the liberation process.

Pinar states that being in school six hours a day in probably some of the most uncomfortable furniture ever designed for people results in a denial of internal bodily messages. Combined with the previous mention of the need for concentration, the resulting effect is that schools produce cognitive individuals, instead of individuals which give consideration to their feelings. Through the denial of the internal messages, the process of individuation is inhibited, and this results in a separation from self. It is the individual that is the source of reality creation, and without individuation the self is not available for the liberation process.

The emphasis on efficiency, functionality, and productivity within the architectural structure of schools communicates that beauty is not the primary concern in the physical design of school buildings. The physical environment combined with the cognitive, intellectualizing, verbalizing approach within the schooling process destroys the aesthetically emerging individual. The results is an analytically induced individual with a flattened reality, a reality in which there does not exist the possibility of liberation, for there is not an awareness of a need for liberation.

Pinar states that the entire schooling process fully communicates that students are to please teachers and other significant adults, and therefore the focus from self-direction shifts to being directed by others. Closely related to this is the loss of self. Students internalize the role that they play externally within the schooling process, and the self-centeredness of being oneself is replaced by the role that the student plays. Within this continuing process, as the

individual within slowly atrophies, the hollowness within needs to be filled. Through the transfer of the student's dependence upon the teacher and the need to fill internal emptiness, the student internalizes the role of the teacher who is an agent of the culture. This identification results in a loss of self.

There is a reduction in the need to belong to, and with others since students are in constant competition with each for, the favor of teachers and other significant individuals within the school. They grow up within a situation not dissimilar to that of being enemies with each other. As a result of this schooling context, their need to affiliate with one another is diminished, and a sense of community bond is often not developed. Lack of a sense of community is damaging to the liberation process sense it is through dialogue with others within a sense of community that the liberation process stimulates the creative processes toward world definition.

It is important to me to note at this point that if there is a loss of self, it is my opinion that this is a prime example of individuals being unable to recognize their power for world transformation or reality creation, for it is the self that is the power source for the creative process within people. It is from the uniqueness of being who we are that we maintain the "lens" of viewing and transforming the world into something special. If we substitute the lens of the world as defined by the constitutive rules of current reality, we lose our unique lens through which to view and create the world, i.e., we lose our self and our uniqueness from which our power of creation derives.

Pinar continues that if the student does not internalize the role he plays or does not internalize the role the teacher plays, the student begins to think of the schooling process just as a game, a game with rules to follow if he is to win and the student becomes a player instead of a person. Within this condition of being a player, the individual gives up the power of creator since it is inherent in being a player that one abides by the rules of the game, i.e., constitutive rules. To me, loss of self or becoming a "player" inherently suggests loss of personhood and therefore the loss of the power to create.

Pinar states that it is necessary for a person to love oneself, to feel oneself, and reflect upon himself, i.e., to have a personal relationship or "personal reality" within oneself, before one can relate to others. This is not possible within schools because of the impersonality of the way schools are organized. Students are constantly within a group, but not part of the group and have very little time for solitude. Because of the great numbers involved with the schooling process, only superficial attention can be given to individuals, and this condition tends to prevent one of the most important human needs, i.e., confirmation by significant others, from being met. Because students are objectified and considered things to be done to, they do not receive confirmation of themselves except as they achieve within the schooling process.

I believe that without a personal reality of who we are which is confirmed by significant others we do not have a personal basis from which to shape the world within which we live. This is depowering.

Pinar argues that schools 'educate' many more individuals than ever before but that there is a pressing question as to whether they are being educated in a manner which is suitable, and congruent with empowering those individuals in such a manner that they will reach their potential as individuals. Many students are treated as products to be dispersed from the educational mill, one dimensional, with flattened realities and flattened potentials, and flattened selves. Schools are in a process of producing products which are perverted from their natural state, and within a human sense, "mad and insane." (Pinar, p. 365). The question of this thesis is whether computer education will inherently reinforce this insanity or not. To continue in this search, it is, as Maxine Greene states, necessary to turn to and examine the "thematically relevant" (Greene cited in Pinar, p. 315) basis of computing, i.e., technology.

I believe it is true that a certain type of freedom is attained only through the lessening of physical hazards and this has been accomplished to some degree through our technological system. We no longer have to worry about the wild beast of the land and the majority of our population enjoys adequate clothing, shelter and food. Our technological reality has allowed certain types of physical freedoms and at the same time has created a certain degree of repression and domination. However, this may not always have to be true. According to Freire, a revolutionary technologically oriented society requires reconceptualization. "Revolutionary society cannot attribute to technology the same ends attributed by the previous society; accordingly, the training of men in the two societies must also

differ. Technical and scientific training need not be inimical to humanistic education as long as science and technology in the revolutionary society are at the service of permanent liberation, of humanization." (Freire, p. 157) However, there are those who perceive an inherent conflict between our technology and liberation, one of the most notable being Herbert Marcuse.

Marcuse's Critique of Technology

Herbert Marcuse states that lifting of certain physical limitations by technological reality provides physical freedoms that ancient man did not have but also provides Man with a dependence upon society as it currently exists and a reality that reinforces itself. People are kept within this repressive reality by the promise of a more comfortable life for increasing numbers of people. This can prevent people from seeking a qualitative change in reality. Marcuse states that the most underprivileged in society are often overtly oppressed while the less underprivileged or more middle classed people are placated by satisfying their more physical needs and imbuing them with the desire for false needs. It provides a "false consciousness," or "a false quarter of facts." (Marcuse, p. 121) The ideology of false needs becomes reality, i.e., one dimensional reality. "The products indoctrinate and manipulate; they promote a false consciousness which is immune against its falsehood." (Marcuse, p. 26) This reality of one dimensional thought and of one dimensional behavior becomes a way of life. It becomes the individual, or it might be said the individual becomes it, for in order to receive the physical benefits and commodities of our society we must support its

continuance. Individuals become so engrossed with the pursuit of fulfilling false needs that they are unable and often times unwilling to recognize their state of bondage. "All liberation depends on the consciousness of servitude, and the emergence of this consciousness is always hampered by the predominance of needs and satisfactions which, to a great extent, have become the individual's own." (Marcuse, p. 23) It may be said that the price of progress is death and the cost of gratification is production. (Marcuse, p. 121)

"The most effective and enduring form of warfare against liberation is the implanting of material and intellectual needs that perpetuate obsolete forms of the struggle for existence." (Marcuse, p. 21) False needs are those that help the system maintain itself. False needs are: "to relax, to have fun, to behave and consume in accordance with the advertisements, to love and hate what others love and hate..." (Marcuse, p. 22) The technological system is the producer of these needs for "...social control is anchored in the new needs which it has produced." (Marcuse, p. 24) These needs help to oppress no matter how much satisfaction they provide. These false needs are implanted in us for purposes of oppression for the only really vital needs are food, clothing, and shelter. (Marcuse, p. 22) "The distinguishing feature of advanced industrial society is its...free choice between brands and gadgets." (Marcuse, p. 23) I believe this is very similar to Pinar's analysis of constitutive rules and preference rules since free choice between brands and gadgets is the same thing as Pinarian preference rules. Individuals have a choice within the larger concept of reality but do not have a choice

among realities.

At the heart of this conflict between the principle of freedom, i.e., liberation, and technological values lies the concept of reality within which our society accepts. The implications for the relationship between liberation and computing will be explored more fully in chapter three. Marcuse regards the basic rule of current reality as involving domination and subjection. (Marcuse, p. 130) In order to acquire the physical comforts that have to some degree been enslaving him, Man has accepted the concept of dominating or subjecting nature to his desires and wishes. Within technological society this has been accomplished through machinery and tools, i.e., instruments. Instruments have become Man's slaves since they do his bidding and perform his will against nature, and once this idea of domination is accepted, whether it be subjection of machinery and/or subjection of nature, the idea of domination within the order of reality is accepted. Once it becomes a basic rule of reality, it is then possible to accept the idea of domination and enslavement of other people. (Marcuse, p. 130)

It is clear that the conflict between the principle of freedom and technological values is metaphysical since "no system or machinery or economic doctrine or theory stands on its own feet: it is invariably built on a metaphysical foundation, that is to say upon man's basic outlook on life, its meaning and its purpose." (Schumacher, p. 246) Technological Man's outlook is one of domination and oppression and is dramatically demonstrated within the daily life of those people who exist within a society that values the

technological system. It would seem that the primary task of technology would be to lighten Man's work burden and to help Man develop what potential he possesses. (Schumacher, p. 140) However it is very important to note that within the technological system there are hidden assumptions that effect human perspective and the reality that is created. The hidden assumption of domination permeates the principle of freedom within our system and invalidates it to a large extent. I believe this is the dilemma that educators face when they attempt to teach the principle of freedom and technological values simultaneously. It is a dilemma and within the practical world the technological system has the upper hand, and indeed, within our conceptions of reality, it has been my experience that technological values dominate to a great extent.

Conflicting Values - Schools & Society

In my opinion, schools are a primary example of the dilemma which results when individuals have a need for achieving the goals of liberation within the technologically based reality of present society. As a result of my experiences, I believe that most educators think they teach the principle of freedom while they arrange schools upon a model of control. We inevitably reward students for the best performance, the average performance, and the poor performance, and do not take into account the value of a person's freedom to decide for himself or herself who he or she wishes to be. We state that everyone is just as good as everyone else but arrange students within the redbirds and the bluebirds reading groups and place students into developmental reading classes and developmental math classes. We

place some students in detention halls and others in discipline classes, while to others we present awards and ovations at student assemblies. We establish a pecking order of slow or problem students, average students, superior students, aids and cafeteria workers, poor teachers, average teachers, excellent teachers, counselors, assistant principals, principals, superintendents, and board members. We reward each according to how well he or she competes and then expect him or her to promote the principle of freedom of choice with more than lip service. How is this possible when we track some students into college, other students into low paying general studies futures, and still even other students right out of the educational process altogether into a life of poverty, denigration and overt oppression?

E. F. Schumacher argues that many individuals seek more than just facts or training from an education; that they are looking for ideas and ways to make their life and their world more intelligible to them. (Schumacher, p. 77) I believe he is correct in his assumption and instead we provide such individuals with an estrangement from their world and their life by providing them with conflicting concepts and values derived from the principle of freedom and technological models of reality. We teach them conceptually about freedom and teach them practically about domination and oppression. The "ritual-authoritarian language" (Schumacher, p. 77) of our society and educational system controls us by reducing our linguistic abilities so that we can no longer adequately reflect upon the contradictions in which our lives are immersed. Marcuse states that it arrests

abilities of abstraction and development by substituting unclear images for accurate conceptions of the world. (Marcuse, p. 90) "The given reality has its own logic and its own truth; the effort to comprehend them as such and to transcend them presupposes a different logic, a contradicting truth." (Marcuse, p. 118) Within the context of arrested development it is almost impossible to perceive a contradicting truth.

The public schools are a major focus of this conflict between the principle of freedom and the values of a technological system, i.e., the basis of which is false consciousness. More importantly I believe it is a conflict which is also experienced within the individual. Within this dilemma of domination versus liberation or freedom within the context of human existence exists the issue of schooling versus education.

Freire states that conventional schooling is like depositing knowledge in a student as a person would deposit money in a bank. (Freire, p. 58) Within the banking concept of education students are treated as objects to be filled with knowledge and teachers are those who perform the act of filling. This is not a liberating education since students are treated in an intellectually derogatory manner. The purpose of the banking concept of education is to change the being or the consciousness, not to a consciousness of liberation but to a false consciousness. Students are viewed as intellectually and socially deficient much as a medical patient would be considered biologically deficient. The purpose of conventional schooling is to repair them or to make them well within existing cultural standards.

