

**TEACHERS, TECHNOLOGY AND PATRIARCHY:
FEMINIST DISCOURSE IN EDUCATIONAL TECHNOLOGY**

BY

LINDA C. MLODZINSKI

**A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of**

MASTER OF EDUCATION

**Faculty of Education
University of Manitoba
Winnipeg, Manitoba**

(c) July, 1991



National Library
of Canada

Bibliothèque nationale
du Canada

Canadian Theses Service Service des thèses canadiennes

Ottawa, Canada
K1A 0N4

The author has granted an irrevocable non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of his/her thesis by any means and in any form or format, making this thesis available to interested persons.

The author retains ownership of the copyright in his/her thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without his/her permission.

L'auteur a accordé une licence irrévocable et non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de sa thèse de quelque manière et sous quelque forme que ce soit pour mettre des exemplaires de cette thèse à la disposition des personnes intéressées.

L'auteur conserve la propriété du droit d'auteur qui protège sa thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

ISBN 0-315-77003-1

Canada

TEACHERS, TECHNOLOGY AND PATRIARCHY:
FEMINIST DISCOURSE IN EDUCATIONAL TECHNOLOGY

BY

LINDA C. MLODZINSKI

A thesis submitted to the Faculty of Graduate Studies of
the University of Manitoba in partial fulfillment of the requirements
of the degree of

MASTER OF EDUCATION

© 1991

Permission has been granted to the LIBRARY OF THE UNIVER-
SITY OF MANITOBA to lend or sell copies of this thesis. to
the NATIONAL LIBRARY OF CANADA to microfilm this
thesis and to lend or sell copies of the film, and UNIVERSITY
MICROFILMS to publish an abstract of this thesis.

The author reserves other publication rights, and neither the
thesis nor extensive extracts from it may be printed or other-
wise reproduced without the author's written permission.

ABSTRACT

This thesis integrates the concept of feminist discourse with educational technology in order to demonstrate that technology is a gendered cultural production that reinforces the patriarchal hegemony. The goal is to facilitate feminist praxis within the technological classroom by providing a practical guide to the use of technology without the exclusion or subordination of females.

Educational technology is reconceptualized and presented as a non-neutral, cultural text. The definition of the technological text is derived from a review of the literature of technology and educational technology. The text is presented as a set of commonalities, in order to give technology immediacy and presence. It is then subjected to analysis, or "read", in order to determine the rhetorical claims and assumptions of technology. A poststructural analysis is then conducted, and through the process of deconstruction, the power imbalances and asymmetries of technology are revealed.

It is argued that technology, as a product of patriarchal culture, reflects and transmits the political, ideological and economic values and assumptions of the dominant culture. Technology is explored as an invisible paradigm that acts as an agent of patriarchy. It is perceived as an instrument of control that manifests the dominant interests of gender, class and racial hegemony, and works against a feminist worldview.

A strategy is presented for teachers to conduct their own analysis of technological products and processes. The design consists of three sets of questions that explore three fundamental issues of technology -- power, gender and integration -- and describes how to conduct a feminist analysis of the use of hardware and software.

ACKNOWLEDGEMENTS

I wish to thank several people who have supported me throughout the production of this thesis and have contributed to its successful completion:

Dr. Denis Hlynka, my advisor, for his unfailing guidance, encouragement and thoughtfulness. This gratitude extends back to the days of my undergraduate program, and through my Pre-Master's and Master's years. He has contributed tremendously to my growth as an educator.

Dr. Sheldon Rosenstock and Dr. Rosa Bruno-Jofre, my committee members, for their insights and constructive criticisms.

Dr. Rosenstock, who has encouraged me since my undergraduate days, and Dr. Bruno-Jofre who has helped me to find my feminist voice during the writing of this thesis.

Dr. Cleo Cherryholmes of Michigan State University, who gave me several days of his time, clarifying the concept of poststructural criticism and helping me to chart the path eventually taken during the analysis of technology.

Dr. Eric MacPherson, from whom I have learned so much about education.

Lyle Ball, my husband, who always encourages and supports me and never complains.

TABLE OF CONTENTS

ABSTRACT		i
ACKNOWLEDGEMENTS		ii
CHAPTER 1	INTRODUCTION	1
	Goal	1
	Focus	3
	Statement of the Problem and Research Method	5
	Definition of terms	9
	Background and Rationale	17
	Possible Significance	20
	Delimitations	21
	Limitations	21
	Summary	22
CHAPTER 2	REVIEW OF THE LITERATURE	25
	A Female World-View	25
	Feminist Pedagogy	28
	Feminism and Technology	44
CHAPTER 3	METHODOLOGY	53
	Poststructuralism as Critical Pragmatism	53
	The Cherryholmes Methodology	57
	Poststructural Strategies	59
	Reading	61
	Interpretation	63
	Criticism	64
	Communication	71
	Evaluation and Judgement	72
	Eleven Analytical Questions	73
	Application of Methodology	74
CHAPTER 4	A DESCRIPTION OF TECHNOLOGY AND EDUCATIONAL TECHNOLOGY	77
	Technology -- Toward a Definition	77
	The Non-Neutrality of Technology	82
	Technology, Science and Patriarchy	93
	Technological Bondage -- The Myth of Liberation	106
	The Technological Classroom	116
	The Systems Approach	116

Shifting Paradigms	124
Educational Technology -- Effects and Implications	131
 CHAPTER 5 TECHNOLOGY AS A METANARRATIVE -- A DESCRIPTION AND POSTSTRUCTURAL ANALYSIS	 146
Overview	146
"Writing" the Technological Text	147
A Description of the Technological Text	149
Critical Descriptions of Science and Technology with Traditional/Positivist Binary Distinctions	151
Traditional/Positivist Descriptions of Technology	153
Educational Technology	157
Summary of the Traditional Technological Text	163
Technology	163
Educational Technology	164
Analysis	165
A Structuralist Reading	165
Poststructural Analysis	171
Technology and Power	184
Power Asymmetries	188
A Strategy to Counteract the Patriarchal Imbalance of Technology	192
The Challenge of A Feminist Strategy	201
 CHAPTER 6 CONCLUSION	 203
Summary	203
Summary of Methodology	204
Conclusions	209
Implications for Educators	214
Directions for Future Research	216
 BIBLIOGRAPHY	 218

CHAPTER 1

INTRODUCTION

Goal of the Study

This thesis will demonstrate that educational technology is a gendered cultural production that reproduces and reinforces the patriarchal hegemony, through both the overt and covert curricula of the classroom. The goal of this study is to integrate feminist discourse and educational technology. This is done to develop a strategy to deal critically with technology in the classroom. The strategy is intended to be a practical guide, or design, for the "reflective practitioner" (Schon, 1983) to integrate technology without excluding females. The strategy will facilitate feminist praxis within the contemporary technological classroom, a classroom that typically reflects a technological world-view. Praxis is defined as "reflection and action upon the world in order to transform it" (Freire, 1970, p. 36).

A feminist examination of the issues of educational technology will provide a philosophical foundation that will aid in understanding the patriarchal nature of technology and the effect it has on our lives. We can begin to think about the ramifications of technology and attempt to change it only after learning what technology is, where it came from, and how it affects and changes us as human beings. It is critical to understand the issues before any changes are attempted within the educational system. The changes that would enable a feminist orientation to flourish should not be a Luddite dismissal of modern machines, devices and tools. Instead, the conversion to a female-inclusive

environment requires that educators develop an awareness of the patriarchal influence of the products and processes of technology, resulting in a more conscious and critical use of technology. A feminist transformation of this nature requires that educators undergo a process of learning, reflection and understanding. Only by learning, and reflecting upon new information, will awareness, critical consciousness and ultimately, feminist praxis occur.

This analysis will explore the way in which educational technology acts as an agent and support of patriarchy within the classroom, and contributes to the subordination of females in school and society.

The ultimate aim of the thesis will be to develop a strategy within a feminist framework for the more critically conscious use of educational technology.

In Teaching Technology from a Feminist Perspective, Rothschild (1988) writes that a feminist approach in education involves much more than simply adding more courses about women. She refers to that sort of practice as an "add women and stir" technique -- one that she describes as nothing more than the addition of a diversionary new ingredient that increases the risk that feminist scholarship will be diluted. Rothschild believes that the infusion of feminist philosophy into education and, as well, into courses that deal specifically with technology, involves nothing less than a complete "transformation of the traditional curriculum" (p. 31). The nature of this change would be to repropose the structure of human interaction within the classroom to be one of inclusiveness rather than the exclusive, patriarchal view that currently dominates.

Focus of the Thesis

The primary focus of this thesis is the issue of the non-neutrality of technology.

There is a commonly held view that technology is neutral and does not transmit political or social values (Lipscombe & Williams, 1979). This perception of technology as a neutral force is a myth that has been developed to disguise technology's political role, according to Lipscombe and Williams. (This aspect of technology is explored more fully in Chapter 4.)

Western technology has arisen out of Western society, and consequently, the real nature of technology has been obscured from us while an illusion of neutrality has been created. Lipscombe and Williams believe that the alternative is not the development of a different and neutral technological system. They conclude that any technology is value-loaded and the alternative is a technology committed to different values.

Technology, according to Kranzberg and Pursell (1966), is much more than simple tools, artifacts, machines and processes, and has to do with human work in an attempt to satisfy wants, by way of action on physical objects. Technology is the human process of the manipulation of nature in order to cope with the physical environment. This is done in an attempt to subdue or control that environment through imagination, ingenuity and the use of resources.

The definition of the term technology moves beyond the simple and commonly accepted notion of technology as a concrete product (hardware and software), to include the idea of technology as a system. At its simplest, technology is often perceived to be machines such as chainsaws or televisions, but an encompassing definition must regard technology, as Franklin (1990) refers to it, as a multifaceted entity. Franklin equates technology with practice in order to show "the deep cultural link of technology, and it saves us from thinking that technology is the icing on the cake. Technology is part of the cake itself" (p. 17).

There is a connectedness between technology and culture, according to Hill (1988). He describes technology as a "cultural text" and believes that values are built into its form. The technological text has actualized the industrial world-view, according to Hill. He perceives an interrelationship between technical knowledge and socially constructed reality, where technology becomes a frame within which social meaning and reality develop.

By extension, educational technology focuses the broader concept of technology into the domain of education. The term refers not just to machines such as computers and projectors that are used in schools, but also to the systems and processes associated with the use of those machines.

In summary, then, the focus of this thesis is the analysis of educational technology as a non-neutral text that perpetuates patriarchy.

Statement of the Problem and Research Method

What is the impact of technology in schools as examined from a feminist perspective?

The methodology of this thesis combines the approach of two researchers -- Weiler (1988) and Cherryholmes (1988) -- to explore the impact of technology in schools.

Weiler employs feminist theory and critical education theory to build a new way of addressing gender issues in the classroom. She explores the concept of subjectivity and believes that "students are shaped by their experiences in schools to internalize or accept a subjectivity and a class position that leads to the reproduction of existing power relationships and social and economic structures" (p. 6).

Weiler's objective is to raise the issue of the connectedness of schooling and class interests, patriarchy, and race.

(E)ducators in particular need a theory that can place human action and consciousness in an historical and social context [and] need to be able to encompass both individual consciousness and the ideological and material forces that limit and shape human action... Only by understanding the complexity of social forces can we begin to transform them (p. 3).

There are significant differences between the concerns of critical educational theorists and feminist theorists, but the two views are compatible in many ways. Critical education theorists concern themselves with the production and reproduction of class through the education system under capitalism. These theorists are critical of society and argue that it is exploitive and oppressive, but they believe it is also subject to change. Feminist theorists, according to Weiler,

are concerned with the production or reproduction of gender within patriarchy, something else she believes is also subject to change.

Weiler observes of education that "there has been little work using these two traditions to examine the production and reproduction of gender through the process of schooling itself" (p. 3). Despite their differences, the two approaches share a concern with the relationship between the individual and oppressive social structures. Both approaches focus on the idea of the social construction of knowledge, and, as well, the notion that both knowledge and social structures are open to contestation and change.

A synthesis of critical educational theory and feminist theory is necessary to address adequately the relationship of gender and schooling, as neither is sufficient on its own, according to Weiler.

Cherryholmes adapts the poststructural techniques of deconstruction from Derrida in order "to reexamine and rethink...seemingly nonproblematic assumptions and to call into question their coherence and plausibility" (p. 2). In the context of this thesis, the technique of deconstruction will be used to problematize the myths and assumptions of educational technology. Deconstruction is a form of poststructural criticism. (See Section 4 in this chapter, Definition of terms, for a more comprehensive description of deconstruction.)

Cherryholmes also focuses on power arrangements, which he refers to as relations among individuals or groups based on social, political, and material asymmetries by which some people are indulged and rewarded and others negatively sanctioned and deprived. These asymmetries are based on differences in possessions or characteristics, and power is constituted by relationships among those

differences (p. 5).

The methodology of this thesis, then, is to combine critical educational theory and feminist theory with the poststructural technique of deconstruction.

It will be argued that power is fundamental to patriarchy, and technology is an agent that assists in the maintenance of patriarchy. Cherryholmes writes that "ideology and power arrangements infiltrate our thinking and actions, they shape our subjectivities...how and what we think about ourselves and so act" (p. 6).

Summary of Methodology

In order to determine technology's impact then, several steps will be undertaken in this thesis:

1. Based on the literature, to provide a comprehensive description of technology and educational technology, and to decode the patriarchal, non-neutrality aspects of the issue.
2. Treating the broader concept of educational technology as a metanarrative, to develop a list of the common themes found in the products and processes of technology, using bibliographic material as a source of information.

Cherryholmes describes a metanarrative as a story, or set of rules, characterizing knowledge. Within that story are the themes, characteristics or principles that "function to outline what is or is not acceptable, desirable, efficient, and so forth regarding educational

discourses-practices" (p. 11).

3. To deconstruct the list of themes using Cherryholmes' methodology.

This includes:

- (a) A description of Cherryholmes' methodology.
- (b) An examination of the transcendental signifieds and binary distinctions found within the metanarrative of technology.
- (c) The application of analytical questions to illustrate the power asymmetries of technology.

Transcendental signified, a term Cherryholmes borrows from Derrida, refers to a high-level concept, or a metaphysical commitment to meaning that does not require logical, rational or scientific justification. Justice, equality and fairness are educational transcendental signifieds.

Binary distinction, as Cherryholmes describes the term, refers to a basic dichotomy. It is a logical device for discrimination in determining whether an object has a particular quality or attribution. In education, binary distinctions include theory/practice and cooperation/competition. Addressing the distinctions or differences helps us to rethink and reexamine the values and assumptions that permeate the metanarrative.

This stage in the methodology of this thesis -- deconstruction -- will illustrate the contradictions and limitations of technology in terms of a feminist world-view.

4. To provide a strategy for educators to do further feminist critique of the products and processes of technology. This would

consist of a listing of questions that would deal with the gendered metanarratives and power imbalances of technology and a description of how to apply those questions.

Definition of Terms

Binary Distinction

A binary distinction is a term and its opposite or negation. (C. Cherryholmes, personal communication, April 15, 1991) Cherryholmes (1988) also describes a binary distinction as a simple logical device to discriminate the presence or absence of a quality or attribute, and gives the following educational examples: achievement/failure, theory/practice, cognitive/ affective, subject-centred/learner-centred, emancipation/oppression.

Critical Consciousness

Persons embodying critical consciousness exhibit a spirit of awareness and judicious evaluation for and of the circumstances within which they find themselves. As well, they display the qualities of perception and knowledge. A person of this nature is not one that will be unconsciously controlled and manipulated by the forces of the greater culture. No mere object, a critically conscious individual is an aware participant in the creation of her or his own social culture. Freire (1970) believes critical consciousness allows people "to enter the historical process as responsible Subjects...[and] enrolls them in the search for self-affirmation" (p. 20).

Deconstruction

Cherryholmes (1988) defines deconstruction as a form of poststructural criticism. To understand this, structuralism must be defined. Cherryholmes believes structuralist (and positivist) modes of thought dominate the discourses-practices of education, and that "structuralism is a systematic way of thinking about whole processes and institutions whereby each part of a system defines and is defined by other parts" (p. 13). He believes poststructuralist thought or criticism attacks structuralist assumptions and the arguments upon which they are built. Cherryholmes writes:

Deconstruction, which is one form of poststructural criticism, questions whether proposed first principles that purportedly ground structuralist programs and meanings ever transcend our texts and discourses-practices. If no transcendent first principles exist, then our structures are not as fixed or "structured" as they might appear, because every term or element is always defining every other term or element...with no clear cut beginning or ending (p. 13-14).

The process of deconstruction is the pursuit of the play of meanings in a text. Deconstruction denies structure and recognizes that meanings are dispersed within a text. (C. Cherryholmes, personal communication, April 15, 1991)

Feminist Discourse

Discourse refers to the expression of oneself within the confines of interchange based on socially shared beliefs and values. The meaning of feminist discourse, then, involves expressing oneself from within the shared beliefs and values of a feminist point of view. Lerner (1986) believes that the term feminism is one that is common and is frequently

used indiscriminately. She suggests the following as currently used definitions:

(a) a doctrine advocating social and political rights for women equal to those of men; (b) an organized movement for the attainment of these rights; (c) the assertion of the claims of women as a group and the body of theory women have created; (d) belief in the necessity of large-scale social change in order to increase the power of women (p. 236).

Lerner thinks that most common usages of the word feminism tend to incorporate all but the last aspect of social change. The author believes that in defining feminism, a distinction should be made between the concepts of women's rights and women's emancipation.

According to Lerner, women's rights "means a movement concerned with winning for women equality with men in all aspects of society and giving them access to all rights and opportunities enjoyed by men in the institutions of that society" (p. 236).

Women's emancipation refers to freedom from the oppressive restrictions imposed by sex, including biological and societal restrictions. Emancipation also means self-determination, or the freedom to choose one's social role and destiny. Finally, according to Lerner, emancipation includes the notion of autonomy, or the earning of status as opposed to marrying or being born into status.

Lerner believes that the term feminism can encompass both aspects -- rights and emancipation -- and it can also "refer to a level of consciousness, a stance, an attitude, as well as the basis for organized effort" (p. 237).

It is in the dualistic sense that the term feminism will be used in this thesis, referring to both women's rights and women's emancipation, while feminist discourse refers to the expression of oneself in

those terms.

Gender

Gender refers to the culturally defined social roles of behaviour. This is distinguished from the term sex, which refers to biological differences.

Hegemony

The concept of hegemony, according to Apple (1986) refers to the common sense view of the world held collectively by a society, where meanings and practices are so deep seated in people that those meanings and practices become the only way the world can be. Hegemony can be described as the unconscious metanarratives that define and explain the way the world is and should be. Individuals are socialized into and within a particular hegemony. The dominant ideologies that are the focus of this thesis are patriarchy and technology.

O'Brien (1987) writes that the idea of hegemony is reliant on cultural relations "to elaborate the axioms and practices of common sense" (p. 44). She describes hegemony theory as concerned with "the problem of false consciousness as a brake on class struggle, and properly enquires into the processes whereby partial, ruling-class knowledge gains consent as general cultural truth" (p. 48).

Patriarchy

The definition of this term also comes from Lerner (1986) and refers to the general male dominance over women in the home and in

society. Patriarchy refers to a situation of power imbalance, where men hold the key power positions in the institutions of society while women are denied access to such power.

Pedagogy

Pedagogy refers to the art of teaching. This definition is intended to convey the holistic nature of teaching. Pedagogy is the sum total of training, experience, creativity and intuition.

Positivism

The term positivism was adapted by Auguste Comte in the nineteenth century. (Giddens, 1974) According to Giddens, it refers to a philosophical system in which the concepts and methods of natural science are the basis of all knowledge. The fundamental supposition of positivism, according to Giddens, is the

experiential foundation of all (viable) knowledge in sensorily apprehended 'reality'. Secondly, as necessarily following from the first proposition, the idea that judgements of value have no empirical content of a sort which renders them accessible to any tests of their 'validity' in the light of experience" (p. 3).

In short, science, being the only true knowledge, denies the validity of investigations outside the realm of the facts and laws of scientific method.

Power

Power refers to the "relations among individuals or groups based on social, political, and material asymmetries by which some people are indulged and rewarded and others negatively sanctioned and deprived"

(Cherryholmes, p. 5). This implies a relational concept, where someone or some group is dominant and another is subordinate.

Praxis

Praxis is the union of critical theory and action. It is defined as "reflection and action upon the world in order to transform it" (Freire, 1970, p. 36). This definition is closely related to the concept of critical consciousness, for it is only through critical consciousness that one is able to reflect upon the world. That reflective level of awareness is a necessary prerequisite in order to affect change or transformation in any situation.

Sexism

The term sexism refers to discrimination based upon sex, and is closely related to the notion of patriarchy. In a patriarchal state, power is maintained by the dominant group through sexist practices that limit or eliminate the subordinate group in power positions.

Sexism is to paternalism as racism is to slavery: "both ideologies enabled the dominant to convince themselves that they were extending paternalistic benevolence to creatures inferior and weaker than themselves" (Lerner, 1986, p. 240). The connection ends there, however, for slaves were driven to solidarity in their plight, while women remain effectively separated from each other by sexism.

Subordination of Women

The term will be used as defined by Lerner (1986), who regards the

subordination of women to men

paternalistic dominance, which, while it has oppressive aspects, also involves a set of mutual obligations and is frequently not perceived as oppressive...Subordination does not have the connotation of evil intent on the part of the dominant; it allows for the possibility of collusion between him and the subordinate. It includes the possibility of voluntary acceptance of subordinate status in exchange for protection and privilege, a condition which characterizes so much of the historical experience of women" (p. 233-4).

Technology and Educational Technology

The term technology as it will be used in this thesis refers to both products and processes. Products include tools or implements as well as mechanical or electrical devices. Process encompasses the idea of technology as a system, defined by Franklin (1990) as involving "organization, procedures, symbols, new words, equations, and, most of all, a mindset" (p. 12).

Educational technology focuses specifically on the technological products and processes of the classroom.

Transcendental Signified

A transcendental signified is a metaphysical commitment that does not require rational, scientific or logical justification (Cherryholmes, 1989). Transcendental signifieds are accepted as authority of meanings, but Cherryholmes counters that perception:

Meanings are dispersed from word, to definition, to definitions of words in definitions, and on and on...Reading, in part is a pursuit of traces of meaning in a text. A consequence of the dispersal of meanings in a text is that proposed categories of inclusion and exclusion deconstruct and break down (p. 38)

Cherryholmes borrows the term transcendental signified from Derrida and uses it to represent the themes or beliefs found within texts, or, metaphysical commitments. The term text is used in the broad sense and refers to any source of information or authority, written or otherwise. Cherryholmes' examples of transcendental signifieds from Bloom et al's Taxonomy include individual accountability, authority of disciplinary knowledge, subject-centred learning, teacher authority, fragmentation of knowledge and information and others.

Background and Rationale for the Research

Weiler (1988) emphasizes the need for critical feminist research in education. She writes that there is a need for "analyses of the ways in which gendered subjects are shaped through the experience of schooling, and in which the complex interaction of conflicting subjectivities and the power of gender, race, and class is made clear" (p. 4).

Much of the research with respect to women and schooling has been focused on the topic of sex stereotyping, sexism and bias. Although these issues are important, Weiler recognizes that such a narrow focus has significant shortcomings, having ignored "the depth of sexism in power relationships and the relationship of gender and class" (p. 28). Schools and schooling must be placed within the context of a wider broader social and economic analysis and examined for the constraints under which education transpires, according to Weiler.

Schools play a major role in the social enculturation of students into the hegemonic view (Giroux, 1981). One of the main objectives of schools, according to the author, is the transmission of "cultural tradition and ideology as knowledges of hegemonic groups in society" (p. 3). To understand this is to know that schools greatly influence children's attitudes and ideas, and play a major role in cultural reproduction. Viewing schools primarily as agents of social reproduction, Giroux focuses on the political aspect of schools. He believes that the wider culture of positivism is embedded and reproduced in the public school curriculum. He describes that culture as having a limited

focus on technique, efficiency and objectivity, and suggests it is characterized in schools.

Patriarchy is a dominant force in society (Lerner, 1986). Using Giroux's and Lerner's ideas together, it can be argued that the cultural tradition and ideology that is transmitted by schools is not just positivistic, but also patriarchal.

This notion of social enculturation is not a contemporary idea, and indeed has historical roots. The perception of schools as agents of social control is probably as ancient as the notion of schools themselves. Plato recognized this more than 2000 years ago. In The Republic, he discusses the power of education to produce citizens that reflect the beliefs of the state.

Our only purpose was to contrive influences whereby [the students] might take the colour of our institutions like a dye, so that in virtue of having both the right temperament and the right education, their convictions about what ought to be feared and on all other subjects might be indelibly fixed, never to be washed out by pleasure and pain, desire and fear, solvents more terribly effective than all the soap and fuller's earth in the world (p. 123).

Plato's notion of schools as institutions to produce citizens have been echoed by many throughout history, including Horace Mann who influenced the development of education in the United States in the early part of the nineteenth century. Mann has been described as the father of public education (MacPherson, 1989). He perceived schools as a tool to fashion a new American character from the many immigrants that were changing the social face of that country. His simple yet powerful philosophy with regard to shaping the thoughts of a child suggested that educators could "train up a child in the way he should go, and when he

is old he will not depart from it" (in Cremin, 1957, p. 100).

Returning to the present and the concept of hegemony, O'Brien (1987) discusses the power of schools in the reinforcement of the dominant world-view. Borrowing from Gramsci, she writes that "education is the key to the maintenance of hegemony but also to breaking down of hegemony by the challenging and eventual overthrow of consensus" (p. 45).

The power of schools lies in their ability to reproduce the hegemonic conditions of society (Apple, 1986). Like Giroux and O'Brien, Apple views schools as a force in the cultural reproduction of the capitalist economic system, an idea that has important implications for feminists.

After all, isn't education simply one tool among many within capital's arsenal for getting its own way in teaching and curriculum and in the reproduction of the labour force?...economically and sexually dominant groups have a good deal of power (and is increasing in some areas). However, this power is highly mediated and altered by the self-formative actions of teachers, by class factions within the state, and by the very fact that schools are very much a part of the political, not just the economic arena. Because of this latter point in particular, they will be pressured to act according to democratic norms (p. 185).

Just as schools play a major role in social reproduction, so too is technology an important force in the classroom. Determining the extent to which technology is a patriarchal force is the point of this thesis.

One potential starting point for the feminist transformation of schools, then, is the examination of technology with respect to its patriarchal influence. With the increasing pervasiveness of technologi-

cal devices and systems in schools, it is critical that teachers become aware of the impact of technology on the attitudes of children.

Utilizing technology from within a feminist perspective will be an important step in redefining the nature of classroom interaction to one that is inclusive of the female view.

To return to the goal of this thesis then, the integration of feminist discourse and educational technology is prompted by the connection between technology and the perpetuation of patriarchal hegemony. Becoming aware of the hegemonic influence of schools, and technology's role in that process is a critical first step in a feminist transformation.

Possible Significance of the Thesis

There are a number of reasons for carrying out this study. Perhaps the most significant is the fact that technology is an all-pervasive force within our society, and it is essential to demonstrate the nature of its influence in society and in schools. Important also, as our consciousness with respect to feminist issues grows, is an understanding of the interrelatedness of the concept of patriarchy and the use of educational technology.

In short, the following are significant aspects of this thesis:

1. To provide a feminist framework with which to view technology in general and educational technology in particular.

2. To identify the nature of the relationship between patriarchy and educational technology.
3. To demonstrate the importance of critical consciousness with respect to the use of educational technology.
4. To clarify the impact of educational technology as process and product in schools.
5. To provide the impetus to use a feminist perspective in the adoption and implementation of educational technology.

Delimitations of the Study

The major delimitation of this study is the feminist framework within which it has been conducted. Although it is recognized that the use of educational technology has other far-reaching implications beyond the subordination of woman, including race and class subordination, for purposes of this study, the research will be restricted to feminist issues.

Limitations of the Study

One limitation of this study stems from the feminist delimitation. The conclusions will reflect a feminist orientation and not necessarily be applicable to other concerns, such as race and class subordination.

Another limitation is the fact that much of the research is foreign to Canada and is being applied to the Canadian situation.

Canadian sources are used where available, but due to the lack of local resources, some reliance has been placed on American investigations.

A third, paradoxical limitation stems from the concept of patriarchy. This study is ostensibly being conducted from outside patriarchal consciousness. It must be acknowledged that the research sources that are cited have also been created inside patriarchy, or in a conscious posture external to it. The paradox is that it is impossible to determine whether any researcher who has been raised within the patriarchal hegemony (including this writer) can ever fully be outside of patriarchy's walls. This research is an attempt to break out of what Bleier (1984) calls the consciousness of a patriarchal conceptual prison.

Summary

Chapter 2 will review the pertinent literature related to this thesis. It will include information from experts in the field that suggest that feminist research must address political and ideological issues, thus providing a foundation for this particular study. It will examine the notion of a female world-view, and explore feminism in relation to pedagogy and technology.

Chapter 3 will describe the methodology to be used in the analysis of technology. It will recount the analytical techniques of Cherryholmes, and provide a summary of his approach as derived from his

book, articles he has written, reviews of his work and personal interviews with the author.

Chapter 4 will begin by exploring definitions of the term technology. The major issues of the topic will be examined, including:

- The relationship between technology and scientific thought
- The non-neutrality of technology
- The technological myth of liberation
- Technology as a patriarchal force
- The technological classroom

Chapter 5 will begin by describing the technological metanarrative, or text. This consists of providing an annotated description of the transcendental signifieds of technology, based upon the information established in Chapter 4. Following that lengthy description will be a brief summary of the information.

Next, the text will be given a structuralist reading, according to the methodology of Cherryholmes. Following that will be a poststructuralist analysis. In this section, the transcendental signifieds and binary distinctions will be examined from a feminist perspective. Cherryholmes' analytical questions will be applied to the metanarratives in order to illustrate the power asymmetries of technology which subordinate women.

The final section of Chapter 5 will be a strategy for the critique of technology which may be used to illustrate the patriarchal metanarratives and power imbalances that are manifested within technology.

The strategy will consist of a series of questions that can be

applied to educational technology. The queries address power and gender issues and will be accompanied by a description of how they might be used.

Chapter 6 will provide a summary of the thesis, as well as a discussion of conclusions and implications for educators. This chapter will end with a section entitled "Directions for Future Research".

Chapter 2

Review of the Literature

This chapter will review feminist literature with respect to pedagogy and technology. It is divided into three sections:

The first section is a brief introduction to the idea of **A Female World-View**. It is included to provide background to the notion of feminist pedagogy.

The second section, **Feminist Pedagogy**, reviews the literature with respect to feminism in education.

The third section is an exploration of **Feminism and Technology**.

A Female World-View

The goal of this thesis is to facilitate feminist praxis within the technological classroom. In order to incorporate a female world-view, it is important to understand what constitutes feminism and feminist scholarship.

Feminist scholarship is divided along three distinct political lines: liberal, radical and social (Gaskel and McLaren, 1986). All three aspects of feminist thought are concerned with change.

Liberal feminists, according to Gaskel and McLaren, are primarily concerned with the issue of equal opportunity. They desire that women should have the chance to participate equally in all social and economic institutions.

Socialist and radical feminists go some distance further than equal opportunity, and are more concerned with actually changing social and economic institutions. They would like to see power, status and income inequalities completely eliminated.

Radical feminists are concerned with the gender oppression that is typical of patriarchy. They target male ownership and control of the social, ideological and economic processes in society. Radical feminists want more attention paid to women's concerns, as well as more power for women.

