TRANSFORMATIONAL THEORY: AN ALTERNATIVE PARADIGM FOR CURRICULUM THEORIZING

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Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
May, 1991

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PARADIGM FOR CURRICULUM THEORIZING

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ACKNOWLEDGMENTS

I consider it an honor to have had the opportunity to study curriculum and curricular theorizing with someone as renowned and knowledgeable as Dr. Russell Dobson. I am indebted to Dr. Dobson for affording me the opportunity to investigate alternative curricular realities and for sharing his wisdom and epistemological understanding. I wish to sincerely thank him for the encouragement and support he provided as committee chairman and friend. Appreciation is also expressed to the other committee members: Dr. J. Randall Koetting, Dr. Carolyn Bauer, and Dr. J. Barbara Wilkinson, for their friendship and for the kindness, support, and guidance they have shared throughout the doctoral program.

A very special word of thanks to the members of my family who have been generous in their giving of time and assistance during this endeavor. Most importantly, I want to express my love and appreciation to my husband, Ramon, without whose encouragement and support this dream might never have been realized. His belief in me never faltered and continued to provide sustenance through periods of self-doubt. Thus, it is to Ramon that I sincerely dedicate this finalized work. Thank you.

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CHAPTER I

INTRODUCTION

Quest for Knowledge

> Nature speaks with a thousand voices, and we have only begun to listen.
>
> --Prigogine and Stengers (1984, p. 77)

Since the beginning of civilization, humankind has had an inherent curiosity concerning nature and a fascination regarding the essence of their own existence in the world as they perceived it. Humans seek to understand the known and the unknown, and assiduously pursue the sources of knowledge and the ways of knowing.

Among those involved in that early pursuit were prominent Greek philosophers and scientists like Heraclitus, Parmenides, Socrates, Aristotle, Copernicus, and Galileo. These men and subsequent others were in quest of singular solutions to the puzzlements of nature. However, scientists today are finding the realities of nature, those self-existing truths, to be pluralistic and very complex, as Prigogine and Stengers (1984) attested in the opening statement.

Toffler (1984) reaffirmed Prigogine and Stenger's (1984) view of the complexity of nature, stating that while structures may disappear, they may also appear, that while one process may be described by deterministic equations, another may be problematic.

An example of confirmation of the complexities of nature is apparent in the wave-particle paradox. Louis de Broglie (Wolf, 1981), while trying to provide a mechanical explanation for the wave-particle duality of light, contemplated that matter, also, might have a wave nature. Broglie (Folse, 1985) discovered that systems whose behavior could be described as composed of particles could also exhibit behavior that could describe those same systems as being composed of waves. Bohr's (1934) Principle of Complementarity confirmed that, like light, matter had a dual nature. Bohr formulated this inconsistency into the dualism of particles and waves (Folse, 1985).

Clearly, as Prigogine and Stengers (1984) have reasoned in their book, Order Out of Chaos, nature does unequivocally have a pluralistic, complex character. Furthermore, there are apparently no obviously simple, singular answers to the realities sought by humankind, yet theirs is a continued quest for knowledge that is ultimate and absolute.

Pattern of Procedure

The method of inquiry into the laws of nature has been traditionally scientific, which encompasses the realm of empirical investigation. The pattern of procedure known as the scientific method begins with the attainment of data through experimentation and observation by scientists who remain detached and objective in their efforts. The data are then quantified, classified, and analyzed in an objective, rational, and sequential manner. Use of this systematic scientific method facilitates researchers in their attainment of results which are verifiable and devoid of error and personal bias. As a result of this knowledge being based on critical objective observations and experimental tests, the scientific method has been used as a model for other disciplines, including the field of curriculum study.

Curriculum Study and the Scientific Model

Encouraged by the scientific discoveries of men like Copernicus, Galileo, and Newton, educators turned to the method of scientific inquiry as a model. Francis Bacon (Scruton, 1981), known as the father of the scientific method, firmly believed that knowledge should be systematically obtained, categorized, critically analyzed, and empirically verified. Thus, this testing of ideas against experience, Bacon (cited in Schubert, 1986) claimed, would produce results that were totally objective and free from personal bias. His was an inductive method founded on part-to-whole logic and characterized by the forming of generalizations or universal laws on the basis of observed instances. It was Bacon's contention that Aristotle's deductive method provided no means for the discovery of new facts, but rather, a means of reordering facts that were previously known. The following quote by Francis Bacon (cited in Shepard, 1985) reiterated his philosophical perception of inquiry:

> If we begin with certainties,
> we shall end in doubts;
> but if we begin with doubts,
> and are patient in them,
> we shall end in certainties (p. 12).

In like manner, Rene Descartes, according to Schubert's (1986) account, continued the development of empiricism that had profound effects on education. Descartes concluded that not only could knowledge be achievable by empiricism but truth could also reach the intellect through intuition. Hence, Descarte's view of nature was based on a fundamental division of mind and matter into two separate and independent domains. Descarte's dualism of mind and body, this twofold distinction, has influenced Western scientific and intellectual thought for centuries and has come to be a driving force in education as well.

Doll (1989) also noted the influence of classical science and the scientific model upon education. He contended that Newtonian thought is part of the foundation upon which current curriculum theories are based.

This argument may be substantiated by investigating a comparison of currently dominant curriculum theories like Tyler's (1949) orderly, means-ends curriculum theory and the deterministic and mechanistic theories of Isaac Newton. Newton's view of reality held the universe as a well-organized and stable "Great Machine" that seemed to run efficiently and effortlessly by precise mathematical laws. In like manner, Tyler's curriculum, by its step-by-step design and systematic approach, would also be efficient, deterministic, and mechanistic.