The purpose of conventional schooling is to adapt the human being to society and the process is infused with a lack of trust of human beings and their creative powers -- that they exist, and if they do exist, that people will not use their creative powers wisely. This lack of trust results in a reality of superordinate and ordinate, i.e., the teacher is a depositor, a domesticator, and a prescriber for students. Students are to be filled by the teacher with knowledge so they will adapt to society by emulating the model set by the educator. Within the schooling process an "educated" person is a person that is adapted to society, but not to a liberated or free life, i.e., "adapted to liberation" is a contradiction of terms. According to Freire, schooling is an exercise in domination and indoctrination to a world of oppression. Schooling is a concept formulated and initiated within the reality of oppression. Within the context of this thesis the question remains as to whether the inherent concepts associated with computing power will be established in relation to education or to schooling. Education, as opposed to conventional schooling, allows people to find meaning in their experiences which is a prime goal of liberation. The issue is whether or not computers facilitate or suppress the human impulse for making meaning of experiences.

I believe that it is a fairly well accepted truth among a large number of people that experience affects who we are and who we become. I remember writing an essay in high school English class concerning the dominance of teacher decision making within the schooling process. I expected a poor grade for the essay for it was written with fervor

and what I then considered disregard for diplomatic communication from student to teacher. Fortunately, it was graded by a teacher more interested in encouraging the development of my cognitive and emotional processes than in molding my social behavior and protecting the status quo.

Of course the essay was a result of many experiences that only culminated in the writing of that long ago paper. Many of the experiences submerged in my consciousness, I am sure, merged together which helped me formulate that essay. I am certain I did not use the word "liberation" within the paper I handed in that day, for liberation was a word that connotated radicalism and even worse, communism. The word liberation means different things to many people; therefore, it is of value to formally provide an explanation of what I mean by liberation within the context of this thesis.

Liberation within the context of education means that individuals empower themselves to "take charge" of their lives and their world. In fact, it proceeds beyond the simple matter of "taking charge" for it entails becoming empowered to create the world in which one exists. I believe this power is inherent in all people and that the ability to focus and utilize this power derives from environmental conditions which allow and encourage the development of this inherent power of creation. Since we are part of the world we create and exist within, liberation also means creating and defining oneself within this process of creation. There are certainly multiple conceptual aspects to the process, many of which have been outlined by Paulo Freire in his Pedagogy of the Oppressed.

Paulo Freire is a radical Brazilian educator who has developed one model of education designed to lead to liberation. His lifelong effort toward creating a model of educational liberation is a major building block upon which I construct my overall thesis. Freire's involvement with the South American peasants' oppressed condition is the focus of his model. Since the essence of the model is one of humanization, I believe it is significant and applicable to technologically advanced countries such as America. Vital to Freire's model is the concept that liberation is education and that education is liberation.

An Overview of the Model

Within Freire's model there exists communication among teachers and students since teachers and students are co-educators as well as co-students. They learn together, they reflect together, and they act together. They are conscious of each other's problems and of common problems, and collectively solve shared problems through a process of cognition. This results in an involvement in the examination of reality and the emergence of students' and teachers' consciousnesses. Student and teacher learn together through dialogue as mediation occurs by the world. Responsibility for the educational process and for growth is a jointly held responsibility.

The teacher is in dialogue with students, and his purpose is the cognition of problems which relate to the world in which they both live. "In problem posing education, men develop their power to perceive critically the way they exist in the world with which and in which they find themselves; they come to see the world not as a static

reality, but as a reality in process, in transformation." (Freire, p. 71) There exists a major difference between Freire's model and that of conventional schooling. Whereas the purpose of schooling is the acculturalization of students, in Freire's model it is reality which is the object of change. The educational process begins with people and their relationship with the world and projects into the future. The process occurs communally within the dialogue among individuals and begins with the oppressed asking why. It depends upon praxis, i.e., reflection, action, reflection and action, which can exist only where there is dialogue among people. It is a process dependent upon trust between authentic human beings, i.e., human beings that do not prevent other human beings from becoming liberated. Within Freire's educational model continual acts of creation and recreation of reality are accomplished within the context of commitment to other people. It is a process which "enables men to overcome their false perception of reality." (Freire, p. 74) It is having more without preventing others from having more and from being human. It is a process dependent upon gaining a critical perception which enables individuals to recognize and "see" beyond Marcusian false consciousness.

Components of the Freirian Model

According to Freire dialogue is necessary for an education to occur. This dialogue cannot exist between the oppressed and the oppressors, i.e., individuals that deny others the right to create and recreate reality. To deny others this right is to deny them their rights as human beings and is dehumanizing. It is each individual's right to create and recreate his or her own reality. One person

cannot do this for another since it is through the dialogue of praxis that men create the world while liberating themselves. Although one person cannot liberate another, neither can an individual liberate himself without dialogue with others. Liberation is a communal effort through dialogue.

Humility is necessary if dialogue is to occur. One person cannot have dialogue with another and it be meaningful if one of the individuals considers himself to be the holder of knowledge and the other person the receiver of knowledge. For a meaningful dialogue to occur all individuals that are involved in the process of liberation must enter into that education within a joint effort "to learn more than they now know." (Freire, p. 79)

Just as humility is necessary before dialogue can take place, faith is also necessary. Each participant must have faith that each person has the ability to create and recreate reality. This is not to say that this power of creation and recreation cannot be impaired within a reality of oppression. However, faith must be maintained that this power for creation and recreation, i.e., the transformation of reality can be reborn through education. There always has to be hope and expectation that man's efforts for liberation will be successful. Freire states that without humility, faith and hope, dialogue is not possible. (Freire, pp. 80-81)

Dialogue also cannot exist without critical thinking. Critical thinking has to be based upon the belief that the world and human beings are basically one in the same, i.e., man creates his own reality and therefore defines himself, and that reality is a process

of transformation rather than an undeniable truth. The basis of critical thinking is praxis. Praxis cannot exist without both reflection and action for one without the other negates any situation in which praxis would be a part. Reflection without action only reinforces a reality of oppression and this does not lead to education. A vital aspect of the model is the object of actions for transformation. "For the truly humanist educator and the authentic revolutionary, the object of action is the reality to be transformed by them together with other men--not other men themselves." (Freire, p. 83)

According to the Freirian educational model, cooperation, unity, and organization are necessary for liberation. There must be cooperation among teachers and students, as well as unity, i.e., community. To unify students the myths of the reality of oppression must be dispelled. Students must come to know why and to know how they have come to believe in the reality of oppression, and once this occurs, unity among the oppressed is possible. Group organization is directly linked to unity and is also a natural development of unity. Organizing the students is a process in which teachers initiate the learning experience of how to transform reality. It occurs with the students but it is not imposed upon them, and it is from this point that freedom to create the world eventually occurs and is gained. Freedom and authority are related. As students become free, authority is granted for the organization which freedom requires. It is a process which builds upon itself as the world and as reality are transformed.

Education consists of praxis, i.e., a continous reflection about the world followed by action as a result of that reflection, followed by reflection and action; dialogue, commitment to other people, a humility to learn with other indivdiduals, faith in Man's ability to transform reality, and hope that efforts toward liberation will result in transforming oppressive reality to a reality of freedom and liberation for all people. Teachers and students must cooperate and be organized within an atmosphere of unity. Even though teachers and students are co-students, there resides a special responsibility upon teachers within the relationship.

Teacher Responsibility in Education as Liberation

There are other theorists who provide further insight to the model of education as liberation. Maxine Greene, William Pinar and Michael Apple are three such contributors who provide guidelines as to what education for liberation might be like. According to Greene each person brings to the world his or her own person and individuality. Each person brings to the world the culmination of what it is to be him or her -- the past experiences and perceptions gained from experience and from others. Society forces its conception of reality upon us. If people are to create their own reality, they must be able to take on the perspectives of various disciplines which enhance their abilities to make order of the world. By viewing the world through the perspectives of different disciplines, individuals can gain the understanding that reality is not static, but just as importantly various disciplines provide different values to choose from when deciding how to transform reality. From the perspectives inherent

within the values of various disciplines, individuals have a beginning point from which to create new knowledge, disciplines, and perspectives. (Greene cited in Pinar, p. 307)

According to Greene a student is like an illiterate person with a piece of paper. Through the help of another person, e.g., a teacher, a student begins to understand that the piece of paper is also a map of the area he inhabits. The teacher does not fully understand and cannot interpret all of the symbols on the map but with the student can understand part of it. As they explore the area they inhabit together, they can add additional symbols and build more meaningful knowledge into their map. Because in the beginning the teacher knows the secret that it is a map of their inhabited area and understands some of the symbols, it is the teacher's purpose "...to aid in the identification of the thematically relevant." (Greene cited in Pinar, p. 315) As the student and teacher explore their area together and make meaning of their individual perceptions of their world they build knowledge into the map. It is a process of exploration within the realization that all knowledge created is a result of individual perception. There arises the necessity for more than one map since the teacher's map and the student's map may no longer coincide and be congruent. Each one begins to make meaning of the world in an individual fashion. This is a time of danger if the teacher resorts to oppressive tactics in order to impose a conception of reality upon students. In recognition of this danger Greene

emphasizes that "The problem for their teachers is to stimulate an awareness of the questionable...to beacons beyond the everyday." (Greene cited in Pinar, p. 315)

William Pinar emphasizes that it is the teacher's responsibility to stimulate an awareness of the rules that constitute reality and to encourage students to identify those rules and challenge them as the students become creators of their own perspectives and knowledge. It is an individual as well as a communal search for value (values) in which to make meaning from their own definition of self. "This evolution can be conceptualized as a slow, continued emergence from reality, a transcendence of self from circumstances. This process is tantamount to what is called humanization, and it is precisely that, a becoming of what we are, a bringing out of what is there but obscured if not buried by conditioning. That sense of bringing out of course recalls another term: education." (Pinar, p. 394) Teachers cannot think for their students nor without them, but only with them. Through a gradual process the causes of reality become known as a result of the teachers' critical knowledge concerning the perception and transformations of reality as well as the empirical knowledge of students.

Freire also recognizes that in many instances what the teachers desire and what the students see as their needs do not coincide. All is lost if teachers resort to oppressive tactics to impose freedom within the context of a liberating education. Cultural synthesis, i.e., a "meeting of the minds," is required when there is a contradiction between the teacher's vision and what students feel

their needs are. This is a dialectical process in which students and teachers reflect upon their own as well as others' insights and emerge with some understanding of each other, and this understanding is incorporated into their world view. It is the responsibility of the teacher to listen to the students and to extend the immediate needs of the students toward a theory of liberation. Teacher and students must critically analyze reality, and from this a cultural synthesis will emerge. The solution requires a continuous dialectic dialogical encounter among students and teachers in which the cultural synthesis, i.e., communal understanding of reality, is in constant reconsideration. Through dialogue teachers and students share experiences, values and perspectives and use this process as a resource in creating and recreating their own reality. The process and resulting cultural synthesis will give support to them without violating either. To act otherwise and force one reality upon people would result in defaulting to an oppressive reality.