Socialist feminists focus on gender oppression within economic structures that benefit men and subordinate women. This approach to feminism examines capitalism to determine the way in which it shapes gender relations in modern industrial societies. Socialist feminists want to transform the economic structures of capitalism in their entirety in order to have them incorporate a female world-view.

It is useful and important for educators to keep these three political orientations in mind, particularly when dealing with feminist research. The distinctions provide revealing information as to the assumptions that underlie research, point out Gaskell and McLaren. If a researcher's feminist orientation is clear, awareness of the orientation will help the reader more fully understand the writer's ideas.

The three political distinctions are not always crystal clear, however. "Changing opportunities for women demands changing social structures; changing patriarchy demands changing economic processes, and changing capitalism can involve challenging male power. Indeed, few

writers can be placed easily into one political camp as opposed to another" (Gaskel & McLaren, p. 13).

In a Different Voice, a book by psychologist Carole Gilligan (1982) explores the idea of a female world view. Although her ideas are considered to be controversial by some, they provide an important perspective in terms of this thesis. In the book, Gilligan challenges Kohlberg's theory of moral development. Her perception of feminism rests upon the notion that females perceive the world differently than males and also behave differently. This gender distinction stems from early childhood when personality and identity develop. These differences, Gilligan tells us, are directly related to mother-child relationships.

For girls and women, issues of femininity or feminine identity do not depend on the achievement of separation from the mother or on the progress of individuation. Since masculinity is defined through separation while femininity is defined through attachment, male gender identity is threatened by intimacy while female gender identity is threatened by separation. Thus males tend to have difficulty with relationships, while females tend to have problems with individuation (p. 8).

In a similar discussion of this perception of male separation from mother, and female attachment to mother, Standish (1981) is not surprised that women and men take on different attitudes toward work, relationships and life. Men operate as autonomous entities in work, play and life. Women, on the other hand, seek to develop intimate relationships, and "find psychological wholeness in knowing others and being known by others. Work and human connectedness cannot be easily or happily separated" (Standish, 1981, p. 10).

A critical differentiating experience in the development of boys and girls grows out of the fact that women are largely responsible for early child care (Chodorow, 1974). Because a girl's first relationship is with a member of her own sex, Chodorow argues that psychological development is fundamentally different for females than it is for males, whose first important relationship is with a member of the opposite sex. Feminine personality grows in connection and relation to mother, while masculine personality must undergo a breaking away and distinguishing from mother. This is an explanation of why women are less individuated and men are more autonomous, according to Chodorow.

Millet (1971) addresses the need for a feminist point of view, and observes that there exists two distinct cultures within society: a dominant male culture and a subordinate female culture. Within each culture female and male experiences are fundamentally different. "Implicit in all the gender identity development which takes place through childhood is the sum total of the parents', the peers', and the culture's notions of what is appropriate to each gender by way of temperament, character, interests, status, worth, gesture, and expression" (Millet, 1971, p. 31).

Feminist Pedagogy

Research in education has traditionally been positivistic in nature, and has been conducted within the conceptual confines of patri-

archy. More recently, a feminist voice is starting to make itself heard in research and in the classroom (Lather, 1986).

The starting place of feminist pedagogy is the acknowledgement of the subordination of women and the gendered nature of the classroom (Briskin, 1990). Feminist pedagogy is concerned with student-teacher interactions and the curriculum itself. Briskin focuses on the power relationships of the classroom and believes that teachers must also address that issue. Conscious attention to the power relations within schools by teachers and students will increase their capacity and responsibility to act as agents of change. Briskin observes that feminist strategies need to be applied to the racist, heterosexist, patriarchal, and capitalistic contradictions within the classroom.

Changing teaching practices and schools, empowering students with knowledge, embracing a feminist perspective in the classroom involve a forceful challenge to the contradictions that play themselves out in the educational context. Contradictory messages about womanhood, about the authority and expertise of female teachers, about strategies for dealing with sexism, about the possibilities for change, all must become part of a self-conscious political approach (p. 20).

A feminist pedagogy, according to Briskin, consists of teaching from within a feminist world-view. This includes a perspective that allows for the sharing of privilege, power, property and opportunity. It acknowledges the systemic and systematic subordination of women, and at the same time, believes in change as it challenges the accepted, traditional, patriarchal way of the world.

For Briskin, feminist pedagogy means teaching in a particular way: "recognizing the relations of power -- based on gender, class, race and sexual orientation -- that permeate the classroom. The feminist

orientation accepts the intrinsic link between changing curricula and changing teaching practice" (p. 22).

Feminist pedagogy is a process of identifying the personal as political and treating individual experience as both social and political reality. Briskin warns that many structural and ideological barriers inhibit feminist pedagogy, and although she does not specifically address the issue of technology, acknowledges the pervasiveness of patriarchal hegemony.

Ellsworth (1990) addresses the issue of critical pedagogy, a term which is typically regarded to mean "sharing, giving, or redistributing power to students" (p.306). Critical pedagogy, postulates Ellsworth, is actually comprised of rationalist assumptions which are inherently repressive and "has failed to launch any meaningful analysis of or program for reformulating the institutionalized power imbalances...or of the essentially paternalistic project of education itself" (p. 306).

This reproach of critical pedagogy is rationalized in terms of personal subjectivity. Teachers, even those who are critically conscious, bring to their classes a social 'subjectivity' and

can never participate unproblematically in the collective process of self-definition, naming of oppression, and struggles for visibility in the face of marginalization engaged in by students whose class, race, gender and other positions [they] do not share. Critical pedagogues are always implicated in the very structures they are trying to change (Ellsworth, 1990, p. 309-10).

The solution to the problem of teacher's social subjectivity, according to Ellsworth, is not student empowerment through critical pedagogy, but rather, a sort of stepping outside of Western ways of

knowing, and recognizing that all knowings are partial. Teachers must recognize that there are fundamental issues that can never be known. For example, a man can never know what it is to be a woman, or a white person can never know what it is to be a person of colour. Ellsworth discusses 'identity politics', pointing out the politically and historically situated nature of a person's individual identity. Identity is regarded as nonessentialized, having emerged from historical experiences. Ellsworth maintains that the acknowledgement of identity politics is the way to lessen the effects of social subjectivity.

Identity in this sense becomes a vehicle for multiplying and making more complex the subject positions possible, visible, and legitimate at any given historical moment, requiring disruptive changes in the way social technologies of gender, race, ability and so on define "Otherness" and use it as a vehicle for subordination (p. 322).

Ellsworth's attitude toward pedagogy is influenced by feminism and poststructuralism, and leaves 'no one off the hook', not even critical pedagogues. No person, argues the author, is exempt from becoming an oppressor in what she calls the "mythical norm" that exists in North America "for the purpose of setting the standard of humanness against which Others are defined and assigned privilege and limitations. At this moment in history, that norm is young, white, heterosexual, Christian, able-bodied, thin, middle-class, English speaking and male" (p. 323).

Lewis (1990) focuses on patriarchal aspects of the educational system. She believes the system is characterized by unchallenged practices that reflect patriarchic privilege.

(W)omen find themselves inside [educational] institutions whose practices and intentions are historically designed to keep them outside its concrete and theoretical frames. For women students, negotiating masculine content and practices often means that they have to absorb as well as struggle to survive the violations of their subordination (p. 472).

The hegemonic constraints of patriarchy explains the way in which a dominant group maintains power and control by projecting its own brand of social reality, according to Lewis. This is done so successfully that the dominant view is widely accepted as common sense and a part of the natural order...even by those that are subordinated within the system. The very point of patriarchal hegemony is to allow the dominant group to continue in its position of power.

Education is regarded by Lewis as an avenue to rectify the imbalance of patriarchy, as "the content and processes of feminist curricula and teaching can result in...consciousness raising" (p. 476). The process of consciousness raising is a transformative act as well as an act of perception, and is essentially a political activity.

The challenge of a feminist approach in teaching, contends Lewis, is to find "ways to make speakable and legitimate the personal/political investments we all make in the meaning we ascribe to our historically contingent experiences" (p. 484).

Lewis also points out the contradiction of women's lives. Within this contradiction, women's interests lie at the same time with the dominant male group and against it. This conflict is referred to by Lewis as "the deeply paradoxical nature of the conditions of the subordinate in a hierarchical culture marked by gender, class and race inequalities" (p. 484).

Much of the subordination of females in society and in schools is perpetuated by teachers and is unconscious (Lande, 1990). Teachers' belief systems are generally unexamined, asserts Lande, and "are manifested in their behaviour, which communicates, overtly and covertly, expectations and attitudes that maintain girls in subordinated roles" (p. 104). Teachers are responsible for the transmission of the ideology of the capitalist, patriarchal society. This occurs primarily through teachers' acceptance of the dominant beliefs of society and through their behaviours that reflect those beliefs. Lande recommends that teachers engage in "an open interrogation of inequitable power relationships. Such politically and philosophically conscious struggle and resistance might begin to effect real far-reaching changes in schools and in the society that schools reflect" (p. 108).

Weiler (1987) addresses the importance of socialist feminism in educational analysis. Two critical assumptions underlie socialist feminism. One, capitalism and patriarchy are interconnected; and, two, capitalism and patriarchy are mutually reinforcing and reinforced within the educational system. Feminist reproduction theory marks the manner in which schools function to reproduce gender divisions and oppressions. This theory, writes Weiler, "employs the concepts of resistance and cultural production to look at the lived experience of girls in schools" (p. 31). She believes that socialist feminist theory has developed rapidly, but that application of the theory within schools has been limited.

Counter-hegemony is one way feminist theory might be applied to education. Weiler describes that action as

resistance in the form of various kinds of opposition to oppressive beliefs and practices...[and] more critical and politicized work in the form of organized and conscious collective oppositional actions...By this is meant the creation of a self-conscious analysis of a situation and the development of collective practices and organization that can oppose the hegemony of the existing order and begin to build the base for a new understanding and transformation of society...It is vital that teachers recognize not only the structural constraints under which they work, but also the potential inherent in teaching for transformative and political work (p. 52).

Teacher empowerment is an issue that catches the attention of Lather (1987). The subordination of women has been built into the teaching role, as teachers act more as transmitters than transformers of social norms. Lather sees teachers, like mothers, "caught in the contradiction of perpetuating their own oppression...serving the dual function of both presenting the capitalist-patriarchy's human face and providing social and political containment" (p. 30).

Women in western society are not totally aware of the nature of their subordinate role because they live intimately with their oppressors, and are continually subjected to myths about themselves and society. Coming to terms with the issue of gender as a world-view structuring experience, according to Lather "can shed much light on the processes of both ideological mystification and coming to critical consciousness" (p. 31).

Feminism and feminization, for Lather, are concerned with deeply structured patterns of inequality that are reinforced through dominant practices and meanings. Lather believes that teaching can be trans-

formed by feminism, for it is feminism that attends to gender and inequality issues.

In an earlier work, Lather (1986) stresses the inherent difficulty for teachers who attempt to work from an alternate frame of reference. For teachers to encourage feminist (or other) changes within their classroom means that they will be working in opposition to prevailing standards. Lather acknowledges that challenge when she observes that "feminist research, new-Marxist critical ethnography, and Freirian 'empowering' research all stand in opposition to prevailing scientific norms through their 'transformative agendas' and their concern with research as praxis" (p. 64).

Peterat (1990) agrees with Lather that feminist research or any other research is a challenging prospect. She perceives feminist research to be in "opposition to the dominant positivist tradition in social science research...Feminist research is interested in change, in confronting oppressive realities and in bettering conditions for women, commonly with a vision of empowering and liberating women in society" (p. 34).

Also like Lather, Peterat focuses on gender and patriarchy. Writing in particular about Home Economics, but with ideas that transcend her subject area, Peterat sees in feminist research the desire to change and better the human condition. This is accomplished through non-neutral, openly interested and critically reflective research.

The political aspects of education are explored by O'Brien (1983) who believes there exists a fundamental contradiction within education. Education is described, on the one hand, as being concerned with social transformation. On the other hand, according to O'Brien, "educational systems and school curricula are structured hierarchically and are profoundly conservative: educational institutions are bastions of male supremacy and ruling class power" (p. 3).

O'Brien rejects the notion that schools are institutions engaged in the open pursuit of truth. Instead, schools are perceived to be sitting on ideological ground, where knowledge is socially defined and legitimated by the bureaucracy. That bureaucracy is described as political, being characterized by gender, race and class bias.

Schools have impact on individual enlightenment and social change. The power of pedagogical feminism comes from its integrative or interdisciplinary nature. O'Brien contrasts feminism with patriarchy:

The mode of dealing with reality by separation and categorization is the very heart of patriarchal culture, with its furious, futile terrorisms of the either/or. Divide and rule has been the practice by which patriarchal canonists and conquerors have ruled the natural/ historical world, including the separation of the that world itself into nature and history. The movement from interdisciplinary to integrative studies, currently in progress, is a vital one, showing with increasing strength its radical proclivities and seeping steadily into school and family socio-educational practices and disclosing the hidden curricula of patriarchy (p. 6).

A feminist approach to education reaches out for a redefinition of knowledge, based on an alternate and female perception. This approach is as equally political as any other sort of education, observes O'Brien:

The content of education, its heart in curricula, whether this be understood as truth, ideology, practical know-how or mixtures of these, is ultimately an instrument of control, a power play enacted in the interests of gender, class and racial hegemony. Education is the process by which knowledge steeped in partiality is passed out as universal truth. The socio-historical processes by which truth is certified, approved and disseminated and in which knowledge comes power and consensus are the essential moments with which educational studies contend (p. 7).

The goal of a feminist education is the destruction of gender as an oppressive cultural reality. Education has a dependence on patriarchal ideology, observes O'Brien, yet still remains the route to critical and analytical skills: "Feminist education is the process by which [patriarchal] skills are utilized to bite the hands which have so confidently but parsimoniously fed us" (p. 13).

Most education faculties, notes O'Brien, still "train" teachers instead of "educating" them. Training is to be equated with obedience, while education is associated with thinking. O'Brien describes the orientation that focuses on training over education as one that is a "patriarchal pedagogical prescription for women" (p. 13).

The curriculum of schools is one that is "predominantly white, male, Western and heterosexist in its assumptions" (Schuster and Van Dyne, 1983, p. 1). The development of women's studies has made visible patriarchal political structures and the attendant exercise of power within the classroom. Schuster and Van Dyne believe the invisible paradigms of academic systems serve to subordinate and trivialize the lives of women and all others outside the dominant class and culture.

In contrast, observe the authors, a woman-focused classroom brings the invisible paradigms into the open. Schuster and Van Dyne observe that within the paradigms are to be found

the internalized assumptions, the network of unspoken agreements, the implicit contracts that all the participants in the process of higher education have agreed to, usually unconsciously, in order to bring about learning. This infrastructure has worked so long and supported the commerce of higher education so effectively that we no longer see it, notice its presence or, most importantly, name it for the determining force that it is. Not surprisingly, these invisible paradigms are organized around power (who has it and how we're allowed access to it) and around values (among available choices, what is important and what is best). The invisible paradigms govern not only the content and organization of our syllabus, but the way we claim and exercise authority in the classroom and, in addition, what students expect to get from us as teachers and for themselves by becoming educated (p. 5-6).

Schuster and Van Dyne use the term 'woman-focused' in reference to college classes where women students are in the majority, and in which the professor is a woman who encourages reflection on the human experience. Despite this relatively narrow focus, the authors' ideas spill over to the broader spectrum of public education. The invisible patriarchal paradigm and its accompanying assumptions permeates the lower levels of education as well as the college level, and Schuster and Van Dyne's observations are relevant at all levels.

A teacher in a woman-focused classroom is aware of the power relationships that are at the root of the invisible paradigm. Within this setting, a teacher self-consciously extends her or his power to increase student authority. This is achieved by allowing students to intellectually validate and authorize each other's ideas. Collaborative learning, shared responsibility and intellectual rigor in the uncovering

of cultural bias are other qualities in a female-friendly classroom, as described by Schuster and Van Dyne.

The authors believe that once teachers recognize the impact of the invisible paradigm in classrooms, the situation becomes conducive to change or transformation. Awareness is the key. "We need to recognize, in short, the pervasive and unconscious forms in which the dominant culture is reproduced in the classroom, even as we have as our conscious goal to transform that culture's understanding of women" (p. 34).

Turning to the more pragmatic aspect of schooling, Linn and Hyde (1989) write that practices within the educational environment must be altered in order to promote success for females and males. The incorporation of feminist ideals within the curriculum will encourage equity. These ideals include cooperation over individualism, as well as encouragement and collaboration over competition.

A resource book to improve the participation and success of females in math, science and technology was recently developed for the Canadian Teacher's Federation by Robertson (1988). In her book, the author acknowledges the harm caused by the restriction of gender roles within the school system and believes that, as enlightened as many people have become, "outdated ways of seeing the world [still] cling tenaciously to our students and our institutions" (p. 2). Measures must be taken in order to move the system out of the traditional patriarchal methods of schools toward a more feminist approach, concludes Robertson.

Shakeshift (1986) examines educational practices that contribute to gender inequity in the classroom.

True excellence in education cannot be achieved, Shakeshift writes, without attention to gender issues. The author maintains that few schools provide an equitable culture that is conducive to the growth of all students and faculty, as

females and members of minority groups...must obtain their education in systems that are at best indifferent and at worst hostile to them. Women and members of minority groups learn that their concerns, their lives, and their cultures are not the stuff of schooling. They discover that school is not a psychologically or physically safe environment for them and that they are valued neither by the system nor by society. Few schools are equitable, and, not surprisingly, few schools are excellent (p. 500).

A male model of schooling is perpetuated by and reflected in the classroom, through both what is taught, and through the general goals of education. Shakeshift perceives curricular decisions, including what to teach and when to teach it, to be based on male developmental patterns. Academic content is perceived to be shaped in a male image in order to transmit to boys what they need to know in order for them to become public people. The author notes that textbooks, instructional materials, and even instructional techniques reflect a male pattern. Competition is favoured over cooperation, and the ethics of rights are favoured over the ethic of caring.

Shakeshift also examines teacher behaviours that contribute to and reinforce inequity in the classroom. Educational research, Shakeshift observes, has shown that male students receive more attention from teachers than female students, are more likely to be praised, and are more likely to be reprimanded. Also, Shakeshift points out, teachers

tell boys and *show* girls what to do. Teachers allow more time and opportunity for boys to express opinions and give answers, resulting in a class where boys are the dominant group. According to Shakeshift,

[boys] talk more, interact more, receive more teacher time, and have more opportunities to learn. Boys learn to handle criticism because they have opportunities to respond that allow them to grow. Boys also have more opportunities to build self-esteem because they speak more and are more often praised and told that they have ability.

The average female is ignored -- neither reprimanded nor praised. The high-achieving female receives the least attention of all students. Both majority and minority girls learn that their opinions are not valued, that their responses to questions are not worthy of attention. Consequently, female students come to believe that they are not smart or important. They learn that, if they do well in school, it is because they are lucky or work hard, not because they are smart or capable. The interactions of teachers with students reinforce the societal message that females are inferior (p. 501).

A starting point for feminist pedagogy is a distrust of bureaucracy and a questioning of traditional authority relations between teachers and their students (Gaskell and McLaren, 1986). Similar to Shakeshift, Gaskell and McLaren believe that teachers engage in many overt and covert practices which reinforce sex-role stereotypes.

However, feminist research, according to the authors, is responsible for uncovering such inequitable practices.

Feminist scholars documented and questioned practices such as having separate playgrounds and line-ups for girls and boys, allocating different chores for boys and for girls, and having girls and boys compete against each other. Teachers' expectations about the capacities and interests of males and females were revealed to be stereotyped. Studies showed that boys received more attention from teachers than girls. The research amounted to a well documented assault on stereotyping in its various guises in the school (p. 8).

Despite the fact that the women's movement has lost public momentum since the 1970's, feminist scholarship and research has nonetheless made positive progress. The movement has been supported by the emergence of women's studies journals and programs, as well as by an increase in female academics whose work is filtering through to the mainstream of education, according to Gaskel and McLaren.

Feminist scholarship has impacted on all disciplines and fields of study, resulting in what the authors term an "explosion of knowledge" about women and their particular experiences.

Where women were invisible in academic texts, they are beginning to have a presence. Where questions about women were never asked, they are now being pursued. The enormous gaps in our knowledge about how women live, think and feel are providing opportunities for new research and innovative scholarship (p. 10).

The authors refer to this feminizing process as a "revaluing" of the female. To successfully revalue women's ways of knowing, the entire process of education must be reevaluated, for schools are a powerful institution in reproducing the dominant patriarchal ideology.

Recently, feminist scholarship has begun to focus on the social reproduction of knowledge, which in turn has exposed the biases of traditional scholarship. Gaskel and McLaren write that within the theory of social reproduction of knowledge, it is believed that one's perception of the world is shaped by gender roles and male domination.

Traditional scholarship is described by Gaskel and McLaren (who borrow the term from O'Brien) as "malestream" thought. This is defined by the authors as an academic orientation that is "partial, based in male experience, and therefore inadequate. Seemingly objective and value-free inquiry is revealed to be based on unexamined assumptions

about male and female" (p. 11). Feminist scholarship, using the theory of the social reproduction of knowledge, is responsible for exposing the male intellectual bias of socially produced knowledge.

The field of education, note Gaskel and McLaren, is particularly receptive to feminist transformation, partly because of the high proportions of female students in education programs, and the large numbers of female teachers. The field of education is similar to feminism, in that both education and feminism draw upon a variety of modes of inquiry, and are concerned with social phenomena and real world problems.

At the heart of feminist critique is the notion of bias. Gaskel and McLaren declare that "our very conception of education, of what counts as important knowledge and good pedagogy, has a male bias. It has been designed by men, for men, it treats women as "other", and it ignores women's experience" (p. 193). Feminism has called into question these taken for granted assumptions of curriculum.

To make schools female-friendly involves the representation of female experiences within the curriculum. Part of this reorganization of curriculum and knowledge involves changing not only what teachers teach, but also how teachers teach. The ultimate goal of challenging male-based knowledge, according to Gaskel and McLaren, is to make education more favourable to female students and teachers by eliminating gender-based imbalances. A feminist transformation of the education system is a "glacially slow" process, primarily because education is a particularly difficult area to change.

In Canada the changes happen slowly because of the bureaucratic entanglement involved in three political jurisdictions -- federal, provincial and local -- as well as the conservative nature of education in general. But Gaskel and McLaren believe that feminist theory offers new questions and paradigms that open up exciting possibilities for educational research and practice.

In a 1986 report for the Manitoba Government, Morrow and Goertzen examined math, science and computer gender differences in schools. They recognize that, although gender disparities are a product of society, schools exert significant influence as well. In order for gender differences to be minimized in schools, teachers must be educated. Teachers must improve their sensitivity to the unconscious and subtle influences of curriculum and instruction.

Morrow and Goertzen recommend as a solution to the underrepresentation of girls in science related areas, that computer use be broadened to include subject areas outside of math and science. The authors imply that exposure to the technology will help to minimize gender differences.

Feminism and Technology

A primary focus of this thesis is the non-neutrality of technology and its impact on education. Technology is a complicated issue and impacts on our lives in many ways.

Women can have significant influence in the world of technology (Franklin, 1990). Women's greatest contribution, according to Franklin, lies in "their potential to change the technostructures by understanding, critiquing, and changing the very parameters that have kept women away from technology" (p. 104). Women will bring to technology a newness and freshness of vision that will enhance the field and make it more accountable in human terms.

A technological discourse designed along the lines of feminist interaction would result in a breaking away from the technological mindset. This would allow for a focus on justice, fairness, and equity. Technological practices need to be questioned and examined in order that new practical ways of doing things will evolve. Those practical ways, according to Franklin will include a concern for all living things upon this planet.

In an earlier work, Franklin (1984) creates an analogy for the technological marginalization of women. She believes a similar situation can be found within the idea of immigration. A solution for women's marginalization lies within the immigration analogy, as well. In developing the analogy, Franklin observes that women are similar to ethnic groups who have settled new lands and have kept their cultures alive over the centuries. Over time, women have also maintained a community and culture that can be drawn upon for support and strength. She states that it is important "to remember and stress all the positive aspects of women's culture, to celebrate the creativity, the joys the

achievements and the resourcefulness that women have shown in the past" (p. 86-87).

Moving away from the immigration analogy toward research, Franklin sees a genuine need for new methodological contributions within science and technology, and believes feminine methods of inquiry would bring rigor without rigidity. She recommends a move away from the current over-emphasis on the quantifiable and the fascination with numbers.

A feminist approach is not necessarily a rejection of technology; a critical view does not involve discarding all that has been achieved, but rather looks for new ways that reflect social conscience. A strictly numbers approach cannot be considered a conscientious method, observes Franklin.

Kerr (1990) addresses the issue of educational technology and perceives a male bias in the models and approaches that have been used to advance technology in the schools. Educational technology reflects the science and technology centred model of industrial technology. The solution to this male bias in educational technology is not a blind rejection of technology. Rather, it is an integrative approach that recasts educational technology as having the potential to foster care along with efficiency in education. Kerr suggests four elements to achieve this, including using technology: as a facilitator, and not a replacement for teaching; to increase interpersonal connections; to support caring; and as a means to express concern for social and other problems.

Technology is viewed by Kerr as a social production that reflects male bias, but he does not extend his analysis to an exploration of the implications for gender reproduction and reinforcement. However, his ideas do reflect the incompatibility of a female world-view and male-biased technology and he makes relevant observations and suggestions for the female-friendly classroom.

Rothschild (1988) has developed a guide book for teaching technology from a feminist perspective. Her ideas are also relevant for teaching with technology from a feminist perspective.

In order to integrate gender materials into technology teaching, a feminist conceptual framework must first be developed. To do this means that attention must be paid to gender issues, the analysis of which, must inform all scholarly inquiry. "Creating a gender framework for incorporating feminist materials into technology studies means showing how and why gender is a necessary category of analysis for thinking and studying about technology" (Rothschild, 1988, p. 45).

Rothschild points out that a feminist conceptual framework can be interpreted to mean

explicitly contrasting masculinist and feminist categories and approaches; for others, it can mean concentrating on feminist aspects, the contrast with the dominant and masculinist approach thereby implied; for still others, it can mean developing a distinctly feminist mode of analysis of technology (p. 45).

At the heart of a feminist perspective or gender analysis is the notion that the exclusion of the female world-view is not accidental, for it reflects a fundamental power imbalance. This imbalance is

evident in the history of Western scholarship, and it reflects social and ideological power imbalances as well.

A white male elite has control over society and academic scholarship, observes Rothschild. This elite establishes the framework and the categories for academic analysis, which, in turn, legitimizes what can and cannot be studied. Within this framework,

women are the Other who are to be repressed and controlled, as are the poor (who are more female than male), and as are the races and cultures that are not of the white race and dominant cultures. A feminist resource, therefore, must reflect the consciousness of the Other so as to raise and change the consciousness about who and what is studied (p. 69).

A feminist conceptual framework that addresses gender issues must be developed in order to teach a course about the impact of technology. Rothschild's ideas, even though they are concerned with teaching about technology, are applicable to this thesis in its focus on teaching with technology.

A new definition of technology is necessary if science and technology are to be feminized (Bush, 1985). Past definitions of technology, according to Bush, have been overly simplistic and exclusive of women. She presents the following as an equitable definition:

Technology is a form of human cultural activity that applies the principles of science and mechanics to the solution of problems. It includes the resources, tools, processes, personnel, and systems developed to perform tasks and create immediate particular, and personal and/or competitive advantages in a given ecological, economic, and social context (p. 164).

The virtue of this definition is its consideration of advantage. Humans develop and adopt new technology in relation to what advantages it will provide them and what disadvantages will result for their competitors. Bush believes this definition will provide opportunity for an equity analysis that will highlight the benefits and risks associated with the introduction or use of technology.

The direction in which the feminist movement is going has important implications for teachers concerned with making their classrooms more female-friendly. Current feminism is closely connected to the ecological movement (King, 1983). Ecological science as an area that is concerned with the interrelationships of all life forms: an integrative science in an age of scientific fragmentation and specialization of knowledge. The philosophical foundation of ecologists involves harmony between human society and the natural environment. King perceives this field as being one that connects rather than separates scientific and social issues, and is very similar to the feminist view.

"Ecofeminism" is the term King uses to describe a melding of the two fields of ecology and feminism. This approach becomes one of social ecology which "challenges the dualistic belief that nature and culture are separate and opposed" (p. 119). The very future of life on earth depends on this new feminist orientation toward our world, according to King who writes:

The survival of the species necessitates a renewed understanding of relationship to nature, of our own bodily nature and nonhuman nature around us; it necessitates a challenging of the nature-culture dualism and a corresponding radical restructuring of human society according to feminist and ecological principles (p. 120).

Feminism within scientific enterprise is an issue addressed by Standish (1981). Her ideas are included at this point for two reasons. First, her theory supports King's ideas of ecofeminism. Second, there is an important connection between technology and science. (This relationship will be developed in Chapter 4).

Standish uses the autonomy theory (female attachment to mother, male separation from mother) to explain both the lack of women within scientific enterprise and the shortage of social consciousness within science. Her observations are relevant for the technical domain, as well.

Advances in science often result from a fascination with subject matter, and, according to Standish "this fascination with things as opposed to people would be considerably easier for a self-in-separation than a self-in-connection" (p. 10). In other words, the rational, objective nature of science is more conducive to male success than female success. Standish believes that women are not attracted to the scientific domain.

(F)or very fundamental psychological reasons, inanimate science, the science of things, is less likely to attract the fascination and intellectual and emotional commitment of a woman than would animate science. The psychology of many women is poorly suited to the solitary study of small invisible objects and events or very large distant entities (p. 11).

This lack of women in science is described as a worrisome state of affairs, because the scope and influence of inanimate science far outweighs animate science. Standish worries that serious human problems are occurring because of the male-dominated nature of science which results in an ignoring of social issues.

It is too easy to just reject the male world of science as a system that does not work, cautions Standish. Science has worked exceedingly well in many areas, despite social and biological problems that are currently happening as a result of science and technology. However, science would benefit tremendously from feminization.

The solution to the problem of one-sidedness in science, maintains Standish, is to reconceive the field from a feminist viewpoint, based on the idea of self-in-connection. It is important to not attempt to make women more successful in science by training them to be more like men, for to do so would not solve the problem of social issues. The scientific field needs to be philosophically reconceived from a feminist point of view.

Standish admits the technical and financial obstacles of such a radical change would be formidable. Instead, she recommends the formation of women's science collectives where females in the field meet regularly to share ideas and consult with each other.

Standish warns that if science and technology are not feminized, society will be leaving a powerful tool solely in the hands of female-raised males, a situation she perceives as very wrong. It is possible and desirable, writes Standish, for women to use their relational capacities in science and the expansion of knowledge, the result of which would be the responsible control of science and technology.

This section concludes with a return to the work of Rothschild (1988). She, like King and Standish, observes that feminization of science and technology will have positive benefits for all of humanity.

Rothschild observes that scientists and technologists, who typically work within a positivistic framework, continually attempt to be objective and rational in their work. However, human subjectivity can never be fully repressed.

Subjectivity should not be repressed, argues Rothschild, for it is subjectivity that places scientific endeavour back within the human realm. Although women make no particular claim to moral superiority in terms of science and technology, Rothschild argues that they do have a different perspective, as

feminists do claim an approach to research and scholarship that widens human perspectives in special ways. Bringing the female back into the technological picture -- from which she [has] long been excluded -- not only restores a necessary balance to scholarly inquiry. Feminist perspectives also bring an experiential and holistic approach that can transform such inquiry to be greater than the sum of its female and male parts (p. 222).

Feminism, feminist scholarship and pedagogy, and, feminism and technology are all fundamental issues within this thesis. This chapter has explored these ideas as a foundational beginning to a feminist analysis of educational technology.