In addition, there is evidence to support the notion of dominance of Western intellectual thought by the aforementioned Newtonian reality and by Descartes' doctrine of dualism. This framework of reality is characteristically constructed of concepts that reduce, quantify, categorize, and segment organisms into independently separate fragments.

Likewise, there is evidence to support a doctrine of contrast, one that disputes the concept of Descartes' dualism and fragmentation. This world view, this alternate vision of reality, is one of connectedness. The framework of connectedness is characteristically constructed of concepts that embrace unity, wholeness, relatedness, integration, and interaction (Oliver and Gershman, 1989).

Furthermore, an adverse argument may be made pertaining to the use of a dualistic approach of segmenting and fragmenting organisms when one deliberates the fundamental concept of organism. The Oxford English Dictionary (1989) describes an organism as a body of interdependent parts which have a functional relationship with the whole. This would infer the existence of an extremely complex being or structure with components that are so intricately united that the relationship of those parts to one another is ultimately controlled by their relationship to the entity of the whole.

An interaction of parts is a mutual, reciprocal action, a condition in which everything influences everything else. The very essence of organism establishes the existence of a basic oneness, an interconnectedness that refutes prior concepts of separateness and isolated, fragmented parts.

The reality of interconnectedness brings into question the fragmenting practices upheld in the field of curriculum study which deals exclusively with organisms, both living and nonliving. According to Toffler (1974), Western civilization's continued commitment to this fragmenting and mechanistic view of reality has taken education in the direction of Newton and Descartes and used their reductionist perspectives to create curriculum practices which are rational, sequential, linear, and fragmenting.

In affirmation, Doll (1989) reiterated Lodge's (1983) position that education is firmly rooted in the constructs of classical science and asserted that, as a result, it lacks the ability to prepare young people to cope in an ever-changing world.

Purpose of the Study

The basic purpose of this study was to investigate the characteristics and historical beginnings of the dominant scientific model and corresponding influence on the development of curriculum theory.

From the Greek atomists to Rene Descartes and Isaac Newton, mind and matter have been held as two original and independent elements (Wolf, 1981). Capra (1975) argued that the Cartesian bifurcation, the division into two separate branches of mind and body, has caused a conflict between the conscious will and involuntary instincts.

As a result, the individual being has been divided into separately categorized compartments of feelings, beliefs, and activities, consequently generating confusion and frustration which Capra (1975, p. 9) has termed "inner fragmentation." As was previously noted in this text, the parts of an organism are so intricately interrelated that each is mutually dependent upon the other. This reciprocity of activities, beliefs, and feelings, both physical and emotional, tends to substantiate Capra's (1975) theory of inner fragmentation.

Fragmentation is not only apparent within the individual being, but is manifested in many aspects of Western culture. Capra (1982) asserted that Western civilization's overdependence on the Cartesian-Newtonian method of fragmenting to be the underpinning, the determinant factor in the current series of cultural, ecological, and social crises. In affirmation, Pirsig (1974, p. 117) stated, "The cause of our current social crises is a genetic defect within the nature of reason itself."

As I previously stated, the limits of this view of reality are evident in all facets of humankind's existence in the present world. The natural environment is deteriorating and, at the same time, economists are dealing with spiraling inflation. The medical community is desperately seeking cures to mystifying diseases, while violent crimes, substance abuse, and suicides continue to be dynamic signals of soaring social deterioration. Modern technology has increased the ability to produce an abundance of food from an ever-decreasing number of cultivated acres, yet thousands of people throughout the world die of starvation and thousands more remain hungry.

Moreover, Ferguson (1980) and Capra (1982) illustrated these problems and determined them to be mutually reciprocal. However, because these crises are characteristically interdependent, interconnected, and interrelated, it may not be possible to solve them with the fragmented approach of the past. First, social organizations and individuals alike need to develop a conscious awareness of the interrelatedness of the problems. Secondly, society should begin to cultivate a new world view that would encourage the development of a new framework of thought which, in turn, would embrace a new world view of integration and universal connectedness.

The focus of this study, however, was directed toward curricular theorists' reliance upon the Cartesian-Newtonian model and factors influencing the establishment of currently used curriculum theories. The intent of the study, ultimately, was to determine the existence of an alternate paradigm inherent in the reality of quantum theory and to establish a parallel between that reality and a new direction for curriculum development.

The thesis of this dissertation postulated that since all phenomena are interdependent and interconnected (Capra, 1975; Zukav, 1979; Ferguson, 1980; Wolf, 1981; Toffler, 1984; Toben and Wolf, 1987), the paradigm of fragmentation used by educators appeared to be incongruous with the reality of nature. As the scientific world is reconceptualizing its vision of reality, in like manner, it may be beneficial for curricular theorists to investigate the possibilities for a transformational paradigm.

The challenge to America's educational society is tremendous (Sommer, 1984), and the cry for educational reform is equivalent to the scientific revolution described by Kuhn (1970). In his book, Kuhn introduced the reader to paradigm, a new term which he used to denote a pattern of ideas. By way of further explanation, the connotation of paradigm, according to Ferguson (1980) refers to a framework of thought for explaining reality. In addition, Schubert (1986) referred to paradigms as conceptual lenses through which problems may be perceived.

According to Kuhn (1970), when currently used methods fail to work in the present dominant paradigm, a crisis evolves, a revolution takes place, and a new paradigm begins to emerge. The current issues most frequently raised regarding the failures of education tend to focus on items like test scores, discipline, time-on-task, dropout rates, retention, and placement. Goodlad (1984) also concluded that most criticism of the schools is directed toward the "system of schooling" (p. xv).