Freire states that teachers cannot impose an education upon their students for a education must be attained <u>with</u> students. The only legitimate dimension of values a teacher may bring to the educational process is a critical perception of the world, i.e., a critical perception of reality. This implies a method for unveiling reality, for creating reality, and for transforming reality. Since the student is not an object to be filled with knowledge, education cannot be imposed. It is true student and teacher learn together; however, it is the responsibility of the teacher to bring this critical perception of reality. "Men will be truly critical if they live the plenitude of

the praxis, that is, if their action encompasses a critical reflection which increasingly organizes their thinking and thus leads them to move from a truly naive knowledge of reality to a higher level, one which enables them to perceive the causes of reality." (Freire, pp. 125-126)

CHAPTER III

AN ANALYSIS OF THE RELATIONSHIP BETWEEN COMPUTER CONCEPTS AND EDUCATION AS LIBERATION

> Nevertheless, it is plausible that all of us make all our inferences about reality from mental models whose structures, and to a large extent whose contents as well, are strongly determined by our explicitly and implicitly held theories of the world.
>
> I have argued that tools shape man's imaginative reconstruction of reality and therefore instruct man about his own identity.
>
> Joseph Weizenbaum
> Computer Power and Human Reason

Computers are tools fashioned by people and are becoming an obviously integral part of our culture. What significance computer education has for liberation becomes increasingly important at a similar rate that computers become important in our society. "Whether or not computer scientists ever create an artificial intelligence that can think like a person, computers change the way people think--especially about themselves." (Turkle, p. 162) The ways in which people think about themselves and the world in which they exist is one of the bases for education as liberation. The relationship between computers and education as liberation lies within the basic concepts of education as liberation, as explored in the preceding chapter of this thesis, but also in the basic concepts of computing as they are related to education as liberation. It is the relatedness between these two groups of basic concepts that the relationship between computers and education as liberation is established. It is within

this chapter of the thesis that exploration of fundemental computer concepts important to the establishment of the relationship between computers and education as liberation is examined. Examination of artificial intelligence concepts is a logical choice to begin exploration since intelligence is a basic and important human quality within the educational context and artificial intelligence theories imply a perspective of what is intelligence.

Nature and Definition of Artificial Intelligence

Artificial intelligence (AI) theories are double edged swords when viewed in relation to education as liberation since the idea of artificial intelligence is based upon a model of intelligence. There is a common cliche of the computer culture and the general population that states that computers do only what they are programmed to do. This is the Lovelace model of viewing computers and comes from some of Ada Lovelace's thoughts on Charles Babbage's analytical engine. (Turkle, p. 274) Within the concept of liberation this is similar to the idea of fixed reality which is anathema to liberationists. There are two related views of computers which exist within the theoretical realms of artificial intelligence. They are the concepts of "emergence" and "heuristics," both of which rely upon the notion of "primitives." AI researchers postulate the concept of primitives as certain processes which people are not fully aware of, i.e., not fully in touch with, that take place which discard approaches that are not likely to be productive within the context of a specific problem. This is the heuristic use of logic subroutines, i.e., primitives. The emergent use of primitives is the power built into routines to

alter their own logic, i.e., their perspective on the way they evaluate data, e.g., the outside world. The concept of primitives relies upon the fashion in which software programs are traditionally constructed. A program is a listing of instructions which the computer executes in a sequenial manner. When data is encountered within the context of attempting a solution to a "problem," the main program "decides" how to categorize the data in relation to the problem to be solved and which primitives, i.e., logic subroutines or mini programs with a particular perspective or logic, will "work" on which part of the solution to the current problem. Very simply stated it is a division of labor within a conceptual, problem solving framework. Each primitive reports to the main program whether the conceptual approach to problem solving is likely to produce positive results or not. If not, that conceptual approach is discarded, while more likely avenues of reaching a solution are pursued. As the program gains experience in problem solving, it "remembers" likely avenues of success and alters its own logic or perspective for more efficient operation in the future.

AI researchers use emergence and heuristic theory to construct computer programs with primitives or logic routines that operate simultaneously. When a program receives a problem and data, these primitives operate on their small section of the problem and the data. If they produce what they consider useful results, their data is then transferred to the main program. If they do not receive what they consider pertinent data, or if they do not produce what they consider meaningful results, they do not interact with the main program. One

of the basis for this emergent intelligence is the idea of the program being recursive, or self-referential, and heuristic by nature. An emergent approach incorporates the idea that a program can alter its own programming code based upon its "experiences" via decision routines built into it and the information it gains from its primitives. This is circular by nature and is the power source of emergence. The break in circularity is the interjection of experience with the outside world. Within Freire's thought this computer experience is analogous to the experience an individual incorporates into his world. It is also one of the basis for education as liberation. (Turkle, p. 284) These and other AI theories have implications for the establishment of a relationship between computers and education as liberation.

In the 1950's, Arthur Samuel developed an AI checker playing program based upon emergent theory, i.e., the program could modify its own rules of playing checkers based upon previously played games. In other words it learned from its own experiences. The checker-playing program eventually experienced enough and "learned" enough that it beat its creator at playing checkers. This was a very dramatic event in artificial intelligence circles. The machine beating its creator was such a dramatic event that Norbert Winar addressed it in his <u>God and Golem, Inc.</u> The power behind the idea of emergence was demonstrated by this event and leads to interesting speculations such as when will we be able to win at a game of checkers with God? This should be left for a later discussion since it is not within the scope of current discourse.

Emergence and AI

The idea of emergence, i.e., artificial intelligence learning from its experiences, is really rather simple. A computer program consists of various primitives or subroutines that accomplish individual goals by manipulating data in a certain fashion for desired results. The idea behind emergence is that various and many primitives exist within a program that manipulate data in their individual fashions depending upon their particular perspectives or points of view. Each is limited to its individual point of view but has input into overall rule formation and decision making. In other words the program is dependent upon what each primitive generates and the experiences the overall program has encountered, and resultingly recreates and redefines its own parameters, i.e., the program itself. In reference to Freire's thought on liberation, this is a very powerful concept when applied to an individual and the world in which he lives. It is the classic idea of individual self creation and individual world definition. The different perspectives built into the primitives allude to the value, in liberation theory, placed upon the different perpectives which are of value to individuals if they are to exist within an ever evolving reality as a result of the perspectives gained from various individuals within a community. Although this aspect of the relationship between this particular theory is positive, a limiting factor to the positive computer/liberation relationship is the AI view of the individual solely as an information processor.

The Turing Concept

A key concept in computing that speaks to the significance of the individual as a information processor is called the Turing machine, i.e., a machine that can emulate any other machine. (Weizenbaum, p. 62) Computers are Turing machines since any computer can emulate or simulate any other computer if provided with the correct programming. The input and output of two entirely different computers can be identical although the language they are programmed with may be different. Identical output is achieved by programming the machine with the same principles. It can also be argued that if a computer is able to simulate a human being's responses, then indeed it does have intelligence for it acts as a human being would act. This is the basis for artificial intelligence. The theory of behaviorism is based upon this premise, i.e., given a certain input to a human being a certain output can be expected. If you give that same input to a machine and it provides the same output or response that a human being would provide, the assumption is that intelligence exists. This is a simple assumption but can be implied to mean that if a computer could simulate human responses, then it is conceivable that it could generate knowledge as if it were human. Implicit in this assumption of human modeling is the conception that humans create knowledge, i.e., possess the power of creation, but it derives from the idea of Man soley as a information processor operating within a fixed reality. Since the focus of these inferences derived from computer theory are about human beings and the focus of education as human liberation is upon human beings, these inferences are part of the relationship

between computing and education for human liberation.

A Heurestic Approach to AI

The heuristic approach is not exclusive to the idea of emergence but has a different slant toward the utility of primitives. Primitives can be thought of as the base upon which heuristics and emergence rest. They are closely related much as are half brother and sister. The heuristic approach is an attempt to understand how human beings approach the resolution of a problem and what categories of thought are used. Herbert A. Simon and Allan Newell are two leading artificial intelligence researchers who have taken an heuristic approach to artificial intelligence. Their heuristic approach might be said to program according to human insight. The positive implication for the computer/liberation relationship is that humans possess certain intuitive and creative powers. When AI researchers attempt implementation, they attempt to formalize or decode how a human being would approach a problem through an intuitive model. When a problem arises, it is theorized that human beings unconsciously and almost automatically disregard certain approaches to the resolution of a problem. Heuristic researchers theorize that there are certain processes, named primitives, which people are not fully aware of, i.e., not fully in touch with, that take place which discard approaches that are not likely to be productive within the context of a specific problem. They use this theory to construct computer programs with primitives or logic routines that operate simultaneously. When a program receives a problem and data, these primitives operate on their small section of the problem and the data.

If they produce what they consider useful results, their data is then transferred to the main program. If they do not receive what they consider pertinent data, or if they do not produce what they consider meaningful results, they do not interact with the main program. With these primitives operating as "semiconscious" modes of thought, researchers believe that they have begun to simulate human intuition within a problem solving context. (This is overstated and simplified to a certain extent for example purposes.) As the main program of the computer receives data from its primitives, it "knows" in which direction it should "concentrate" toward solving the problem presented to it.

Although computers are fast, this increases their efficiency in problem solving and according to many researchers emulates or simulates the human process as the data is outputted. The heuristic approach of AI espouses a view of Man as a intuitive, creative problem solver. This aspect of computer theory combined with emergence implication of differing realities, i.e., primitives, and the power of self-definition builds toward a supportive relationship with liberation educational theory. The idea within emergence that a program learns from experience and can alter itself is supportive to liberation theory of Man being creative. However, the view that the individual, i.e., the program requires alteration or repair as it learns from its experiences purports a more negative relationship between computers and liberation theory. One of the basic premises of emergence and the heuristic approach of AI, that Man is a information processor, detracts from the supportive aspects of the relationship.

(Weizenbaum, p. 140). This Marcusion one-dimensional view of Man as information processor does not address "knowing" or consciousness. Many AI people discount this aspect of Man much as the theory of behaviorism does.

Computers and the Construction of Reality

AI programmers use languages to construct programs for computers as others use other languages to construct their understanding of reality. Language gains its power from the words that compose it. Words have fairly specific meanings, and it is from these meanings that language can be useful in communication. The other power of words lies in their limitation, i.e., in their capacity to conceal or omit. Concepts by definition limit the range of our thought. If there are not words to sufficiently express certain ideas within our developed language, it can be said that there are ideas of which mankind cannot or is unlikely to conceive, or at least ideas humans may express only in another medium, e.g., an artistic medium such as poetry or art. Tools and the inherent ideas behind the conception and use of tools are a representation of this. A computer is a tool, but inherent within that tool are the ideas which are the basis of its conception and use. As computers are used and implemented within the educational setting, the inherent theories upon which computers are based can affect the goals defined for and achieved by the educational process. As computer concepts are incorporated within the educational setting, they can have an effect upon educational theory. Computer concepts may be incorporated into current reality or may be the basis for creating new language which can be used for redefining constitutive

rules. If the relationship between computers and education for liberation is to be mutually supportive, the inherent basis of computers must contain a conceptual language congruent with the language of education for liberation. It is within this context that computers and computing theory may open certain doors to man and may close other doors. If computers are thought of as words in a language which Man uses to construct his world or reality, then it can be said that computers carry the same limitations and possibilites inherent within their conceptual foundations much as if they were words in any language of communication. (Weizenbaum, p. 38). These limitations and possibilities of computers affect what type of relationship will exist between computing power and education for liberation.