The following chapter describes the methodology of that analysis.

CHAPTER 3

METHODOLOGY

This chapter describes the methodology to be used in the analysis of technology that takes place in Chapter 5. That analysis is based on the work of Cherryholmes (1988).

This chapter is divided into two sections. The first section describes Cherryholmes' approach to educational criticism.

The second section describes how Cherryholmes' work will be used in the analysis of technology and educational technology.

Section 1: Poststructuralism as Critical Pragmatism

A political scientist and a former high school teacher, Cleo Cherryholmes has recently written a number of articles and a book that address the issue of poststructuralism in education. For Cherryholmes, his latest work represents a move away from his previous (and self-described) stance of behaviourism and positivism.

In a personal interview, Cherryholmes acknowledged that prior to the 1980's he was a behaviourist, but was becoming increasingly disillusioned with that philosophical framework. In recounting his move into critical education theory and poststructuralism, he stated that "positivism was dead by the 1950's and the philosophers even knew it by 1960...and political science had just then become scientific. Educators

did not really become scientific until the 1970's. But I knew by 1970 that [positivism] was not going anywhere." (C. Cherryholmes, personal communication, April 15, 1991) It was not until 1979, when he met Henry Giroux that he became aware of and interested in critical education theory.

Since then, Cherryholmes has written a number of articles dealing with poststructuralism in education, including, "Theory and Practice: On the Role of Empirically Based Theory for Critical Practice", (American Journal of Education, November, 1985); "A Social Project for Curriculum Poststructural Perspectives", (Journal of Curriculum Studies, July, 1987); "An Exploration of Meaning and the Dialogue Between Textbooks and Teaching", (Journal of Curriculum Studies, January-March, 1988); and, "Construct Validity and the Discourses of Research", (American Journal of Education, May, 1988).

His book, Power and Criticism: Poststructural Investigations in Education, was published in 1988. As the title indicates, the publication focuses on poststructural analysis in education. Cherryholmes writes that the purpose of the book is to rethink and reexamine the assumptions of education. He refers to this reflective and critical process as critical pragmatism.

As Lather (1988) observes in her review of his book, Cherryholmes is not the first to explore poststructuralism in education, but is breaking what is relatively new philosophical ground. Lather notes that "Power and Criticism helps move educational discourse into the transdisciplinary crisis of confidence in methods and purposes that so charac-

terizes the contemporary academy" (p. 127). Since poststructuralism is a comparatively new phenomenon in education (Hlynka & Belland, 1991) Cherryholmes' work may be regarded as being on the leading edge of a paradigm shift in the field. (See Chapter 4 for a further discussion of this paradigm shift.)

As noted above, Power and Criticism provides the methodological foundation for the analysis of technology in this thesis. This work has been chosen as a foundational base because, as Lather (1988) notes, "poststructuralism provides an important movement toward unmasking the politics of educational thought and practice" (p. 133). Henderson (1988) praises Cherryholmes' work and regards Power and Criticism as an "important and useful introduction to [poststructural] analysis" (p. 135).

Cherryholmes is given substantial emphasis in this thesis because of his poststructural stand. By this very posture he widens the scope of his own work and the scope of this thesis. Cherryholmes regards the use of poststructural techniques and methodology as a way of subjecting a work or text to multiple readings, interpretations, and criticisms. Poststructuralism, he tells us, is characterized by incredulity, and takes a wide approach to the analysis of an issue.

In the case of this thesis, employing Cherryholmes widens the scope of the analysis of technology, for it is through his work that the dimension of poststructuralism is introduced.

Cherryholmes does not address the issue of feminism in Power and Criticism. Lather criticizes him for this in her book review, which Cherryholmes (1988) counters in a published response:

Patti Lather's major point was that feminist theory and criticism were neglected. I agree...Feminist theory was not included for a number of reasons: (1) I wanted to criticize, reinterpret, and deconstruct major themes and arguments in contemporary education on their own terms...In doing so, it has been pointed out, in Chapter 3 the 'great white fathers,' Tyler, Bloom and Schwab, were deconstructed. To deconstruct discourses and practices inherited from the past is, often, to deconstruct patriarchy. (2) Many are much better qualified than I to write about feminism in this context. (3) Even though I agree with much that I find there, feminist theory and criticism has been constituted by others for their (pragmatic?) purposes, therefore, I hesitate to appropriate it for my (our?) purposes (p. 214).

Despite this shortcoming, Cherryholmes methodology is still regarded as useful for this thesis. Even if Cherryholmes does not address feminist issues in his own work, his methodology is nonetheless a helpful tool in the analysis of technology. Atkins (1990) perceives Power and Criticism similarly. She describes the book as "an excellent tool for developing a more critical understanding of educational issues and practices" (p. 81). Just as Cherryholmes borrowed from and adapted his sources to develop his own particular model of criticism, the writer of this thesis borrows and adapts that which is appropriate from Cherryholmes' work, despite its feminist shortcomings, to do an analysis of technology.

The Cherryholmes Methodology

In his book, Cherryholmes adapts the work of a number of writers from a variety of backgrounds outside of education, and applies their work to the field. He takes the work of Foucault, Derrida, Habermas, Rorty, Saussure and others, and creates a new educational model for critical pragmatism. He combines the work of many different authors, with the result being a unique approach to criticism and analysis in education.

As noted earlier, the purpose of Cherryholmes' book is to rethink and reexamine the assumptions of education. This reflective and critical process, to Cherryholmes, is critical pragmatism. When asked in an interview if critical pragmatism is similar to Freire's concept of praxis, Cherryholmes pointed out that, despite differences, both terms encompass the idea of reflection.

Within any domain, Cherryholmes tells us, critical pragmatism regards the unspoken and widely accepted criteria and standards as in themselves problematic. Critical pragmatism is a conscious addressing of those standards and criteria, and other professional choices and decisions that are made. It "results when a sense of crisis is brought to our choices, when it is accepted that our standards, beliefs, values, guiding texts, and discourses-practices themselves require evaluation and reappraisal" (Cherryholmes, 1988, p. 151).

Cherryholmes clarifies the concept of critical pragmatism by contrasting it with unreflective functional efficiency.

This is pragmatism premised on unreflective acceptance of explicit and implicit standards, conventions, rules and discourses-practices that we find around us...Vulgar pragmatism results when efficiency is pursued in the absence of criticism, when actions are privileged over thought, when practice is valued and theory disparaged, when practice is divorced from theory (as if that were possible) for the sake of making things work 'better' (p. 151-52).

This process is described as decision making which tests new ideas and practices by comparing them to traditional or conventional norms. This results in a reinforcement of what is already in place. Pragmatism of this nature occurs without a sense of crisis or criticism, and promotes local ideology as global reality. It also accepts historical ideology as current and timely.

The choices that are made by educators, and the actions they take are pragmatic responses to situations. Those choices are based on what Cherryholmes calls "visions" of what is right or appropriate. Choices are usually made by referencing values, interests and criteria, or the "constitutive rules of practice" (p. 4). Together the rules constitute ideology. Ideology is intertwined with power, and power arrangements support the choices people make. Cherryholmes refers to power as the

relations among individuals or groups based on social, political, and material *asymmetries* by which some people are indulged and rewarded and others negatively sanctioned and deprived...Ideology intertwines with power as individuals accept, believe, and internalize explanations and justifications for the asymmetries of their social world (p. 5).

Power arrangements support the particular ideology or "vision" of what is right, and influences the choices that people make. Power arrangements and ideology infiltrate both thinking and actions [and] shape subjectivity.

Poststructural analysis adds the dimension of criticism to pragmatic choice, and avoids what Cherryholmes calls the untamed functionalism of vulgar pragmatism. To reiterate, Cherryholmes describes poststructural analysis as a rethinking or reexamining of the seemingly nonproblematic values, assumptions and arguments that permeate a particular domain, and a calling into question of their coherence and plausibility.

Within this thesis, poststructural analysis will be used to rethink and reexamine the myths, assumptions, values and arguments that permeate educational technology in order to determine if there is a connection between technology and patriarchy.

Poststructural Strategies in Education

Professions such as education, Cherryholmes asserts, are "constituted by what is said and done in their name" (p. 1). The accepted ways of doing things in education, observes Cherryholmes, are typically unquestioned or unexamined by practitioners in the field. Practices are based upon shared assumptions, or paradigms, which permeate the entire domain of education.

Regularities in what is said (discourse) and done (practice) are based on shared beliefs and values ranging across tasks accomplished, problems addressed, values articulated, and research undertaken. Vast areas of agreement about how to proceed in contemporary education dwarf noteworthy and important conflicts and disagreements. Areas of agreement include (in principle if not always in practice): structured use of textbooks in classrooms, instruction based on learning objectives, educational

practice guided by research findings, standardized approaches to research design and program evaluation, systematic approaches to curriculum design and development, and learning as acquisition of a positive body of knowledge and skills (p. 1).

Cherryholmes borrows the term paradigm from Thomas Kuhn to describe the phenomena whereby all members of a particular group agree upon the way of their world. In education as in all fields, he notes, there exists a paradigm which involves widespread agreement upon the values, beliefs, and practices that are accepted as normal and appropriate for the field. These beliefs are described by Cherryholmes as "primitives", for they are unquestioned and accepted as given. They are not defined, nor even mentioned, and are the basis for all things that educators say and do. Professional discourse and practice is possible only because of the existence of these tacit agreements. Cherryholmes observes that the paradigm that is currently dominant in education is structuralism. He gives as three examples of structuralism in education, Tyler's 'Rationale', Schwab's 'The Practical 4' and the Bloom et al 'Taxonomy of Educational Objectives'.

Poststructuralism in education is a move away from structuralism, into the realm of criticism and analysis. Cherryholmes describes poststructuralism as a method by which "some aspects of the exercise and effects of power can be read, interpreted, criticized, talked and written about, and evaluated. They can be employed critically and pragmatically from classrooms to work on research projects to teacher training" (p. 152). The strategies are not intended to suggest to researchers, teachers, administrators or others what they ought to be

doing in their jobs. Rather, poststructural strategies should be employed by all practitioners in order to rethink and reexamine what they each say and do.

Following is a summary of Cherryholmes' five poststructural strategies: reading, interpretation, criticism, communication, and, evaluation and judgement.

1. Reading

To critically "read" a text is one poststructuralist strategy. Barthes (1985) describes the reading of a text as a process of "rewriting...the text of the work within the text of our lives" (p. 101). To "read" a text, for Barthes and for Cherryholmes, is to make it relevant in the context of our lived experiences.

In his discussion of reading, Cherryholmes borrows from the linguist Saussure and the theory of semiotics. Semiotics is the study of signs, symbols and meanings.

Texts and discourses-practices impose and reinforce values and assumptions, and can be read, or analyzed to determine what they might be communicating. Texts exist to be consumed, accepted and acted upon, and make us who and what we are, individually and collectively. Cherryholmes borrows the term "textual power" from Scholes (1985) and describes it as similar to other effects of power. To observe texts as having power is a move toward viewing them, not as closed and finite entities with definite meanings, but as things open to interpretations, multiple readings and criticisms.

Textual power is asymmetrically weighted on the side of readers if readers subject a text to multiple readings, and search for the endless play of meanings within the text. Conversely, textual power is asymmetrically weighted on the side of the text if readers seek to find definitive meaning in a text. Textual power weighted toward readers is a necessary condition for social change, Cherryholmes writes, for "without textual power, we remain unwitting captives of texts and discourses—practices from the past" (p. 154).

The reading of a text occurs when one can relate or "tell" the story within the text. The interpretation of a text is subject to a number of different "tellings", or perspectives. In his book, Cherryholmes gives his particular reading of a variety of texts, including elementary text books, research findings, theoretical formulations, and, as well, of Tyler's rationale, the Bloom et al Taxonomy and Schwab's Practical 4. He points out, however, that his reading is just one reading, or his version of the telling.

[They] could have been told in terms of the history of domestic politics, technology, industry, and social elites; theoretical formulations, as explanations of discrete behaviours and outcomes; teaching, as instruction in the dominant and accepted views of knowledge and society; construct validity, as coherence among constructs and their measurement -- a coherence with inherited research; and curriculum content, as something that is linear, cumulative, and structured. Stories such as these overlap...The fact that texts within texts are multiple yet overlap thematically bridges reading and interpretation (p. 155-56).

Reading is not entirely separate or distinct from interpretation and criticism, Cherryholmes points out, just as interpretation and criticism are not independent of each other.

2. Interpretation

Interpretation builds upon reading, or upon previous interpretation, and produces text *upon* text. Interpretation is a kind of thematizing of a text, or, as Cherryholmes puts it, a getting from the said to the unsaid. Interpretation places text in *context*. This poststructural strategy involves reading as experiencing, and Cherryholmes sees it as "exploring multiple voices of textual possibilities" (p. 156-57). Interpretation is the extension of reading -- reading as experience -- and a rendering of that experience.

Interpretation is assisted by structural analysis, writes Cherryholmes, as structural analysis identifies the valued and disvalued categories of texts. It examines how texts are organized and constructed, as well as the manner in which discourses-practices are pursued. "Structural analysis identifies binary distinctions, metaphors, models, modes of argumentation, inferences, and repetitions, [and] it moves from the story and narrative to the background" (p. 157).

Examining binary distinctions is an interpretative strategy. These distinctions help to highlight rhetorical claims and inconsistencies within a text. A binary distinction, it is remembered, is a device to determine whether an object has a particular quality or attribution. Addressing the distinctions or differences help us to rethink and reexamine the values and assumptions that permeate the story or metanarrative.

3. Criticism

Just as interpretation builds upon reading and other interpretation, Cherryholmes tells us that criticism builds upon readings, interpretations and other criticisms. This is said to produce text *against* text.

Criticism provides the opportunity to break out of dominant interpretations and readings. It addresses texts that masquerade as objectivistic, being founded on supposedly uninterpreted hard facts within the foundation of empiricism. Cherryholmes summarizes this point:

Objectivistic texts implicitly claim to *represent* things the way they are...Textual themes invoke cultural codes, valued categories, and ideological orientations. Criticism develops extra-textual concerns by evaluating, discussing, examining, and questioning these codes, categories, and orientations...Reading produces stories (among other things). Interpretation provides context. Criticism surfaces and evaluates that which narrative and interpretation has omitted, suppressed, devalued, silenced, and opposed as well as what has been claimed, asserted and argued (p. 159).

Cherryholmes suggests three approaches to criticism, including structural criticism, analysis of power (based on the work of French philosopher Michel Foucault), and deconstruction (based on the work of French philosopher Jacques Derrida). Cherryholmes describes the three approaches:

1. Structural criticism illuminates counterstructures that texts and discourses-practices ignore or seek to silence.
2. In a Foucauldian genre, criticism produces histories and politics of the present, wherein texts and discourses-practices are effects of the exercise of power.
3. In a Derridean deconstruction, criticism exposes silences and gaps between that which is valued and disvalued, traces the

sedimentation of meanings, and documents contradictions and ambiguities within texts and discourses-practices (p. 160).

These three approaches are discussed at length below.

The first approach, **structural analysis** is not a poststructural technique, as the term poststructural implies a moving beyond structuralism.

Structural analysis is an important step within and toward criticism, as it allows a "reading" of a structure or text as that text presents itself. This straightforward, uninterpreted reading reveals the rhetorical claims of a text. When criticism moves to the poststructural (deconstruction) stage, these claims become important, as they are examined and exposed as self-subverting, self-negating and self-deconstructing.

Structural analysis emphasizes the wholeness and unity of a structure, or the sum total of its parts. The abstract codes and rules that underlie structures become obvious during structural analysis. The constitution of a structure is revealed by relationships among the units in a structure. Those relationships are observed to regenerate and reproduce the structure, and are self-regulating. Pure structuralism decentres the subject, as relationships within the structure are emphasized over individuals.

Structuralism has been influenced by linguistics, Cherryholmes observes, as texts or discourses are

constituted by words, utterances, and statements with which ideas, thoughts, and concepts are associated. Textual, discursive ideas are also projected on our object-referent world as words, and

utterances assign ideas and concepts to our perceptions. Meanings assigned to objects are socially constructed (p. 19).

Words are important within structuralism, arbitrary that they are. Words convey meaning within a system because of relationships to, and differences with other words in a system. Binary distinctions determine the content of a structure because, according to Cherryholmes, language is determined by relationships and differences among words. These distinctions underlie every assertion or denial made by a structure.

As stated, the binary distinction is a logical device for discrimination. It aids in determining whether a quality or attribute is present or missing. Words are distinguished from each other through binary distinctions. Cherryholmes perceives many binary distinctions operating in education: cognitive/ affective; subject-centred/learner centred; emancipation/oppression, and so on. He clarifies how the terms are used:

In structural analysis and criticism, the word valued by the structure is stated first, the disvalued word second, and which orientation one adopts toward educational discourses-practices determines one's values and disvalues. The normative commitments of a structure, then, are highlighted by identifying its valued and disvalued categories (p. 22).

Structuralism is supposedly ideologically neutral. It is a description and mapping process -- a straightforward presentation of the meanings and assumptions within a structure -- and does not purport to interpret, or take sides. This is consistent with logical positivism and logical empiricism, according to Cherryholmes. The goal of

structural analysis is to describe something as it is, and not where the critic would like it to be.

Cherryholmes notes that structuralism can be criticized on several grounds. First, it can be seen as antihumanistic, displacing individuals from the centre of meaning, putting "structures at the centre and people at the margin" (p. 31). Structuralism can also be regarded as a process which ignores history, culture and values. Finally, and most significantly, structuralist assumptions, as Cherryholmes observes, "contain arguments that subvert themselves...and lead to poststructural analysis and criticism" (p. 31).

Criticism of structuralism, Cherryholmes notes, has produced poststructuralism. Structuralists claim that systematic knowledge is possible, while poststructuralists regard that as an impossibility.

Systematic knowledge is based on fixed meanings, and one way to fix meanings in structures or texts is through transcendental signifieds. As meanings are elevated above texts, they become fixed, unquestioned and accepted as transcendental signifieds. Transcendental signifieds, as described earlier in Chapter 1, refer to metaphysical commitments to meaning. The acceptance of a transcendental signified as a description of some part of the world does not require logical, rational, or scientific justification. Examples of transcendental signifieds in education include justice, equality, and excellence.

The second approach to criticism, Foucauldian analysis, is a post-structural approach. Cherryholmes applies the work of Michel Foucault

to education in order to focus on power relations within the field. Cherryholmes sees Foucauldian analysis as a way to "uncover how power operates in, through and on discourses, institutions and social practices" (p. 162). This interpretive-analytic type of criticism, writes the author, may attack liberal beliefs as to human ability to make autonomous choices. At the same time, however, it offers the opportunity for intervention in the anonymous discourses-practices that are commonly regarded as beyond our control.

This criticism is interested in the political production of truth, and the manner in which discourses and practices are constituted. The rules of any discourse, observes Cherryholmes, determine what may be said and what remains unsaid. The rules identify those who speak with authority and those who may only listen. Finally, the rules are anonymous with no identifiable author, and no clear-cut beginning.

Cherryholmes borrows from Jacques Derrida to describe the third type of criticism, **deconstruction**.

Deconstruction, which is one form of poststructural criticism, questions whether proposed first principles that purportedly ground structuralist programs and meanings ever transcend our texts and discourses-practices. If no transcendent first principles exist, then our structures are not as fixed or "structured" as they might appear, because every term or element is always defining every other term or element and vice versa and back and forth with no clear cut beginning or ending (p. 13-14).

The process of deconstruction is the search for meaning, or the pursuit of the play of meanings within a text. Deconstruction denies structure and recognizes that meanings are dispersed and deferred within a text. (C. Cherryholmes, personal communication, April 15, 1991)

Because meanings are dispersed through texts and deferred in time, they are never centred or fixed.

For instance, the meaning of a particular word is *dispersed* as it relies upon the meaning of other words for its own particular meaning. Although that may sound confusing, it is not. A definition of one word turns into an infinite series of other definitions and words, all of which rely upon each other for meaning. Meaning is dispersed among all of the different meanings.

Deferral of meaning is similar to dispersal of meaning, in the way that meaning depends on other meanings. However, deferral has the added dimension of time. Cherryholmes explains the subtle difference between dispersement and deferral using the word *achievement*:

An example of dispersed meanings is given by tracing meanings of a word to its definition, which is itself composed of words that have definitions, which are themselves composed of words, and on and on. If this search is considered in terms of the time it takes to complete the search, the meaning of *achievement* will not be decided until the meanings of *successful*, *conclusion*, and *accomplish* are determined. Determining the meaning of *achievement* is put off until yet a later time (p. 37).

Thus, the meaning of any word is deferred in time.

Just as meanings are dispersed and deferred from word to word, so are they from definition to definition. This dispersal and deferral of the authority of meaning continues to the level of transcendental signifieds. The very meaning of any transcendent concept rests upon other concepts, which are also postponed by deferral and dispersement.

Although transcendental signifieds become slippery and illusory upon critical examination, Cherryholmes argues "that disciplines and

professions, including educational discourses-practices, are not possible without the transitory 'certainties' they offer" (p. 38).

Deconstruction, then, involves examining the rhetorical claims made by texts. Binary distinctions and transcendental signifieds are examined to highlight plays of references, traces of meanings, and inconsistencies within a text.

At some point, Cherryholmes observes, the two poststructural types of criticism, interpretive-analytic and deconstructive, begin to reinforce each other.

Foucault highlights empirical, contingent circumstances by which transcendental signifieds are adopted and enforced. Derrida argues that transcendental signifieds that attempt to norm and police texts are logically suspect and do not deliver on rhetorical claims made for them. First principles, which are logically suspect in Derrida's analysis, are in Foucault's view, sometimes persuasive and adopted because of circumstances and situation and time and place. Effects of power identify authoritative principles that guide discourses-practices (Foucault), but there is often less and more to these guiding principles than meets the eye (Derrida) (p. 166).

Poststructural criticism is a method that examines issues within structural themes that are not necessarily visible at first glance. Structural themes and narrative history force order upon things. Linear planning and models of rational choice also force order. Cherryholmes perceives poststructural criticism as a way to expose the "tentative, provisional, contingent, incomplete and ambiguous" (p. 166) nature of that orderliness. Poststructural interpretations may reveal the

problematic nature of the themes and distinctions revealed in structural analysis.

Multiple interpretations and criticism are unlikely to uncover new "truths" or paradigms. Instead, Cherryholmes concludes, "they are likely to identify complexity, disorder, and movement and bring to the foreground play, aesthetics, politics, criticism, and ethics that structures legislate against in the name of rationality and control" (p. 167).

4. Communication

Reading, interpretation and criticism never occur in isolation. Cherryholmes maintains that an important part of poststructural analysis is interaction with other people -- talking and writing about our observations.

Communication, like texts, is subject to multiple readings and interpretation, and is constrained by place, time, and the exercises of power. It is also subject to deconstruction.

Cherryholmes cites Grice's four guidelines for clear communication:

- (1) quantity (provide as much information as required and no more;
- (2) quality (avoid saying what you believe is false or for which you have no evidence;
- (3) relation (make it relevant); and

(4) manner (be orderly, brief, clear, and avoid ambiguity and obscurity) (p. 168).

5. Evaluation and Judgement

Ultimately, readings, interpretations, criticisms and communications involve evaluation and judgement. This final poststructural strategy relies on comparisons, observations and agreed upon standards.

Cherryholmes reminds us that judgement and evaluation are a fact of daily life, and are historically conditioned. They, like texts, reflect the exercise and effects of power, and rely upon standards. We can escape neither the time nor place in which we are situated, nor the impact our situation has upon us.

Agreed upon standards imply values. Cherryholmes ponders values, and speculates which are to be proposed for our standards. He considers liberty, equality, tradition, security, possessions, as directions some might choose, but settles on human dignity, with a qualifier.

Conceptions of human dignity are important in shaping and planning what we say and do and in assessing what has been said and done; and, its complexity notwithstanding, I believe promoting human dignity is an important, if not the most important, educational goal. Having said that, what does it mean. Alternative conceptions of human dignity not only require interpretation and invite criticism; they are also ambiguous and contradictory. The resulting indeterminacy produces additional readings, interpretations, and criticisms (p. 172-73).

The process of sorting through different interpretations of a value is a difficult process indeed. Cherryholmes concludes that in doing so, no single definition or interpretation should be treated as

transcendental or definitive, or as a critical standard. He warns that we should guard against any argument for a final solution.

In the end, our evaluations and judgements are the end product of the poststructural analysis. Whether we are concerned about human dignity or feminism (if those are even different concepts), our final conclusions are made according to what we find persuasive. But, given the exploratory and informative nature of poststructural strategies, including multiple readings, interpretations, criticisms and communication, we can at least be enlightened in our evaluations and judgements, and avoid vulgar pragmatism.

Eleven Analytical Questions

Cherryholmes puts forth 11 questions for critics to consider when analyzing discourses and practices. Any or all of the questions can be applied at any stage of the analytical process to facilitate critical pragmatism, depending on their appropriateness:

1. Who is authorized to speak?
2. Who listens?
3. What can be said?
4. What remains unspoken?
5. How does one become authorized to speak?
6. What utterances are rewarded?
7. What utterances are penalized?

8. Which categories, metaphors, modes of description, explanation, and argument are valued and praised; which are excluded?
9. What social and political arrangements reward and deprive statements?
10. Which metaphors, modes of argumentation, explanation, and description are valued?
11. Which ideas are advanced as foundational to the discourse? (p. 107)

Cherryholmes acknowledges that these questions are just a starting point for any researcher involved in critical analysis, and that they contain some redundancy. (C. Cherryholmes, personal communication, April 15, 1991) They provide a guideline for the critic and must be adapted to her or his particular topic.

Section 2: Application of Cherryholmes' Methodology

The methodology of this thesis borrows from Cherryholmes' work. The point of this analysis is to do a feminist analysis of educational technology in order to illustrate the power asymmetries of technology, as well as the self-contradictions and limitations of technology in terms of a feminist world-view.

The first step of the methodology, then, is to treat technology as a text, in the semiotic sense of the word. In order to regard it as such, a description of technology is first necessary. To do this, technology is presented in terms of what a number of professional writers involved with technology and educational technology have to say about it.

Because this thesis is centred around feminist concerns, the sources of information for the description of technology have come not only from the fields of technology and educational technology, but also from the feminist field. The sources have included books, journals, theses, dissertations, and reports from conferences.

The description of technology is presented in Chapter 4. The information in that chapter provides the foundation for determining the nature of the technological text, including the rhetorical claims of the text, the binary distinctions, and the transcendental signifieds.

In Chapter 5 the technological text is described. This description is derived from the information gathered together in Chapter 4. In order to establish technology as a text, the broader concept of technology is treated as a metanarrative.

A metanarrative is a story or set of rules characterizing knowledge (Cherryholmes, 1988). Within that 'story' are the themes, characteristics or principles that "function to outline what is or is not acceptable, desirable, efficient, and so forth regarding educational discourses-practices" (p. 11).

It is the belief of this writer that technology itself constitutes a metanarrative within our society. Technology has within its domain its own particular story. It has its own set of rules that characterize legitimate knowledge, and its own set of principles that outline what is or is not acceptable, desirable, and efficient regarding educational discourses and practices.

Given the existence of this technological metanarrative, technology is then given a structuralist reading, and examined for the common threads, observations, conclusions, arguments, rhetorical claims, binary distinctions and transcendental signifieds. These threads have been sorted and sifted out of the metanarrative, and presented in Chapter 5 as a list of the concepts and constructs which comprise the traditional technological text.

That text is then subjected to a feminist critical analysis. As described by Cherryholmes, this analysis includes: interpreting, criticizing, evaluating and judging. This is done in order to discover, reveal, explore, and, (to use Cherryholmes' term) "play" with the dispersal and deferral of meanings, and to "play" with the myths, values and assumptions power asymmetries that are communicated through technology and educational technology.

To summarize the methodology of Chapters 4 and 5:

1. Describe technology according to the experts in the field.
2. Do a structuralist reading of technology, based on the description by experts, revealing technology's constitutive rules, themes, concepts, constructs, assumptions, rhetorical claims, binary distinctions, and transcendental signifieds. This reading produces the technological text.
3. Do a poststructural analysis of the technological text from a feminist perspective, revealing the power asymmetries of technology, as well as the way in which meanings are dispersed, deferred and at play within the text of technology.

CHAPTER 4

A DESCRIPTION OF TECHNOLOGY AND EDUCATIONAL TECHNOLOGY

This examination of technology will begin with the macrocosm of technology as a product of society. Given such a global perspective, the exploration will then move into the microcosm of the classroom to look at educational technology. This chapter is divided into five sections:

1. Technology -- toward a definition
2. The non-neutrality of technology
3. Technology, science and patriarchy -- a connectedness
4. Technological bondage -- the myth of liberation
5. The technological classroom

Technology -- Toward a Definition

Although the impact of technology is widespread, it is an elusive and difficult term to define precisely. To begin with a dictionary definition, Webster's New Collegiate Dictionary interprets technology as "1: technical language 2: (a) applied science (b): a technical method of achieving a practical purpose 3: the totality of the means employed to provide objects necessary for human sustenance and comfort" (p. 1188).

Technology is an idea that is similar to the notion of democracy, observes Franklin (1990), who regards both as multifaceted entities. However technology is defined, it must include the notice of practice, for doing so illustrates the deep cultural link of technology. Thinking

of technology as connected to culture prevents us from treating it as icing on a cake. Technology, says Franklin, is part of the cake itself.

Technology can actually be analyzed within six levels different levels: tool, process, system, environment, epistemology, and ethic (Henchey, 1987). The divisions range from simple to highly complex and Henchey explains them as follows:

At its simplest level, a technology is a *tool* or instrument: a pin, a bicycle, or a printing press. It is also a *process* or method: a computer simulation, bureaucracy, or assembly line. It is a *system* that integrates instruments and elements into a structure or organization: a communications network, a technocratic state. As the influence of technology expands, it becomes an *environment*, the medium or context within which we live and within which our institutions and values are formed: an electronic environment of computer arcades and information networks. It can be an *epistemology* or way of thinking: technical rationality, the concern with methods and disinterest in goals. Finally, technology may be an *ethic*, a value system that is primarily utilitarian: efficiency becomes the standard of what is good -- methods are neutral and what can be done should be done (p. 44).

The very essence of technology is control, writes Henchey, and technological control can be expressed in four different dimensions, including mastery of:

- the physical environment,
- products available to us,
- energy and work, and,
- information and social organization.

Humans control the physical environment with technological innovations such as bridges and airplanes which allow us to be independent, powerful, and less bound by nature. Technology also gives us control of

the products available to us. It allows us to modify nature in order to produce new products, as in the way diamond drills are used for petroleum exploration. Technology expands human control over energy and work to increase speed, accuracy, reliability, efficiency and capacity with minimal costs, time and materials. Hydro-electric dams and assembly lines are examples of this type of control. Technology also involves control over information and social organization. This allows us to expand our senses as well as our power to organize ourselves. Henchey gives alphabets, printing presses and computers as examples of control over information and social organization.

Henchey regards technology as a quantitative entity that is

(w)ritten in the language of mathematics. [It] is an instrument for controlling length, width, weight, movement, time, space, light, sound, particles or impulses. The control offered by most technologies rests on the precision of measurement, the quantification of processes, the consistency of materials, and the fidelity with which principles guide procedures and procedures develop products (p. 43).

This description of technology with its emphasis on quantification and measurement places technology within the domain of science.

In Technology in Western Civilization, Kranzberg and Pursell (1966) attempt to define technology by reviewing different interpretations of the term. They, like Henchey believe that at its simplest level, technology is most commonly defined as tools or machines such as computers, automobiles, televisions and other mechanical or electrical devices.