As one recognizes that there may truly be a need for massive changes in today's schools, one may then need to consider, as Pirsig (1974) has indicated, the necessity for change in the way one perceives nature and knowledge. The fragmenting, mechanistic reality of Newtonian thought that has dominated Western civilization for centuries is being challenged by the reality of quantum theory (Wolf, 1981). In a paper written with Basil Hiley at Birkbeck College, the eminent physicist, David Bohm (Bohm and Hiley, 1975) wrote, in reference to quantum theory:

> The essential new quality implied by the quantum theory is nonlocality; i.e., that a system cannot be analyzed into parts whose basic properties do not depend on the . . . whole system. . . . This leads to the radically new notion of unbroken wholeness of the entire universe (p. 94).

A new vision of perception was at hand.

The quest for change had begun. Prigogine and Stengers (1984, p. xxvii) posited, "Our vision of nature is undergoing a radical change toward the multiple, the temporal, and the complex." A mechanistic world view, which provided simple, singular solutions, dominated Western science for centuries, but quantum physics has challenged that mechanistic world view as humankind begins to realize they live in a complex and pluralistic world.

Similarly, Ferguson (1980) was cognizant of the emergence of a new world view. She asserted that an ecological world view is now emerging which reflects a change in the thoughts, assumptions, perceptions, and values that have formed the reality of the sociological, scientific, and educational communities for several decades.

Likewise, Weber (1986) affirmed the reality of unity. Conversely for Weber, the process was not one of change but one of resistance to change. She related her personal struggle to deny inner beliefs and suppress the reality of unity in what proved, for her, to be a futile attempt to embrace the reality of fragmentation. She divulged:

> . . . I can settle for nothing less than the whole. . . . It has accompanied me through all the years of education at elite universities, where it stayed underground for the sake of prudence. But it only went into hiding. It is still there and has been in the background all along, the scale against which every particular truth I have met with is weighed. It is the sense of the unity of things: man and nature, consciousness and matter, inner and outer, subject and object--the sense that these can be reconciled. I have never really accepted their separation and my life--personal and professional--has been spent exploring their unity (p. 1).

This new view of reality is apparently being embraced worldwide. According to Clark (1988), this new world view is integrative, postulating all phenomena--social, cultural, physical, psychological, and biological--to be interdependent and interconnected.

This concept became further apparent as one considers Boyer's (1990) human commonalities of birth, growth, death, and the implications of quantum theory. Research of these aspects of universal connectedness should conclude that the realities of nature are not segregated organisms or events to be treated as isolated entities but are interrelated experiences of a networking unity.

Organization of the Study

This study is organized into five chapters. The chapters are structured as follows:

Chapter I. This introductory chapter provides the reader with a history of humankind's quest for knowledge and the direction in which that search has led. Also presented is a capsulized view of the parallel between Western civilization's dependence upon the Cartesian-Newtonian paradigm and the effects of its influence on curriculum theory.

Chapter II. In order to increase the reader's understanding of the effects of fragmentation and the influence of Cartesian-Newtonian reality in the development of curriculum theory, it is imperative that the historical roots of fragmentation and of the dominant scientific model be presented. The characteristics of this scientific model were explored and a brief investigation into its continued prevalence up to the present day has been included. Also included in this chapter is a concise elucidation of the nature of curriculum and the effects of language.

Chapter III. This chapter explores the paradigmatic curriculum perspectives of eminent curriculum theorists and investigates their respective realities of nature, curriculum, and language.

Chapter IV. Kuhn's (1970) concept of scientific revolution and how it relates to transformational theory is investigated. Quantum theory and the implications of an emerging new paradigm as an alternative curriculum perspective receives emphasis.

Chapter V. This final chapter provides a summarization of the study, speculations, and recommendations for further inquiries.

Limitations of the Study

Because this is a theoretical study, the applications of the inquiry may be limited. For purposes of this study, transformational theory has been used to critique the affects of the old paradigm on the development of curriculum theory and to explore the implications for an alternative curriculum perspective. Regarding alternative curriculum paradigms, Schubert (1986) reasoned:

> . . . we all view the world and our own functioning in it through paradigm or conceptual framework that accepts certain assumptions about such matters as the nature of inquiry, reality, and values. To view educational phenomena through different paradigms is analogous to viewing a society through the language and values of different cultures. Perhaps we need to be multi-intellectual in much the same way that values of multi-culturalism have arisen in recent years to counteract ethnocentrism. In intellectual matters, we can suffer from a kind of centrism of inquiry (p. 7).

Due to the problematical nature of curriculum studies, any attempt to develop absolute concrete and generic solutions to the fundamental problems thus raised in the confines of this brief study would be a futile effort. As Schubert (1986) has concluded, there are no panaceas or magical answers to the questions of curriculum.

CHAPTER II

HISTORICAL ROOTS OF THE DOMINANT SCIENTIFIC MODEL

Emergence of Cartesian-Newtonian Reality

'Cogito ergo sum'--I think, therefore I exist.

--Descartes (1637, p. 84)

The beginnings of Western science may be found in early Greek philosophy. Eminent philosophers like Heraclitus, Parmenides, and Descartes presented their respective generations with contrasting views of reality. Heraclitus' (Capra, 1975) view of reality was of a world in continual flow and change, which he believed represented a cyclic interplay of opposites that he interpreted to be a unity. During this period in time, science, religion, and philosophy were not fragmented into separate areas of thought because the focal point of inquiry was metaphysical, directed toward the essential nature of things, of which these particular distinctions were believed to be a part.