Computers and Individual Control

Within the context of the relationship of computers and liberation, sight of the individual should not be lost for it is control of the individual or empowerment of the individual that is affected by the consistency of that relationship. From different perspectives the individual may wear many labels, i.e., teacher, student, programmer, computer user. "The computer programmer, however, is a creator of universes for which he alone is the law giver." (Weizenbaum, p. 115) "But the programmer moves in a world entirely of his own making. The computer challenges his power, not his knowledge." (Weizenbaum, p. 119) It is this computing world that Turkle has written about in The Second Self: Computers and the Human Spirit. Just as Pinar has so pointedly described how the conventional school setting possibly affects students and Freire has written

concerning the process of education for liberation, Turkle has investigated the computing environment which may have implications for the computer/liberation relationship. Computerists operate from within a microworld of their own creation imbued with power derived from the computer. This provides them with a tremendous amount of freedom, but there is another aspect to this use of freedom. The problem with this association with the almost unlimited power within these abstract computer systems is that when they apply their rules to the real world, they are oftentimes in danger of failing since the conditions of freedom they are use to operating under do not, or rarely, exist outside of computer systems. There are other dangers associated with these microworlds of which video games are a part since they are based on computing power. "Video games offer a chance to live in simulated, rule-governed worlds, they bring this kind of experience into the child's culture and serve as a bridge to the larger computer culture beyond." (Turkle, p. 79) The rule-governed worlds of video games are of course an analogy to the constitutive and preference rules of the human world that Pinar speaks to. "You can postulate anything, but once the rules of the system have been defined they must be adhered to scrupulously. Such are the rules for creating rule-governed worlds." (Turkle, p. 81)

"Here is another world where everything is possible but where nothing is arbitrary." (Turkle, p. 82) This is the paradox of computers that world creation and self-definition are possible, but there are also preference rules and constitutive rules within the real world. These ideas are transferred within computer usage, but they

also have a history within other areas. "Ultimately there are programs that stand behind the action. They can be deciphered; children speak of learning their secrets, recognizing them as worlds of complex behavior that in the end are rule-driven--like science fiction, like D and D (Dungeons and Dragons), and, as they are starting to learn, like computers." (Turkle, p. 82)

> But when you play a video game you are a player in a game programmed by someone else. When children begin to do their own programming, they are not deciphering somebody else's mystery. They become players in their own game, makers of their own mysteries, and enter into a new relationship with the computer, one in which they begin to experience it as a kind of second self. (Turkle, p. 92)

This is the fixed world of constitutive rules that Pinar describes when expounding educational liberationist theory. Computerists as game players can choose between the preference rules of a fixed reality. This attitude is not congruent with a supportive relationship between computing and educational liberation theory. However, computerists that are programmers do experience a relationship of creativity within the context of programming which is congruent with the ideal of creating your own world, which is the basis for liberating theory.

Turkle divides programmers into at least two types, hard programmers and soft programmers. Soft programmers negotiate and seem to have a relationship with what they are working with much as if an artist working on a piece of pottery feels the clay as he or she molds it. The hard masters on the other hand are much more abstract with their work, and there is a separation between them and their work. Their work becomes an object that they manipulate instead of a piece

of art that they are in relation with. Hard progammers may be thought of in terms of individuals who have accepted the Marcusian description of technological dominance. They accept and experience nature as dominating and therefore have incorporated dominance into their conception of reality, which is a reality of oppression. Soft programmers on the other hand have accepted a more fluid relationship with their world and still maintain their power and conception of creation. Seemingly, hard programmers are not in harmony with liberation theory and soft programmers are. However, on the positive side both types maintain and acknowledge their capacity for creativity. The inherency of this creativity is supportive of a positive computer/liberation relationship, although the reality of oppression that hard programmers seemingly subscribe to is destructive in terms of liberation as Marcuse indicates, since a theory of dominance permeates every aspect of their realities.

Computers and Creativity/Perception

"Man can create little without first imagining that he can create it." (Weizenbaum, p. 18). Although man experiences or encounters the world as an external force, what he indeed confronts is the model of his own creation. If indeed computerists gain the perspective that it is possible to create microworlds, then it is possible that they may also realize that the creation of the external world is also available to mankind; and therefore the analogy between the language a programmer uses to create his microworld is true indeed to the power of language in creating external realities, Man, and the knowledge he possesses. (Weizenbaum, p. 131) If this connection is made between

microworlds and the world at large, then there is a supportive element extant to the computer/liberation relationship.

Almost without stating the obvious, it is understood that people's perceptions are closely intertwined with their knowledge, and these two related areas constitute their reality. Knowledge is an outgrowth of a specific perspective and vice versa. It is important to note that this is not a one-way street for if a person accepts certain knowledge, he also accepts the perspective inherent from which that knowledge was created. When people accept the power of computing, they also accept certain aspects inherent within that power. Even though it may initially be disturbing, this leads to an impact upon their ideas about how Man and his world are defined. People attempt to incorporate these concepts as they order their world. The computer, because of its newness, "standing between the physical and the psychological, between the animate and the inanimate, creates a new disorder and provokes... new conceptualizations." (Turkle, p. 32)

Perhaps one of the most interesting and profound insights, or new conceptualizations, was made by a fifth grade girl during an interview and reported by Sherry Turkle in The Second Self: Computers and the Human Spirit. The young girl relates her life as being programmed much as a computer is programmed. The fifth grade girl had some experience programming and understood the linear approach to executing instructions and spoke of her life as being exactly or very similar to that of the computer executing instructions. She knew the procedures for who she was allowed to play with, what games she was allowed to

play, who her friends could be, and which clothes she was supposed to wear at certain times. Even her clothes closet was organized according to a sequential order. During the interview she spoke of how her mother and priest had programmed her and that the priest was programmed by the Pope.

During the course of the interview, Sherry Turkle made a comment to the effect that a life programmed as such could be somewhat difficult. Turkle uses the word "astounds" to describe her reaction to the young girl's next comment of how she related programming to her own life. The insightful fifth grader stated, "'Well, you know, you can change the program. Once you know how, you can change the program. I can't do it now, but that doesn't mean that I won't be able to someday.'" (Turkle, p. 156) Because the young girl's life was so programmed, she was able to relate it to the programming within a computer. Because of her knowledge that programming can be changed, she was able to relate that possibility of change back to her own life, with the stipulation that a person have the knowledge of knowing how to change the programming. This is the basis of Freire's thought concerning the path to liberation. By experiencing the computer within the context of programming, the young girl was able to relate that experience to her own life. This brought about the realization that individuals are affected by a variety of experiences and rules which can oppress them. Within the relationship that was established in her mind between computer programming and her own life, the fifth grader had the insight which allowed her to realize the basis for liberation is the possibility of changing those rules, i.e., defining

one's self in the world in which he or she exists.

Computers and Empowerment

Of course there are different facets to the relationship that individuals experience within the context of computing, therefore, experiences of individuals vary. However, the computing experience "can mean new feelings of empowerment..." (Turkle, p. 143) even though those feelings of empowerment and experience do not always seem to be focused in the same direction by all people. There are the contrasting backgrounds of two individuals interviewed by Sherry Turkle that exhibit this characteristic. There is the young woman from a relatively poor background and who viewed her world as chaotic and the young man from a relatively educated and well-off background that wants or desires his world to be chaotic. The young woman used her computing experience with microworlds to experience "a greater degree of control than she had ever known." (Turkle, p. 150) The young man in an almost total reversal of priorities intentionally used his computing experience as an adventure into the realms of chaos. Whereas the young woman used the power of computing to order and create microworlds under her control, the young man used the power of computing to intentionally explore the possibilities of creating microworlds that went against the constitutive rules of the computer with which he worked. Amazingly, the commonality between these two individuals is the empowerment both felt at taking charge of their own relationship with the computer. There is the individual that dropped out of college after two years because he never quite could grasp the theoretical or analytical aspects of numbers within the engineering

profession. After working with computers and numbers, he began to make the connection between the concrete and the theoretical. As he stated, he began to find the numbers in his fingers. As Marvin Minsky said, "'The body...is a teleoperator for the brain.'" (Turkle, p. 255) As a result of this, the feelings of failure began to disappear and feelings of empowerment began to appear. As a result of his experience and his relationship with computing a reconsideration of his self-image took place. (Turkle, p. 169)

Just as the young man had a need to understand himself within the world in which he existed, the holding power of computing is related to the human need to understand and define the world. For computerists this need is translated into a need for an understanding of how the computer works. This need for understanding fluctuates with different people, and the fluctuation is reflected by the depth at which they wish to understand the inner workings of the computer. Wishing to understand how the computer works at different levels is directly related to people's desire to understand the world around them. A physical and mental relationship exists in what Seymour Papert calls the "body syntonic" relationship that exists between the computer user and what happens inside the computer. Because of the commands and codes the user types into the computer, various things are caused to take place within the computer. This makes the individual oftentimes feel like the machine is part of himself or herself. This "encourages appropriation of the machine as a tool in Marx's sense--as an extension of the user." (Turkle, p. 182)

Even though the computer is considered a tool, it is considered

an extension of the user just as an individual considers his or her world an extension of himself or herself. People have a need to understand the world within which they live, and people also have a need to understand the tools that they use. Oftentimes the world within which we live is of such a wide scope and the information that is available about it is so fragmented, it seems an almost impossible task to understand the world much less define and create that world. We are in the world physically just as we also have a physical relationship with computers. For some individuals their need for understanding the world is transferred to a need of understanding one aspect of the world, e.g., computers. For some individuals it is seemingly easier to understand a somewhat finite machine such as a computer, and once success is attained in this relationship and a sense of empowerment results, individuals are encouraged to apply this success to the world at large. This aspect of computing is supportive in stimulating and encouraging individuals toward "taking charge" of their lives and their world. This is a congruent and supportive aspect of the relationship between computing and education for liberation.

However, not all individuals agree that the study of computer concepts inherently has the possibility of liberating aspects. In fact the spectrum varies from seemingly full embrace of computing power and ignorance or lack of concern for education as liberation to sturdy opposition in the belief that computers are inherently instruments of domination. Stanley Aronowitz and Henry Giroux, albeit brief, provide major thoughts in this regard in Education Under Siege:

The Conservative, Liberal, and Radical Debate Over Schooling.

Viewing the debate in strictly drawn "sides" Herbert Simon, Seymour Papert, Edmund Sullivan, and Joseph Weizenbaum would be viewed as proponents of computing power, although it is very important to note that there exists sharp differences between Simon and the others. David Noble, Harry Braverman, Herbert Marcuse, Stanley Aronowitz, and Henry Giroux are skeptical and nervous about computing power, but more specifically concerned about the aspects of technological power connoting a sense of dominance in human realities and therefore human relationships. The Marcusian view as social relations being embodied in technology underlies the concerns of Aronowitz and Giroux. They succinctly state the overall thrust of this school of thought when they conclude, "They view the machine as the reified form of social relations of domination." (Aronowitz, p. 15)

Summary

As previously stated, there exist sharp divisions between those represented by Herbert Simon and other proponents of computer power. Simon views people simply as information processors very similar to a computer processing data. Seymour Papert differs in that he is a humanist who views education as a means of empowerment via knowledge, and computers are tools which are means of enhancing this educational process. Papert's view can be associated with the Lovelace model previously mentioned since he views the computer at the beck and call of the intentions of the user.

Sullivan can also be considered a critical advocate of computer education since his insight provides some positive attributes to

individuals' associations with computing power. He agrees with Papert's viewpoint that the student should be the center of the computing experience and that it is part of the culture and not just a tool representative of Marcusian defined domination. Sullivan, as does Papert, believes that experience with computing power provides students with intellectual adventure as well as a sense of mastery. However, reminiscent of Martin Buber's I/Thou thesis, he does stipulate that since computers are concrete objects, i.e., nonhuman machines, that human machine communication is not possible. "Hence, it cannot provide the moral side of sociability." (Aronowitz, p. 16) In an associated supportive vein, Joseph Weizenbaum, a computer scientist, argues within the humanistic tradition that human mental processes such as value and judgment cannot be transferred to a machine. Sullivan further charges that compter aided instruction (CAI) neglects the more imaginary aspects of the human personality.