The authors observe that some definitions present technology as processes or systems, and others as applied science. Thinking of technology as applied science is inaccurate, they believe, for throughout much of history, technology has had little relation to science. Historically, people have been able to make machines and devices without necessarily having any understanding of why or how they function.

Technology is a great deal more than tools, artifacts, machines and processes as Kranzberg and Pursell interpret the term. It has more to do with human work in an attempt to satisfy wants by action on physical objects. To paraphrase the authors, the definition of technology is the human effort to cope with the physical environment in an attempt to subdue or control that environment through imagination, ingenuity and the use of resources.

An attempt to understand technology by doing a survey of its history, and by listing various inventions and their creators is also insufficient in coming to grips with the term. Kranzberg and Pursell believe that comprehending technology means regarding it as complex and much more than simple physical devices.

They see technology as a social requirement, affected by social needs and economic environments. Technology is also influenced by both the level of technology at a given time as well as the sociocultural and psychological circumstances.

The chief distinction that separates humans from their primitive, non-human ancestors, according to Kranzberg and Pursell, is the thoughtful use of technology: humans made and used tools and weapons. The authors speculate that without this ability, humans would never have

survived or even evolved. Early humans are described as too weak and puny to compete with nature armed only with their hands and teeth: "The lion is stronger, the horse is faster, and the giraffe can reach farther. [Humans] have been able to survive because of their ability to adapt to [the] environment by improving [their] equipment for living" (p. 7).

The authors attribute our evolution as Homo Sapiens, and our standing on two feet to technology. Humans did not learn to throw stones because they were already walking upright and had their hands free to manipulate weapons; they stood erect in order to have their forearms free to throw stones. The authors conclude that humans could not have become thinkers if they had not also become makers. Humans made tools, but important too is the fact that tools made humans.

As early as 1 million B.C., Homo Erectus, (an ancestor of Homo Sapiens), used technology. Homo Erectus' tools included fire and simple stone weapons and tools. Those tools had influence on the evolution of early humans.

Increasing technological mastery of the environment continued through the ages and the evolution of humans. The very terms with which we define history are technical (Kranzberg & Pursell). The Stone Age, Bronze Age, Iron Age, and Industrial Era all reflect technological advances. The Atomic Era and the Computer Era are two more contemporary descriptions of technological advancement.

The Non-Neutrality of Technology

There is a commonly held view that technology is neutral and does not transmit political or social values (Lipscombe & Williams, 1979).

Closely associated with [the commonly held view] is the idea that technology itself is neither good nor evil. Any beneficial or harmful effects arise out of the motives of the people applying a particular piece of technology and the end to which it is used. Where a particular application, chosen for its beneficial results, produces harmful side-effects, these are blamed either on inadequate social policies or on lack of sophistication in the control of the effects of technology. Whichever is [blamed], the technology itself remains 'neutral' (or blameless) (Lipscombe & Williams, 1979, p. 19).

The idea of technology as a neutral force is a myth that has been developed to disguise technology's political role, according to Lipscombe and Williams. The term "technological politicism" is used by the authors to describe the impact of technology on culture.

They give as example of this process, the promotion of powdered milk in developing countries. A seemingly benign or 'neutral' technology such as milk can have profound impact on a society. The use of powdered milk in developing nations regularly results in widespread infant malnutrition. Parents often have little knowledge of hygiene, are frequently unable to read instructions, and cannot always afford sufficient supplies. Consequently, the milk they feed to their infants is often diluted and served in dirty bottles, resulting in malnutrition.

The real nature of technology is obscured from us, and an illusion of neutrality has been created. This occurs, according to Lipscombe and Williams, because of the fact that western technology has arisen out of

western society. The alternative to a value-laden technology is not the development of a different and 'neutral' technological system, for a neutral technology is an impossibility. Technology is and always will be value-laden, and the only real alternative is a different technology committed to different values, conclude the authors.

Although, as Lipscombe and Williams observe, many perceive technology to be a neutral force, the notion of non-neutrality is not a new idea of the 1990's.

Almost three decades ago McLuhan (1964) coined the phrase the "medium is the message" to explain the impact of technology. McLuhan made observations of the impact of electronic communication devices such as television and radio. Writing before the widespread use of computers, (which, if he were writing today, would most likely be included in the list), McLuhan believes that despite the verbal messages that are transmitted, the very presence and use of machines have impact on human lives. The physical presence and the very process of using electronic communications technology has psychic and social consequences in the way they amplify or accelerate existing processes. For McLuhan, the 'message' of technology is "the change of scale or pace or pattern that it introduces into human affairs" (McLuhan, 1964, p.24).

Baudrillard (1991), like McLuhan, sees an important connectedness between message and medium. He writes that "the medium is no longer identifiable as such and the merging of the medium and the message is the first great formula of this new age" (p. 468-70). The medium cannot

be separated from the message as being a neutral force in the delivery of information.

Franklin (1990) also regards technology as a non-neutral force. She describes it as a system or force that has profound influence over the human condition. This force is accompanied by ideas, practices, myths and various models of reality, and, it affects and changes our social and individual relationships.

Franklin rejects the extreme view held by some that technology is a self-determining entity. (See Ellul, 1968) Although she does not see it as self-determining, Franklin believes that technology, since it has been developed in social, political and economic contexts, reflects contextual values, myths and assumptions, and is not neutral in any sense of the word. According to Franklin, technologies are generated in social structures, are influenced by those structures, and, as well, have their own influence. Technology's impact is seen to be unpredictable, and "may reinforce [the social structure] or destroy it, often in ways that are neither foreseen nor foreseeable" (Franklin, 1990, p. 57).

An environment has evolved within society which is structured for the well-being of technology, and not the well-being of humans, maintains Franklin. Publicly supported infrastructures such as transportation, communication and power sources contribute directly to a technological milieu that is conducive to production and efficiency. This milieu is not conducive to natural growth. Franklin perceives technology as a method of controlling or denying nature, which has become very

distant to humans who live and work in climate controlled conditions that have completely eliminated any sense of season.

Hill (1988), like Franklin, believes that technology has a connectedness to culture. Technology is described as a "cultural text" with values built into its form, and "has developed the power to emerge as a cultural frame for the constitution of cultural meanings across all reaches of contemporary life" (Hill, 1988, p. 231). The technological text has actualized the industrial world-view, and there exists an interrelationship between technical knowledge and socially constructed reality. Technology becomes a frame within which social meaning and reality develops.

Hill, again similar to Franklin, rejects the notion of technology as autonomous and self-determining, disagreeing that technological systems are somehow independent from the culture that creates them. But, even if technology is not autonomous, he does believe it has progressed to the point of being beyond human control. This loss of control is referred to as the "tragedy of technology", and Hill asserts that humans have become the servants of a technology that has created our culture. Social life is dominated by technological change, writes Hill, despite the fact that the technical frame is a human product which ought to be malleable. He perceives the situation to be getting worse, and writes:

[T]he remorseless tragedy of technology continues to unfold, continually displacing the technological frame of social experience with a progression of more encompassing frames, a progression in scale and international connectedness between technological systems of production, consumption, transportation, communication, urbanized living, and military destructiveness (p. 24).

The way in which the human tragedy is experienced is in a remorseless and inevitable "reworking of things". Human action is so completely enframed within the technical text, Hill concludes, that it is virtually impossible to "stand outside and kick the system into new life or wrestle it into a trajectory that departs from the...expansion that has characterized industrial history" (p. 230).

Benston (1988) is also aware of the far-reaching impact of technology and thinks a technological world-view exists in industrialized societies. According to the author, female and male experiences within industrialized societies differ greatly.

Boys and men are expected to learn about machines, tools and how things work. In addition, they absorb, ideally a 'technological world-view' that grew up along with industrial society. Such a world-view emphasizes objectivity, rationality, control over nature and distance from human emotions. Conversely, girls and women are not expected to know much about technical matters. Instead, they are to be good at interpersonal relationships and to focus on people and on emotion. They are to be less rational, less capable of abstract, 'objective thought' (p. 15).

Benston also addresses the patriarchal assumptions of technology and asserts that women are marginal to a male-created and male-dominated technology. Technology reflects the interests of the dominating class and works against a feminist view of the world.

For those of us seeking a more egalitarian, cooperative society, many fundamental tools and techniques -- such as those to support democratic decision making and communications -- simply do not exist. The telephone system, for example, makes communication between two people easy but it is very difficult to arrange a group discussion. This situation is quite appropriate to an individualistic society but not necessarily in one where cooperation is more highly valued (Benston, 1988, p.18).

There exists a relationship between science, technology and culture (Henchey, 1987). Technology is a non-neutral element of culture, at once existing within the context of culture, and, instrumental in the development of culture. Technology is both made by culture, and makes culture, observes Henchey.

Technology is the way a culture provides its food, makes its clothes, builds its shelters, worships its gods, communicates its feelings, and entertains itself. But a technology is by no means a neutral cultural tool, since technology shapes the culture that invents or borrows it. The automobile, transistor radio, and birth-control pill are technologies that transform cultures and produce social change, often in unforeseen ways (p. 44).

Critiques of technology involve two dimensions, according to Henchey: the physical consequences of technological use, and the extensions of technology into society and culture.

Technologies have led to unforeseen physical consequences including acid rain, air pollution, and toxicity of land and water. These negative and often unexpected fallouts have resulted in further technological interventions, some of which have resulted in further consequences.

With respect to social consequences, technology has impacted negatively on developing nations, increasing their dependence on imported commodities and altering their lifestyle.

Some critics, according to Henchey, are concerned with the manner in which technology is extending into culture and transforming life. He uses the term "domino effect" to describe the technological chain reaction that can occur.

A tool such as an automobile sets in motion a domino effect involving processes of production, systems of transportation,

roads, support services, and suburban environments dependent on private transportation, a way of thinking and a set of perceptions that support separateness and privatism, and an ethic of consumption and obsolescence. At a more general level, advancing technology becomes increasingly integrated into a social system, shaping our living environment, drawing attention away from questions of meaning to questions of method, and becoming the justification of our dominant values (p. 45).

Bush (1983) explores the non-neutrality issue of technology. She theorizes that values and assumptions are built right into technology, and occur at two different levels.

Level 1: Intended Purpose

On one level, tools or objects reflect the values of their creators through their **intended purpose**. In a discussion of weapons, Bush writes that the purpose of a gun is to maim or kill, and that purpose cannot be separated from the gun. The expression commonly used by gun enthusiasts, "guns don't kill people, people kill people" is an attempt to separate the idea of a gun from its intended purpose. Bush reminds us that guns do indeed kill people and it is for precisely that reason they cannot be considered a neutral technology.

Guns are a class of objects with a collective concept. Bush thinks "they comprise a technology that is designed for killing in a way that ice picks, hammers, even knives -- all tools that have on occasion been used as weapons -- are not" (p. 154).

To accept that technologies are neutral and subject to the inclinations (or morals) of the user is to ignore their collective significance. Bush assigns the term "valence" to technology to describe the built-in bias effects users of the technology.

Guns, for example, are valenced to violence; the presence of a gun in a given situation raises the level of violence by its presence alone. Television, on the other hand, is valenced to individuation; despite the fact that any number of people may be present in the same room at the same time, there will not be much conversation because the presence of the TV itself pulls against interaction and pushes toward isolation. Similarly, automobiles and microwave ovens are individuating technologies while trains and campfires are accretionary ones (p. 155).

Level II: Methods and Techniques

At the second level, values and assumptions are present in the **method or techniques** by which tools are used. As Bush describes this level, "technology refers to the organized systems of interactions that utilize tools and involve techniques for the performance of tasks and the accomplishment of objectives" (p. 155).

Using Bush's hypothesis, a technology can be examined for the values and assumptions present at the method or techniques level. Computers, for example can be recognized to operate on linear and logical principles, using knowledge which can be reduced and inputted as objectified data. In order to operate a computer, users must think and operate in the linear fashion of the machine. One can only use a computer by adapting to this method. Qualitative, subjective and experiential knowledge are incompatible with the techniques of the computer. The Cartesian view is central to the operation of a computer and those particular values cannot be separated from the machine. The computer user is forced to function within the scientific method built into the framework of the computer.

The assumptions of the designer and of society are transmitted by and through the object at both levels, that is, through the **purpose** of

the object and the **techniques** by which it is used, according to Bush. Values and assumptions become a part of technology because of the fact that the development and use of tools and techniques occurs within the context of society. There are four separate contexts within which assumptions become evident: **design, user, environmental, and cultural**. To paraphrase Bush,

- The **design context** includes all of the materials, personnel, decisions, processes and systems needed in the production of tools from raw materials.
- The **user context** refers to the motivation and intentions that are part of the use of the technology.
- The **environmental context** refers to the physical surroundings in which a technology is used.
- The **cultural context** includes the myths, assumptions, values and norms of the society within which the technology is developed and used.

People within western culture are very aware of the design context, thinks Bush, but pay little attention to the user, environmental, and cultural contexts. The author notes that we either accept or are unaware of the myths and assumptions that are attached to the latter three contexts and, instead, focus on the design context in our attempts to produce newer, better, more efficient devices. Bush homes in on the issue of patriarchy and asserts that technology transmits and reinforces the myths and assumptions that accompany the male world-view.

Pursell (1980) addresses the non-neutrality of technology. Like Bush, he regards the form of an object and the purpose of an object to

be interconnected. He refers to the Aristotelian belief that form and purpose are necessarily related, and observes that

[a] chair and bomber have certain purposes, and these are built in, as it were, to their form, and influence the material from which they will be built. Indeed, if we know the form and material of a tool, we can make a shrewd guess about its purpose, and if we know its purpose we can say something about its likely form and fabric. According to this argument, therefore, the purposes (ethics and values) of our society are built into the very form and fabric of our technology, and the latter does not exist in some neutral sphere divorced from that purpose (p. 98).

Mumford (1979) explores the impact of technology and maintains that technology actually usurps human authority and increasingly deprives humans of freedom of choice. Technology claims priority in human affairs, according to Mumford, and puts the demand for continual technological progress before "its own efficiency, its own continuity, or even, ironically enough, its own capacity to survive" (p. 11). The maintenance of such a system requires total human conformity which results in a technological system of total control, starting with humans themselves.

In an earlier work, Mumford (1934) compares technology to religion. He declares that "only as a religion can one explain the compulsive nature of the urge toward mechanical development without regard for the actual outcome of the development in human relations themselves" (p. 365).

Ellul (1964) similarly rejects the notion of technology as simply machines and examines the social impact of technology. He views technology as a system, which he refers to as "technique". Technology

actually becomes a system essentially dedicated to the rational pursuit of efficiency. According to Ellul's theory, technology is an autonomous and self-determining entity that has moved beyond human control. All social phenomena are situated within a technical milieu, and the human mind is dominated by technical values. Within this system, individuals themselves become the "objects" of techniques and procedures. Ellul maintains that humans have been taken over spiritually by the technological society, and have been "profoundly technicized" in the process.

Humans make no attempt to despise technique, worries Ellul, which in itself has come to be regarded as a good thing. Humans do not even pretend to assign values to technique, "which to them is in itself an entity working out its own ends. They never claim to subordinate it to any value because for them Technique is value" (p. 15). Humans, according to Ellul, can never be free of the values and assumptions of the technical milieu.

In a later work, Ellul (1979) further describes technique as an "ensemble of rational and efficient practices; a collection of orders, schemas, and mechanisms" (p. 18-19). In this system, freedom of choice is limited. Because we live within the technical milieu, we think the technical milieu. We cannot escape its influence and, although technique has freed us from what Ellul calls "ancient constraints", it has imposed new constraints as rigorous and oppressive as the old in the conscious pursuit of efficiency.

Technology, Science and Patriarchy -- A Connectedness

Technology has a connectedness to the scientific domain, (Rothschild, 1988) and therefore an analysis of technology involves its scientific aspects.

Since the seventeenth century, scientific thought and method have reflected Cartesian principles (Mitcham, 1980). Within this mindset, the physical world is viewed as mechanistic, with particular emphasis on logic, observation and rational thinking. Researchers who operate within the scientific method, according to Mitcham, employ generalization, inductive reasoning and deductive logic. In a description of the Cartesian influence on scientific thought, Mitcham notes that the methodology strives to find empirical truth in order to gain power over the elements. He observes that "Descartes' methodological doubt aims not only at the construction of an indubitable system of thought, but also at making [humans] 'the masters and possessors of nature' (Discourse VI)" (p. 284).

Clark (1989) addresses scientific research, focusing on patriarchal and retrospective bias within that research. Until recently, she observes, relatively few women have been involved in scientific research. The majority of scientists have been men who work within and conduct research from a male perspective.

Women, Clark writes, are under-represented as participants in research and have been missing in the ideas and artifacts of the past

that have been preserved and presented as important. Women's contributions to society, Clark observes, have frequently been ignored or discounted by those studying the past. She explains this phenomena:

Language, behaviour, and unconscious assumptions can combine to downgrade women. Anthropologists have realized, as more women work in the field, that a male observer may fail to notice the women's activities, or they may be deliberately excluded. They have also seen that societies give high value to male activities and low value to female ones, so that agriculture or pottery or face-painting may be classed as important or menial depending on who does it: men define themselves by being unlike women. Women's studies have challenged assumptions about...patriarchal scholarship (p. 1).

Although Henchey (1987) does not address feminist issues, he perceives an interrelationship between technology, science and culture. Although technology is the application of science, the reverse is also true. Science is also the application of technology. Astronomy, chemistry, physics, and biology, in fact all of the sciences, according to Henchey, use technological tools to extend the senses and increase scientific knowledge. Microscopes, telescopes, computers and other devices are technological tools that increase the scope of the sciences.

There exists, however, a fundamental contradiction in western society between female values and the principles of the scientific and technological order (Franklin, 1984). This contradiction can be viewed as a dichotomy where on one side exists scientific and technological tasks, and on the other exists women's tasks. Franklin describes technological tasks as fragmented, narrowly specialized, and focused on efficiency. Women's tasks are seen to be more unpredictable, flexible, unplanned and spontaneous as they often arise out of contextual need.

Bleier (1984), similar to Clark, focuses on scientific research. She notes that although researchers claim that research is an objective endeavour, it is value-laden. Science, Bleier writes, is neither neutral nor dispassionate in its pursuit of truth, and scientists are not disinterested, objective or culturally disengaged from their research and the questions they ask. It would be impossible for science or scientists to be any different than this, she observes, "since science is a social activity and a cultural product created by persons who live in the world of science as well as in the societies that bred them" (p. 193).

Keller (1983) makes observations of science that are also important within this discussion of science, technology and patriarchy. Science is seen by the author as a male endeavour, and the assumptions that accompany science are said to be masculine in character. She asserts that science is all-pervasive and a mythology of science has developed within society. This mythology is complete with a set of claims and has become the map of our social reality and the matrix of our collective conscience. Keller lists eight characteristics of the scientific mythology, contrasting the masculine way science is perceived with the way women are generally regarded:

1. Science is impersonal while women are personal. Science has to do with things, and women with people.
2. The female sense of self is tied to the world, while the male sense of self is separated from the world.
3. The male way of knowing is objective and analytical; the female way is more intuitive.

4. Science is pure reason and therefore separate from feeling. Feeling is female and thinking is male.
5. Science is hard; women are soft.
6. Science is asexual; women are erotic.
7. Science dominates nature. The scientific mind is masculine, while nature is feminine.
8. Science is the quest for power, while women seek harmony.

However untrue these claims are, Keller points out that there is widespread popular acceptance of the mythology of the scientific male mind. Since science and gender are both social productions, the popularly held image of "science as male" continues to exist in a state of distorted objectivity, according to the author. Since technology is connected to and grows from science, this scientific mythology filters through to technology.

With respect to technical scholarship, women are typically outside and invisible (Rothschild, 1983). Women's contributions have essentially been left out of technological history. The things that have been classified as "women's work" have not been accounted for within technological development, according to Rothschild.

Rosaldo and Lamphere (1974) address this issue raised by Rothschild. They offer an explanation for women being ignored in technical scholarship. In a discussion of the scientific process and the speculative nature of knowledge, the authors conclude that it is male bias in scientific research which results in the exclusion of women.

Writing from within the field of anthropology, Rosaldo and Lamphere also note that due to the nature of historical research, scientific theories are often based upon scant evidence preserved from the past. The resulting knowledge may be interpretative and speculative. Deriving knowledge through this process of retrospective analysis involves observing the past through patterns of contemporary thought. The authors caution that, because of this potential for retrospective distortion and the speculative nature of knowledge, scientific knowledge may be biased.

Rosaldo and Lamphere also maintain that human culture has historically been regarded as patriarchal.

The current anthropological view draws on the observation that most and probably all contemporary societies, whatever their kinship organization or mode of subsistence, are characterized by some degree of male dominance.

Whereas some anthropologists argue that there are, or have been truly egalitarian societies...and all agree that there are societies in which women have achieved considerable social recognition and power, none has observed a society in which women have publicly recognized power and authority surpassing that of men. Everywhere we find that women are excluded from certain crucial economic or political activities, that their roles as wives and mothers are associated with fewer powers and prerogatives than are the roles of men (p. 3).

Sex roles that emerged in early societies had less to do with biology than is commonly believed, according to Rosaldo and Lamphere. Using evidence from primate studies, research on human infants, studies of adult hormones and research into the behaviour of hermaphrodites, they conclude:

Biology constrains but does not determine the behaviour of the sexes, and that differences between human males and females reflect an interaction between our physical constitutions and our patterns of social life...In other words, whatever the biological

determinants of their behaviour, primates, like humans, seem to have an impressive capacity to adopt new forms of social relationships in new social and physical worlds (p. 5).

It is common in anthropology to use the "Man as Hunter" theme to explain male dominated societies. In this theme, biology is frequently used as an explanation for the diversity of sex roles that develop within a culture. According to the theory, women are at the mercy of the natural elements because of the incapacitating nature of pregnancy, lactation and child-rearing. Rosaldo and Lamphere write:

The argument has been that hunting large animals demands the coordinated efforts of several individuals, and because it often involves danger and extensive travel, it tends to exclude women, who must produce and care for children, and so are constrained in their movements. A related argument is that male strength and size dictated that men rather than women would adopt the responsibility for intergroup aggression and defense (p. 6).

In a view similar to Rosaldo and Lamphere, Millet (1971) believes that physical strength is an inadequate category upon which to base political relations within civilization.

Male supremacy, like other political creeds, does not finally reside in physical strength but in the acceptance of a value system which is not biological. Superior physical strength is not a factor in political relations...Civilization has always been able to substitute other methods (technic, weaponry, knowledge) for those of physical strength, and contemporary civilization has no further need of it (p. 27).

Social and cultural acknowledgement is necessary for anyone or anything to be granted validity and status in society, according to Millet. Likewise, social and cultural decisions affect who is granted power and authority. The notions of superiority/inferiority and

dominant/subordinate exist within the framework of a culturally defined value system.

Cultural Decision Making

The "might makes right" notion of authority is a result of cultural decision making; the granting of authority is accomplished through a collective cultural process (Clark, 1989; Bamberger, 1974; Ortner, 1974; Millet, 1971; De Beauvoir, 1952).

Throughout history, both women and men had to accept the notion that men were indeed more capable wielders of power before men could become wielders of power. If physical might and hunting ability were high status qualities, it was because people perceived those skills as worthy and granted them status. If child-rearing had been perceived to be of high status, then women would have gained power through that role.

Human activities are the result of both biological propensity and cultural determination (Clark, 1989). Biological differences (with the exception of pregnancy and lactation) do not in themselves determine sex roles. Clark believes that what is female and what is male is socially sanctioned. Women deliver and nurse babies, but cultural determinism dictates that after children are weaned, women continue in the role of caretaker. Observes Clark:

Women do not spend all (or, for some women, any) of their lives bearing children. The assumption was that even when they are not doing so, they must lead a domestic life under male protection, for they are not suited to independence. Women were seen as more emotional than men (a question still in dispute), more gullible, more likely to yield to impulse or desire, less rational -- generally less in control of their reactions than men are (p. 4).

Hubbard (1988) echoes this notion of cultural determinism and observes that women's work is tremendously undervalued within our society. Women's work is described as "trivialized, ignored, and undervalued, both in economic and political terms" (p. 4). Hubbard asserts that women have never been given status in terms of work and continue in our modern society to be ignored. She notes that the statistics included in the Gross National Products of countries do not in any way reflect all of the work that women do.

Women work considerably more than men if all the work women do is counted -- on average, about seventy to eighty hours per week as against men's fifty or sixty -- since in addition to working for pay, most women also do most or all housework as well as most volunteer work in schools, hospitals, and other parts of the community. Women earn fifty-seven cents for every dollar men earn, not because we do not work as much or are less effective than men, but because women usually are paid less than men in workplaces and are not paid anything for much of the work we do. If women stopped doing all work for which we are not paid this society would grind to a halt, for much of the productive work men do depends on women's unacknowledged and unpaid labour (p. 4-5).

Women's subordinate role within patriarchy is one of the true universal notions and is a 'pan-cultural' fact (Ortner, 1974). The subordination of women is attributable to social constructionism, and, although Ortner agrees that biological facts are not irrelevant, patriarchy is not solely the result of genetic determinism. Women are devalued, Ortner asserts, because they bear children and, are therefore perceived to be closer to nature. Women are identified with nature, while men are universally perceived to have transcended nature. Men are identified with culture and ultimately, with technology. According to Ortner,

[e]very culture...is engaged in the process of generating and sustaining systems of meaningful forms (symbols, artifacts, etc.) by means of which humanity transcends the givens of natural existence, bends them to its purposes, controls them in its interest. We may thus broadly equate culture with the notion of human consciousness, or with the products of human consciousness (i.e. systems of thought and technology), by means of which humanity attempts to assert control over nature (p. 72).

Bamberger (1974) observes that many anthropologists have studied human evolution and the roles and activities of women within societies, and that Margaret Mead is the one who is probably most widely recognized. Mead's research, according to Bamberger, illustrates the great diversity of sex roles within different cultures. However, despite the anthropological documentation of sex role diversity throughout a variety of cultures, Bamberger notes that no current matriarchies exist nor is there evidence that they ever did exist. She recognizes that because of the lack of primary sources depicting cultures where women dominated, "both the existence and constitution of female-dominated societies can only be surmised" (p. 261). Patriarchal societies abound in fact and theory, despite the fact that there is "no certifiable way of documenting the political and jural relations of the earliest human societies" (p. 265).

Patriarchy is a reality of modern existence, asserts Millet (1971). Patriarchy has been the dominant social form within all of recorded history, having roots which may extend back to the very dawn of civilization. According to Millet, patriarchy is not a result of the natural proclivity of humans, but a by-product of society and a result

of social determinism. Patriarchy maintains its tenacious hold within society by successfully passing itself off as nature.

Millet's discussion of the patriarchal nature of contemporary and ancient society centres on power issues. All avenues of power within society are currently, and have been historically, entirely within male hands. Millet points out that the military, technology, science, industry, political office, finance and the police force -- all agencies of power -- are controlled by men.

The manifestations of patriarchal power are evident in many aspects of life, according to Millet, the most notable being in economic terms. She observes at a very basic level of economics, the term "work" has been defined over the centuries as those things that men do, not those things that women do.

De Beauvoir (1952) addresses biological issues within patriarchy. The facts of biology must be seen as interrelated with social phenomenon, according to the author. Biology cannot be isolated, but must be viewed within ontological, economic, social, and psychological contexts. Biology alone does not explain why women are identified with nature, and viewed as physical instead of intellectual beings. De Beauvoir sees as the result of this that women are unable to gain transcendence and full humanity in the same manner as their male counterparts.

The subordination of women and the social limitations placed upon their power is described by De Beauvoir as the enslavement of the female of the species.

Science, Technology and Patriarchy

The notion of a patriarchal society is a critical concept in this exploration of technology. Technology has developed according to the needs of civilization (Kranzberg and Pursell, 1966), and the history of human civilization has been dominated by patriarchy (Clark, 1989; Bamberger, 1974; Ortner, 1974; Millet, 1971; De Beauvoir, 1952). As a social production, then, technology reflects the values of patriarchy (Franklin, 1990; Benston, 1988; Hubbard, 1988; Everts, 1986; Cockburn, 1985; Bush, 1983; Keller, 1983).

Technology has an inherent male bias (Franklin, 1990). Because tools are developed by and for men, the quality of maleness becomes an accepted part of the definition of those technologies.

Franklin uses the male bias of technology to explain the difficulty women have breaking gender barriers and entering traditional male jobs. Citing engineering as an example, Franklin observes that

[i]f engineers are male and maleness is part of engineering, then it's tough for men to accept women into the profession. The apparent ease with which women acquire the knowledge necessary to practice only seems to increase the perceived threat to the male practitioners (p. 16).

Science and technology are not only dominated by men, but the men who dominate happen to fit a particular mold -- a mold which Hubbard (1988) describes as "white, university-educated, upper-middle and upper-class men accustomed to working in hierarchical institutions" (p. 14). The values of that particular demographic group are transmitted to and assimilated into society through science and technology.

Everts (1986) also describes technology as a patriarchal production. The terms 'feminine' and 'masculine' are cognitive/ conceptual terms, and Everts observes, are used in technological analysis instead of the biological categories of men and women. As such, feminine and masculine are gender distinctions which become a socially constructed and culturally defined dichotomy.

Like Franklin, Everts focuses on the maleness of science and technology. A mechanical view of nature, she maintains, is inherently male-biased. This male approach is narrow, for it typically ignores social consequences. Everts believes that attention to social consequences should be an indispensable factor within research. To ignore the social aspects of science and technology is to ignore their impact upon our lives.

The masculine stereotype of science, according to Everts, is one that controls rather than cares for nature and is concerned with individual success and personal results over humanity. It excludes feelings and emotional involvement, and ignores social consequences. The injection of feminine qualities into the scientific model, maintains Everts, would only enhance the model. She describes the characteristics of a feminine stereotype as including "social responsibility, caring, orientedness to the needs of others, (and) concern for life and humanity" (p. 70). Everts argues against a strictly masculine approach to technology and science, and concludes that a more balanced approach which incorporated feminine values and assumptions would ensure that social relevance and responsibility became factors in the scientific equation.

Cockburn (1985) also argues that technology is patriarchal in nature. She perceives gender discrepancy within technological competence. This discrepancy is a factor in the sex-segregation of women into jobs requiring little or no technical competence, and men into occupations that require advanced training. This is a historical trend, according to the author, with men controlling technical knowledge and governing both the instruments of labour as well as the labourers.

With the rise of capitalism, an economic system based on continual advances in technology, men were thrown into perennial conflict with capital and with each other over the possession of technological competence and the power to use it. Women were actively excluded from technological knowledge, acted upon by the technology and not interactive with it (p. 9).

Technological Bondage -- The Myth of Liberation

Contrary to common sense, technology is not a liberating force (Franklin, 1990). People commonly regard technology as liberating, and manufacturers often advertise new technology as freedom from toil and labour-saving. Franklin observes that the reason businesses present new gadgets, processes or systems as better, more efficient, time-saving, or liberating, is simply to control consumer fear and to sell more products. By making the new product appear user friendly, consumers are made to feel proud of their technical mastery.

The promises of liberation actually imprison consumers, warns Franklin, for technology actually becomes the ticket to enslavement. Citing the sewing machine as an example, the author explains that upon its introduction in the late 1800's, the device was heralded as the way to more productive and easier sewing by the very housewives who had always sewn. However,

[r]eality turned out to be quite different. With the help of the new machine, sewing came to be done in a factory setting, in sweatshops that exploited the labour of women and particularly the labour of women immigrants. Sewing machines became, in fact, synonymous not with liberation, but with exploitation. The sewing machines at home were used less, as machine-sewn household goods and garments began to be readily available on the mass market...In the subsequent evolution of the garment industry, much of the designing, cutting, and assembling began to be automated, often to the complete exclusion of workers (Franklin, 1990, p. 101).