A subsequent Greek philosopher, Parmenides (Capra, 1975) was in strict opposition to Heraclitian thought. Conversely, his view of reality held change to be impossible because the "Being" which directed all the world from above was considered to be stable, consistent, unique, and unchanging. Parmenides therefore considered any perceived changes to be mere illusions of the senses, according to Capra's (1975) account.

Rene Descartes (1596-1650) (Clarke, 1982), sometimes called the founding father of modern philosophy, was also well known as a mathematician. Because he refused to believe anything which was not supported by noncontrovertible proof, Descartes embarked on a search for the systematic discovery of truth and the elimination of error. Scruton (1981) reported that Descartes was guided in this exploration by his "method of doubt," which was designed to eliminate all claims to knowledge that could not be irrefutably validated. This inquiry led Descartes to conclude that the only certainty that could endure his test of doubt was the fact of his own existence. He could, as a result, be certain of nothing except that which he could not doubt. This logic prompted the famous quote which was printed at the beginning of this chapter: "Cogito ergo sum"--I think, therefore I exist" (Descartes, 1637, p. 84). According to Scruton's (1981) interpretation, the very fact that Descartes could doubt verified the fact the he could think and therefore deduce his own existence.

Hence, Descartes believed it necessary to separate mind from matter and that by doing this, all things could be placed into either one of those two categories. In addition, Livingston (1973) related that neither one could influence nor benefit from the other. Furthermore, by separating a rational mind from a mechanical body, Descartes was also able to separate religion, science, and philosophy, which had not been previously segmented. This division of thought was the beginning of the dualism between mind and matter, man and nature, science and religion, fact and value, and object and observer, which Wolf (1981) claimed has dominated the Western intellectual tradition for centuries.

The heart, inmost essential part of Descartes' philosophy, was his own mind. Gardner (1985) affirmed the accounts of Livingston (1973), Capra (1975), Scruton (1981), and Clark (1982) regarding Descartes' view of reality. Gardner stated that in Descartes' view of reality, the mind is central to human existence and stands separate from and operates independently of the human body as a totally different entity. Intriguingly, Descartes' doctrine of dualism between mind and matter has remained a controlling element of Western thought to the present day.

This dualistic thought also guided the Cartesian scientists as they separated themselves from the matter with which they worked. Consequently, matter was believed to be made of elementary building blocks, dead particles whose movement was caused by some completely different and external force. As a result of Rene Descartes' (Scruton, 1981) philosophy of the universe in automation, scientists, with their mathematical theorems, endeavored to determine the workings of this universe, which they perceived to be a well-organized Great Machine that ran effortlessly by precise mathematical laws. In this scheme, according to Scruton (1981), and Clarke (1982), God had been transformed from a clockmaker to a supreme mathematician who had designed the plan and set the universe in motion.

Isaac Newton (1642-1727), whose contributions ultimately became the very basis for classical physics, also shared this mechanistic world view, which held living things as the sum total of lifeless inanimate parts, according to Rifkin (1983). Newton wanted to explain the processes of the mechanistic world by means of mathematical calculations, reasoning that if all known facts of an experiment agreed with results mathematically derived from a law, then validity would most certainly be guaranteed. By means of calculation, a wealth of phenomenon could be elucidated and physical observations would not be a necessary part of the procedure, since scientists reasoned it possible to predict results from the initial conditions.

Seventeenth and eighteenth century scientific thought was deeply rooted in rigorous mechanistic determinism. Heisenberg (1974) asserted that Newton's mathematical theorems were so successfully used that succeeding generations of scientists supported the principle which posits that one should be able to trace all events in the world back to mechanical processes.

By the beginning of the nineteenth century, according to Heisenberg (1974), one of the founders of quantum physics, it was inconceivable to hold in question the accuracy of the mathematically formulated natural laws of Isaac Newton. The mathematician Pierre Simon Laplace (Capra, 1975) applied Newton's theorems to the flow of the tides and to the movement of the planets within the solar system, thus determining Newton's laws of motion to be the stabilizing force within the solar system. This further reaffirmed the deterministic picture of the universe as an elaborate, self-regulating mechanistic system operating in a logical and predictable manner under the fundamental laws of nature (Capra, 1975).

Isaac Newton and Rene Descartes, the architects of classical physics, had thus established the conceptual framework of intellectual thought for subsequent generations of Western civilization.

Characteristics of the Dominant Scientific Model

The Cartesian-Newtonian model reflects a concept of rigid causality and mechanistic determinism which precludes any notion of the existence of human consciousness, intuition, or subjectivity. The scientific method for gaining absolute knowledge within the Cartesian-Newtonian model was to study and observe the object or phenomena of inquiry from an uninvolved, passive position. Wolf (1981) reported that during this era it was generally accepted that scientists were detached, value-free, and totally objective in their observations. Based on these assumptions, their observations should be measurable with a high degree of accuracy and should produce predictions about future events with absolute certainty.

In addition, this Cartesian view of reality regarded all aspects of the physical realm and the nonphysical realm to be mechanical in nature. An essential element of thought in this mechanistic world view was the idea of the whole, which was precisely equal to the sum total of all its parts. By eliminating the probability of missing pieces, everything could therefore be measurable and verifiable. Because it was assumed that the act of observing does not disturb the observed, scientists could study those seemingly less complicated individual component parts of nature in an attempt to understand the overwhelming complexities of the entity, and presumably the gigantic clockwork would continue to run exactly the same as before.

The Newtonian view of reality was not only mechanistic but deterministic as well. As Wolf (1981) has clearly illustrated, for every effect there was a cause and for every cause there was an accountable effect. In addition, the present was regarded as a result of the past and the future, subsequently, became a consequence of the present. Heisenberg (1974) believed Isaac Newton's thesis about gravity and motion to be instrumental in establishing the belief that events of the future could be predicted with absolute certainty based upon knowledge of the present. For example, the belief held that one could predict precisely when and where an object would land if given the initial facts concerning the size, weight, and density of the object, the distance to be traveled, and the speed of travel.