Although there remain sharp differences among the advocacy school, clearly Papert, Sullivan, and Weizenbaum are the "middle ground" and espouse positive statements concerning computer education. Aronowitz and Giroux clearly state steadfast concerns and opposition to computing power, "...this neutralization of technology reveals complete support for the scientific ideology of objectivity through experimental method and value-free research." (Aronowitz, p. 16) It is this world view that separates the forces of contention into two camps. Aronowitz and Giroux are representative of educators whose primary and overriding concerns deal with human liberation, while Simon and Newell are representative of computer scientists whose

primary and overriding concerns deal with computers, and seemingly have publically provided little insight into the existing or future relationship between computing and education as liberation. Weizenbaum, Papert, Turkle, and Sullivan are computer advocates that have not dealt specifically with the relationship between computing and liberation, but within whose research the seeds have been sowed for an identification of that relationship.

Within a postive vein some computerists support the idea that computers can be utilized to promote empowerment of the individual through an acquired sense of mastery while some of the more liberation oriented educators state that technology, specifically computers, are detrimental to individual empowement since it is the most recent development of Mankind's domination of nature and therefore other people. Neither school seems to overtly relate the inherency of computer based concepts to the establishment of a positive relationship between computers and education as liberation, i.e., an inherent congruence of aspects of the foundations of both areas.

CHAPTER IV

ANALYSIS OF THE RELATIONSHIP BETWEEN EDUCATION AS LIBERATION AND COMPUTING WITHIN A PRACTICE CONTEXT

Critical Perspective - The Lens by Which to See

For review and clarity purposes there exists a need to briefly detail the major elements of the critical perspective established by research in previous chapters through which examination is possible.

Education as liberation consists of a process involving two or more individuals cognizant of each other's and their own creative powers capable of transforming an ever evolving reality of world creation and self-definition through a dialogical praxis. The power source for creativity and discovery is the uniqueness of the individual which is awakened by the confirmation by significant others and bolstered by a sense of self-identity and confidence in oneself and others. It is a process involving equals although initially the "teacher" has a special responsibility of bringing to the relationship a critical perspective of how to uncover the causes of reality. It is a process centered on finding a solution to the ever present problem of making meaning of life ignited by concern for others and supported through communal effort in search of an ever evolving cultural synthesis. Although use and development of adequate language are necessary for dialogue and critical perspective, inadequate language carries with it the power of limitation. Inadequate language much as

false needs can arrest our ability to shed Marcusian false consciousness and critically perceive the causes of reality such as the hidden acceptance of the idea of domination by technological Man and the banking concept of conventional schooling.

In the last chapter I have applied this framework to major computer concepts. The conceptual foundations of education as liberation and computers provide the particular lens through which to view their sometimes supportive and sometimes unsupportive relationship. The Turing machine perspective of Man simply as an information processor implicitly denies there being a self which is the source of power for liberation. It is a behaviorist view of Man congruent with the Lovelace model of computing, e.g. garbage in/garbage out. The conceptual framework is based in the view of the world as a fixed medium, i.e., fixed reality, through which information flows and is altered, but the medium remains static. Control and domination by the fixed medium, e.g., the world, the computer, has to be adjusted to by the participants. Active participation within the context of this world view is the video game player. The computer is a fixed reality providing only predetermined choices to the player. By being the "player" in the scenerio, the individual surrenders ultimate definition of the medium. Even success within the context of being a player only enhances the idea of accepting preferential choices from within a fixed medium. Opposite to this concept of a fixed medium in which individuals do not have power is a view of computers which rests on the concepts of heuristics and emergence. Inherent within the conceptual framework of heuristics

is the implication of Man as an intuitive being which has a relatedness to Man as an individual, i.e., a self. This becomes clearer when heuristics is viewed in conjunction with the related concept of emergence. The ability of a program to learn from its experiences, i.e., perceive the causes of reality, and alter the hitherto "fixed medium", i.e., alter the instruction codes of the program, demonstrates a potentially positive relationship since it provides a supportive conceptual basis for Man having the creative power for reality transformation and self-definition as described in the education as liberation model. An individual's success in a framework of this type provides the conceptual seeds for confidence in participation in more expanded reality transformation.

In this chapter I apply the same framework of education as liberation to a particular and concrete example of computer practice. By examining both theory and practice, I believe I can gain further insight into the issues. For my example of practice I have chosen the area of instruction giving and more particularly the area of instruction giving on the IBM PC.

I believe the cliche about first impressions being important is justified in many instances. A student's perception of the computer's potential for liberation can be influenced while learning how to operate a computer. I believe this is especially true when students are initially introduced to computers. The underlying concepts presented within an introductory context can leave long lasting impressions. The underlying concepts also provide an indication of how computists, i.e., the software designers, view the computer. I

have examined software intended to introduce students to computer operation. I have chosen Exploring the IBM Personal Computer because this package is significant in more than one regard. Because of its depth within an introductory context, it is influential in introducing operational and attitudial concepts. IBM is a major computer producer, and because IBM sells this program, the concepts introduced in the program are experienced by a large portion of students trained on the IBM PC. For this reason the potential for the package being used within a formal as well as an informal educational setting is significant. Even so, the examination of the package and resulting conclusions are not intended to be regarded as representative nor comprehensive, for there exists a variety of introductory packages as well as a variety of categories of currently available software. The intent is to examine the relationship, within the software, between the foundational concepts of education as liberation and computer concepts. The conceptual framework established in previous chapters is the "lens" or perspective utilized to critically examine the hidden curriculum in regards to the relationship between education as liberation and computers. I believe an investigation of this type, specifically targeted within the conceptual framework that it is, is original.

The Software

The software is divided into the five basic sections of instructions for operating the software package, the keyboard and word processing, disk storage and disk operating commands, BASIC language programming, and printer operation. I have utilized this package with

hundreds of students within an introductory context. I have observed that students generally "catch on" to its operation rather quickly and easily, and seemingly enjoy the package. When operated in conjunction with a color monitor, it is a bright and attractive package and does not lose this quality after "going through" it several times. Within the traditional instructional context, it provides a sound introduction to the IBM PC and elementary operational concepts.

Operational Description

When the software is initially started up, the letters IBM are displayed in very large print on the screen, and a hypnotic tune is played by the computer speaker. The next screen that is displayed contains the copyright messages, and a very light and airy music is played. The next screen is a welcome screen and displays the following message:

> IBM has made every effort to make your Personal Computer easy to use and learn. This lesson gives you a chance to discover this powerful machine on your own terms. Take your time and have some fun -- there's no time limit. Feel free to review important topics and don't be afraid to guess should you get confused. You will find the Personal Computer to be a patient and capable teacher. (IBM, Introduction)

This message stays on the screen for approximately 18 seconds. The next screen is the table of contents screen. It lists the contents as (1) instructions, (2) the keyboard, (3) disk storage and DOS, (4) BASIC programming, and (5) the printer. The last message on the screen is "Stay tuned for Chapter 1." (IBM, Introduction) This screen stays on for approximately 12 seconds.

The next screen to be displayed is titled "Chapter 1 Instructions" and states "This program has pages and chapters, just

like a book. You can page both forward and backward or skip around from chapter to chapter. Let's see how it's done." (IBM, Chapter 1) The Chapter 1 instruction screen stays on for approximately 12 seconds and then the program moves ahead to the next page.

The next eight pages, or screens, of Chapter 1 instruct the user how to page forward and backward, i.e., turn pages within the software. Within these options there exists the possibility of the user skipping the remainder of the chapter and paging to the beginning of the next chapter or skipping to the beginning of the current chapter so that the previous sections that have been gone through can be reviewed.

Within Chapter 1, "The Instructions," there is a graphic representation of the keyboard with labeled keys. The last page of Chapter 1 provides instructions on how to turn the sound effects either on or off. There does not exist any control by the user for the first few screens of the software package. The user does not have any option as far as the music being played nor the screens being displayed, nor the time that they are displayed. The IBM logo, the copyright page, the welcome page, the table of contents page, and the Chapter 1 instructions page are predetermined and preprogrammed as to the amount of time they are displayed upon the screen. The instructions for paging forward or backward do allow the option of retracing steps for review, and also for skipping over pages when forward or backward movement is desired by the user. The concept of movement is linear by nature.

The initial page of Chapter 2, "The Keyboard," provides a brief

summary and review of the material that was introduced in Chapter 1. The second page of Chapter 2 displays the keyboard in graphic form and states:

> the keyboard lets you control the personal computer. It's easy to learn, yet flexible enough to be used by all types of programs. Don't be surprised to see certain keys used differently from one program to the next." (IBM, Chapter 2)

The next seven pages introduce the typewriter keys, enter key, function keys, cursor keys, numeric keypad, and the modifier keys. As each key is introduced within these seven pages, it is made to stand out with a different color from the other parts of the keyboard.

The final review of the keyboard section of the chapter is the "press any key" page. This provides the option of pressing any key to learn more about or to review the uses of the key which is pressed. For instance, if any letter key is pressed on the keyboard, a graphic representation is given of the key in upper and in lower case. The key is highlighted by blinking and changing colors on the graphic representation of the keyboard. This representation of the key and its written definition stays on the screen for approximately 17 seconds, and then the original page returns and says "try another one." (IBM, Chapter 2) There are also instructions to press the page down button to go to the next page or to press the page up button to go to the previous page. The timing is still programmed when a key is pressed for additional information or review with the user having the option of paging back or paging forward and thereby breaking the preprogrammed timing sequence.

The next session of Chapter 2 is the funwriter which is a

tutorial on word processing. There is a rectangular block with text in the center and small hearts in inverse video on the top half of the screen. The hearts move clockwise and counter clockwise on the outside of the rectangular block. As the letters of the instructions are printed on the screen in a slower than normal speed, a click is heard as each letter appears on the screen. The next 14 pages introduce the different modes of operation of the Num Lock key, the Caps Lock key, the Scroll Lock key, and the Tab keys.

After the user is introduced to the different keys in the previous pages, a menu appears at the bottom of the screen. This menu consists of eight of the function keys and their uses. The different functions of the funwriter word processor consist of cut, paste, pickup, putdown, print, radio on/off, hearts on/off, autotype on/off. The function key six, i.e., the radio key, when pressed provides eight different melodies which are very similar to what may be heard when a person opens a music box. The function keys work on this screen. The last instruction on this screen is "press Page Down for a suggestion." (IBM, Chapter 2) The next dozen pages are instruction on the various options available within the funwriter. They are: turning the racing hearts on and off, turning the automatic typing mode on and off, overstrike correction capability, the paste or insert capability, the home and end key functions, the control home key function which erases the screen, the block move or put down function, the repeat key function, the delete character function, the backspace, spacebar, and delete keys, the insert key, the radio function, and the print or hardcopy capability. After the introduction of the various functions

and capabilities of the funwriter, a screen appears and states that this is a practice page that the user is allowed to spend as much time as he or she desires to practice any or all of the keys and functions of the funwriter.