According to Franklin, another negative technological fallout of what she refers to as the "real world" of technology is the separation of knowledge from experience. This phenomena occurs when people discount or discredit their own personal experiences and the knowledge

that results from those experiences, over and in favour of "official" scientific and technological explanations.

When a discrepancy occurs between what we think, feel or know, and the information that science gives us, Franklin suggests we should question the scientific explanation, rather than discount our own experiences. Technological emphasis on expert and abstract knowledge has given us a vague sense that what we know is not quite as accurate as the more authoritative technological information.

Franklin theorizes that technological methods have resulted in a widespread "design for compliance". This notion has very real consequences in terms of patriarchy. The technical operations of society involve an assembly line technique of production which Franklin labels "prescriptive technologies". Instead of the traditional, more holistic method in which an artisan would collect materials, design and produce a piece of work, the prescriptive system of technology fragments and divides work into compartments. In this system, workers perform just one task in a long chain of production.

Franklin writes that when a workforce is enculturated into such a prescriptive, technical milieu, external control and internal compliance are regarded as normal and necessary. Eventually there becomes just one way of doing something. This compliance theory operates, not just in materials production, but has also infiltrated administrative, economic and government activities. Franklin does not deny the effectiveness and efficiency of prescriptive technologies, but warns that prescriptive technologies are accompanied by "an enormous social mortgage. The mortgage means that we live in a culture of compliance, that we are ever

more conditioned to accept orthodoxy as normal, and to accept that there is only one way of doing 'it'" (p. 24). In our western society, patriarchy is orthodox, patriarchy is the one way of doing 'it'.

With ideas similar to Franklin, Apple (1988) uses the term "proletarianization" to describe the prescriptive aspect of technology and the deskilling of workers that results. Through proletarianization, skills are broken down and reduced to "atomistic units". This is done as a power move by those in authority. Technological reductionism enhances profit levels, control and efficiency, as the responsibility of individual workers is reduced.

Apple recognizes the potential influence of technology and, although he does not focus at length on the feminist issue, he does perceive an interconnectedness between feminism and Marxism. Marxism, with its focus on class, and feminism, with its focus on gender, both address the dominant forces in society such as patriarchy and technology that dehumanize and subjugate humans, according to the author.

Feldberg and Glenn (1983) support Apple's idea of proletarianization, and Franklin's notion of prescriptive technologies. The authors conducted an extensive review of employment trends in the U.S. over the twenty year period from 1961-1981. Their study examined the impact of automation on clerical workers and concluded that technology has acted as a socio-political mechanism for capitalism. The widespread use of technology ultimately increases managerial control in the work-place by centralizing knowledge and downgrading workers.

The authors describe how central control and increasingly sophisticated technology deskills labour, and reduces the need for intelligent, qualified, and committed workers. Feldberg and Glenn point out that this downgrading of labour has its most significant impact on women, as they are the group that is "increasingly confined to lower paid jobs with fewer opportunities for mobility" (p. 61). The authors cite forty references in this comprehensive study, and conclude that in occupational terms, women have not been liberated by technology, but rather, have been further marginalized by it.

Writing from within the field of education, Bowers (1988) thinks of western society as a commodity culture. He believes that the use of machines "influences our pattern of thinking, and thus contributes to changes in the symbolic underpinnings of the culture" (p. 3). He refers to our technology-dominated society as a "technicist social order" where

cultural orientations that are strengthened generally relate to the technological consumer domain of society: attitudes toward technological innovation, the progressive nature of change, measurement and planning as sources of authority, a conceptual hierarchy that places abstract-theoretical thought at the highest, a competitive-remissive form of individualism, and the definition of human needs in terms of what can be supplied by a commodity culture (p. 6).

According to Bowers, within this technicist world-view, all problems have technical solutions, and, explicit knowledge is that which can be observed, is factual, quantifiable, calculable or measurable. His description of a technical society echoes Mitcham's (1980) description of the Cartesian view of the world. Technology is seen as both a product and a reflection of the scientific method.

Technology devalues the importance of context and subordinates experience to a rational and logical system of linearity. This world-view considers technical innovation as progressive, writes Bowers, and operates with a metaphor that views "the world as a machine; thus the task of the rational-calculating mind is simply to re-engineer the various systems in order to improve prediction, control and efficiency" (p. 9). Bowers continues:

the technicist mind-set privileges experimental innovation over substantive traditions, abstract and theoretical ways of thinking over implicit forms of understanding, the autonomous individual over the collective memory and interdependence of the cultural group, and a reductionist, materialistic view of reality that denigrates the forms of spiritual discipline necessary for living harmoniously with other forms of life that make up the Gaia of planet earth (p. 9).

Technology also mediates and transforms the human experience, according to Bowers. He uses the theory of amplification and reduction to explain how human experience is controlled by technology. The telephone is given as an example of how technology amplifies voice over distance, but reduces the personal contact of body language. The term 'selectivity' is used to describe how technology selects the aspects of experience that will be heightened or diminished. Bowers argues that it is because of these two qualities -- amplification and reduction -- that technology cannot be regarded as neutral.

Bowers, similar to Bush and Benston cited earlier, illustrates the way in which machines directly or indirectly influence value-systems through the intended purpose or method of use of the machine. Using computers as an example, Bowers demonstrates how that particular technology cannot cope with the metaphorical nature of language and

knowledge. Consequently, and in order for computers to be useful, experience must be reduced to an algorithmic system where tacit and heuristic forms of knowledge are cut out of the communication process. The technology amplifies objectivity, and reduces the importance of perspective.

The amplification-reduction quality of technology is important in terms of feminism. Technology as a patriarchal production, by its very nature amplifies the male way of knowing and reduces the female way.

Cockburn (1985) addresses the issue of technological liberation in her discussion of technology and power. Power is perceived to be a fundamental issues within technology. At its simplest level, according to the author, the technology of levers and pulleys increases the power of the arm, while more sophisticated devices such as thumbscrews, battering rams and nuclear weapons extend the power of nations. Cockburn states that ownership of technology -- tools, machinery, or equipment -- and the hiring of people to operate it, are the fundamental sources of economic power. Knowing how to make or use technology is the ticket to power over nature and power over people. Those individuals without knowledge of technology or access to it (hence, without power) are dependent upon those who do.

Technology, observes Cockburn, plays a major role in power relations between workers and managers, as well as between men and women.

When the United Nations reported in 1980 that 'women constitute half the world's population, perform two-thirds of its work-hours, receive one-tenth of the world's income and own less than one-hundredth of the world's property' they might have well added that women possess an all-but-invisible fraction of its technological know-how and technical jobs...The technical competence that men as

a sex possess and women as a sex lack is an extension of the physical domination of women by men (p. 7).

This notion of technology as power ties directly into the myth of technical liberation. The way in which technology contributes to the proletarianization and deskilling of workers, and to the oppression and political control of women through economic dependency, is essentially a power issue. Workers in technologically prescriptive environments are without power and trapped within a capitalist system that centralizes control through the division of labour.

Cockburn observes that women performing unrecognized and unpaid labour in the home are without power in a patriarchal system that isolates women and has made them technologically and economically dependent.

Rothschild (1983) agrees that technology is not a liberating force. She asserts that technology "has aided a capitalist-patriarchal political order to reinforce the gender division of labour and to lock women more firmly into their traditional roles in the home" (p. 79).

Technology actually contributes to women's economic dependence and enhances political control over women's household labour processes. Technology is tied to a capitalist socio-political structure and to patriarchal ideology. Rothschild views capitalism and patriarchy as intertwined.

Capitalism is a system of privately-owned production for private profit, dependent, materially and ideologically, not only on class hierarchies but on gender, racial and other social hierarchies to sustain the system. Patriarchy is a system of male supremacy, dependent, materially and ideologically, not only on a hierarchic gender division of labour but also on the 'naturalness' of that

division and its necessity to the political order in which the system is situated. Capitalism and patriarchy intersect through the gender division of labour (p. 80).

Women are associated with domestic labour and have been since the Industrial Revolution, observes Rothschild. Previous to that period, there had been gender divisions of labour, but the increase of technology in society firmly implanted women in the home, while men's work moved increasingly outside of the home. Even though many women were employed in the workforce, (as domestics, factory workers, and later, as office workers), Rothschild notes "the unpaid work of maintaining the household came to be viewed as women's primary work, and women's work exclusively" (p. 80). With the development and acceptance of the middle class ideal of two different spheres of work and home, women's perceived proper role within the family and home sphere developed into an ideology that still exists today, according to the author.

The gender division of labour in and out of the home has far reaching implications for the strengthening and perpetuation of patriarchy, capitalism and the technological milieu. Men, Rothschild points out, were able to sell their labour in the workplace because they had wives working in a supportive role at home. The patriarchal nuclear family became the cornerstone of industrial-capitalist production. Rothschild notes that by staying at home, women biologically reproduced the labour force, and became economically dependent upon husbands. This dependency extended to the political economy and, as well, strengthened patriarchy. Women, who were economically dependent upon men, were then subjected to their authority as well.

Rothschild asserts that technology played and continues to play a key role in the capitalist-patriarchal subordination of women. Technology, she writes, has neither liberated women, nor changed the social fact that they are still primarily wives and mothers. Technology may have made domestic life easier, but it has not changed women's roles. If women are employed outside of the home, they are perceived as being "working wives" or "working mothers", both terms which are reminders that women's place in society and that women do not work in the home, according to the author.

Rothschild also points out that technology reinforces the isolated nuclear family structure while perpetuating a dependence upon technology. That isolation and dependence, in turn, further strengthens the capitalist-patriarchal political order. As individual nuclear families proliferate, additional households become necessary. In turn, each household must be equipped with the appropriate domestic technical products. Without such a home, women would be unable to perform their supportive roles in the unpaid maintenance of the labour force.

Rothschild writes that "through the mediation of this personal wife-mother-servant, the washer-dryer cleans clothes for the...family members, the refrigerator preserves their food, the stove cooks their meals, the car transports them to and from work, school and play" (p. 85). Technology as it is used in individuated family structures, actually results in a strengthening of the dependency on technology itself. Rothschild succinctly describes technology's role in the subordination of women:

More important is a resulting economic dependency for the woman within the patriarchal family and on the economy. She becomes de-

pendent on her husband if he is sole or main breadwinner and thus providing the technology (on which he is also dependent); the entire family is tied further into the economy in order to obtain these technological 'necessities.' Far from domestic labour's being outside the capitalist economy, which had never been the case...domestic labour and thus the housewife, through increased use of and dependency on technology, become more closely linked into the exchange relations of capitalism. As...the need for more household technology grows...the ties with capitalist exchange relations are further reinforced. Technology, in providing material advantage, helps to mask a strengthened patriarchal authority and economic dependency that obtain both for an unemployed housewife and for women partially and fully in the labour force (p. 85-86).

The Technological Classroom

The Systems Approach in Educational Technology

In the last two decades, the field of educational technology has focused on technological process, which has been a move away from earlier concerns with machinery and hardware. The systems approach to instruction and, behavioral and cognitive theory have garnered the attention of educational technologists (Dick & Carey, 1990; Dick & Reiser, 1989; Kerr, 1989; Percival & Ellington, 1988; Spencer, 1988; Gagne, Briggs and Wager, 1988; Knirk and Gustafson, 1986).

There is an important relationship between educational technology and the systems approach. Technology in education refers to hardware, while the technology of education refers to the system or process of technology.

A system is a set of interrelated parts which work together toward a defined goal (Dick & Carey, 1990). The various parts of the system are dependent upon each other for input and output. The system uses feedback processes in order to determine if desired goals have been reached. Dick and Carey describe instruction as a system within which various elements including teacher, students, materials, and the learning environment itself, are components of successful learning. This particular educational orientation is labelled a "systems point of view".

Proponents of the systems orientation also use the approach to design instruction. The systematic approach to instruction is primarily concerned with effectiveness and efficiency. Designing instruction

within the systems model, according to Dick and Carey, involves 10 components:

- Identify an instructional goal
- Conduct an instructional analysis
- Identify entry behaviours and characteristics
- Write performance objectives
- Develop criterion-referenced test items
- Develop an instructional strategy
- Develop and/or select instruction
- Design and conduct formative evaluation
- Revise instruction
- Conduct summative evaluation

The success of the systems approach in instructional design is attributable to three reasons, according to the authors: its focus on objectives; the relationship between instructional strategy and desired learning outcomes, and; the fact that it is an empirical and replicable process.

Instruction is the solution to a problem, note Dick and Carey, and the systems approach is the most efficient and effective way to design instructional strategies.

In a parallel view, Heinich, Molenda and Russell (1989), expound the merits of the systems approach. Educational technology is perceived by them to be a powerful tool for solving instructional problems. They use Galbraith's definition of technology and describe it as "the systematic application of scientific or other organized knowledge to practical tasks" (p. 24). They adapt that definition to education and define instructional technology as

the application of our scientific knowledge about human learning to the practical tasks of teaching and learning. A technology of instruction, thus, is a particular, systematic arrangement of teaching/learning events designed to put our knowledge of learning

into practice in a predictable, effective manner to attain specific learning objectives (p. 24).

Instructional technology can be examined within three dimensions, write Heinich et al: hardware, pedagogical and management. The hardware dimension is described as one that is simply concerned with physical machinery.

Within the pedagogical dimension, the authors refer to textbooks and educational films as 'old fashioned' resources that typify a 'primitive pedagogical view'. This type of technology was once regarded as effective instruction, they note, even though it is one way, non-reciprocal and essentially a pouring out of mass quantities of information. Heinich et al give interactive videotape as an example of the next step above the textbook and film. In this more sophisticated resource, questions about the information in the video, as well as pauses for viewers to respond/discuss are incorporated into the presentation of information.

The third dimension of instructional technology is management. On the high end of this dimension are tightly organized procedures that adapt to different users, such as computerized tutorial programs. On the low end are traditional lectures which start, proceed and end according to the lecturer's preferred pace, with little or no adaptation to listener's needs.

Heinich et al explore instructional technology within the three dimensions, and speculate what a system would be like which rated highly within all three dimensions.

What might a [high in all three dimensions] technology of instruction look like? Imagine an interactive video setup employing high-resolution TV linked to a computer. It controls a simulation program that is used by pairs of students. Together they play the role of Andrew Jackson on the eve of the Battle of New Orleans in 1815. The video program shows the scene and pauses to provide historical data about the military, political, and economic conditions. It asks the users to decide whether to engage in battle or to await news of the peace talks going on in Ghent. The results of the decision are shown visually and in the form of new political and economic data. And the program continues. Such a program exemplifies pedagogical design that is interesting, clear, challenging, involving, discovery oriented, and collaborative. The management system is self-paced, adaptive to different student learning strategies, responsive to different choices and is modular. It could also incorporate tests to determine student mastery, sending the student forward only after she demonstrates mastery (p. 26).

Kerr (1989) also observes that the recent history of educational technology reflects a systems approach. The field has undergone a transition from an earlier focus on machines and devices, to a high level of concern with systems and processes.

Instructional design and development were invented as a result of the transition from machinery to system. Kerr writes that "no one can deny at this point the popularity and practical appeal of [instructional development]..." (p. 6).

Instructional design is a "systematic process for designing, developing, implementing, and evaluating instruction" (Dick & Reiser, 1989, p. 3). The purpose of instructional design is to develop learning aids such as printed materials, computer-assisted instruction, and television instruction. Research, according to Dick and Reiser, has proved the systematic approach to be an effective means of planning any instruction. The authors list the four components of instructional

plans to be goals, objectives, test items and instructional activities. This list is similar to the Dick and Carey model of systematic product development presented earlier.

Gagne, Briggs and Wager (1988) agree that instructional design is most effectively carried out by means of a systems approach, which they describe as

the carrying out of a number of steps beginning with an analysis of needs and goals, and ending with an evaluated system of instruction that demonstrably succeeds in meeting accepted goals. Decisions in each of the individual steps are based upon empirical evidence, to the extent that such evidence allows. Each step leads to decisions that become 'inputs' to the next step, so that the whole process is as solidly based as is possible within the limits of human reason. Furthermore, each step is checked against evidence that is 'fed back' from subsequent steps to provide an indication of the validity of the system (p. 5).

The principles of learning are the basis for instructional design, and Gagne et al note that those principles have been under investigation by scientists for many years. Skinnerian theory and Piagetian cognitive research are the scientific foundations for the systematic approach of instructional design.

An instructional system is defined by Gagne et al as one in which "an arrangement of resources and procedures are used to promote learning" (p. 20). They cite the Dick and Carey model of systematic design as suitable for the design of instruction. All of the phases in any instructional system can be categorized into one of three stages, according to the authors: instructional goals, instructional development, and evaluation of the effectiveness of instruction.

Gagne et al also use the term "instructional technology" to refer to a combination of the systematic process of planning instruction, and the systematic process of implementing the plan.

Instructional technology is a broader term than instructional systems, and may be defined as the systematic application of theory and other organized knowledge to the task of instructional design and development. Instructional technology also includes the quest for new knowledge about how people learn and how best to design instructional systems or materials (p. 20).

The selection of media within a classroom is also regarded to be a part of the larger instructional plan and, as a consequence, should reflect the objectives of the plan. Because of time constraints, teachers cannot always produce their own materials, nor always find appropriate resources. However, Gagne et al observe that if teachers cannot do it all themselves, commercially produced materials are more often beginning to reflect the systems approach.

On the brighter side, publishers and other suppliers of media are providing modules of instruction with increasing frequency. Such modules often give directions to both teachers and learners on how the materials and exercises can be used to reach the objectives, as well as how to know that they have been reached. Although such modules may not always be designed around the specific set of instructional events described in this book, they usually have been designed to implement a systematic strategy of instruction... As the use of such modules becomes more widespread, teachers should experience fewer difficulties in lesson planning and in selecting media and materials (p. 200).

Gagne et al also present a systematic model for the selection of media, noting that use of such a model "makes media selection a highly rational matter based upon theory and research pertaining to learning effectiveness" (p. 216).

The systems approach, according to Percival and Ellington (1988) is the foundation of the majority of modern educational technology developments. The principal role of educational technology is to improve the overall efficiency of the instructional process. The authors summarize four manifestations of this improved efficiency:

- (a) increasing the quality of learning, or the degree of mastery;
- (b) decreasing the time taken for learners to attain desired goals;
- (c) increasing the efficiency of teachers in terms of numbers of learners taught, without reducing the quality of learning;
- (d) reducing costs, without affecting quality (p. 14).

The systems approach has three fundamental elements, assert Percival and Ellington, including: the learning process itself, and, inputs to, and outputs of the process.

The authors cite three definitions of education technology, all of which reflect the systems orientations:

'Educational technology is the development, application and evaluation of systems, techniques and aids to improve the process of human learning'.

Council for Educational Technology for the United Kingdom (CET)

'Educational technology is the application of scientific knowledge about learning, and the conditions of learning, to improve the effectiveness and efficiency of teaching and training. In the absence of scientifically established principles, educational technology implements techniques of empirical testing to improve learning situations'.

National Centre for Programmed Learning, UK

'Educational technology is a systematic way of designing, implementing and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication and employing a combination of human

and non-human resources to bring about more effective instruction'.

Commission on Instructional Technology, USA (p. 20)

The three definitions are similar, note Percival and Ellington, in that each focuses on improving the efficiency of the instructional process, and, each reflects the systems approach.

The authors also believe that scientific research, and in particular, Skinnerian behavioral psychology has had impact on the field of educational technology.

Educational technology, writes Spencer (1988) is grounded in empiricism, operates within the systems approach, and is based upon behavioral learning principles. He believes that the field is just now starting to explore the work of Piaget and Bruner in the area of cognitive research.

Earl (1987) believes that the language of instructional design falls within the stimulus-response (S-R) paradigm. He maintains that the S-R paradigm can help designers use their "intuition, creativity and logical thinking to set up an environment of appropriate stimuli to which the learner can respond...The S-R paradigm and its language are...valuable tools in diagnosing and correcting problems with course and lesson designs" (p. 16).

The theories of Ralph Tyler are foundational to Earl's work, who believes that the quality of the learning experience can be rated

according to four criteria: effectiveness, value, likability and efficiency.

A learning experience, according to Earl, is

- *effective* when the learning goal is met;
- *valued* when the learner found her or his learning time and activity worthwhile;
- *liked* when the learning experience has been enjoyed and has motivated the learner for more;
- *efficient* when the time and energy spent in learning what had to be learned is minimum (p. 17).

The systems approach that is dominant in instructional technology, has roots that can be traced back to the military (Knirk & Gustafson, 1986). Rigorous and systematic training systems were needed to be designed as weapons became more sophisticated and the need for rigor increased. Knirk and Gustafson recount:

As weapons systems became more complex and required teams of specialized interacting personnel, the armed services sought new procedures for developing and delivering training. The systems approach draws on concepts from general systems theory as well as from information science, communication, learning theory, and other fields. While a variety of systems models was created, all contained three fundamental steps: defining needs; stating instructional objectives; and developing, evaluating, and implementing the instruction (p. 3).

The authors describe instructional technology as an evolutionary step in education, as people attempt to improve the system by making it more effective, efficient and humane.

Shifting Paradigms

Heinich (1970) observes that during the early 1970's, education and instructional technology were undergoing what he called a "paradigm

shift". Heinich borrows from Thomas Kuhn's theory of scientific paradigm shifts and writes:

Incipient paradigm changes in science may be detectable by examining certain shifts in emphasis in the literature of a particular field. By paradigm, [Kuhn] means those fundamental theories which are responsible for establishing the frameworks and research traditions of sciences or fields within sciences: e.g., Newtonian physics, Copernican astronomy, or genetic code theory. The changes he refers to, therefore, are not the simple ebb and flow of interests which occur during the development of a tradition, but, rather, the ending of a tradition and the beginning of a new one...If we grant his premise, the same possibility of detection of paradigm change may be true in education (p. 15).

The educational paradigm shift Heinich refers to is a move away from the previous concerns with machines in education, toward the technological systems approach to design and instruction. Based upon evidence he observes within education, he writes: "The possibility of incipient paradigm change centred on technology is evident...the most significant indications here appear to centre on interest in what is referred to as systems" (p. 16).

Heinich explores theories and models of paradigm change and attempts to develop a new paradigm for instructional management that fits within the framework of applied systems. The elements of Heinich's "new" paradigm of instructional management include strategies for curriculum planning, mediated teachers, and students. Heinich describes mediated teachers as those who use instructional media or technology in their teaching. He presents the elements of his model for systematic instruction in flow chart fashion, complete with feedback loops, inputs and outputs.

This observation by Heinich of a paradigm shift in education occurred as he wrote his book in 1970. He described the shift as a move toward a technological-systematic model of instruction. The review of the systematic approach in education in this thesis provides support for Heinich's theory. The shift that Heinich observed and predicted is supported in the work of Dick and Carey, Dick and Reiser, Percival and Ellington, and the other researchers cited above. Their work indicates that the systems model continues to influence educational technology.

Twenty-one years after Heinich suspected that a paradigm shift was under way in educational technology, Hlynka and Belland (1991) explore the idea of another paradigm shift within the field. They observe that although educational technology is currently centred in the positivistic systems approach, a new perspective is showing up in the literature of the field.

Hlynka and Belland describe the current systems model as a "technological, means-ends model which goes by a variety of names including the *systems approach*, *instructional development*, *instructional design*, or just plain *educational technology*" (p. v). But, they also note, although educational research is mostly limited to positivistic traditions, "phrases and concepts such as 'qualitative methodologies', 'semiotics', the post-modern condition', 'reader response theories', and 'poststructuralism' have begun to permeate even the literature of educational technology" (p. vi).

This new perspective is described as "criticism", as it is used in the arts and humanities. Criticism in educational technology, according

to Hlynka and Belland, "is that study concerned with defining, expounding, an evaluating processes and products of educational technology" (p. vi).

Hlynka and Belland's book, Paradigm's Regained: The Uses of Illuminative, Semiotic and Post Modern Criticism as Modes of Inquiry in Educational Technology, gathers together what they describe as "key documents" that reflect the new perspective. In the book, criticism is presented as the new paradigm in educational technology, but is accompanied by a warning that "criticism is not the only paradigm, and that it is open to misuse, abuse and inappropriate interpretation" (p. vii).

Kerr (1989) does not openly address this issue of paradigm shift. His ideas, however, do reflect a shift from the traditional positivistic orientation of educational technology and may be indicative of the paradigm shift to which Hlynka and Belland refer.

The work of educational technologists, Kerr observes, is becoming increasingly distanced from the work of teachers. He perceives a dichotomy between the systematic design and development of instructional technology and the people who actually use the materials. Although teachers use educational technology, they may reject "the technologist's vision of precisely engineered materials, controlled experiences, and measured outcomes" (Kerr, 1989, p. 7).

Teachers often have little opportunity to think about educational technology as anything more than hardware and software. Kerr gives as the reason for this that teachers do not acquire alternative models of technology during teacher training.

The reality of classroom life, as Kerr observes, is "often less organized and less goal-oriented than technologists would prefer" (p. 10). Technologists, and not teachers, are the ones that should adapt to this reality. Kerr supports this argument when he writes that educational technologists

should not be trying to supplant the models and practices that teachers have developed to cope with the uncertainties of their world, nor should we assume that that world can be radically altered over the short term. Instead, we should try to develop (jointly with teachers) models of teaching-with-technology (in a sense of using tools, materials, and processes) that recognize those difficulties, seek to alleviate their impact, and provide at the same time the opportunity for teachers to expand their thinking about what is possible in the classroom (p. 10).

As part of this transition, Kerr recommends that teachers and technologists must critically address technology in the classroom, and determine "what meaning technology has in the context of the constraints and uncertainties with which teachers must deal" (p. 10).

Similar to Kerr, Nunan (1983) does not use the term 'paradigm shift', but presents ideas that seem to reflect a move away from the traditional systems approach toward school-based design and development of instruction. His book, Countering Educational Design, attempts to wrest the responsibility for curriculum planning from educational designers, and place it in the hands of teachers. The purpose of his book is to further the interests of classroom teachers who see instructional design as a fundamental aspect of their teaching practice.

Traditional educational design, as Nunan sees it, uses the systems model, and "is an activity which attempts to employ scientific

approaches to design problems. Design is practised by specialist groups who, through their knowledge and practice of certain techniques, hand down the end-products of their design activities to be implemented by teachers" (p. 2).

If teachers are not in control of curricular decisions, Nunan warns, the act of teaching becomes an acting out of pre-prepared presentations, while teachers become consumers of pre-packaged educational products. Designers reinforce the consumer status of teachers by discouraging them from producing their own materials. The basic message to teachers from instructional designers, Nunan observes, is "hands off" and "leave design to experts".

The issue of power is of great importance to Nunan. He regards external and isolated designers to be managers working from strategic centres of power within educational institutions. Their managerial influence is vast and impacts upon administrators, teachers and students. Designers, and the entire concept of systematic design, "support particular values which establish and further their interests within institutionalized education. Such values determine the limits of educational design and contain prescriptions about how to judge 'good design'" (Nunan, 1983, p. 4).

Systematic educational design may be perceived as an ideology, according to Nunan. To regard it as such, he notes, "is to focus upon the 'meaning-making' and 'social interest' functions of the design concept..." (p. 32). Nunan contends that there are two key values associated with the ideology of design. The first is "an insistence upon knowledge derived from rational sources...It points to the use of

theoretic knowledge as a means of legitimating control over the processes of teaching and learning" (p. 33). He writes that the second value is

an insistence upon dividing the teaching/learning totality into a design phase and execution phase. Again, such a value appears almost common sense, yet behind it lies a division of labour which can be used as a means of prevention of access to the totality of the teaching/learning situation (p. 34).

The second value, Nunan argues, is a "political necessity" in the establishment of a group of experts to control curricular decisions.

Within this political framework, technology comes to be a tool that supports the decision makers (designers/managers). Nunan explains that technology is usually developed and promoted by a group in power and transmits only those ideas and devices that are of value to the group. Although the technology may be detrimental to its users, it helps the dominant group maintain power.

Nunan contrasts the scientific or systems approach with the "ad hoc" traditional model. The ad hoc model is often disparaged by those steeped in the scientific model. System adherents, Nunan writes, believe the ad hoc model is

subject-matter dominated, methods oriented, and suffers from unclear aims and philosophy, inappropriate logic for sequencing and narrow evaluation. Little heed is paid to such theoretic concerns as psychological factors, learning theories, the philosophy of knowledge, instructional media, evaluative techniques and so on (p. 73).

The implication of this criticism of the ad hoc model is that teachers carry out design haphazardly. Nunan believes that "teachers stress the 'wholeness' of the teaching and learning 'totality' as a

contrast to the educational designer's separation of design and execution" (p. 116). Nunan's book, as the title indicates, is an attempt to counter the systems approach and get control back into the hands of teachers.

Educational Technology - Effects and Implications

Technologies are developed and used within social, political and economic contexts, and have far-reaching implications for the institutions that employ them (Franklin, 1990). Technologies "arise out of a social structure, they are grafted onto it, and they may reinforce it or destroy it, often in ways that are neither foreseen or foreseeable" (p. 57). Society has granted technology a right of way, the social consequences of doing so being far-reaching. Those consequences, according to Franklin, include:

- A move away from the holistic practices of the past where a craftsperson controlled production through all stages of development to the current prescriptive technological characterized by a division of labour.

- The development of a culture of compliance where, because of factor such as the division of labour, external control and internal compliance are necessary.

- The diffusion of a production metaphor throughout society, as contrasted with a growth metaphor. In a society operating within the boundaries and limitations of a technological production metaphor, everything (in principle) is predictable and controllable. In this mindset, externalities such as context are considered irrelevant.

- A downgrading of personal experience and an upgrading of reliance on scientific and technological expertise.

- The creation of pseudorealities and pseudocommunities through the experience of radio, television, video and film.
- The elimination or reduction of reciprocity -- a term Franklin uses to describe real communication. Reciprocity is that genuine communication that can only occur when two people interact face to face. She perceives the lack of reciprocity in our society as a "technologically executed inequality [that] has very profound political and psychological consequences" (p. 49).
- Technologically-induced changes in political and social patterns, dominated by notions of production and consumerism.
- The publicly funded development of infrastructures necessary for the continuation and advancement of technology -- infrastructures such as power production and transportation systems.

Franklin's observations of technology are significant within the field of education. She is concerned that the technological metaphor of production dominates the school system.

Although we all know that a person's growth in knowledge and discernment proceeds at an individual rate, schools and universities operate according to a production model...Yet all of us who teach know that the magic moment when teaching turns into learning depends on the human setting and the quality and example of the teacher -- on factors that relate to a general environment of growth rather than on any design parameters set down externally. If there ever was a growth process, a process that cannot be divided into rigid predetermined steps, it is education (p. 28-29).

The technological world-view also has tremendous gender impact. Franklin observes that a substantial body of documentation exists, "showing how teaching, research, and practice in most areas of science and technology follow essentially male patterns by being basically hierarchical, authoritative, competitive and exclusive" (p. 103). The

prescriptive practices that develop within this technological model are being closely tied to the notion of power and control.

Contrary to Franklin, Kerr (1990) argues that although technology has been a major feature in schooling this century, it has not impacted greatly on schools. Technology has failed to live up to the claims made by its proponents, according to Kerr.

From films in the 1920's, through radio in the 1930's, television in the 1950's, programmed instruction in the 1960's, learning laboratories and the advent of 'instructional systems design' in the 1970's, computers and videodisc in the 1980's and 'multimedia' in the 1990's, there has been a steady progression of technological panaceas, with relatively little effect on educational practices (p. 7).