This concept of determinism implies that when the original situation has been established, future situations will also have been established. As Zukav (1979) has stated, if one is to accept the concept of mechanistic determinism upon which Newtonian physics is founded (in essence, that the laws of nature govern the future), then one might accept the theory that everything that is to happen in the universe has been predetermined since the beginning of time.

Based on this philosophy of mechanistic determinism, the events of the universe may have been predetermined and man's seemingly free will and ability to alter events may therefore not exist (Wolf, 1981; Zukav, 1979). If all events from the beginning of time have been predetermined, Zukav (1979) reasoned, then the universe is a ". . . prerecorded tape playing itself out. . . ." (p. 26), and all things and events are merely cogs in the huge mechanical system of the universe. Pagels (1982), when establishing an analogy to the reality of determinism, uses the metaphor of a film that has already been developed by the omniscient God.

Characteristically, the Cartesian-Newtonian model is mechanistic and deterministic and concerned with causality, the relation of cause and effect. Gardner (1985) seemed convinced that humanity is determined to unravel the nature of human knowledge and disclose the mystery surrounding causality. Throughout history, it appears that civilizations have been driven in pursuit of explanations for the why of things. The knowledge of why things happen seemed to provide some scientific assurance that the behaviors of organisms, of individual beings and objects, would produce certain results.

Toffler (1980) explored the "ultimate why" and determined the mystery of causation to be revealed in Newton's law of gravity. Because Newton defined the why or causes as ". . . the forces impressed upon bodies to generate motion. . . ." (p. 103), the reality of Newtonian causation focused on outside forces that were both measurable and identifiable. The traditional example of causation is the billiard balls that strike one another and move in response to that strike. Toffler (1980) presented a more scientific example: if one atom strikes another atom, the first is cause of the movement and that movement is the effect of the movement of the first atom.

Since this theory of causality could be subjected to experimentation and empirical testing, it could thus be validated. Through validation and its successful use, this theory has made possible many great advancements in science and in technology and at the same time has also created, according to Heisenberg (1974), a mechanistic mentality for viewing the world that has endured for generations.

The beginnings of science dealt with things that could be seen and manipulated and in that particular domain all objects could be reduced, fragmented into smaller individual components (Capra, 1982). These beginnings charted the direction for Western society's belief that the world could thus be explained only in a rational and logical manner. However, as Copi (1961) and Rorty (1979) have illustrated, because rational knowledge has its roots in objects, events, and experiences, it is therefore a limited knowledge. The scientific and intellectual methods of this rational manner would include procedures such as quantifying, classifying, and analyzing.

In summation, the nature of the Cartesian-Newtonian model was rigorous, mechanistic determinism. This model, the example for imitation, was characteristically rational, linear, sequential, causal, and fragmenting. Nevertheless, it continued to dominate Western intellectual thinking for many generations (Heisenberg, 1974; Capra, 1975; Wolf, 1981).

Prevalence of the Dominant Scientific Model

It was not my intent to trace the use of the Cartesian-Newtonian model through all of Western culture, but rather to focus upon the reliance of curricular theorists upon the model. However, I would be remiss in providing the reader with adequate supportive information if the prevalence of this model in other aspects of society were not explored, at least briefly.

Western culture's reliance upon the Cartesian-Newtonian model and its reductionist view of nature has been further extended to living organisms. The universe and the living organisms within it, according to Capra (1982) and Rifkin (1983), were also regarded as machines, constructed from numerous tiny, separate parts. This method of reducing the complex phenomena of living organisms into the individual basic building blocks of Newton and Descartes has resulted in a culture that apparently has become progressively fragmented. According to Capra (1982), Ferguson (1980), and Toffler (1980), the effects of this division have led to fragmentation in all aspects of society, including medical, social, environmental, and academic. One of the tenets of Schwab's (1978) thesis for the practical correlates the present state of the curriculum field and the reliance of curricularists upon theories that have been adopted from fields outside that of education. He proposed:

> The problems of the theoretic arise from areas of the subject matter marked out by what we already know as areas which we do not yet know. This is to say that theoretic problems are

> states of mind. Practical problems, on the other hand, arise from states of affairs in relation to ourselves. . . . Practical problems can be settled by changing either the state of affairs or our desires. . . . [P]ractical problems intrinsically involve states of character and the possibility of character change (p. 289).

According to Schwab (1978), in the method of the practical, the problem slowly emerges, and through the slowness of formation, provides direction for solution. Similarly, the slowly emerging problems of Western civilization's reliance upon the Cartesian-Newtonian model and its reductionist view of nature has provided direction for solution. As in Schwab's (1978) practical, the principle aim is the identification of desired changes and the accomplishment of those changes.

Approaching the universe from the Newtonian paradigm of reductionistic fragmentation presumes that events happening at one place do not essentially involve other events happening elsewhere. However, it seems that as our material wealth has grown richer, the condition of our environment has grown poorer, and the acquisition of more leisure time has been met with neither adequate available space nor beautiful surroundings. Miller (1972) described this constant reminder to our senses, which may include, ". . . the tremor of anxiety . . .frustration and alienation . . . choking air, rotting rivers, lakes and oceans. We seemingly live in the midst of a crisis of crises" (pp. 5-6).