Chapter 3 introduces the user to disk storage and to DOS (disk operating system). The initial page states that the disk drives can store or record information and also be rewritten. It also informs the user that large amounts of information can be manipulated with ease. Also on this page is a graphics representation of the front of the IBM system unit. The next few pages distinguish between a floppy disk and a fixed disk drive and inform the user that the difference in storage capacity ranges from 180 thousand characters to 10 million characters. The drive names A, B, and C are notated for the user. One page informs the user of how to care for the diskettes. Another page introduces the user to write protection, i.e., how to prevent a diskette from being written on, i.e., prevent erasing data by storing new data in its place. The "accidents will happen" page provides a cute graphic demonstration of a little bug or worm biting a large chunk out of the diskette with text assuring the user that a backup copy of diskettes is always a wise choice. This chapter then defines what a file is and how to name files and provides an analogy between files and a physical file drawer. In the final page of this section of the chapter, the directory is defined and its function explained and graphically displayed.

The last part of this chapter is involved with the disk operating system. DOS is defined as a program and two cartoon diskettes are

graphically demonstrated on the screen so that the user can practice the commands that the software explains in this chapter. The user is assured that he only needs to know a few DOS commands. Starting up the system is explained, and if any DOS commands are entered during this process, a new page appears on the screen and states, "Please don't use any other commands until you have finished learning Dir, format, copy, and diskcopy. When you get to the 'for experts only' page you can play til your heart's content." (IBM, Chapter 3) In the succeeding pages the directory, format, copy, and diskcopy commands are explained and demonstrated with the opportunity provided to the user to practice on the cartoon diskettes displayed upon the screen. At the conclusion of the explanation of these DOS commands, a "for experts only" page appears with the instruction that if you are an experienced DOS user, you can type the word "help" to receive a list of advanced commands. Within the help page definitions are provided, as well as instructions on how to use twenty-three additional DOS commands.

Chapter 4 provides a very brief introduction to the BASIC language by presenting a four-line program and allowing the user to make changes in it. It also instructs the user how to make a hardcopy of the program that is being changed.

Chapter 5 introduces the user to the printer. The initial page of Chapter 5 provides a very dramatic sound and graphics display of the printer. A graphics display of a sheet of paper is represented on the screen as instructions are printed on the screen which is accompanied by sound effects. Instructions are given on paper

alignment and online lights. Text is displayed on the screen very slowly, very much as if a printer were printing the words. The user does not have any control of the speed at which the text is displayed on the screen. Instructions and practice are provided on how to dump, i.e., print the contents, the screen to the printer.

To terminate the program the machine sometimes has to be turned off even though the instructions state that a system reset can be initiated. It takes approximately two hours for a novice user to thoroughly review the software.

The Conceptual Lens

A primary foundational basis of the liberation model is the nature of reality, i.e., reality is either fixed or can be transformed. The second major foundation is the inherent capacity of the individual for reality transformation, i.e., reality may be transformable but is it transformable by people? The essence, or very existence, of reality is the human conception of it, whose power source is the uniqueness of the self. These two considerations are the basis upon which the "second tier" of the foundation of the liberation model is built. The "second tier" of the model's conceptual foundation is again composed of two major categories of related consideration. Firstly, they are the environmental conditions which encourage and promote the development of the second category which is the tools, e.g., critical perspective, confidence, sense of self, etc., needed by individuals if they are to use their inherent capacity for reality creation and transformation. It is through this conceputal lens that the software package, i.e., the instructional

environment, was analyzed for the relationship exhibited between education as liberation and the computer concepts promoted within it. The focus of the lens has been sharpened by the application of the concepts of Marcusian false consciousness, i.e., domination and control associated with fixed reality, the Turing machine, i.e., Man as information processor, and the AI concepts of heurestics and emergence, i.e., perception of the causes of, and the transformation of reality.

The Analysis

The concept of a fixed medium or fixed reality is a very readily observable message of the package when viewed critically. The instructions section provides a means for the user to "flip" foward or backwards within the software package as if thumbing through a book. The instructions are easy to understand and provide ease of operation. This is noted only on two accounts. The first being that ease of operation is important for first time users and builds their confidence in the package, and secondly this confidence in the package may create an atmosphere of acceptance of hidden messages. Examination and discovery of aspects of the software such as ease of use is important in this analysis only as it is related to the relational framework, e.g., the perspective "lens," as previously delineated. Within that context the instructions section is a clear indication of the hidden assumption that a fixed reality exists. Within this section the prime indication is that the user is provided with an explanation of how to make preferential choices within a fixed set of circumstances. The user is a "player" within a fixed reality.

The second section continues with the idea of a fixed medium since it explains the layout of the keyboard, the uses of the various function keys, and what their utility is to the operator within software packages. The latter part of this section involves instruction in using the funwriter word processing option. It too provides a fixed medium although with some allowances. Discussion will be expanded on this later.

The disk operating system and the printer operation section are more of the same. They instruct the user on how to perform in order to select from availabe fixed options. It is the player mentality which is encouraged and promoted as the user learns to operate efficiently within each specific medium, whether it be operation of the package, keyboard function keys, word processing concepts, the disk operating system or becoming functional within the printer medium. The view is one of the operator, i.e., Man, as an information processor who makes choices from predetermined choices as defined by the fixed reality of the software. Within the context of this package, one of the active and overriding conceptual bases established is that of a fixed reality and Man as a player with only preferential choices which results in a noncongruent and unsupportive, and indeed detrimental, relationship between education as liberation and computers. Indeed, the rules of the game are overtly stated by one screen as indicated by its title "Practice DOS Rules." (IBM, Chapter 3) In the section which discusses disk care and disk capabilities, commentary as well as the rules of the game are given: "The rules to make up a new file name are easy . . . Each file in a directory must

have a different name." (IBM, Chapter 3) These are the rules to which the player must adhere if success is to be attained.

There are other examples within the software with hidden, attitudinal messages of domination and control but when viewed through the conceptual lens are glaringly apparent. The following quotes are taken from several screens from the keyboard section of the package.

> Press the Num Lock Key...
> Change the Num Lock label...
> Press the Caps Lock Key
> Try typing your name...
> Type a lower case "a"...
> Press the Tab Key (IBM, Chapter 2)

From the printer section of the package these quotes are found.

> The Online light shows that it can receive instructions from your computer.
>
> Now press the ONLINE switch once.
>
> When the printer is Online the Line Feed switch does not work. The Online light must be OFF for the Line Feed switch to work. (IBM, Chapter 5)

From the word processing part of the instruction section a more suggestive approach is taken, but nevertheless the user is still bound by the predetermined rules of the game.

> It's time for you to put funwriter through its paces. Each time you press the PgDn key, a suggestion will appear. Wait for the typing to stop before trying it.
>
> Press PgDn for a suggestion. (IBM, Chapter 2)

And from the last screen of the software package the following is seen.

> This is the end. You have three options:
> 1. Review the lesson.
> 2. End the lesson.
> 3. Try a new program.
> (IBM, Chapter 5)

The message to the user is that he or she is not in control of the microworld in which he or she is operating. Indeed, it is a message transferred to the user that is attitudinal in nature in that the concept of pressing keys at the direction of another, e.g., a computer software package or human teacher, provides the hidden message that the user is in control only at the leisure of the software and there is a need for the user to be directed or filled with knowledge by another. When the package is first placed into operation, this message is quite clear since the first several screens are pretimed and set as to when they will appear and disappear from the monitor. The user absolutely does not have any choice within the context of the package during this time. The chastisement found in the DOS chapter, "please don't use any other commands until you have finished learning Dir, format, copy, and diskcopy" (IBM, Chapter 3) is polite and refined indication of this situation. However, the main thrust is one of total refusal to accept the possibility that it would be beneficial for a student to follow a path other than the one prescribed. The statement, "You will find the Personal Computer to be a patient and capable teacher" (IBM, Introduction) assures us that this is the banking concept of education which is anathema to human liberation. This demonstrated conceptual framework found within the package establishes a negative relationship between education as liberation and computers within the context of this software. Seduction of the user to accept an attitude of control and dominance may be accomplished by the offer of an avenue of success within the confines of the package when he or she reads "Recorded information may be

recalled or rewritten at your command." (IBM, Chapter 2) A pseudosharing of control is possible if the rules of the game are mastered.

The word processing, disk operating and printer operation sections are prime examples of information processing within a fixed medium. The essence of word processing is the processing of information, while one aspect of disk operation is the transfer of text, i.e., information, to and from the storage medium of the disk, and printer operation entails transfer of information to the storage medium of paper. On a fundamental level, the hidden message is that human beings are traffic cops utilizing the computer as a directional signal to direct the flow of traffic, i.e., information. Again, this is within a fixed reality of limited options in which there does not exist an uniqueness of self which allows selection and creation of choices other than those presented by the fixed medium, i.e., fixed reality.

Associated with the concept of fixed reality is the Marcusian concept of false consciousness, aspects of which are found within the package. The Marcusian concept of false consciousness is a concept centered upon subtlety. There are three similar and prime examples of creation of false needs and diverting the operator's attention away from foundational issues. In the instructions section the user is told that he may turn off or turn on the sound effects of the package. Throughout the package there are several instances when words are being displayed on the screen as in the printer section, or when a little worm crawls across the screen in the DOS section, that the user

may or may not wish to hear the sound effects. He or she has this option. During the word processing section, a rectangle containing the text with little hearts appears on the outer edges of the rectangle; the user has the option of placing the hearts into movement or not. Also during the word processing part of the keyboard section the operator is notified that he or she has the option of playing a radio which has a half a dozen musical tunes available. There is no doubt that these are enticing options made availabe. That is the point. They are enticing, but they are also options made available within a fixed medium and options of which the user may or may not have a need. Within the foundational framework of this analysis, they can be considered a false consciousness of need which diverts attenuation of the user away from the idea that he or she is operating within a fixed medium. Indeed, to the user's way of thinking he does have control of the package, but when viewed with the critical perspective of the conceptual lens, it is the false needs created within the package that dominate the user's thinking.

At this point in the examination of this particular software program, little can be stated as to a supportive relationship between education as liberation and computing. The totality of computing within the examined context connotes a structure of fixed reality reinforced by an infrastructure of Marcusian false consciousness in support of a reified form of domination and control. These are the messages sent to the new user of computing power who is viewed solely as a processor of information, who at best is a player according to predetermined rules of the game. At this point in the examination,

demonstrable evidence is not extant to suggest that the environment of the package encourages or supports development of the concepts of reality transformation, uniqueness of the individual which is the source of creative power, a sense of self and the confidence found in that sense, or a critical perspective, all of which are required for reality transformation. However, upon further examination some limited aspects of these elements are apparent within the environmental context of the package.

The one section of the package which provides indications of a supportive relationship between education as liberation and computing is the section which gives a very brief introduction to programming. Just as the previously delineated messages were foundational to the structural design of the software, the liberating messages which are conveyed are the basis upon which computing power rests. Although initially the mechanism is one of control, as represented by the statement, "Everything that the Personal Computer does must be controlled by a program," (IBM, Chapter 4) one of the messages of the programming section establishes a supportive relationship between education as liberation and computers when viewed through the conceptual lens. The essence of programming is the creation of a microworld by the user. If the choices within a software package are thought of in terms of preference rules from which the operator makes choices, then the programming behind the infrastructure of that software can be thought of as the constitutive rules, or the causes of reality, within the context of the software package. When users are introduced to the concept of creating their own microworlds via

alteration of the causes of reality, i.e., the instruction codes of a program, through creation of the codes that programs consist of, i.e., through programming, the basis of a supportive relationship between education as liberation and computing power can be established. Simply stated, when users become aware that they have the power to make microworlds of their own creation, the potential exists for them to apply their newly found creative powers to the world at large. Inherent within the new critical perspective is the concept that a fixed reality no more exists in the outside world than it does within the microworlds of their own creation. Within the very brief context in which programming is introduced in this package, the seeds of reality transformation are planted. It is doubtful that maturation of confidence to act in the outside world would be attained from only the brief experience encountered in this package, but the introduction of the concept of fluid reality exists, which is appropriate in the sense that this software is introductory by nature anyway.