With this idea that technology has had little impact in education, Kerr also writes that gender is a factor that influences the application of technology in schools, most particularly at the elementary level. Two issues tie into this gender theory. First, he believes that the nature of educational technology has less to do with the craft-centred traditions of education and more to do with the science and technology centred tradition. Second, he observes that the majority of elementary school teachers are female, and wonders: "is technology little used in schools because most teachers are still women, and because educational technology (as it has been conceived by its proponents) addresses concerns that are primarily male concerns" (p. 9).

To illustrate this gender influence on technology, Kerr borrows from Gilligan (1982) and uses the female/male oppositions of care and justice:

Perhaps educational technologists (mostly men) propose technology as a solution to problems of education that they perceive in terms of justice -- eliminating 'artificial' classroom barriers to individual achievement, making instruction equally valuable for all students, aiding the disadvantaged in becoming more academically competitive, improving access to education thereby solving social problems, and so on. Teachers (mostly women), on the other hand, may see their classroom tasks more in terms of care -- helping children to feel accepted by the group, devising approaches to instruction that capitalize on cooperation rather than competition, encouraging constructive social activity among the students, assuring that individual needs are tied to group concerns (p. 10).

Bowers (1988), similarly to Franklin, believes technology has tremendous impact on society and on schools. He focuses on the impact of computers, but his ideas are important for the use of all types of technology within schools.

The classroom is at once a microcosm of society, and at the same time, a contributor to the direction of society. Bowers observes that the processes of the classroom result in the transmission of status systems, social norms, patterns of thinking, and an economic-political orientation. The use of computers actually influences thinking patterns, Bowers argues, contributing to changes in the "symbolic underpinnings of the culture" (p. 3).

A technological classroom strengthens a particular cultural orientation...one that Bowers describes as a technicist social order. According to the author, the technicist orientation is characterized by:

- **Arrogance**

Rationality, progress and efficiency are viewed as achievements. Crises such as the ecological situation simply require technological "fixes".

- **Technical solutions**

All aspects of experience are viewed as problems that require technical resolutions.

- **Explicit ways of knowing**

Knowledge is that which can be observed, quantified, calculated or measured.

- **Non-contextuality and universal application**

Context is disregarded and the application of findings are unlimited to time and place.

- **Progress**

Any innovation is a positive move forward for society.

- **A favouring of the autonomous individual over the interdependence of cultural groups and collective memory**

- **A reductionist, materialistic approach to reality which eliminates spiritual discipline and social harmony**

- **Planned obsolescence**

Bowers fears that schools directly contribute to the development and maintenance of the technicist social order. Schools are seen as the chief means for providing the necessary conceptual foundations for the knowledge required to operate and develop the sophisticated technologies our consumer society demands. Bowers describes this process:

This involves teaching students to think in a manner that is compatible with the social-engineering processes that keep our commodity culture from falling into a state of permanent destabilization. Students thus learn to think in abstract-decontextualized ways, segment experience into component parts, recog-

nize that the quantification of experience represents the highest source of intellectual authority, consume courses as units of learning, acknowledge the hierarchical structure of knowledge that requires certified experts, and view time in personal terms of self-advancement (i.e., escape from the traditions of an outmoded past) (p. 10).

These observations of student inculcation to the social-engineering world-view directly relates to both the systems approach in instructional technology, and the Cartesian world-view discussed earlier.

When Bowers observes that students within a technicist social order learn to think in abstract and decontextualized ways, segment experience into component parts, recognize that the quantification of experience represents the highest source of intellectual authority, consuming courses as units of learning, acknowledge the hierarchical structure of knowledge that requires certified experts, and viewing time in personal terms of self-advancement, he is in fact describing the systems approach to instructional technology.

Bowers' description of the technicist social order also coincides with the Cartesian world-view. Within the Cartesian model, according to Mitcham (1980), the rational, individual and objective approach of science is regarded as the ultimate authority. This scientific or techno-mindset excludes personal, social, political, or ecological or consequences.

The new information technologies are increasingly making their presence felt in society and schools (Henchey, 1987). The new media are a combination of quicker and better means of controlling information. Henchey observes that "this technology is developing so rapidly, is being diffused so widely, and is becoming so integrated that information

and communication are becoming the major social and economic activities of our society" (p. 45) Henchey describes the new tools and their impact:

Microchips, microcomputers, television, VCR's, lasers, fibre optics, satellites, videotex, robots, compact disks...These tools have radically altered old processes and invented new ones: teleconferencing, computer-aided manufacturing (CAM), computer-aided design (CAD), word processing, remote sensing, electronic entertainment. These tools and processes are increasingly being integrated into unified systems of data bases, satellite networks, and computer-based management systems (p. 45-46).

As the information systems spread, human contact with other people and the rest of the world becomes mediated by technology, resulting in the creation of an artificial reality. Within this system Henchey includes technology such as "automatic banking, robot manufacturing, electronic entertainment, comprehensive record keeping, automated offices, and electronic mail" (p. 46).

These observations have important implications for education. Henchey describes the education system since 1980 as having been "rocked by the wave of interest in microcomputers" (p. 48). The system is portrayed by the author as typically rigid and slow to embrace change, but, uncharacteristically, is latching on to the new information technologies with a passion.

Governments and school boards, constrained by declining enrolments and budget cuts, are finding substantial sums with which to purchase computers, equip labs, maintain service, and purchase software. Teachers, anxious about job security and distressed by public criticism, seem to be attracted by a technology that in other areas shows every indication of displacing workers. Parents, concerned about ensuring mastery of the basics and skeptical of fads and frills, are supporting an innovation that is largely unknown in its potential use, risks, or implications (p. 48).

Henchey lists the following as explanation for the educational interest in the new information technologies:

- Computers reflect state-of-the-art technology, and schools that use computers are perceived to be up-to-date.
- As objects, computers are more accountable than people, processes, or ideas.
- The school system has been under attack from critics and needs a fresh and new approach.
- Computer manufacturers exert pressure on schools for economic control of that market.
- Computers are regarded as the key element of the new information technologies and can be easily "domesticated".
- The aura of a social movement is associated with computers, including rituals, as well as an esoteric vocabulary.
- Computer enthusiasts are providing the necessary impetus and leadership.

Despite the interest surge in computers, many educators reject the new technologies because they feel indifferent, skeptical or anxious about them. Some resist, Henchey says, because "the computer is one more blow struck against literacy, the humanities, personal relationships, and critical thinking" (p. 49). Henchey ponders the minor and major implications of computers and asks:

Is it a matter of a spectacular but essentially minor technical innovation that will modestly alter some teaching practice in schools (Computer Aided Instruction), create a new subject of study (word processing, computer literacy), or implement a new management system (scheduling, testing, record keeping)?...Or is this a technology that will substantially modify the content and processes of the education system, producing new ways of organizing content ("designer" courses), new criteria for selecting curriculum (available courseware), new learner-centred techniques (computer aided learning), new teaching materials (data bases), and new ways of attending an institution (distance education)? Is the computer the tip of an integrated and powerful technological

system of information management and transmission that cannot be denied? (p. 49)

Given the understanding that the new information technologies are more than just tools (computers) or processes (computer-aided instruction), Henchey concludes that the new technologies must be seen as "a total system, an environment, a way of thinking, and a set of values. When we place an order for microcomputers, we are getting more than machines" (p. 50).

Apple (1986) refers to the current technical shift in schools as a technological restructuring. He believes that machines are playing an increasingly important role in the classroom. The academic promotion of technology supports two processes, according to Apple: 1) proletarianization and the deskilling of jobs, and, 2) class, race, and gender-based differences.

With regard to proletarianization, Apple notes that the widespread use of technology is related to the general societal purposes of efficiency, cost effectiveness and accountability. He also points out, that, contrary to the dictates of common sense, the increased use of machines (and in particular, computers) actually results in the deskilling and depowering of teachers. This occurs as curricular planning and decision making is removed from the classroom, and becomes an isolated and fragmented activity. Apple writes that "instead of teachers having the time and the skill to do their own curriculum planning and deliberation, they become isolated executors of someone else's plans, procedures, and evaluative mechanisms. In industrial

terms this is the separation of conception from execution" (p. 162-63).

Although Apple does not specifically refer to the systems approach in educational technology, his description of the deskilling and depowering of teachers equates with the skill fragmentation that is typical of the systems approach.

On the point of class, race and gender-based differences, Apple regards schools as institutional examples of cultural marxism. He believes that educational practices, including the use of technology, reinforce cultural standards. All cultural processes have an intimate connection to social relations, such as the class and sexual divisions that develop within a society, according to Apple. Cultural processes support and reproduce socio-economic and sexual divisions within society. The class and gender relations that develop as a result of cultural marxism are typified by power inequities and asymmetries, where white, middle class males hold and control power. These class and gender distinctions, as well as power inequities are reinforced within the processes of the classroom through the use of technology and other pedagogical practices.

Uncritical reliance on technology and especially upon pre-packaged computer software will have several negative long term effects, observes Apple. These effects include the atrophy of teacher skills, further strain on school budgets (or the elimination of existing programs for new technology), limitations of access according to gender and race, the transformation of schools to lucrative market places for technology, social imbalance, and, "the opening up classrooms to the mass-produced

commodities of industry. The technological 'text' joins the existing textbook in the political economy of commodified culture" (p. 163).

Apple concludes that the unquestioned acceptance of technology in classrooms affects "the very ways students themselves are taught to think about their education, their future roles in society, and the place of technology in that society" (p. 171). Apple, like Franklin, Henchey and Bowers, sees the very presence and use of technology as the embodiment of a particular way of thinking -- a technical way of thinking. The more technology transforms schools to reflect its own image, the more will the current political and ethical understanding of schools be replaced with technical logic. Apple thinks this reliance on machines will replace the current "why" attitude of schools with a more technical "how to" attitude. Even if all students -- not just white males -- become technologically proficient, the critical questions of politics and ethics remain, according to Apple.

Streibel (1986) reflects many of the ideas presented by Bowers and Apple. He focuses primarily on computers and believes that they have had profound impact on education. The computer is seen by Streibel, to be not "just another 'delivery system', but an environment that has certain values and biases associated with it" (p. 137).

Streibel examines computers as they are used for drill and practice (DP), tutorial, and simulation and programming. The author concludes that the sophisticated techniques associated with computers do not necessarily mean more sophisticated instruction.

DP programs treat students as "black boxes", writes Streibel. Student behaviours are shaped by external and mechanical processes that use feedback to guide learners to predetermined goals. This is referred to as a deterministic form of behavioral technology which may be adequate for simple skill building but ineffective in terms of higher learning.

Streibel also believes that DP programs utilize a mastery learning approach, within which "considerations such as the dialectics of learning, accommodation to individual uniqueness, and the possibility of emergent goals have been factored out of the process" (p. 142). The mastery learning paradigm of DP reinforces and reflects classroom and school practices, according to Streibel.

The mastery learning paradigm manipulates the time allowed for learning and the quality of instructional stimuli as the main factors to help students achieve mastery. It therefore entails the rational planning of classroom time, schedules, organization, and conditions of instruction, as well as the rational design of instructional materials (p. 142)

At the core of DP programs is the concept of individualization, maintains Streibel. But, he observes, the dimension of individualization within these programs is limited to an individual's rate of progress through the program, and not the unique characteristics that make up the person.

DP programs also fragment learning by breaking the instructional process into small increments. They assess each response and control a finite number of directions in which a learner may proceed. Choices are limited within a measurable and computable domain, and teachers are relegated to managerial positions, according to Streibel. The author

believes "the philosophy of drill and practice courseware is consistent with the movement in the curriculum field toward the 'technical control' of learning" (p. 144).

Streibel explores the notion of technical control and writes that the use of computer courseware operates within a technologically mediated instructional delivery system. He believes this has cultural implications.

[T]he concept of computer courseware contains a 'technological control' orientation. That is, the technical structure of the delivery system shapes the form and function of the human culture and the physical artifacts. The technical structure also orients those components toward some external goal (i.e. educational performance) and then tries to maximize the levels of this goal. A technological delivery system will therefore ultimately influence the nature of the classroom culture -- unless, of course, the classroom is already organized as a work culture (p. 145).

The impact of a classroom as an instructional delivery system, according to Streibel, is that the environment shifts from one of education and learning to one of training and development.

Many of the assumptions and effects of DP programs can be observed in more sophisticated form in the (supposedly) higher level, tutorial computer programs. Streibel writes that, like DP programs, tutorial programs

also stay well within the bounds of behavioral and technological framework. That is: behavioral outcomes are still pre-specified by expert agents outside of the actual interaction, 'quality control' procedures are still used to guarantee the learner will reach the intended outcomes, and learners are still only given a form of pseudo-control (i.e. rate, route and timing). Furthermore, although the actual interaction is less rigid than in drill and practice courseware, the interaction is still constrained by a computer algorithm, is still focused on maximizing education performance gains, and still treats the learner as a means toward someone else's end. Computer-based tutorials are biased against experiential learning (outside of the technological framework),

quantum leaps in learning, and reflective thinking. Their value in education is therefore very limited (p. 152).

Similar conclusions are made about higher level computer use, where the machine is used as a problem solving tool. Streibel concludes that if humans use computers as tools, they are limited to working within the "epistemological limitations" of the machine. Computers function according to formal, syntactical rules, and serve to legitimize knowledge that fits that particular framework...knowledge with the following characteristics, according to Streibel: "rule-governed order, objective systematicity, explicit clarity, non-ambiguity, non-redundancy, internal consistency, non-contradiction...and quantitative aspects" (p. 154). Higher level computer use also legitimizes deduction and induction as the acceptable methods of intellectual process.

Streibel points out that computers also delegitimize certain characteristics of knowledge, including

emergent goals, self-constructed order, organic systematicity, connotation and tacitness, ambiguity, redundancy, dialectical rationality, simultaneity of multiple logics, and qualitative aspects. And finally, they tend to delegitimize the following epistemological methods: abduction, interpretation, intuition, introspection, and dialectical synthesis of multiple and contradictory realities (p. 154).

Computers, suggests Streibel, force humans to act as if they were rule-governed information processors.

With respect to computer simulations, computers say nothing of the real world, and nothing of lived reality. The world that is presented through computer simulations is a quantitative and artificial reality. A computer, maintains Streibel, "represents the abstract world of

algorithmic logic rather than the lived-experience of historical logic" (p. 155). Simulations cannot present historical logic, and successfully "winning" within these programs is more a result of finding predictable patterns than developing any sense of history.

Streibel concludes that all three computer approaches -- drill and practice, tutorial, and simulations -- may result in short term academic gain, but in fact represent a technologizing of education.

Drill and practice courseware programs alter the nature of sub-skill acquisition, tutorial courseware programs restrict the full range of personal intellectual agency, and computer programming and simulations delegitimize non-technological ways of learning and thinking about problems. Taken together, is this worth the price? (p. 158)

The point of this chapter has been to describe technology and educational technology. The following chapter will examine the technological text, and subject it to a poststructural analysis.

CHAPTER 5
TECHNOLOGY AS A METANARRATIVE:
A DESCRIPTION AND POSTSTRUCTURAL ANALYSIS

Overview

This chapter will describe the technological text and then subject that text to a poststructural analysis. The word "text" is used in its semiotic sense, as meaning a sign system which communicates a variety of meanings to "readers". When technology is referred to as a text, it is meant that the content of technology itself is like "book" in that it is open to readings and misreadings, interpretations and analyses.

As indicated in Chapter 3, this analysis treats technology as a metanarrative. To do is to presume that the story of technology permeates our lives and influences our world-view. The act of treating technology as a metanarrative operates from the assumption that technology defines legitimate knowledge, and has its own particular set of rules, principles, concepts, constructs, rhetorical claims, binary distinctions, and transcendental signifieds. Together, these characteristics outline what is or is not acceptable, desirable, and efficient regarding educational discourses and practices within a technical milieu.

The description of those characteristics is the definition of the technological text. That description is derived from and is a compilation of information presented in Chapter 4. This constitutes the first step of this analysis.

The second step of this analysis is to subject the technological text to a structuralist reading and a feminist poststructural analysis. The structuralist reading, as Cherryholmes (1988) indicates, is a necessary prerequisite step for poststructural analysis. The structuralist reading presents the text the way it is, and not the way the critic would like it to be. Given this text, the critic is then able to conduct poststructural analysis.

The point of the poststructural analysis is to reveal the power asymmetries of technology and to discover, reveal, explore, and play with the meanings, myths, values and assumptions that are communicated through technology and educational technology.

"Writing" the Technological Text

Technology is an unwritten text of society. To treat technology as a metanarrative and to "write" its text, is an attempt to move it from the ethereal realm where it currently resides and to concretize it. The act of writing privileges a subject, and gives to it a sense of presence and immediacy.

Because the text of technology is unwritten, it does not achieve a sense of presence and immediacy. Technology is not commonly regarded as a text or a metanarrative in the way that written metanarratives are perceived. For instance, books are concrete. One such as Ralph Tyler's Basic Principles of Curriculum and Instruction can be held and read. It can also be examined, explored, accepted, rejected, denied, criticized, argued, praised, elevated, denigrated, ignored, or dismissed.

There exists no concrete technological text which can be held and read. Computers, 16mm projectors, tape recorders, and televisions certainly are concrete and can be held. The accompanying user manuals can be read for operating techniques. But the machines and manuals do not constitute the text of technology. Nowhere within the body of the machines or manuals is there to be found a statement (as in Tyler's work) in which the transcendental signifieds, binary distinctions, rules, principles, myths and assumptions of technology are to be readily observed.

The "rationale" of technology has not been written because of the very nature of technology -- it is commonly regarded as an assortment of products and processes scattered throughout our culture. There exists no "rule book" defining the text of technology, because technology is a diverse and complex entity. It is a concept that means many different things to many people, and a definitive description is elusive. Educators write about educational technology, engineers write about the technology of engineering, and many others write about other aspects of technology, and many write about technology in general.

But to describe the "text" of technology involves considering all of technology as a force and to find the commonalities of technology. To commit technology to "writing", is to give it immediacy and presence. That is the intent of this thesis -- to bring technology to the realm of the "readable", to substantiate it, to give it presence, to concretize it and to assemble it so that it may then be poststructurally disassembled or deconstructed.

A Description of the Technological Text

This section describes the traditional technological text, including its rhetorical claims and transcendental significations. The text has been derived from the observations and descriptions of technology in Chapter 4 and represents the views of experts in the field. Each statement about technology is attributed to an author, and represents their observations of technology. The description of technology is presented in three parts:

Part 1 lists the observations of writers who are critical of technology. Alongside the critical views are the corresponding binary distinctions. A binary distinction, as indicated earlier, is a simple logical device used to discriminate the presence or absence of a quality or attribute. A binary distinction is a term and its opposition, such as neutral/value-laden. The opposing distinctions are included in Part 1, as they represent the traditional/positivist assumptions of technology which are the basis of the technological text. The point of presenting the information in this way, (i.e. naming the binary distinctions), is to identify the rhetorical claims of technology as derived from the views of writers who are critical of technology. These critical observations of technology, in their various attempts to negate or deny certain aspects of technology, are used to illustrate the binary distinctions, and thus help to describe the technological text.

As an example to clarify the way in which binary distinctions are to be used, several writers refer to technology as a value-laden force.

They argue against the neutrality of technology by claiming that it is value-laden. By doing so, however, their arguments actually provide support for the possible existence of the transcendental signified of neutrality. The arguments provide credence for the neutrality claim, firstly by addressing it and, secondly, by rejecting it. The debate against technological neutrality substantiates that quality as a rhetorical claim of technology. The argument that makes a case for the non-neutrality of technology, in fact, establishes neutrality as the binary distinction.

Part 2 of the description of the technological text presents the positivist assumptions of science and technology, also derived from Chapter 4. These observations describe the rhetorical claims of technology. Binary distinctions are not used in this section, as the statements already focus on the positivist assumptions of technology.

Part 3 is an unannotated summary of both the text of technology and educational technology. This section combines the binary distinctions of Part 1, with the positivist assumptions of Part 2 and presents the information as the text of technology and educational technology.

The major characteristics of the technological text are highlighted in bold print in Parts 1 and 2.

Part 1, the critical description of technology along with positivist binary distinctions begins on the next page. Following that is Part 2, positivist descriptions of technology and Part 3, the summary.

The Technological Text

Part 1

Critical Descriptions of Science & Technology

Traditional/Positivist Binary Distinction

Clark, 1989; Rosaldo & Lamphere, 1974:

Knowledge which is derived from the scientific process is interpretive and speculative in nature.

Knowledge derived from the scientific process is **factual** and **definitive**.

Bleier, 1984:

Science is a value-laden endeavour, neither neutral nor dispassionate in its pursuit of truth. Scientists are not disinterested, objective or culturally disengaged from their research and the questions they ask. Science is a social activity and a cultural product created by persons who live in the world of science as well as in society.

Science is **value-free, neutral, and dispassionate**. Scientists are **disinterested, objective, and culturally disengaged** from their research and questions. Science is an **asocial** activity and **divorced from culture and society**.

Baudrillard, 1991:

The medium of technology cannot be separated from the message as being a neutral force in the delivery of information.

The medium of technology is **neutral**.

Franklin, 1990:

Technology is not neutral, having developed in social, political and economic contexts.

Technology is **neutral**.

Bowers, 1988:

Technology selects the aspects of experience that will be heightened or diminished, and cannot be regarded as neutral.

Technology is neutral.

Henchey, 1987:

The new educational technologies are to be regarded as a "total system, an environment, a way of thinking, and a set of values" (p. 50).

Technology is value-free.

Streibel, 1986:

The computer is not just another information delivery system, but an environment with values and biases attached to it. Computers delegitimize certain characteristics of knowledge, including: "emergent goals, self-constructed order, organic systematicity, connotation and tacitness, ambiguity, redundancy, dialectical rationality, simultaneity of multiple logics, and qualitative aspects" (p. 154).

Technology is value-free. Technology legitimates **prescribed goals, other-constructed order, denotation, and concreteness, clarity, single occurrences, authoritative knowledge, planned and singular logic, and quantitative aspects.**

Pursell, 1980:

The non-neutrality of technology is supported by an Aristotelian belief that form and purpose are related.

Technology is neutral, as form and purpose are separated.

Lipscombe and Williams, 1979:

Technology plays a political role through its non-neutrality and the values it implants.

Technology is **apolitical and neutral.**

Mumford, 1979:

Technology is usurping human authority and is increasingly depriving humans of freedom of choice.

Technology relinquishes authority and affords humans freedom of choice.

Part 2

Traditional/Positivist Descriptions of Technology

Keller, 1983:

Science is:

- **impersonal** and has to do with things, not people;
- **separated** from the world;
- **objective** and **analytical**;
- **pure reason** and **separate from feeling**;
- regarded as "**hard**";
- **asexual**;
- an endeavour that **dominates nature**;
- the **quest for power**.

Mitcham, 1980:

Scientists view the world in Cartesian terms (mechanistic and logical), and place **emphasis** on observation and rational thinking. Science aims for an indubitable system of thought, and at making humans the possessors of nature.

Franklin, 1990; Bowers, 1988; Hubbard 1988; Everts, 1986;

Rothschild, 1988:

Technology reflects **scientific values**.

Franklin, 1990:

Technology is **acontextual**, separates knowledge from experience and emphasizes **expert and abstract knowledge**. Technological methods contribute to the political design of **external control and internal compliance**. Prescriptive technologies are **effective and efficient**. **Orthodoxy** is a condition of technology, and there is only **one way of doing 'it'**. Technology operates with a **production metaphor**, where everything is **predictable and controllable**. Technology relies upon mass **production and consumerism**.

Apple, 1988:

Within technological systems, **skills are reduced to atomistic units** to enhance profit levels, **control and efficiency**.

Bowers, 1988:

All problems have **technical solutions**, and **explicit knowledge** is that which can be observed, is **factual, quantifiable, calculable or measurable**. Technology is a product and reflection of the **scientific method**. Technology **devalues the importance of context** and **subordinates experience** to a **rational and logical system of linearity**. **Technical innovation represents progress**. The underlying metaphor of technology is **'the world as a machine'**. The task of the **rational-calculating mind** is simply to re-engineer the various systems in order to improve **prediction, control and efficiency**.

Experimental innovation, abstract and theoretical ways of thinking, the autonomous individual, and a reductionist, materialistic

view of reality are privileged. Technology controls human experience through amplification and reduction.

Benston, 1988:

The technological world-view emphasizes objectivity, rationality, control over nature and distance from human emotions.

Hill, 1988:

Technology has actualized the industrial world-view. Technological change dominates social life.

Everts, 1986:

Technology reflects scientific values, including rationality, control and objectivity. Technology ignores social consequences, and views nature mechanically, as something to be controlled and manipulated. Science is concerned with individual success and personal results; it excludes feelings and emotional involvement.

Cockburn, 1985:

Technology is an aspect of power. Technology increases physical, personal and economic power, and extends the power of nations. Technological knowledge is the ticket to power over nature and power over people.

Franklin, 1984:

Technological tasks are fragmented, narrowly specialized, and focused on efficiency.

Bush, 1983:

Technology has power that it exerts over humans.

Feldberg and Glenn, 1983:

Technology deskills labour and reduces the need for qualified, intelligent and committed workers through the mechanisms of central control and increasing sophistication.

Ellul, 1964:

Technology is a system dedicated to the rational pursuit of efficiency and is known as Technique. Technique is regarded as a good thing, and values are not assigned to technique. Technique is value. Technique has freed humans from ancient constraints.

Ortner, 1974:

Technology and culture are identified with men, who are perceived to have transcended nature.

Millet, 1971:

Technology is an avenue of power within the patriarchy.

Kranzberg and Pursell, 1966:

Technology is an attempt to **subdue or control the environment** through imagination, ingenuity and **the use of resources**. Technology is a **social requirement**, much affected by social needs, economic environments, by the level of technology at a given time, and by sociocultural and psychological circumstances. Technology is responsible for our being Homo sapiens and the chief distinction that **separates us from primitives**.

McLuhan, 1964:

Technology's presence has psychic and social consequences as it **amplifies or accelerates existing processes**.

Educational Technology

Hlynka & Belland, 1991:

Educational technology is centred in the **positivistic systems approach** which is described as a "**technological, means-ends model** which goes by a variety of names including the *systems approach, instructional development, instructional design*, or just plain *educational technology*" (p. v).

Kerr, 1990:

Technology in education is proposed as a **solution to problems** and **concerned with justice**.

Dick & Carey, 1990; Dick & Reiser, 1989; Kerr, 1989; Percival & Ellington, 1988; Spencer, 1988; Gagne, Briggs and Wager, 1988; Knirk and Gustafson, 1986:

Educational technology is focused on **technological process** and the **systems approach**.

Dick & Carey, 1990:

A system is described as a **set of interrelated parts** which work together toward **defined goals**. The various parts of the system are dependent upon each other for **input and output**. The system uses **feedback processes** in order to determine if desired goals have been reached. The systems model is concerned with **instructional goals, analysis, entry behaviours, objectives, testing, instructional strategies, and evaluation**. Within this model, instruction is a **solution to a problem**, and instructional design is an **empirical and replicable** process which is the most **efficient and effective** way to design instructional strategies.

Franklin, 1990:

The technological **metaphor of production** dominates the school system.

Heinich, Molenda and Russell, 1989:

Educational technology is a **tool for solving instructional problems** and is "the **systematic application of scientific or other organized knowledge to practical tasks**" (p. 24). Instructional technol-

ogy is the **application of scientific knowledge** about how learning occurs to the practical tasks of teaching and learning. A technology of instruction is a **systematic arrangement** of teaching and learning. Knowledge about the way humans learn is applied to teaching and is a **predictable and effective way** to achieve specific learning objectives.

Kerr, 1989:

The work of educational technologists is becoming **increasingly distanced** from the work of teachers. There exists a dichotomy between the **systematic design** and development of instructional technology and the people who actually use the materials. Although teachers use educational technology, they may reject "the technologist's vision of **precisely engineered materials, controlled experiences, and measured outcomes**" (p. 7).

Dick & Reiser, 1989:

Instructional design is a "**systematic process** for designing, developing, implementing, and evaluating instruction" (p. 3). The systematic approach is an **effective means of planning instruction**. The four components of instructional plans are **goals, objectives, test items** and **instructional activities**.

Gagne, Briggs and Wager, 1988:

Instructional design is most **effectively** carried out by means of a **systems approach**. This involves an **analysis of needs and goals**, and an **evaluated system of instruction**. Success is measured as goals are

demonstrably met. Decisions are based upon **empirical evidence**. **Inputs, feedback, and validity** are characteristics of the systems approach. The principles of learning are **scientifically determined** and provide a **scientific foundation** for the systematic approach of instructional design. **Resources and procedures** are arranged and used to promote learning. All of the phases in any instructional system can be categorized into one of three stages: **instructional goals, instructional development, and evaluation of the effectiveness of instruction.**

Percival & Ellington, 1988:

The **systems approach** is the foundation of educational technology, the principal role of which is to improve the overall **efficiency** of the instructional process. Four results of technology are: **increasing the quality of learning** or the degree of **mastery**; **decreasing the time** taken to achieve goals; **increasing teachers' efficiency** without reducing learning quality; and, **reducing costs**, without affecting quality.

Spencer, 1988:

Educational technology is grounded in **empiricism** and operates within the **systems approach**.

Apple, 1988:

The use of technology is related to the general societal purposes of **efficiency, cost effectiveness and accountability**. Curricular planning and decision making is removed from the classroom and is an **isolated and fragmented** activity.

Earl, 1987:

The quality of the learning experience can be rated according to four criteria: **effectiveness, value, likability and efficiency.**

Henchey, 1987:

The new technologies in education are a combination of **quicker and better means of controlling information.** The new technologies are being increasingly incorporated by schools because they are **state-of-the-art, up-to-date, accountable, a fresh and new approach, easily adapted and incorporated, and, associated with the aura of a social movement.**

Knirk & Gustafson, 1986:

The **systems approach** is dominant in instructional technology which is an **evolutionary step** for education. Technology is used to make schools more **effective, efficient and humane.**

Streibel, 1986:

Computer programs utilize a **mastery learning** approach, **manipulate learners,** and are a **deterministic form of behavioral technology** which is adequate for **simple skill building.** Programs **fragment learning** by breaking the instructional process into small increments. Choices are limited within these programs to a **measurable and computable domain,** and **learning is controlled technically.**

Technological control of learning is characterized by **external goals, educational performance, and maximizing outcomes.**

Nunan, 1983:

Educational design uses the **systems model**, employing **scientific approaches** to design problems. **External and isolated specialist groups of experts control, conduct and manage design, handing down end-products to be consumed by teachers. Technology is a tool that supports the decision makers (designers/managers).**

Part 3 -- Summary of the Technological Text

Technology:

- reflects science and is neutral, value-free, objective, impersonal, dispassionate, disinterested, context-free, and, culturally and socially disengaged.
- is rational, logical, analytical, and pure reason.
- emphasizes expert and abstract knowledge and separates knowledge from experience.
- is hard and asexual.
- is mechanistic. It has transcended nature, and treats nature and the world mechanically, to be subdued, possessed, controlled or dominated.
- is a quest for power. It increases personal, physical and economic power, and extends the power of nations. Technical knowledge is the key to power over nature and over people.
- is concerned with control and predictability.
- is effective and efficient.
- reflects linear thinking and processes.
- stresses orthodoxy, one way of doing something.
- relies on mass production and consumption and reinforces consumerism.
- is reductionist, breaks down skills, fragments jobs.
- has actualized the industrial world-view.
- is materialistic, and dependent on resources.
- views all problems as having technical solutions.
- amplifies and accelerates, or, reduces human experiences.
- regards innovation as progress, and, progress (or change) as positive.
- frees humans from the constraints of nature.
- extends human choices.
- is a social requirement.
- separates humans from primitives.