The Cartesian view of the world which separates humans from nature and mind from body appears to have been the conceptual framework supporting Western civilization's current values, reasoning, and actions toward their environment and ultimately toward their own bodies, according to Blackstone (1974). Ostensibly, this fragmenting and mechanistic view of reality may also have been an influencing factor on the attitudes of physicians toward health and illness. Capra (1982) reasoned that, in the same manner in which the Newtonian scientists regarded the universe to be an efficient machine, modern scientific medicine tends to regard the human body as an efficient machine, a system that can be analyzed in terms of its various component parts. Because illness is usually considered to be a malfunctioning of that system, the physician consequently diagnoses and intervenes to correct the malfunction. Alliteratively, Engel (1977) concluded:

> Three centuries after Descartes, the science of medicine is still based on the notion of the body as a machine, of disease as the consequence of breakdown of the machine, and of the doctor's task as repair of the machine (p. 14).

New diagnostic tools have been invented and medical technology has become more sophisticated, drugs and vaccines have been developed to combat infectious diseases, and biological functions have been studied at the cellular and molecular levels, all aimed at finding a mechanism that is malfunctioning.

Lyng (1988) established a link between clinical medicine and the scientific model. He asserted that the most influential characteristic of that model is the reductionist method of reducing complex phenomena to the simplest level, the basic building blocks of nature. Lyng reasoned that traditional medicine tends to focus on genes and microbes as the causal agents of the disease process and concludes that this is also the focus of most scientific medical research. Lyng alleged that it is easier for practitioners to alter conditions at the microbe level than at the ecological level where problems may indeed originate.

By reducing these biological functions to mechanisms of microscopic size (Capra, 1982), researchers and physicians tend to limit themselves to mere partial aspects of the very phenomena they study and, as a result, they may acquire only a tenuous view of the disorders or malfunctions which they investigate and of the remedies which they seek to develop.

Descartes' (1637) division between mind and body may have been the genesis of thought that led physicians to reduce the body into smaller fragments and to concentrate their efforts on the mechanics of the component parts of the body, individual organs, cells, and molecules rather than the phenomenon of healing, which deals with the interdependency of body and mind. Capra (1982) and Ferguson (1980) felt that the division between mind and body may have led to what they consider the physicians' neglect of the psychological, social, and environmental aspects of illness.

In spite of great advances, this faithfulness to reductionism and fragmentation appears to have offered only tenuous solutions while generating additional problems. Culliton (1978) reported an increasing number of complaints against the medical community, which he noted is made obvious by the rising numbers of malpractice litigations. It is also apparent from daily mass media information, that drug dependency, violent crimes, and suicides are dramatically increasing in number, which in actuality may be representative of medically suppressed symptoms manifested in different and various forms.

This conclusion is also shared by Capra (1982), who believed health, which cannot be represented by one single parameter, to be a complex interplay between the physical, social, and psychological aspects of human nature. In support, Veith (1972) speculated that impressive successes such as organ transplants may tend to overshadow the obvious fact that preventative measures must have been severely neglected in the first place. Likewise, according to Dubos (1968), it is the behavior, food intake, and the nature of their environment that largely determines the quality of health of individuals and not medical intervention.

Because of the limitations of this mechanistic view of reality with its framework of fragmentation and singular causality, physicians may be treating symptoms with prescriptions for chemicals rather than examining the roots of the individual's problem. A whole range of causative factors tends to be involved, from mental attitudes and belief systems to family support and interpersonal relationships.

The Cartesian scientists were passive observers, totally objective in their work. Similarly, Capra (1982) felt that some doctors may choose to remain passive observers as they refrain from discussing a patients' personal life and also may be reluctant to display empathy or emotion. He reasoned that in medical school, things like sensitivity, displays of emotions, and the use of intuition were most likely discouraged in favor of mechanistic, scientific objectivity.

Guided by the Cartesian-Newtonian reality of reductionism and fragmentation, the individual physician continues to become more highly specialized in a concentrated focus of study. As a result, fragmentation of the patient is increased by reducing and segmenting the individual being into numerous and distinctly separate parts. Oftentimes it may be the general family practitioner rather than the highly trained medical specialist who tends to become more involved with the patient as a whole being rather than as a machine with a malfunctioning part.

In sum, every aspect of human behavior is interrelated and ecological. Ecology is reciprocity between an organism and its environment. Dubos (1968), Ferguson (1980), and Capra (1982) believed the ecological concept of health as an interplay of mind, body, and environment extended far beyond the medical community.

"Never before did any civilization create the means for literally destroying . . . a planet," declared Toffler (1980, p. 110). The increasingly sophisticated technology built by modern society to create a better way of life has not necessarily produced a better quality of life. The very process of living, insisted Dubos (1968), is a continual interplay between individuals and their environment, which often takes the form of a struggle resulting in injury or illness. Sinacore (1974) supported Dubo's position by noting that water, air, and land pollutants pose life-threatening health hazards to humans and are disrupting the natural environment.

Likewise, Livingston (1973, p. 21) concluded, "This [pollution] is a symptom of a much more deep-seated illness." The deep-seated illness to which Livingston referred is the Western paradigm of humankind's separation from nature that appears to be the underpinning of present environmental ethics. The central issue of the environmental crisis, Livingston adds, is not isolated problems but the threat to life and the quality of that life.

Another aspect of Western culture that appears to be molded by the Cartesian model is that of the business community. Guided by a world view of tenuous vision, characterized by isolated and fragmented components, the economical systems of businesses seem driven to increase productivity and profits without seemingly much regard to long-term ecological effects. Increased production necessitates increased energy consumption, which has subsequently depleted nonrenewable fossil fuels at an exorbitant rate. Byproducts of this economical growth may include particulars such as food additives, pesticides, and chemical wastes, which may prove to have ecologically detrimental effects (Capra, 1982).