As previously stated, the initial context in which the programming section is presented, and the entire package, is one of step-by-step instructions which are to be followed by the operator. However, within this context the concept that the user does have the capability to create and alter the conditions of a microworld within the computer environment is evident within the fundamental definition of programming. Indications of the power are evident within the basic definition of the Disk Operating System (DOS) section as well as the printer section when viewed in relation to programming. As previously stated, within these sections the concept of people as information

processors is evident; however, when viewed within the conceptual framework that people have the power to utilize the computing power inherent within DOS to alter the computer environment, i.e., the microworld, a supportive relationship between education as liberation as computers is extant.

The printer section can be conceptually viewed as the link between the microworld and the outside world. Again, although viewed initially as a statement of Man as a processor of information, e.g., the traffic cop signaling which direction information is to flow, when viewed in conjunction with the idea that people can design the computer environment, and that printer output is one aspect of that environment, the concept of the power of creation by individuals begins to germinate. When printer output is viewed in conjunction with word processing the transference of creative power to the outside world is made. Word processing at a fundemental level is truly representative of people acting only as information processors, but when viewed as a medium in which ideas and concepts are used to create microworlds of intellectual discourse, i.e., creative aspects of writing, the establishment of a supportive relationship between education as liberation and computing is evident. Within this conceptual context, transference of human creative endeavors to the world at large is possible. Of course one of the links to the outside world within the concepts presented within this package is the use of the print medium, e.g. concepts presented within the printer section.

Summary

As previously noted, there is a double edged sword when establishing the relationship between education as liberation and computing within the design of this package, as well as within many of the fundamental computer concepts presented. The overall design of the microworld of this package exhibits a reliance upon the concept of a fixed reality in which the user has only preferential choices and is diverted from considering concepts of liberation by establishment of Marcusian false needs, e.g., turning sound on/off. However, continued examination through the conceptual lens does provide the establishment of a supportive relationship between education as liberation and computers. The fundemental concept of programming in which the user possesses the power to create a microworld exhibits a conceptual basis which enhances a positive relationship between the concepts associated with human liberation and the computer concepts found in the DOS, printer and word processing sections of the software.

CHAPTER V

CONCLUDING STATEMENTS

The concluding chapter of this study consists of a summary, some recommendations, and a series of reflections. The summary section represents a reinteration of key concepts concerning computers, education as liberation, and the relationship between these concepts. Also summarized is the case study of the analysis of a specific computer software program from the perspective of education as liberation.

Summary

The microchip revolution has significantly increased the numbers of people using computers and therefore has encouraged expressions of valid concerns since the resulting technological and philosophical changes result in difficult adjustments for society and its members, e.g., economic and financial displacement, self-image, and issues of control and domination. Some individuals believe "education" plays a major role in helping people in making these adjustments. Addressing basic philosophical considerations concerning our cultural direction is related to education as a humanizing process, or liberation, and is one of the issues educators should be examining. Since computers will continue to be a major force within our culture, educators should address concerns as to the impact computers are having and will have on the struggle for freedom, i.e, liberation. Whether computers will

be used for liberation or control will depend in part upon the relationship between computer concepts and the goals of education as liberation.

Education as Liberation

Education as liberation consists of a process in which individuals are aware of human beings' creative powers which enable them to change a fluid reality. This means they possess the ability to create the world in which they live and define their own being in the process. The power source for creativity is the uniqueness of the individual which is bolstered by the confirmation by significant others which leads to a sense of self-identity and confidence. Although the process involves equals, the "teacher" has a special responsibility of bringing to the relationship a critical perspective of how to discover the causes of perceived reality. This process is a communal effort oriented toward making meaning of life which is invested with a concern for others and results in a continuing evolving cultural synthesis. The continued reconsideration of the cultural synthesis centers upon praxis, i.e., it involves continual reflection and action, which necessiates dialogue with others. Although use and development of adequate language is necessary for dialogue and critical perspective, inadequate language carries with it the power of limitation. Inadequate language as well as false needs can arrest our ability to shed Marcusian false consciousness and critically perceive the causes of reality such as the hidden acceptance of the idea of domination by technological Man and the hidden curriculum of conventional schooling.

Technology and Liberation

Many of the conflicts which exist within our conventional educational system result from the inherent conflicts between the value of freedom and some of the principles upon which our technological system is based. These conflicts result not only in contradictory demands being placed upon our public educational system but also can lead to conflicts for the individual.

One of the obstacles to liberation is that people's consciousnesses are submerged by the reality of oppression. Associated with this submerged consciousness is the schooling process which supports its occurrence. In order for an individual to consciously create or change reality, it is necessary the individual be aware of the possibility. Part of the hidden curriculum is the knowledge that this possibility does not exist since the hidden curriculum by definition is hidden from people. Liberation cannot take place until this realization of reality creation occurs. Their exists a need to identify the constitutive rules within the context of our existence and create new language within which thinking occurs if we are to free ourselves, i.e., become liberated, from the effects of the hidden curriculum of conventional schooling.

Freedom has been enhanced through our technological system by decreasing physical hazards, but at the same time a degree of repression and domination has resulted. Herbert Marcuse sees an inherent conflict between our technological system and the goals of liberation. Our technological system makes people dependent upon society and a reality that reinforces itself by imbuing them with a

consciousness of false needs, i.e., a false consciousness which is one dimensional in that people believe their false needs can only be fulfilled by reinfocement of reality. This can prevent people from seeking a qualitative change in reality since efforts toward supporting reality thwarts effort toward changing reality. Individuals become so engrossed with the pursuit of fulfilling these false needs that they are unable and oftentimes unwilling to recognize their state of bondage. Marcuse regards the basic rule of this current reality as involving domination and subjection since technological Man's one dimensional view is one of domination and oppression and is demonstrated within the life of people who exist within a society that values the technological system.

The public schools are a major focus of this conflict between the principle of freedom and the values of a technological system. Within this dilemma of domination versus liberation or freedom exists the issue of schooling versus education. Within the schooling concept of education students are treated as objects to be filled with knowledge by teachers. The purpose of conventional schooling is to change the being or the consciousness of students to a false consciousness. Students are viewed as intellectually and socially deficient, and the purpose of conventional schooling is to repair them or to make them well within existing cultural standards. Conventional schooling is an exercise in domination and indoctrination to a world of oppression since it is a concept formulated and initiated within the reality of oppression. Education, as opposed to schooling, allows people to find meaning in their experiences. The issue examined within this thesis

has been whether or not the relationship between computers, i.e., foundational computing concepts, facilitates or suppresses the human impulse for making meaning of experiences, i.e., education as liberation.

Computers and Education as Liberation

There are a number of important computer concepts that have significant implications for education as liberation. The Lovelace model of computers, for example, is a behaviorist view which states that computers do only what they are programmed to do. It is a framework which conceptualizes the world as a fixed reality through which information flows and is altered, but the medium remains static. The individual surrenders ultimate definition of the medium, i.e., reality, and even success within this context only enhances the idea of accepting preferential choices from within fixed reality. Empowerment is not an issue since the individual does not possess the power to alter reality, i.e., the computing environment.

Related to the concept of a fixed computing medium, i.e., fixed reality, is the concept of the Turing machine, i.e., a machine that can emulate any other machine, which speaks to the significance of the individual as a information processor. Computers are Turing machines since any computer can emulate or simulate any other computer if provided with the correct programming. The output of two different computers can be identical if programmed with the same principles. The Turing machine, like the Lovelace model of computing, is based upon the theory of behaviorism that given a certain input within the parameters of specified conditions, a specified output can be

expected. It is upon this assumption that artificial intelligence theory concludes that if a computer is able to simulate a human being's responses, then indeed it does have intelligence for it acts as a human being would act. This assumption can be implied to mean that if a computer could simulate human responses, then it is conceivable that it could generate knowledge as if it were human. Implicit in this assumption of human modeling is the conception that humans create knowledge, i.e., possess the power of creation, but it derives from the idea of Man soley as a information processor operating within a fixed reality.

The concept of a fixed reality is rejected when viewed from the perspective of the artificial intelligence (AI) model of intelligence from which the concepts of heuristics and emergence derive. Within the conceptual framework of heuristics is the implication of people as intuitive and diverse beings, each with a self. When a problem arises, it is theorized that people almost unknowingly discard approaches to the resolution of a problem which are not likely to be productive. Artificial intelligence programmers emulate this human model when constructing software programs. The AI intelligence model becomes clearer when heuristics is viewed in conjunction with the related concept of emergence.

Within the concept of emergence, a program has the ability to learn from its experiences and alter its own instruction codes. This demonstrates a potentially positive relationship since it provides a conceptual basis for Man having the creative power for reality transformation and self-definition. This human model of AI espouses a

view of Man as a intuitive, creative problem solver who possesses the creative power of self-definition. This builds toward a supportive relationship with liberation educational theory. However, the view that the program, or individual requires alteration or repair as it learns from its experiences purports a more negative relationship, as does the AI premise that Man is a information processor. Man as information processor does not address "knowing" or consciousness.

AI programs as well as all computer programs have to be programmed by someone initially. Computerists who are programmers tend to feel creative when programming, which is congruent with the ideal of creating your own world, the basis for liberating theory. If computerists gain the perspective that it is possible to create microworlds, then it is possible that they may also realize that it is possible to change or create reality. If the connection is made between microworlds and the world at large, then there is a supportive relationship between computing and liberation.

Individuals such as Papert, Weizenbaum, Turkle, and Sullivan support the idea that use of computers can promote individual empowerment through a sense of mastery while the more liberation oriented educators state that technology, and specifically computers, are detrimental to individual empowerment since it is the most recent development of people's domination of nature and therefore other people. None of these individuals seem to relate basic computer concepts to the establishment of a positive relationship between computers and education as liberation.

Examination of a software package has provided further insight

into the issues. There does exist a double cutting edge when establishing the relationship between education as liberation and computing within the design of the software package examined in the research study, as well as within many of the fundamental computer concepts presented, e.g., programming, creativity, control, and the power and limitations of language. The overall design of the microworld of the package studied during this research exhibits a reliance upon the concept of a fixed reality in which the user has only preferential choices and is diverted from considering concepts of liberation by the establishment of Marcusian false needs, e.g., allowing the user to turn sound on/off is only a preference choice within a fixed reality. However, continued examination of the software with a critical perspective does provide the establishment of a positive foundational relationship between education as liberation and computers. The fundamental concept of programming in which the user possesses the power to create a microworld exhibits a conceptual basis which enhances a positive relationship between the concepts associated with human liberation and the concept of programming.

Although initially the context of the programming section is one of control, the essence of programming is the creation of a microworld by the user. If the choices within a software package are thought of in terms of preference rules from which the operator makes choices, then the programming behind the infrastructure of that software can be thought of as the constitutive rules, or the causes of reality, within the context of the software package. When users are introduced to the concept of creating their own microworlds via alteration of the causes

of reality, i.e., the instruction codes of a program, through programming, the basis of a supportive relationship between education as liberation and computing power can be established. When users become aware that they have the power to create their own microworlds, the potential exists for them to apply their newfound creative powers to the world at large if they realize that a fixed reality no more exists in the outside world than it does within the microworlds of their own creation. At best, within the software the seeds of reality transformation are planted since it is doubtful that maturation of confidence to act in the outside world would be attained from only the brief experience encounted in this package. The introduction of the concept of fluid reality is subtly present which could be considered appropriate in the sense that this software is introductory by nature.