Educational Technology:

- can be regarded as a tool, or a system or environment.
- is systematic, a set of interrelated parts.
- is based on a means-ends model.
- is concerned with planning, goals, objectives, inputs, outputs, feedback, analysis, strategies, testing, evaluation, validity.
- is replicable, accountable and empirical.
- is used to increase the quality of learning and facilitate mastery, to increase efficiency of teachers, to decrease time spent on task, and to reduce costs.
- can be used to manipulate learners and the learning process.
- fragments learning by breaking tasks to small units of instruction.
- maximizes learning.
- is designed, managed and controlled by external experts.
- is distant, removed and isolated from the classroom during development phases.
- is a quicker and better means of achieving instructional goals and of controlling information.
- is precisely engineered.
- controls, conducts and manages learning experiences.
- has measurable, quantifiable, and demonstrable outcomes and effects.
- legitimates: prescribed goals, other-constructed order, inorganic systematicity, denotation and concreteness, clarity, single occurrences, authoritative knowledge, planned and singular logic, and quantitative aspects.
- is state-of-the-art, up-to-date, a fresh and new approach, easily incorporated and associated with the aura of a social movement.
- is evolutionary.
- is concerned with justice.
- is humane.

ANALYSIS

A Structuralist Reading

Technology is an extension of science, and educational technology is an extension of technology.

Technology is a neutral tool or system that separates humans from primitives. It frees humans from the constraints of nature and extends human power. It allows humans to control, predict, manipulate, possess and dominate the natural environment.

Technology increases human efficiency and effectiveness by introducing technical solutions to human and natural problems. Technology extends human choices and opportunities.

Technology is produced according to the needs of civilization and is impersonal, dispassionate, and context-free. It relies upon expert and abstract knowledge and is rational, linear, logical and analytical.

Continual progress, innovation and evolution are characteristic of technology.

Educational technology is developed and used within the systems approach to instruction. Experts outside of the classroom use scientifically based knowledge to make curricular decisions and design instructional programs in order to maximize learning. Educational technology is replicable, accountable and empirical.

Based on a means-ends model, objectives are defined, and the most efficient and effective strategies are employed to achieve goals. Emphasis is placed on measurable, demonstrable and quantifiable out-

comes. Tasks are precisely engineered and broken down to manageable and controllable increments or units.

The use of technology in the classroom provides a systematic, scientific approach to instruction. Materials and resources that are produced outside of the classroom by experts are purchased and utilized by teachers. Textbooks, films, videotapes, computer software, individualized learning packages and so on are just a few of the educational products that are brought into schools.

The products are promoted as tools to improve instruction. They are believed to be better at managing learners and the learning situation, as well as being quicker at transferring information. They are an efficient use of resources as they can be reused. They are cost-effective means to improve the productivity of classrooms.

The new information technologies are promoted as humane, and connected to the concept of justice. Computers are regarded as user friendly and adaptable to individual needs, as students work through programs at their own speed.

Technology in schools is perceived as state-of-the-art and embody progress. They are a positive step in the evolution of the classroom.

Technology solves educational problems. Films, filmstrips, slide-tape programs and videos convey information to large or small groups in an entertaining and interesting manner. Computers can be used for individual tutoring or drill and practice. Books, computer simulations and audio-visual software allow students experiences they would otherwise miss in an ordinary classroom setting. A multitude of products and

processes are available to meet the needs of teachers and their students.

The structural characteristics of educational technology and a technical classroom are as follows:

1. Knowledge and information is transferred one-way, from a source (films, software, etc) to students.
2. Knowledge is abstract, removed from context and experience, scientifically based, hierarchical and authoritative. It originates outside of the students' experience and outside of the classroom.
3. The knowledge and information presented through educational technology is ahistorical. Objectives and goals are scientifically determined outside of the school, and individual classroom and personal situations are regarded as extra-contextual.
4. Knowledge is that which is explicit, observable, factual, quantifiable, calculable or measurable.
5. Teachers and students are decentred, as meaning and value is controlled and determined by external experts.
6. Technical processes and interactions are linear and non-reciprocal.
7. The design process and products are ideologically neutral.
8. Reality becomes a technologically constituted reality, as technology controls and influences what information is presented and what is left out.
9. Technological processes infiltrate classroom practices and interactions. Linear, objective, and analytical thinking is the technical norm, and comes to be regarded as an efficient and effective way to think and behave.

10. A technical production metaphor permeates the classroom. Within this metaphor, everything is predictable and controllable. Externalities such as context are considered irrelevant.
11. Experiences are controlled externally through amplification or reduction.
12. Power and control resides outside of the classroom.
13. The values of the external designers of educational products are transmitted to and reinforced in the classroom.
14. Learning becomes fragmented as tasks are broken into manageable units. Mastery of facts is emphasized.
15. Technical expertise is valued over personal experience.
16. Pseudo or artificial realities (simulations) are presented as reality.
17. Communications reciprocity is reduced or eliminated.
18. Competition and exclusivity are favoured.
19. Science-centred, prescriptive traditions are favoured over craft-centred, holistic traditions.
20. Justice and fairness are promoted.
21. Economic-political values of production and consumerism are reinforced.
22. Teachers and students become consumers of information.
23. Planned obsolescence is built into the system.
24. Problems are solvable through technical solutions.

25. The presence of technology is progressive and evolutionary.
26. The autonomous individual is favoured over the collective group.
27. A reductionist, materialistic approach is the norm.
28. Human interactions are technologically mediated.
29. Technical devices and products are costly in a financial sense.
30. Educational technology asserts the following binary distinctions:

neutral - value laden	uninvolved - involved
objective - subjective	impersonal - personal
dispassionate - passionate	disinterested - interested
context free - context dependent	culturally disengaged - engaged
socially disengaged - engaged	reason - intuition
rational - intuitive	logical - questionable
analytical - illogical	expert - amateur
abstract - concrete	hard - soft
asexual - erotic	mechanistic - natural
power - impotence	control - chaos
dominate - share	predictability - randomness
effective - weak	efficient - unproductive
linear - deviating	orthodox - nonconforming
consumption - production	consumer - producer
reductionism - holism	fragment - whole
materialistic - intangible	progress - regression
frees - confines	extends choice - limits choice

systematic - haphazard	planning - spontaneity
replicable - unique	accountable - blameless
empirical - theoretical	reduce costs - increase costs
distant - close	removed - part of
isolated - included	quicker - slower
better - inferior	precise - vague
measurable - unaccountable	demonstrable - invisible
prescribed - emergent	other constructed - self
concrete - tacit	clarity - ambiguity
single occurrences - redundancy	authority - dialectic
singular logic - multiple logics	quantitative - qualitative
humane - inhumane	

Technology promises a great deal to education, including rationality, objectivity, order, organization, logic, expert advice, control, power, predictability, effectiveness, efficiency, orthodoxy, asexuality, solutions to problems, freedom from the constraints of nature and situation, increased choices, progress, advancement, accountability, replicability, increased quality, decreased costs and time spent on tasks, maximization of learning, precision, humaneness and justice.

Poststructural Analysis

This analysis will begin with an analysis of the binary distinctions and transcendental signifieds.

Neutral/Value-Laden

neutral/value laden	uninvolved/involved	objective/subjective
dispassionate/passionate		disinterested/interested
culturally disengaged/engaged		impersonal/personal
context free/context dependent		socially disengaged/engaged

An important rhetorical claim or transcendental signified of technology and educational technology is neutrality. The binary distinction of neutral/value-laden exposes the idea of values and assumptions that technology claims to deny. The other binary distinctions that relate to the neutrality theme (objective/subjective, context free/context dependent, and so on) are included at this point because of their conceptual similarity, but in order to eliminate redundancy, only neutral/ value-laden will be deconstructed. Because the other distinctions are so similar in concept to the neutrality distinction, the same arguments can be applied.

Webster's New Collegiate Dictionary defines neutral as 1 : not engaged on either side; not aligned with a political or ideological grouping 2 : of or relating to a neutral state or power.

In order for technology to be neutral, (or objective, impersonal, dispassionate, disinterested, etc) it must not be engaged on any side, nor aligned with a political or ideological grouping; it must be neutral in power, neither one thing or another, and indifferent. At first glance, one might be tempted to perceive technology as neutral. However, under examination, this notion breaks down.

The review of the literature in Chapters 2 and 4 suggest that technology is a product of culture, and that culture is patriarchal. Therefore, it is argued that as a cultural creation, technology carries, reflects and transmits the political, ideological and economic values and assumptions of patriarchal culture.

The use of technology may confine users within a technological mindset -- a mindset based upon patriarchal assumptions. Technological devices are the physical manifestation of a technical system that involves particular modes of organization and procedures. Technology, as it is connected to science, reflects scientific principles, functions according to those principles, and brings them into operation wherever technology is present.

Values and assumptions may be transmitted through technology at two levels: physically, through the machinery itself, and intellectually, through the content that is transmitted. The physical presence of technology in classrooms may carry with it the cultural messages of patriarchy. The information contained within software may also deliver

similar messages. Both the products and the processes of technology might be transmitting technological and cultural bias. Following are several examples of this phenomena.

A computer **physically** forces users to think and operate in linear, logical, objective, rational fashion. Information in drill and practice, tutorial and simulation programs is presented to computer users in linear and logical fashion, and must be fed back by into the computer in a similar way. "Facts" that become part of a computer program are those reducible and quantifiable bits of information that can tailored to fit the language and construction of the program. Information and answers that are returned to the computer by users must also conform to this reductionist way of thinking. All of the information that flows into and out of commercially prepared programs is limited in this way, and the vast potential scope of knowledge is reduced to a finite number of possible reactions that conform to standard operating procedures. Computer operation in any other fashion will simply not work, due to the physical limitations of the hardware. Humans are forced to work within the limited physical parameters of the computer.

According to the review of the literature, females seem more inclined to view the world holistically and not in the fragmented way that technology presents it. For girls and women to use or be exposed to technology may be forcing them into a foreign (male) way of thinking and operating. To do this might be to subordinate the female world-view and to encourage girls to reject their own world-view in favour of the male, technological-scientific world-view.

Values may be transmitted through the content of technology, as well. For instance, a filmstrip, video or software program conveys information through the script or visuals. The social and political biases of the original designer/writer/ producer underlie the messages that are transmitted. If the creator of the program operated from within a patriarchal bias, then those assumptions are likely to be a part of the final product. Females may be absent or subordinated in the examples used. The values that are valorized may be the scientific, positivist values of patriarchy. Students exposed to programs with such a built in bias may get the subtle (and sometimes not so subtle) message that the way of the program is the way of the world.

Another example of the physical transmission of values is to be found in individualized learning programs. Programs of this nature physically isolate learners from their peers, remove them from the social group and reinforce the scientific values of autonomy and individuality.

Externally produced instructional products have the effect of turning teachers into consumers and distributors of expert knowledge. The systematic approach to instruction is built into the content of programs and software. The systems approach, as indicated in Chapter 4, focuses on efficiency and effectiveness. Within this model, learning is a means-ends activity. These values and assumptions of the systems approach may be transmitted or reinforced within users.

All pedagogical materials that are produced outside of the classroom may also carry with them into the classroom the subtle message that knowledge is something that comes from outside of the school and is

external to personal experience. Knowledge can become decontextualized in this manner, and removed from the day to day lived experiences of students. The result of this may be that knowledge itself comes to be regarded as those things that are abstract, decontextualized and handed down from external experts who "know better". This decontextualization may work to subordinate females who, according to the feminist literature, relate to the world in a more global and holistic manner.

None of these effects are neutral. Internalized within the processes and products of technology are the assumptions of its creators. The unspoken agreements as to the way of the world are manifested within the technology. Carried with technology are the hegemonic constraints of culture. Those assumptions have been described previously as predominantly male, white, western, and heterosexist. The values within the hegemony focus upon empiricism, efficiency, rationality, objectivity, linearity, control, fragmentation of knowledge, narrow specialization, experimental innovation, abstract and theoretical ways of knowing, the autonomous individual, and a reductionist materialist view of reality. Those values are transmitted physically through the medium and intellectually through the content of technology. The medium cannot be separated from the message, as both the medium and the message convey values. Neither are neutral.

The technological text logically deconstructs as it rhetorically claims what it cannot deliver. The binary distinction of neutral/value-laden exposes the rhetorical claim. Neutrality is not a possible

condition within the confines of culture, and therefore, as a product of culture, technology cannot be neutral.

Effective/Weak Efficient/Unproductive

Another transcendental signified of technology is that it increases efficiency and effectiveness. The binary distinctions efficient/unproductive and effective/weak come into play.

Davies (1981) regards efficiency as doing things right, and effectiveness as doing the right thing.

Efficiency implies competency, capability, practicality, productivity and proficiency. Effectiveness implies usefulness and constructiveness. But, in the deconstructive process, one must ask: "Efficient and effective according to what or whose standards?"

The answer to that question within the technological text is straightforward: "...according to technical and patriarchal standards." In the design of educational technology and instructional programs, goals and objectives are selected that are observable, measurable, quantifiable, and demonstrable. This is necessitated by the operating principles of the systems approach. The efficiency of achieving goals and objectives are determined by how quickly and easily they are met. Effectiveness is evaluated according to the original goals and objectives.

These transcendental signifieds are two other rhetorical claims that logically self-deconstruct. The meaning of both efficient and

effective are dispersed and deferred within the technical text. Efficiency and effectiveness are defined at the outset in technical terms and, they are observed and evaluated in technical terms and standards. Anything that falls outside of the rules and practices of technology are considered inefficient or unproductive, and ineffective or weak. The binary distinctions favour efficient and effective and reject unproductive and weak. That which does not fall under the definition of the technical system is regarded as unproductive and weak. The standards of efficiency and effectiveness are determined according to technical definitions, within the technical model, and those things that meet the standards "fit" the model. And, if they fit, they are considered to be efficient or effective. The definition and evaluation of both efficient and effective in technical terms becomes a self-fulfilling prophecy. Both terms logically deconstruct as the meanings of each are dispersed and deferred within the text.

The feminist significance of this binary distinction relates to the female world-view. If, as the feminist literature would indicate, there is a unique female way of thinking, operating, and viewing the world, a way which falls outside of the scientific, positivistic way of the world, then that way may be regarded as technically inefficient and ineffective, weak and unproductive.

Asexual/Erotic

A third rhetorical claim of technology is that it is asexual. The binary distinction is asexual/erotic. Asexual implies lacking sexual orientation. This claim also deconstructs. It has been argued that

since science and technology are cultural productions, and culture is patriarchal, science and technology reflect patriarchy. The masculine, scientific-technological paradigm has been described as linear-thinking, analytical, rational, impersonal, unemotional, dispassionate, and scientific. Technology, as an extension of science and an extension of "man", is therefore linear, analytical, rational, unemotional, dispassionate, scientific and masculine. Technology, through deconstruction, becomes apparently masculine eroticism. The claim of asexuality deconstructs.

Expert/Amateur

Technological information is regarded as expert. Knowledge is that which can be scientifically or technically discovered, verified and defined. That sort of knowledge which subordinates personal experience is regarded to be expert. This claim deconstructs in the same way that the binary distinction of efficient/unproductive deconstructed. One must ask the question: "Expert according to whose standards?" The answer, similarly to the effective/ efficient question, is dispersed and deferred within the technical text. The answer is: "...according to technical, scientific and patriarchal standards.

Knowledge that is not quantifiable, measurable, observable, replicable, or empirical is not considered expert. Expert is defined in technological terms, and its meaning relies upon technological definition. In the binary distinction, technical knowledge is expert, and anything else is amateur and unimportant. Females and female knowledge,

then, would fall outside of the male and patriarchal definition of expert by this definition.

Increased Choices/Decreased Choices

Technology promises choice. This claim deconstructs, as choice within the technical realm is an illusion. Choice implies freedom in all realms, but technology limits alternatives to technical possibilities, and therefore negates freedom of choice. Technology offers finite and restricted possibilities, and limits options to just those things available within the technical realm.

When a teacher decides to use technology as part of instruction, her or his choices are immediately limited to those things available within the possibilities of technology. The teacher is restricted to the finite number of options that are available. The alternatives are actually decreased, as other non-technical possibilities have been eliminated from the equation. The rhetorical claim of increased choice deconstructs as the binary distinction increased/decreased is made obvious.

For females, the choices may be narrowed, decreased and limited to a male world-view that is potentially perpetuated by technology.

Frees/Confines

The transcendental signified of technological freedom deconstructs in the same way that the idea of increased choice deconstructed. The binary distinction frees/confines aids this deconstruction. Technology claims to free humans from the constraints and confines of nature.

Technology frees humans in one sense, but may actually be confining humans in another sense. Technology may be trapping or imprisoning its users within the technological realm. Teachers may feel "free" to choose from a number of films, videos, filmstrips, or slide-tape programs, but their choices are narrowly confined within technical limits. Living and working within a technical hegemony becomes the way of the world. A technological milieu exists inside which humans are confined to a technological existence. Infrastructures have built up to support the continued existence and development of technology. Problems in our world are solved with technical solutions, and technological gadgetry mediates day to day experience. Technology has freed humans from the constraints of nature -- has allowed humans to fly like the birds and swim like the fishes; to extract resources from the earth, ocean and air; and to conquer space and distance -- but technology has confined humans to living and teaching in a technical world.

Technology may also be trapping females within the male, technical view of the world. Females may be forced to think and function within the patriarchal parameters of technology.

Control/Chaos Systematic/Haphazard

Technology promises control and systematicity. Using the binary distinctions control/chaos, and systematic/haphazard, all that which falls outside of the technological definition of control and system is considered to be chaotic and haphazard. In the same way that freedom, effectiveness and efficiency are defined in technological terms, so are control and systematicity .

Technology promises control. The binary distinction reminds us that everything that falls outside of the technical definition of control is chaos. On the surface, control might be interpreted as a positive feature. Control of students. Control of the learning process. Control of information.

But the control that technology exerts is over personal experience. Technology changes the pace of the classroom. It controls by amplifying or reducing student experiences, and, it controls what information is transmitted.

In terms of a feminist approach, the assumptions that are amplified may be masculine, technological and scientific, while female qualities may be reduced, subordinated or marginalized. The controlled information may result in a controlling and diminishing of the female world-view.

In terms of pedagogy, educational lesson plans that do not reflect the control of the systems approach would be considered to be chaotic. That which falls outside of the technical definition is regarded as haphazard and therefore inferior.

As a binary distinction, the concept of control deconstructs, as its meaning is dispersed within the text of technology.

Increased Quality of Learning/Decreased Quality of Learning

Technology promises to improve the quality of learning. Again, this is defined by technical and patriarchal standards. The meaning of quality learning is deferred and dispersed within the text. It may be

defined in terms of efficiency or effectiveness, or expert and external knowledge, all of which might be working against females.

The claim of increased quality is dispersed and therefore, deconstructs. The meaning of quality depends on the meaning of other words within the technical definition. Quality learning is not a definable term. The binary distinction implies that there is a decrease in the quality of learning. Learning that does not fit the technical standard is not encouraged, reinforced or pursued and is therefore decreased.

From a feminist point of view, that learning which contributes to the reinforcement of patriarchal assumptions would be regarded as quality learning...efficient, effective, rational, empirical, quantifiable, demonstrable, and so on. All other forms of learning would fall outside of the technical definition of quality.

Reduce Costs/Increase Costs

Technology claims to reduce the costs of instruction as it increases efficiency and effectiveness. Materials, processes and products are replicable and reusable and therefore cost efficient. This claim of reducing costs deconstructs because its meaning is dispersed in the text. Efficiency and effectiveness are defined according to technical standards, and the concept of reduced costs relies upon that interpretation. In a sort of self-fulfilling prophecy, costs are perceived to be reduced as technologies are interpreted as more effi-

cient and effective means of presenting instruction. Costs are measured against technical standards.

The binary distinction reduce costs/increase costs asserts that technology increases costs. Hardware and software are financially expensive to purchase, maintain, operate, repair and replace. The costs in terms of feminism, as well as the other political and social costs of utilizing technology, are not quantifiable in monetary terms, but may be assumed to be incremental as well.

Other terms that can be similarly deconstructed include humane/inhumane, maximization/minimization, logical/questioning, orthodox/nonconforming, better/inferior, quicker/slower, demonstrable/invisible quantitative/qualitative, precise/vague, concrete/tacit, measurable/unaccountable, replicable/unique, and, clarity/ambiguity.

Technology and Power

Technology's claim of neutrality logically deconstructs because of the social and cultural context within which it is developed. Technology cannot be neutral, having been developed by and for humans. Therefore it is value-laden.

Because technology does not achieve the neutrality it claims to achieve, technical products and processes manifest dominant ideology and power arrangements. Cultural conditions determine the nature of the technological product. The technical product may reflect patriarchal, political, historical, cultural and economic conditions.

These biases are potentially reflected and reinforced through both hardware and software. Technological devices physically manifest dominant ideology. Values are built into technology's form.

For instance, technology operates in linear fashion -- on/off, inputs/outputs, feedback, gradations of loudness, brightness, and colour, levels of difficulty, and so on. People using machinery must function within the linear processes of the equipment.

This involves following explicit operating directions and using the equipment according to the expert, and external-to-the-classroom instructions. If directions are not followed, machinery may not work. If 16 mm film is not looped properly, the projector will not function. If information is not entered properly and according to the parameters laid down by the designer, a computer program will not function.

For females working within a holistic world-view, step by step directions and explicit operating procedures may be contrary and

foreign. Girls (or boys) who may function in a more random, creative fashion, might be forced through the use of technology to relate to the world in linear and lock-step fashion.

Technology may be reflecting the biases of science and patriarchy. Technical tasks are fragmented, narrowly specialized and focused on efficiency. Male tasks and male ways of knowing have been described as reflecting similar qualities. If this is the case, it can be argued that technology has a relatedness to maleness. The operation of technical devices may also be associated with maleness. Women's tasks, if they are perceived as unpredictable, flexible, unplanned and spontaneous, would fall outside of the technical framework. The use of technology, therefore, would be fundamentally contradictory to women's way of knowing.

The information and content of the software (films, videos, computer programs, textbooks, and so on) also manifest dominant ideology. Values and assumptions are transmitted through the written and visual texts, as well as through the audio and video channels of technology. The information that is channelled to students via textbooks, filmstrips, computer programs, posters, and individualized learning programs may contain patriarchal, political, historical and cultural and economic biases. The stereotype of young, white, heterosexual, Christian, able-bodied, thin, middle-class, English speaking and male is the image that is revered by society (Ellsworth, 1990) and may be reinforced within the content of the information technologies.

Also important in this potential channelling of patriarchal, political information is the notion of external, expert, hierarchical,

authoritative knowledge. Technology may be reinforcing external expert authority. Knowledge, within the systems approach, is that which is handed down from above or imported from outside. Personal experiences are devalued over authoritative wisdom. Female and male students are continually subjected to technical values and assumptions. The message is repeated in books, films, and a multitude of other products. Students may get the message that the information transmitted via technology is authoritative and representative of culture. If the messages reflect patriarchal assumptions, girls might be getting the idea that they are inferior and subordinate.

This transmission of cultural information is reinforced on two levels. The messages may be clear within the content of the software itself, which is reinforcing on that level. Secondly, the information is presented via technology, which in itself may be perceived as a source of unquestioned, expert and authoritative knowledge. Information transmitted from books, films and computer programs may be regarded as factual or correct **because** it comes out of books, films and computer programs. The technical message of "reality" doubly reinforces the spoken, visual or written message of cultural reality.

Economic ideology may also be transmitted through technology. This can occur at the level of content, and at the level of machine. Software that is produced within our culture contains messages pertinent to capitalist ideology. These messages permeate technological products. Every film, video, slide-tape program and computer simulation that captures and transmits any aspect of our capitalist culture is sending a

message that reinforces that capitalist culture, as capitalism is the way of our culture and the way that is communicated.

As teachers import technological products into classrooms, as they purchase and consume and distribute technology, they reinforce economic and patriarchal standards. Teachers purchase technical goods, and in using them, further promote consumerism and materialism among students. As teachers use technology they thereby promote a variety of capitalistic assumptions, including: efficiency; rationality; orthodoxy; competition and justice over cooperation and caring; fragmentation of knowledge and an assembly line mentality; external control and internal compliance; and, proletarianization and the deskilling of workers.

Technology may be aiding the capitalist-patriarchal political order, as the two concepts are mutually reinforcing. Technology might be transmitting the hegemonic values and assumptions of the dominant ideology and subordinating and locking females firmly into a particular place within the political order.

Power Asymmetries

The following questions from Cherryholmes (1988) illustrate the power asymmetries of technology:

1. Who is authorized to speak?
2. Who listens?
3. What can be said?
4. What remains unspoken?
5. How does one become authorized to speak?
6. What utterances are rewarded?
7. What utterances are penalized?

1. Who is authorized to speak?

Males are authorized to speak.

Technology, as a physical product of a patriarchal culture, has been shown to reflect a male world-view. According to the technological text described earlier, the processes of technology reflect science and are neutral, objective, impersonal, dispassionate, rational, logical, analytical, empirical, culturally and socially disengaged, expert, abstract, mechanistic, concerned with control and predictability, efficient, linear, orthodox, reductionist, materialistic, and progressive. These characteristics have been shown to be associated with maleness. The content of technological products may also reflect a male world-view and subordinate the female world view.

As technology is used, the male world-view may be reinforced through the physical presence and processes of the machinery. The messages within the content presented through technology may further reinforce and authorize the male voice or point of view. Technology may be very well be legitimating patriarchy through both its physical processes and the content of its software. It may also be extending and reinforcing male power, manifesting an asymmetrical power imbalance.

2. Who listens?

Females listen.

If technology embodies and reflects the male view of the world, then it also authorizes and legitimates the male view. If this is indeed the case, the female world view would be made invisible and subordinate. Females would not be heard, but would have to listen to and accept the orthodox male view as authority. Their differing world-view would be outside of the dominant ideology. If the male voice is the one to be authorized and legitimated, then the female voice, in order to be heard, recognized and valued, would have to conform to the accepted patterns of maleness. In order to be heard, females would have to speak according to the parameters of the male world-view. Otherwise, they would have to listen.

3. What can be said?

Male messages can be said.

If the male voice is authorized and legitimated, male messages can be said. It has been argued that technology is a product of a patri-

archal society, reflecting a male world-view and subordinating the female world-view. If the products and processes of technology are a product of a male world-view, then meaning and knowledge, as they are presented by and through technology, also reflect the male voice.

Knowledge within the technical realm, as discussed earlier, is defined within the parameters of that realm, and meanings are dispersed and deferred within the technical realm. If technical products are developed within the confines of a male world-view, then those products are likely to reflect and reinforce that view, and legitimize what is acceptable, or what can be said.

4. What remains unspoken?

Everything that falls outside of the male world-view potentially remains unspoken.

If the male voice is authorized and legitimated, all that which falls outside of the male world-view potentially remains unspoken, unaddressed and unattended. This includes the female world view as well as other minority discourses that do not fit the white, heterosexual, Christian, middle class, male pattern.

5. How does one become authorized to speak?

One becomes authorized or legitimated by speaking messages that conform to the dominant view.

In order to be heard within the technical realm, one must speak in meanings and convey information that conforms to the technical definition of knowledge. One becomes authorized to speak by reflecting

those behaviours, actions, values, assumptions, attitudes and opinions that fit the definition of what is acceptable and listened to. If the technological text defines knowledge according to the male world-view, then those speakers (female or male) who conform to those parameters are authorized to speak and are heard. The messages that are legitimated are those that fit the pattern defined within the parameters of technology.

6. What utterances are rewarded?

Those that conform to the definitions of meaning and knowledge.

If meaning and knowledge are defined within the male world-view, then utterances which fit that view will be rewarded. The definition of meaning and knowledge is deferred and dispersed within the technological text. If the text is a product of the male world-view and reflects that view, it will define legitimate and authoritative utterances as male and reward those that conform to the definition, whether spoken by females or males.

7. What utterances are penalized?

Those that do not fit the definition of authorized knowledge.

Like those utterances that remain unspoken, those that fall outside of authorized and legitimated knowledge are penalized. Because they do not conform to the established standards as defined by the technological text, they will be ignored or penalized. If the female world-view is absent within the technical realm, then female utterances will be penalized.

These answers to Cherryholmes' questions reflect a feminist reading and interpretation of the technological text. Other readings would result in different answers and might reflect an ethnic interpretation, a political interpretation, an economic interpretation and so on. But for purposes of this thesis, the discussion of the power asymmetries of technology will focus on feminist concerns.

To reiterate, technology promises a great deal to education, including rationality, objectivity, order, organization, logic, expert advice, control, power, predictability, effectiveness, efficiency, orthodoxy, asexuality, solutions to problems, freedom from the constraints of nature and situation, increased choices, progress, advancement, accountability, replicability, increased quality, decreased costs and time spent on tasks, maximization of learning, precision, humaneness and justice.

Technology does not deliver what it rhetorically claims to deliver. The transcendental signifieds deconstruct and the binary distinctions illustrate the biases of technology. Technology manifests the very characteristics it attempts to negate with its rhetorical claims. Technology at once denies and displays non-neutrality, intuition, subjectivity, chaos, disorganization, impotence, weakness, nonconformity, eroticism, unanticipated additional problems, constraints, reduced choices, regression, decreased quality, increased time and costs, minimized learning, and inhumanity.

Technology may be reflecting the power asymmetries of patriarchy. It has been argued that technology is a male-created and male-dominated

entity, and that it plays a political role in society. Technology may be an instrument of control that manifests the dominant interests of gender, class and racial hegemony. It potentially reflects the interests of patriarchy and works against a feminist world-view.

The dominant ideology that is internalized within technological processes and products exists as an invisible paradigm, an unwritten text, which may be transmitted to society. The text governs what is and is not possible within the technical milieu. It determines meaning and authority, and that which is constituted as knowledge. Anything that falls outside of the text may be repressed or subordinated. The technological text does not allow for the sharing of privilege, power, property or opportunity. It authorizes, reinforces, and restricts power and control.

Within the hegemonic constraints of patriarchy, males are privileged while females are subordinated. As a patriarchal production, technology becomes an aspect, instrument and avenue of male power, projecting its own particular brand of social reality. At the same time it reflects and reinforces the patriarchal asymmetrical power imbalance. Technology keeps women outside and invisible.

As technological processes and products are incorporated into school programs, the patriarchal power imbalances may be carried into the classrooms. Female and male students may be presented with a technological and patriarchal reality. Within this particular reality the standards of humanness are set against which all others are judged and assigned status and power. Within the patriarchal, technical world-

view, male messages can be said while female messages remain unspoken. In the patriarchal technical classroom, the male voice is authorized to speak.

A STRATEGY TO COUNTERACT THE PATRIARCHAL IMBALANCE OF TECHNOLOGY

This section will present the direction necessary for teachers to conduct their own analyses of technology. This strategy should be useful in analyzing technological products and processes within individual classrooms. In order to have a classroom that is inclusive of the female world-view, and in order to facilitate feminist praxis, technology must be used in such a way that patriarchal characteristics are minimized or eliminated.

The essence of the strategy is that all aspects of technology -- processes and products -- are to be questioned. If one is concerned with the potential impact of technology in terms of feminist issues, technology should not be used in a classroom without first assessing them for the cultural and social messages they communicate.

The strategy consists of three sets of questions to be applied to technology in order to determine its impact. The questions address issues of power, gender and integration.

Questions of Power

The first set of questions is adapted from Cherryholmes (1988). The questions examine the power asymmetries of technology and may be applied to the content of films, videos, filmstrips, slides, audiotapes, software, textbooks, posters and other products. Where appropriate they can also be applied to the very presence and processes of technology.