Furthermore, world hunger will probably never be eliminated as long as large corporations, concerned mainly with high productivity for large profits, are the major food producers. Capra (1982) illustrated that these large corporations tend to produce crops which are profitable and suitable for export regardless of the local food need. As a result, those countries whose primary use of agriculture as an export income rather than as a method to feed people, may actually be perpetuating world hunger and starvation by putting poor people in direct competition with the affluent. Capra (1982, p. 258) concluded, "More food is being produced, yet more people are hungry." Thus, it would appear that increased expansion may not only perpetuate world hunger but also fuel the vicious cycle of energy consumption and environmental pollution which may, in turn, produce ecological imbalances.

The Newtonian mechanistic view of reality has generated fragmented lifestyles, technologies, and institutions that Capra (1982) felt were both mentally and physically unhealthy. In support of Capra's contention of a fragmented society, Bloor (1976) posited that the wholes and collectivists of society are oftentimes seen as sets of individual units. Likewise, Evans (1982) and Turk, Wittes, Wittes, and Turk (1975) concluded that social institutions tend to splinter the individual even further. By way of illustration, the poor may be given welfare assistance but their individual self improvement is oftentimes severely neglected and any assistance the socially disadvantaged receive may be discontinued as soon as employment is obtained. The developmentally disabled and the elderly may be given adequate physical care, but they are frequently fragmented, isolated from the remainder of society.

Similarly, social institutions known as schools and various curriculum theorists may also have been greatly influenced by the Cartesian-

Newtonian model (Doll, 1989). The dualistic doctrine of Descartes, which has seemingly permeated all segments of society, apparently tends to dominate educational thought as well.

Cartesian reality reasons that events which occur at one place do not essentially involve other events occurring elsewhere and that thought may be the underpinning of current curriculum designs. As a result, individual disciplines may be designed and offered to students in a fragmented and isolated fashion rather than as an integrated part of a whole. Likewise, within individual disciplines the content may be reduced and presented to learners in fragmented units, where the sum total of the component parts may not always add up to the whole realm. Learners may accumulate splinter skills and fragmented knowledge with which they can neither determine relevancy nor make application.

Modeling Cartesian scientists, curriculum workers and educators strive to be detached, value-free, and totally objective in an attempt to provide results that can be both measurable and verifiable. Scientific efficiency and mechanistic productivity have become the goals of the schools, as in the business world, the bottom line. The growing concern appears to be focusing upon what the student has learned (Dobson and Dobson, 1981), rather than how the student has learned and what has affected that learning. Reminiscent of the medical community and various other segments of society, the emphasis of curriculum appears to be on fragmented parts as opposed to an integrated whole whose parts form an interrelated and interdependent unity.

Similarly, Trow (1925) reasoned that curriculum developers had divided knowledge into isolated, separate, and distinct disciplines, as is typical of Descartes' dualism, to be presented by an orderly procedure in the direction of a given end. Likewise, Dewey (1902) also referred to the classification of subjects in which he elucidates how facts are segmented from their original place and rearranged to fit some general principle then given to children in what he termed a pigeonholed manner.

The Cartesian practice of fragmentation in curriculum has also been noted by Ferguson (1980), where she drew a parallel between the reductionist and fragmenting practices of the medical community and similar practices within the field of curriculum development. Ferguson wrote:

> Just as allopathic medicine treats symptoms without concern for the whole system, schools break knowledge and experience into 'subjects,' relentlessly turning wholes into parts, flowers into petals, history into events, without ever restoring continuity (p. 282).

The Cartesian-Newtonian thought that produced the scientific model has developed a fragmented curriculum representing a rigid structure guided by lockstep procedures which tend to be oriented toward learner outcomes or the final product, rather than toward the very process by which that achievement is attained. The priority tends to be on performance. To recapitulate, reliance upon this model by various aspects of society, including the field of curriculum, has resulted in what appears to be a very tenuous view of reality, one which tends to be dominated by a concern for parts rather than wholes, for product rather than process.

In the tradition of Newtonian mechanistic reality, curriculum theorists have designed curricula according to an industrial machine logic, which tends to place curriculum development in a scientific mode. This method is analogous to the factory model which uses raw materials transported along an assembly line to produce marketable finished products. In the factory metaphor of schools, the raw product would be commensurate with the student learners who are guided through a previously determined, inflexible assembly line-type curricular route where specific learning is designated to occur. Before leaving the factory, all finished products are likely to be quality tested and evaluated to determine their marketability, and the final products of schooling are no exception. Quality control then becomes a matter of ensuring that the agreed specifications are met.

Thus, scientific curriculum development became the practice of reducing curriculum into small units with goals of performing tenuously specific skills. The development of curriculum was usually in the concise manner analogous to that of an engineer, often resulting in a prescriptive, cookbook, how-to-manual orientation where ideals and activities were analyzed into learning objectives and sequenced in the order of their importance.

Reminiscent of the results that Cartesian scientists obtained via the scientific model, the scientific methodology of curriculum development could also be described as precise, efficient, measurable, and verifiable.

Nature of Curriculum

Schubert (1986) noted eight domains within curriculum studies that range from curriculum history to curriculum development, and from curriculum theory to curriculum design. The processes within Schubert's domain of curriculum theory include the process of reflecting and theorizing, and the process of giving clarity and added meaning to the uses of language. The nature of the domain of curriculum theory may be characterized by the determinants of knowledge, of what is and of what should be known, and how it can be justified.

The agelong axiological question, "What knowledge is of most worth?" is a famous query of philosopher Herbert Spencer (1902, p. 5). Schubert (1986), in his inquiry of curriculum, identified three questions which he believed to be the most basic questions associated with curriculum theory and practice. The questions posed by Schubert are as follows:

> What knowledge is most worthwhile?
> Why is it worthwhile?
> How is it acquired or created? (p. 1).