Recommendations

The essential principle for teaching computing within a model of education as liberation is that human beings ought to be in control of the computing process. It is through the knowledge of how a computer operates that the basic concept of liberation, i.e., reality transformation, is made available to students of computer education. An obvious recommendation to make which would follow this intellectual course would be to recommend that all computer students be taught to program. This is an easy if not facile recommendation to make, but perhaps the most difficult to implement. All students may not have the intellectual capacity nor interest to pursue such a course of study. However, this is the challenge to teachers that teach "computer literacy" curriculums. The critical orientation is not to

stress computers as such or as an end in themselves, but to teach within an environment of concern for education as liberation and use the appropriate computer foundational concepts so as to facilitate human liberation. For example, my experience with the case study proved to be enlightening because: (1) it reflected a clear and particular orientation, i.e., in this case an orientation of control, and (2) it showed the power of programming. My case study was quite limited, and therefore I would urge that a wide range of other software programs be examined from the perspective of education as liberation. For example, it would be valuable to know the basic orientation of such programs as those designed for word processsing, financial analysis, data base management systems, and project control systems.

Secondly, given the importance of the perception of reality and more particularly the importance of how people experience computers, it would be valuable to phenomenologically study individuals involved in computing. For example, studies might be done on the attitudes, experiences, and reality formation processes of computerists, programmers, computer educators, novices, and noncomputer users.

Thirdly, given the significance found in the relationship between education as liberation and computer concepts such as heuristics, emergence, programming, and the AI model of intelligence, and the importance language and dialogue has for the liberation model, it would be valuable to investigate the construction of computer languages for indications of the realities from which they were created and clarification of the relationship between liberation as

education and computing. For example, it would be valuable to examine popular and wide-spread languages taught in many schools, e.g., BASIC, Logo, Pascal, and COBOL.

Lastly, I believe that those educators interested in liberation theory need to further clarify the concept of control. This issue will be discussed in the section below on Reflections.

Reflections - Making Meaning

From the users' viewpoint computers are representative of a fixed medium in which they only have choices within the framework of the computer's program. Examination and analysis ending at this point would result in a single conclusion congruent with Stanley Aronowitz's assertion that computers are the most recent development of Mankind's domination of nature, and therefore people. However, further critical examination, i.e., use of the critical perspective used and described by Freire, Pinar, Apple, and Greene, of the establishment of the fixed medium experienced by users reveals the possibility of a conceptual basis for a positive relationship between the foundations of computing and education as liberation.

Programs experienced by users, e.g., "Exploring the IBM Personal Computer," are most often written in a high level language, i.e., a language which makes it less difficult to program with because its commands are similar to English. This was the type of programming language the young girl was referring to in the interview reported by an astounded Sherry Turkle in The Second Self. The universal concept of creation, whether of microworlds or reality, is found in computer programming and liberation theory. There exists a basis for this

relationship.

The user's computing environment can be thought of in terms of a pole made of building blocks, i.e., a hierarchy, with the fixed reality of the microworld being at the top. The end of the pole is above the waterline in a lake, and it is this end which is the microworld that is visible to the user. Supporting that microworld, below the waterline and invisible to the user, is the program of the software. As I stated earlier, this program is ususally written in a high level language, which means it is at the high end of the pole, but still below the the waterline of the lake, i.e., invisible to the user. If the water becomes clear enough, the user can reach through the surface of the water and change the arrangement of the building blocks enough to effect a change in the angle or positioning of the top portion of the pole above the water, i.e., his or her microworld. This is true of the microworlds inhabited by computer users. If users can look beyond the computer microworlds they see as users, and see the programming codes that the microworlds exist upon, they can change and create. This connection between liberation and computing directly connects and goes beyond a lateral connection, for the power of creation is universal, i.e., it is the foundation of liberation and computing and only takes different forms when viewed from the perspective of computing or education.

Just as we can think of the instruction codes, e.g., words, grammar, syntax, of a high level programming language as the building blocks of software programs, programming languages have building blocks also. They are the instruction codes of the machine, i.e.,

machine language. Although not actually, machine language is traditionally described as the language in which the computer "thinks." It is the instruction codes, e.g., words, grammar, syntax, of machine language that are the building blocks of the words, grammar, and syntax of high level languages. Machine language can be thought of as the cement that holds the building blocks of the pole together. I thought about using the word "bond" or "glue" instead of cement, but cement is more appropriate since changing a program or reality is not easy, and therefore cement provides the proper connotation.

The computer processes, i.e., "thinks," in electronic pulses. These pulses are controlled by the arrangement of electronic logic gates, e.g., words, syntax, and grammar, which are the building blocks of machine language. These electronic logic gates can be thought of as the ingredients that make up cement which bonds the blocks of our pole together.

I stated before that the concept of creativity was universal, and the programming of microworlds and reality creation were more strongly related than through a lateral connection. The electronic logic gates, i.e., ingredients of the cement, that are the building blocks of machine language literally consist of a blend of the human mind, which creates their logic, and the physical world, i.e., reality, or a portion of reality which we call physics. This is true with the analogy of our pole also. The logic of the consistency, i.e, in which proportions and under which conditions, of the ingredients of cement are a blend of the human mind, which creates the logic, and the

physical world, i.e., reality, or a perspective on reality which we call physics. This is the relationship for those that can see it. Stated in another fashion, the foundational concept of creativity upon which computer programming rests is the same foundational concept of creativity upon which reality transformation and self-definition rest, i.e., the power of the human mind. Once the murky waters are cleared, i.e., critical perspective is gained, reality becomes crystal clear and we are able to define ourselves with vision.

I stated that this is the relationship for those that can see it. This was not intentionally coy or egotisical. The statement was made in reference to the elusive qualities I have found when attempting to uncover and grasp the hidden curriculum within the context of the topic of this thesis. I believe the elusiveness wrestled with results from the fact that the curriculum is hidden and that an adequate language does not exist for conceptualization.

I believe that the present language of critical perspective and resulting self-definition may be similar to the grunts used by our ancestor in the cave in comparison to the advanced language used by an atomic physicist in our technological world of today. Just as in the best of conditions modern Man does not concern himself with the gods of wind or fire, there may arrive a time when the language of the critical perspective, in search of self-definition through reality transformation, is as sophisticated as that used by Technological Man in his efforts toward caring for our physical needs.

Human beings have used domination in their efforts toward caring for physical needs. At first it was probably the hunter with his bare

hands, then there was the use of the rock, then the ax or club, and so on until currently we exist in a society in which the domination of nature is not so apparent. We no longer hunt our food in the wilds but raise animals for slaughter. Within this arena domination is almost complete. We rarely gather berries from free growing bushes any longer since we now control the planting and cultivating of huge amounts of grain producing plants. Our domination of our domesticated animals and plants exceeds mere control of their life cycles for we have genetically controlled what they are. Cattle wait patiently for slaughter, and it is difficult for domesticated plants to survive outside the realms of our cultivating care. In order to survive we have entered into a psychology of domination that permeates who we are and what we touch. I believe our physical presence, i.e., our biological needs, has been conducive to promoting development of tendencies within people toward a psychology of control. To exist within a physical world, society has chosen a dominant methodology of controlling nature instead of being fluid with it. This psychology of control is evident within the foundations of computing power just as it is evident within our society. As previously stated, one of the bases of computing is the instruction codes of a program. The word "instruction" connotes to me a giving of orders, within the field of computing as well as within the field of education. The point is that it is a psychology of controlling something, whether it be the computer or students. The question, i.e., argument, that may arise is how can you get the computer to do what you want if you do not control it? And, it is this question that demonstrates the point which holds

the meaning for the current discourse. This question indicates the foundational and hidden aspects of the psychology of control that permeates our thinking not only concerning computing but about society as well. The idea of control has become so much a part of who and what we are that it has become hidden from us. It is not the overt aspects of control, e.g., killing someone or putting someone in jail, but our hidden psychology of control that endangers us because by its very definition it is difficult to recognize and guard against. I stated very early that computers are part of society and their importance and impact will increase with their use; so will the controlling aspects of computing if we are not alert to them.

There have been two foundational aspects of computing which I have noted so far. One is the universal concept of creativity, and the other is the psychology of control. These may be referred to as the relationship of creativity and the relationship of control. Within the framework of a discipline, it may or may not be odd to discover two dissimilar conceptual dimensions. It is seemingly a paradox since creativity is one of the bases of liberation as it is with computing. The question arises as to how humans can produce the products of their creative genius without controlling the environments that those products are produced from. When examined upon the level of functionality of the processes of the human mind, the question that still exists is how can humans be creative without being in control of the environment of their mental faculties, or at least in control of their own mental faculties? This is the same question previously asked concerning computing. How can a person be creative within the

computing environment without controlling that environment?

I believe that there exists a basic incongruence between our current concept of creativity and control. If within a liberating environment human creativity needs sufficient freedom for action, then this connotes a lessening of control from external forces, i.e., these external forces may be conceptual. However, the fact that creativity connotes manipulation of concepts within mental realms and more overt control when creativity is applied to the physical world, demonstrates a need of investigation into and possible redefinition of what is meant by creativity and control. As noted earlier, this calls for a need for new langugage, or more specifically evolution of current language. This paradox between creativity and control is evident not only within the computing environment but within the liberation model as well. Self-definition, reality transformation, and world creation, rely upon the creative power of the individual but connote a controlling transformation and definiton of not only the process but the object of transformation. This is the paradox found within computing and is the paradox found within the liberation model. Between computing and education as liberation this might be termed a relationship of paradox.

The basis for the evolution of new language can be found within the foundational conceptualization of one aspect of computing as well as the liberation model. For new langugage to emerge a blend of old language and new experiences is necessary. Within the liberation model this process results in a cultural synthesis which is continual by nature. Only through continued praxis will human beings be able to

resolve the relationship of paradox. Within artificial intelligence (AI) the process is noted within the concept of emergence, i.e., a program creating itself through integration of new data and changing its own instruction codes, i.e., self-definition via transformation of reality. This may be termed the relationship of cultural emergence for it is a process in which new culture, e.g., new language, emerges from application of current perspective, i.e., instruction codes and the logic built into them, toward interpreting, i.e., making meaning, of world experiences, i.e., data.

Conclusions

I have identified four relationships between computing and education as liberation. They are the relationship of creativity, the relationship of control, the relationship of paradox, and the relationship of cultural emergence. Identification of these relationships raises more questions than answers provided, which is a never ending condition I suspect, e.g., cultural emergence. Investigation is needed in the processes of creativity and control. There is undoubtely much that needs to be discovered about the different processes which constitute what we now consider falls under the umbrella of creativity or under the umbrella of control. There seemingly is a paradox as both concepts are currently defined since there exists a connotation within the liberation model that they are opposing forces, yet as we have seen for creativity to prosper, control, i.e., as we currently conceptualize it, is necessary. This investigation into the relationship between creativity and control would only be one point of departure for determining a new language

for education, i.e., liberation. If education as liberation is to become effective, new ways of conceptualizing are needed, which of course, are dependent upon evolution of language, i.e., cultural emergence. Development of new language via investigation into the relationships among foundational concepts is not only necessary for further development of the model of liberation but is also necessary for development of the current educational environment. Although theory and practice are very closely related within the model for liberation, the fact remains that current practice, i.e., as demonstrated with the practice examined within this study, is far removed from education as liberation theory, even though there exists a basis for the establishment of a relationship within the foundational areas of computing and education as liberation.

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