1. Who is authorized to speak. What viewpoint is legitimated?
2. Who must listen, or is subjugated?
3. What is said?
4. What remains unspoken?
5. Which metaphors, descriptors, explanations and arguments are valued; which are excluded?
6. What social and political ideologies are rewarded?

As an example, during the viewing of a video, educators must do more than turn on the tape player and, following uninterrupted viewing, simply review content with students. The six questions should be asked of the video and its producers, before, during or after the viewing as appropriate. By doing so, both the process and product can be controlled and manipulated to meet the needs of the students and teacher, instead of their being manipulated by the technology.

To take control of process, the video can be stopped, replayed, or fast-forwarded. It can be viewed without the soundtrack to examine how the producer has used visual imagery to convey messages. Conversely, the visual image may be darkened in order to focus on the audio track alone. Important also (if available) is demographic data about the video itself: Who produced the video? When was it made? Where did it come from? Why was it made?

To take control of the content of the product, apply the six questions. Who's knowledge is it? What viewpoint is legitimated? Who is

authorized to speak? What metaphor is functioning? And so on. Asking these questions of technology should reveal the power asymmetries which are being communicated to students.

This active manipulation of product and process will counteract patriarchal bias. Reducing or eliminating the hierarchical-authoritative characteristic of technology will result in knowledge and personal experiences being contextualized instead of being decontextualized. Information will be dealt with in relation to existing knowledge and made relative and subjective. In other words, there will be teacher and student reflection about the information and what it means to them in terms of their lives and their personal experiences.

Questions of Gender

The second set of questions are adapted from Rothschild (1988). They focus on issues of gender.

1. Is the language that is used gender-neutral?
2. If the language is neutral, does it reflect gender awareness, or is it superficial and fundamentally patriarchal in nature?
3. Are women included in the subject matter if it is appropriate for them to be there?
4. If women are included, how are they presented? Are they shown to be a strong, integral part of the content, or are they appendages to dominant male characters? Do they appear in stereotypes? If they are presented as traditional, is it done so uncritically?
5. If women are the main focus of the content, how are they treated? Are they symbolic or real, believable and diverse human beings?

6. Is the content presented in a critical manner? Does it build gender awareness and reinforce a diversified approach? Does it lead to a questioning of traditional patriarchal values?

These questions are straightforward. For instance, when using computer software, examine the language of the program to see if it is gender-neutral. Look at the human situations that are presented and determine if females are included in an appropriate fashion. If they are included, decide if girls or women are present as real and believable characters, and not as appendages to the male characters. Examine the content and structure of the program for similar features.

Films, videos, textbooks, and other resources can be similarly questioned. When the six questions are applied to a particular medium, gender issues will be raised to the forefront instead of being buried within the product.

If, however, the questions are applied to a particular product, and it fails to pass what Rothschild calls the "feminist litmus test", it is important for educators not to completely dismiss all resources that do not meet feminist standards. Feminism is a relatively recent force on the educational technology scene, and it is unlikely that very many products are going to satisfy all six of the gender criteria. To dismiss everything on the basis of patriarchal bias would be, as Rothschild notes, to "dismiss summarily over 2000 years of recorded thought and scholarship" (p. 71).

Where products are assessed and found to be lacking a female-friendly character, yet appear to still have redeeming qualities, educators may be able to adapt the materials.

For instance, if a film does not portray females in an equitable manner, yet does a good job of presenting a particular academic concept, a teacher can discuss the weaknesses of the film with the class beforehand. It is important that this discussion take place before the viewing, so as to compensate for the shortcomings. The film can also be stopped and situations be discussed during or after the presentation, as appropriate.

The same approach (discussion with students) could be used to counter-balance patriarchal bias within textbooks, computer programs, filmstrips, and virtually any technological product that subordinates women or presents them stereotypically.

Where certain sections of programs or materials are particularly objectionable, they can be skipped over, fast-forwarded or avoided in some other manner.

Questions of Integration

The final set of questions relate to the way in which technology may be used within the classroom to integrate the female world-view. They are adapted from Kerr (1990).

Is technology used to:

1. facilitate learning?
2. encourage interpersonal connections?
3. support caring?
4. express concerns for social problems?

These questions are to be asked of the processes of technology. They should be applied to the way that technology is used within the classroom, and how it encourages or discourages human interaction.

When technology is used as a facilitator and not a replacement for the teacher in a classroom, the teacher retains the central pedagogical position and is more able to deal with intellectual and moral growth. Controlling technology and the way that information is presented from a feminist point of view sees the teacher manipulating the technology according to her or his needs and the needs of the students.

Technology can be used to bring students together in a cooperative learning situation or it can isolate individuals from their peers. To encourage togetherness and a female-friendly environment, technology can be used in small or large groups with frequent opportunity for discussion and interaction. This contrasts with the use of technology where individual students work alone on a computer simulation, or singly with a programmed instruction module.

The use of technology can be more humane. Technology can be used in ways that communicate teachers' caring qualities. For instance, computer programs that favour cooperation could be selected over those that favour competition. Learning modules that fragment learning and employ summative evaluation can be rejected over those that approach learning holistically and use formative evaluation.

Technology can be used to express human concerns, for each other and for the environment. Software can be selected that reflects social problems and concerns. Computer networks can be established with distant groups in order to share similar ideas. Photography, video-

taping and film-making that focuses on human issues can be undertaken, and projects can be shared between classes, schools and school divisions.

The Challenge of A Feminist Strategy for the Use of Technology

The challenge of a feminist approach is to find ways to reduce and eliminate the patriarchal bias of technology, and, to find ways to make the female world-view speakable and legitimate.

The goal of using a strategy such as the one described above, is to eliminate issues of gender that arise because of the presence and use of technology. Part of this is to develop a cultural reality that creates a hegemony that is inclusive of discourses that fall outside of the white, male, Christian, thin, able-bodied, heterosexual boundaries.

The essence of the goal is to facilitate feminist praxis, where teachers and students are able to develop a critical awareness of the impact of technology and are also aware of alternatives that may counteract the patriarchal influence of technology.

A feminist approach to technology brings the invisible paradigms, the invisible text into the open, and recognizes that knowledge must be redefined in terms of female perception. It recognizes that technology is a potential citadel of patriarchal power.

Teachers working from within a feminist frame of reference extend power to their students in a self-conscious and critical manner in order to increase students sense of self-worth, authority and power. Students

are allowed to validate each other's ideas and share in the production of their own learning and knowledge.

In short, feminist technological praxis means that an equitable and inclusive environment is encouraged within the classroom. That is the challenge of a feminist approach.

CHAPTER 6

CONCLUSION

It is difficult to invent a better mousetrap if you're taught to be afraid of mice; it is impossible to dream of becoming an engineer if you're never allowed to get dirty.

C. Bush, 1985, p. 158

Summary

The goal of this thesis has been to facilitate feminist praxis within the technological classroom. The analysis explored the way technology acts as an agent of patriarchy within the classroom, and contributes to the subordination of females in school and society.

The attempt of this work has been to demonstrate that, as a gendered cultural production, educational technology reproduces and reinforces the patriarchal hegemony within the classroom through both the overt and covert curricula. The study integrated feminist discourse and educational technology, and developed a philosophical framework from within which educators might be able to deal critically with technology in the classroom.

This thesis has endeavoured to examine educational technology from a feminist viewpoint, illustrating the patriarchal nature of technology and the impact it has on our lives. The point has been to aid in the conversion of the technological classroom to a more female-inclusive environment.

Within a technological environment that is female-friendly, there should exist an awareness of the patriarchal influence of the products and processes of technology. This awareness is one step toward a more conscious and critical use of technology, and an important condition for feminist praxis. As educators undergo the process of learning about, reflecting upon, and understanding the impact of technology, it is hoped that they will develop a technologically critical consciousness. It is also hoped that they will adapt their teaching styles accordingly. Knowing the potential of technology to subordinate females, and taking action to reduce or eliminate the effects, are important steps toward feminist praxis.

This thesis has attempted to develop a feminist approach to the use of educational technology that contributes to the empowerment of females within the school system. The nature of the suggested transformation is a reproposing of the structure of human interaction within the classroom, to an environment that is inclusive rather than exclusive and patriarchal.

The methodology of this thesis has combined the methodologies of two researchers, Cherryholmes (1988), and Weiler (1988).

Cherryholmes applies the poststructural techniques of deconstruction to the field of education. Deconstruction is a strategy he uses to examine the seemingly nonproblematic assumptions that underlie educational discourses and practices and to question their coherence and plausibility. Within the context of this thesis, deconstruction as a form of poststructural criticism was used to problematize the myths and

assumptions of educational technology. Cherryholmes also focuses on the issue of power and the way power is manifested within educational discourses and practices.

Weiler blends feminist theory and critical education theory in order to address gender issues in the classroom and raise the issue of the connectedness of schooling with class interests, patriarchy, and race.

The methodology of this thesis, then, was to integrate Weiler's blend of critical educational theory and feminist theory, with Cherryholmes' approach to deconstruction and power issues.

In order to determine the impact of technology, several methodological steps were taken in this thesis. They are described below.

1. Challenging Assumptions

This thesis began by the challenging of two assumptions. As was discussed in Chapter 4, it is commonly accepted within the field of education that technology is a relatively neutral force. The challenging of this assumption was the first actual step of this thesis. Educational technology was perceived to be a force that was not neutral and had the potential to transmit patriarchal values.

The other assumption to be challenged was the notion that technology is just a collection of various products and processes that, although similar to each other in certain ways, have their own set of characteristics. This thesis started with the premise that all of the

products and processes of technology reflect a technological world-view, and there exists an unwritten "text" of technology that needed to be examined.

2. Review of the Literature

The actual work of this thesis began in Chapter 2 with an examination of feminist literature related to pedagogy and technology.

First, a brief description of a female world-view was included in order to establish the concept of difference between females and males.

Next, the literature of feminism and pedagogy was explored. This section was included in order to give some flavour of the feminist approach to education and to highlight the importance of teaching within a female-friendly environment.

Last, the review of the literature addressed feminism and technology. The point of this was to explore the relationship between women and technology, and the importance of viewing technology as a patriarchal product.

3. Poststructuralism and A Feminist Technology

The next step of this thesis was to describe the work of Cleo Cherryholmes. As his methodology was the foundation for the analysis and deconstruction of technology, it was important to present Cherryholmes' work in order to clarify his poststructural strategies of deconstruction and power analysis in education. The first part of Chapter 3 consisted of a description of Cherryholmes' writings.

The second part of Chapter 3 was an explanation of the way his methodology would be applied to the feminist analysis of educational technology.

4. Description of Technology

A description of technology and educational technology was undertaken in Chapter 4. This was based on the literature and presented under five main topics.

The first topic was an exploration of the various definitions of the term technology.

The next topic focused on the issue of non-neutrality. The ideas, practices, myths and assumptions of technology, and the way technology affects and changes our social and individual relationships were investigated.

The connectedness between technology, science and patriarchy comprised the third topic. This discussion looked at the connection between science and technology, as well as the relationship between science, technology and patriarchy.

The next aspect of technology to be surveyed was the notion of technological bondage and the myth of technological liberation. Technology was examined for the way it impacts on human existence and whether or not it extends human freedom.

The fifth and final topic explored the idea of the technological classroom. This discussion dealt with technology in schools, and looked at the notion of educational paradigms.

5. Technology as Text

The next stage of this thesis was to examine the broader concept of the educational technology text as a metanarrative. This occurred in Chapter 5. This involved the development of a list of the transcendental signifieds found in the products and processes of technology. The bibliographic material of Chapter 4 was used as a source of this information.

The text was first described in annotated detail. It was then presented as a two page-summary, broken down into the common themes of technology and the common themes of educational technology.

6. Analysis and Deconstruction of Technology

The analysis and deconstruction of technology based upon the methodology of Cherryholmes also occurred in Chapter 5. Technology was first given a structuralist reading, and then a poststructural analysis.

Within the poststructural analysis, the binary distinctions and transcendental signifieds of technology and educational technology were examined. The rhetorical claims of technology were deconstructed as they proved to be logically contradictory. The patriarchal implications of technology were revealed in the discussion of the binary distinctions and transcendental signifieds.

7. Technology and Power

The final step of the analysis in Chapter 5 was to investigate the issue of technology and power. This touched upon the patriarchal, political, historical, cultural and economic biases of technology.

The investigation of power also involved the application of Cherryholmes' analytical questions to illustrate the patriarchal power asymmetries of technology.

8. Strategy for Educators

The development of a strategy for educators to conduct their own feminist critique of technology was the final step of this work. The strategy appears as the final section in Chapter 5, and was included in order to facilitate feminist praxis in the technological classroom. Three sets of questions which addressed issues of power, gender and integration were given. Also incorporated in this section was an explanation of the way in which the questions could be applied to technical products and processes.

Conclusions

This thesis supports the notion that technology is a gendered cultural production. As a gendered product of culture, technology appears to reproduce and reinforce patriarchal assumptions within society and within the school system. It also appears to contribute to the subordination of females and the female world-view.

The description of technology as a metanarrative and as a cultural text resulted in a number of observations, summarized below.

From the point of view of a structuralist reading, within the processes of educational technology:

1. The transfer of knowledge and information to students is a one-way process.
2. Knowledge is abstract, removed from context and experience, scientifically based, hierarchical and authoritative. It originates outside of the students' experience and outside of the classroom.
3. Knowledge and information presented through educational technology is ahistorical. Objectives and goals are scientifically determined outside of the school. Individual classroom and personal situations are regarded as extra-contextual.
4. Knowledge is that which is explicit, observable, factual, quantifiable, calculable or measurable.
5. Teachers and students are decentred. Meaning and value are controlled and determined by external experts.
6. Technical processes and interactions are linear and non-reciprocal.
7. The design process and products are ideologically neutral.
8. Reality becomes a technologically constituted and mediated reality, as technology controls and influences what information is presented and what is left out.
9. Technological processes infiltrate classroom practices and interactions. Linear, objective, and analytical thinking is the technical norm, and comes to be regarded as an efficient and effective way to function and operate.

10. A technical production metaphor permeates the classroom. Within this metaphor, everything is predictable and controllable. Externalities such as context are considered irrelevant.
11. Experiences are controlled externally through amplification or reduction.
12. Power and control reside outside of the classroom.
13. The values of the external designers of educational products are those that are transmitted to the classroom.
14. Learning becomes fragmented as tasks are broken into manageable units. Mastery of facts is emphasized.
15. Technical expertise is valued over personal experience.
16. Pseudo or artificial realities are presented as true reality.
17. Communications reciprocity is reduced or eliminated.
18. Competition is favoured.
19. Science-centred, prescriptive traditions are favoured over craft-centred, holistic traditions.
20. Justice and fairness are promoted over caring and compassion.
21. Economic-political values of production and consumerism are reinforced.
22. Teachers and students become consumers of information.
23. Planned obsolescence is built into the system.
24. All problems are perceived to be solvable through technical solutions.

25. The very presence of technology is regarded as positive, progressive and evolutionary.
26. The autonomous individual is favoured over the collective group.
27. A reductionist, materialistic approach is the norm.
28. Human interactions are technologically mediated.

From a feminist viewpoint, it would appear that technology:

1. reflects the values, assumptions and myths of science.
2. is perceived to be rational, objective, disinterested, dispassionate, impersonal, culturally disengaged, and neutral, but is not.
3. is a social activity and a cultural product.
4. is an invisible force.
5. is all-pervasive.
6. is a cultural text with values built into its framework.
7. is a political issue.
8. is a dominating force, concerned with controlling nature.
9. reflects patriarchal assumptions.
10. reinforces patriarchal privilege.
11. reinforces patriarchal power asymmetries.

12. reflects the quality of maleness as both tools and processes manifest the patriarchal and scientific world-view.
13. fragments tasks, decontextualizes knowledge, is narrowly specialized, and focused on efficiency, while women's tasks are perceived to be unpredictable, flexible, unplanned, and spontaneous and arising out of contextual need.
14. does not liberate, but enslaves its users, making them dependent on technology.
15. considers the female world-view to be weak, unproductive, ambiguous, questionable, illogical, amateur, soft, vague, redundant, impotent, random, deviant, non-conforming, haphazard, chaotic, slower and inferior.
16. leaves females outside and invisible.
17. subordinates a female world-view.

If the assumption that technology is a value-laden force within society is accurate, then the use of educational technology may contribute to the subordination of females. The very presence of machines and devices within a classroom could be transmitting cultural messages to girls and boys about the way the world should be, and reinforcing the patriarchal hegemony. Technology may be communicating patriarchal messages.

Implications for Educators

Awareness of the non-neutrality of technology and its impact on the female world-view would appear to be a critical first step in reduction or elimination of the potential patriarchal impact of educational technology. For those educators interested in feminist praxis within their classrooms, consciousness of technology's influence is a prerequisite for modification of the way in which technology is used.

The uncritical use of technology within the classroom is, in essence, tacit approval of technology and the messages communicated by technology. The very presence of technology may be an implicit sanctioning of the myths, assumptions and values associated with it. Tools, machines and devices are products of patriarchy -- products that have been created in and of a world-view which seems to be exclusive of women.

At worst, teachers may be unaware of technology's patriarchal influence and, as a consequence, reinforce the techno-mindset through indiscriminate use of software and hardware.

At best, educators use software appropriately, and talk with students about the conduit nature of technological information, as well as the cultural messages that are implicit and explicit within the content that is transmitted. Teachers make students aware that the information presented in books, films, computer software and so on, is not the final authority. They focus on the importance of personal experience, and allow students to explore ideas in non-linear, creative ways.

Feminist praxis in the classroom is not a simple recipe. Heightened awareness and enlightened attitudes are long-term goals. Certain conditions would facilitate the development of awareness among educators. These conditions would encourage the development of an educational environment that was inclusive of the female world-view:

1. Teachers would take courses in pre-service training that deal with gender issues, and would be aware of these issues within their own classrooms. (A course of this nature would include among other things, an examination of patriarchy, the historical subordination of women, and classroom practices that reinforce stereotypes.)
2. Teachers would be aware of their power to influence children, and would adjust their teaching styles to reflect equitable treatment, and expectations of both sexes.
3. Teachers would be aware of their personal power within the school and the educational system. They would insist on having their share of that power when it came to administrative decisions. They would not leave all decision making to the external "experts".
4. Teachers would be aware of stereotypes presented in text-books, computer software, and other materials and adjust or discard those materials.
5. Teachers would be aware of the way technology reinforces linear thinking and compliance. They would balance that influence with other activities that provide opportunity for creative thinking and personal decision-making.

The injection of feminism into technology could provide a balance within a patriarchal-technological society. The injection of feminism into education might also provide balance.

There are many factors in the classroom that influence what students are, and what they become as individuals. Technology is just

one of those factors. However, it is one that may be having a profound effect upon the lives of students. There appear to be a multitude of assumptions and myths tied to technology, and the presence and use of it may be altering the very way students perceive the world.

This thesis has attempted to provide feminist insight on the issues surrounding the use of technology in our schools. The machines and devices we use are the products of civilization. We engage the tools of technology to train and shape children in order that they might take their places as citizens within civilization.

In order for feminist praxis to occur, for teachers to be able to transform the technological classroom to make it a more equitable place, critical consciousness must be developed. This thesis has aimed to provide impetus as well as a strategy for the critically conscious use of technology in schools.

Directions for Future Research

Future studies should concentrate on the following issues:

1. The intervention strategy proposed within this thesis requires expansion. The strategy could be used by educators to evaluate technology, and in doing so, could be evaluated in terms of its usefulness and appropriateness.
2. More feminist research with respect to educational technology is required.
3. Further poststructural analyses could also be conducted within educational technology. The field currently reflects a

positivist approach and the poststructuralist paradigm is just beginning to make inroads.

4. Another direction for future study is more minority discourse research. Studies similar to this one, but focused on ethnic, racial, economic, historical, political or other discourses instead of feminist discourse could be undertaken. An exploration of multiple discourses within educational technology seems to be indicated.

BIBLIOGRAPHY

- Apple, M. (1986). Teachers and texts: A political economy of class and gender relations in education. New York: Kegan Paul.
- Atkins, E. (1990). Power and criticism: Poststructural investigations in education. [Review of Power and criticism: Poststructural investigations in education]. Journal of Curriculum Studies, 22,(1), 77-93.
- Bamberger, J. (1974). The myth of matriarchy: Why men rule in primitive society. In M. Rosaldo & L. Lamphere (Eds.), Woman, culture and society (pp. 261-280). California: Stanford University Press.
- Barthes, R. (1985). Day by day with Roland Barthes. In M. Blonsky, (Ed.), On signs (pp. 98- 117). Maryland: Johns Hopkins University Press.
- Baudrillard, J. (1991). The precession of simulacra. In D. Hlynka and J. Belland (Eds.), Paradigms regained: The uses of illuminative, semiotic and post-modern criticism as modes of inquiry in educational technology (pp. 441-480). New Jersey: Educational Technology Publications.
- Benson, M.L. (1988). Women's voices/men's voices: Technology as language. In C. Kramarae (Ed.), Technology and women's voices: Keeping in touch (pp. 15-28). New York: Routledge and Kegan Paul.
- Bleier, R. (1984). Science and gender: A critique of biology and its theories on women. New York: Pergamon Press.
- Bowers, C. (1988). The cultural dimensions of educational computing: Understanding the non-neutrality of technology. New York: Teachers College Press.
- Briskin, L. (1990). Feminist pedagogy: Teaching and learning liberation. Ottawa: Canadian Research Institute for the Advancement of Women.
- Bush, C. (1983). Women and the assessment of technology: To think, to be; to unthink, to free. In J. Rothschild (Ed.), Machina ex dea: Feminist perspectives on technology (pp. 151-170). New York: Pergamon Press.

Cherryholmes, C. (1985). Theory and practice: On the role of empirically based theory for critical practice. American Journal of Education, 94(November), 39-70.

Cherryholmes, C. (1987). A social project for curriculum post-structural perspectives. Journal of Curriculum Studies, 19,(4), 295-316.

Cherryholmes, C. (1988). Power and criticism: Poststructural investigations in education. New York: Teachers College Press.

Cherryholmes, C. (1988). An exploration of meaning and the dialogue between textbooks and teaching. Journal of Curriculum Studies, 20,(1), 1-21.

Cherryholmes, C. (1988). Construct validity and the discourses of research. American Journal of Education, 96,(May), 421-457.

Cherryholmes, C. (1988). Power and criticism: Afterthoughts and responses. Journal of Curriculum Theorizing, 8,(4), 205-218.

Chodorow, N. (1974). Family structure and feminine personality. In M. Rosaldo & L. Lamphere (Eds.), Woman, culture and society (pp. 43-66). California: Stanford University Press.

Clark, G. (1989). Women in the ancient world. London: Oxford University Press.

Cockburn, C. (1985). Machinery of dominance: Women, men and technical know-how. London: Pluto Press.

Cremin, L.A. (1957). The republic and the school: Horace Mann on the education of free men. New York: Teachers College.

Davies, I. (1981). Instructional Technique. New York: McGraw Hill.

De Beauvoir, S. (1952). The second sex. New York: Random House.

Dick, W. and Carey, L. (1990). The systematic design of instruction. Illinois: Scott, Foresman/Little Brown

Dick, W. and Reiser, R. (1989). Planning effective instruction. New Jersey: Prentice Hall.

Earl, T. (1987). The art and craft of course design. London: Kogan Page.

Ellsworth, E. (1990). Why doesn't this feel empowering? Working through the repressive myths of critical pedagogy. Harvard Educational Review, 59(3), 297-324.

Ellul, J. (1964). The technological society. (J. Wilkinson, Trans.) New York: Random House.

Ellul, J. (1979). The technological order. In J. Burke and M. Eakin (Eds.), Technology and change: A courses by newspaper reader (pp. 13-19). San Francisco: Boyd & Fraser.

Everts, S. (1986). Feminine values in the practice of technology. In M. Dahms, L. Holmfeld, K. Hansen, A. Kolmos, and J. Nielsen, (Eds.), Proceedings of the European Conference on Women, Natural Sciences and Technology, (pp. 63-73). Elsinore, Denmark: Centertrykkeriet.

Feldberg, R. & Glenn, E. (1983). Technology and work degradation: Effects of office automation on women clerical workers. In J. Rothschild (Ed.), Machina ex dea: Feminist perspectives on technology (pp. 59-78). New York: Pergamon Press.

Franklin, U. (1984). Will women change technology or will technology change women?. In Knowledge reconsidered: A feminist overview, (pp. 81-90). Ottawa: Canadian Research Institute for the Advancement of Women.

Franklin, U. (1990). The real world of technology. Toronto: CBC Enterprises.

Freire, P. (1970). Pedagogy of the oppressed. (M. Ramos, Trans.). New York: The Seabury Press.

Gagne, R. (1987). Instructional technology: Foundations. New Jersey: Lawrence Erlbaum Associates.

Gagne, R., Briggs, L. and Wager, W. (1988). Principles of instructional design. New York: Holt, Rinehart and Winston.

Gaskel, J. & McLaren, A. (1986). Women and Education. Alberta: Detselig Enterprises Ltd.

Giddens, A. (Ed.) (1974). Postivism and Sociology. London: Heinemann Educational Books.

Gilligan, C. (1982). In a different voice. Massachusetts: Harvard University Press.

Giroux, H. (1981). Ideology culture and the process of schooling. Philadelphia: Temple University Press.

Heinich, R. (1970). Technology and the management of instruction. Indiana: Association for Educational Communications and Technology.

Heinich, R., Molenda, M., and Russell, J. (1989). Instructional media and the new technologies of instruction. New York: MacMillan.

Henchey, N. (1987). The new technology and the transformation of learning. In R. Ghosh and D. Ray (Eds.), Social change and education in Canada (pp. 42-56). Toronto: Harcourt Brace Jovanovich.

Henderson, J. (1988). Reflections on an important but unfinished poststructural essay. [Review of Power and criticism: Poststructural investigations in education]. Journal of Curriculum Theorizing, 8,(4), 135-141.

Hill, S. (1988). The tragedy of technology: Human liberation versus domination in the late twentieth century. London: Pluto Press.

Hlynka, D. and Belland, J. (1991). Paradigms regained: The uses of illuminative, semiotic and post modern criticism as modes of inquiry in educational technology. New Jersey: Educational Technology Publications.

Hubbard, R. (1988). Some thoughts about the masculinity of the natural sciences. In M. Gergen, (Ed.), Feminist thought and the structure of knowledge (pp. 1-15). New York: University Press.

- Keller, E. (1983). Women, science and popular mythology. In J. Rothschild, (Ed.), Machina ex dea: Feminist perspectives on technology (pp. 130-146). New York: Pergamon Press.
- Kerr, S. (1989). Technology, teachers, and the search for school reform. Educational Technology Research and Development, 37,(4), 5-17.
- Kerr, S. (1990). Technology : education :: justice : care Or thoughts on reading Carol Gilligan. Educational Technology, 30,(11), 7-12.
- King, Y. (1983). Toward an ecological feminism and a feminist ecology. In J. Rothschild, (Ed.), Machina ex dea: Feminist perspectives on technology (pp. 118-129). New York: Pergamon Press.
- Knirk, F. and Gustafson, K. (1986). Instructional technology: A systematic approach to education. New York: Holt, Rinehart, Winston.
- Kranzberg, M. and Pursell, C. (1966). Technology in western civilization (Vols. 1-2). Toronto: Oxford University Press.
- Lande, A. (1990). A description and analysis of the processes of reproduction and resistance in the marginalization of girls by classroom interaction patterns and a proposed model for classroom intervention. Unpublished master's thesis. University of Manitoba, Winnipeg, Manitoba.
- Lather, P. (1986). Issues of validity in openly ideological research: Between a rock and a soft place. Interchange, 17(4), 63-84.
- Lather, P. (1987). The absent presence: Patriarchy, capitalism, and the nature of teacher work. Teacher Education Quarterly, 14(2), 25-38.
- Lather, P. (1988). Unmasking the politics of educational thought and practice. [Review of Power and criticism: Poststructural investigations in education]. Journal of Curriculum Theorizing, 8,(4), 127-134.
- Lerner, G. (1986). The Creation of Patriarchy. Oxford: Oxford University Press.
- Lewis, M. (1990). Interrupting patriarchy: Politics, resistance, and transformation in the feminist classroom. Harvard Educational Review, 60(4), 467-488.

- Linn, M.C. & Hyde, J.S. (1989). Gender, mathematics and science. Educational Researcher, 18(8), 17-19, 22-27.
- Lipscombe, J. and Williams, B. (1979). Are science and technology neutral? Science in a social context. London: Butterworths.
- MacPherson, E. (1989). Lecture: The influence of Horace Mann. University of Manitoba.
- McLuhan, M. (1964). Understanding media: The extensions of man. New York: Signet Books.
- Millet, K. (1971). Sexual politics. New York: Doubleday.
- Mitcham, C. (1980). The philosophy of technology. In P. Durbin (Ed.), A guide to the culture of science, technology and medicine (pp. 282-363). New York: The Free Press.
- Morrow, D. & Goertzen, S. (1986). A commentary on gender differences. Winnipeg: Planning and Research Branch, Manitoba Education.
- Mumford, L. (1979). The technique of total control. In J. Burke and M. Eakin (Eds.), Technology and change: A courses by newspaper reader (pp. 10-12) San Francisco: Boyd & Fraser.
- Nunan, T. (1983). Countering Educational Design. London: Croom Helm.
- O'Brien, M. (1983). Feminism and education: a critical review essay. Resources for Feminist Research, 12(4), 3-16.
- O'Brien, M. (1987). Education and patriarchy. In D. W. Livingstone, (Ed.), Critical pedagogy and cultural power. Massachusetts: Bergin and Garvey.
- Ortner, S. (1974). Is female to male as nature is to culture? In M. Rosaldo & L. Lamphere (Eds.), Women, culture and society (pp. 67-87). California: Stanford University Press.
- Percival, F. and Ellington, H. (1988). A handbook of educational technology. London: Kogan Page.

Peterat, L. (1990). The promise of feminist research practices. Canadian Home Economics Journal, 40,(1) 33-36.

Plato. The republic. (F.M. Cornford, Trans.) London: Oxford University Press.

Pursell, C. (1980). The history of technology. In P. Durbin (Ed.), A guide to the culture of science, technology and medicine (pp. 70-120). New York: The Free Press.

Robertson, H.J. (1988). The idea book: A resource for improving the participation and success of female students in mathematics, science and technology. Toronto: Canadian Teachers' Federation.

Rosaldo, M. & Lamphere, L. (Eds.). (1973). Woman, culture and society. California: Stanford University Press.

Rothschild, J. (1983). Technology, housework and women's liberation: A theoretical analysis. In J. Rothschild, (Ed.), Machina ex dea: Feminist perspectives of technology (pp. 79-93). New York: Pergamon Press.

Rothschild, J. (1988). Teaching technology from a feminist perspective. New York: Pergamon Press.

Scholes, R. (1985). Textual power, literary theory and the teaching of English. London: Yale University Press.

Schon, D. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Schuster, M. & Van Dyne, S. (1983). Feminist transformation of the curriculum: The changing classroom, changing the institution. Massachusetts: Wellesley College Center for Research on Women.

Shakeshift, C. (1986). A gender at risk. Phi Delta Kappan, 67,(7) 499-503.

Spencer, K. (1988). The psychology of educational technology and instructional media. New York: Routledge.

Standish, L. (1981). Women, work and the scientific enterprise. (Report No. CG 015 959). Boston, Ma: 8th Annual Conference of the Association for Women in Psychology. (ERIC Document Reproduction Service No. ED 217 353)

Streibel, M. (1986). A critical analysis of the use of computers in education. Educational Communication and Technology, 34, (3) 137-161.

Weiler, K. (1988). Women teaching for change: Gender, class and power. Massachusetts: Bergin and Garvey.