These questions are so fundamentally intertwined with all the activities of curriculum researchers, educators, and students that Schubert contended they must be addressed, or other factors such as political and economic influences may dictate educational policy.

The famous quote by Spencer (1902) reflects a facet of curriculum decision and policy making that may, at first glance, appear simple and routine; however, Apple (1990) has indicated that the foundation upon which those choices are made may be deeply rooted in "the history of class, race, gender and religious conflicts" (p. vii). Believing as Schubert (1986), Apple proposed the prestated question be rephrased, "Whose knowledge is of most worth?" (p. vii) because it is very often the influences of certain dominant groups upon educators that tend to make curricular decisions quite political in nature.

Apple (1990) appeared convinced that the theories and policies which are involved in the curricular process are "inherently political and ethical" in nature (p. viii). Curriculum developers may find themselves yielding to the pressure and influence of dominant groups, be those groups categorized by race, class, or gender, and ultimately implementing policies that are commensurate with ideals held by the dominant societal group.

As a point of illustration, fundamentalist religious groups may succeed in the banning of certain literature or textbooks from the classrooms because of contextual language or concepts which that group may thus determine to be unacceptable. Likewise, racial and ethnic groups may find objectionable examples in the materials or take issue with particular school policies which they may find offensive or prejudicial and subsequently exert pressure upon school and government officials to implement changes which best serve the interest of that particular group.

Schubert (1986) offered yet another example of influences which are possibly being exerted upon school officials in regard to the academic ranking of students as compared to their respective counterparts in other countries. Because there appears to be a national obsession with outperforming other nations, government officials may request schools to place major emphasis on certain aspects of achievement in order to improve the students' international academic ranking.

Moreover, business leaders may seek to influence the findings of government commissions which have been designed to assess schools and determine the skills that will best prepare students for positions that, in turn, will benefit those business leaders. As a result, those disciplines will most likely receive increased funding as a result of lobbying efforts by prominent business leaders and influential corporations. It may be perceptive to note that interest groups are usually self serving and may tend to be shortsighted regarding the needs and interests of others.

The direct use of influential political power, as Apple (1990) discloses, is not the only determining force in curriculum decision making. In addition, Schubert (1986) contended that the beliefs and values held by a society were also intricately intertwined with the curriculum and the decisions regarding what should or should not be taught will necessarily reflect the ethics which give that society a sense of commonality. The school, as an agent of society, shares the given set of societal values of the dominant group, usually white and middle class.

Furthermore, Apple (1990) argued that curriculum decisions of what knowledge to teach reflect values that maintain social class hierarchies. The hegemonic process, this absolute sense of reality held by society, in actuality may prevent mobility by teaching the values that maintain lower class status, thereby ensuring the continued power of the upper classes. Apple (1990) concluded: ". . . the process of education itself . . . socializes people to accept as legitimate the limited roles they ultimately fill in society" (p. 32).

Similarly, Marxist Antonio Gramsci (cited in Bates, 1975), insisted that the dominance of certain classes could be maintained by preserving control of the knowledge. Apple (1990) compared the control of knowledge, this cultural capital or symbolic property, to the control of economic capital, hence his illustration. Just as the economic system runs more efficiently if the unemployment rate is maintained at a constant level of four to six percent, so do cultural institutions tend to generate poor levels of achievement because the distribution of high status knowledge (technical knowledge), is not widespread.

An additional illustration of controlling knowledge may be the admission standards presently used by today's colleges and universities as opposed to a policy of open enrollment. By using achievement scores to control college admissions, minorities and children of the poor, who have traditionally scored lower on such tests, may be denied a college education and, as a result, a continuance of their social status will mostly likely be assured.

To recapitulate, there appear to be many powerful political and ethical forces encompassing race, class, and gender, involved in the curricular decision of what knowledge is important, and Apple (1990) has clearly stated his position that the decision conversely is most definitely based upon whose knowledge is important. Furthermore, the selection of what is legitimate knowledge, that lawfully accepted genuine knowledge, appears to be intricately intertwined between cultural control and social and economic structure. Thus, it is Apple's contention that it is through this stratification of knowledge and stratification of people that the educational system ostensibly continues to create and perpetuate social and economic inequalities when deciding what or whose knowledge is important.

Prior to Apple, when John Dewey (1897) wrote My Pedagogic Creed, he professed education to be a process of developing social consciousness within each individual learner who would then be the recipient of what Dewey termed the "funded capital of civilization." Dewey posited a philosophical belief that the acquisition of knowledge through education could ultimately yield a better quality of life for the learner. In addition, he believed that social reconstruction developed as a result of the changes of individual behaviors resulting from social consciousness. These beliefs serve as an emphasis of support for the conviction held by Dewey, the educator and philosopher, that education and philosophy are deeply and intricately infused.

One branch of philosophy most intimately linked with education and curriculum theorizing is epistemology, the process and nature of knowing. Rorty (1979) concluded that as an individual begins to realize that knowledge is a mere justification of one's own beliefs, one may begin to understand the nature of knowledge. Rorty reasoned: "If assertions are justified by society rather than by the character of the inner representation they express, there is no point in attempting to isolate privileged representations" (p. 174). Likewise, Bronowski (1978) related epistemology to attempts of the human mind to determine legitimacy in nature, not necessarily concern for the structure of specific laws of nature, but rather for the general nature of laws.

For humankind there appear to be many truths and many processes or ways of knowing. Schubert (1986) identified several ways of knowing, including intuition, reason, empiricism, revelation, authority, and the scientific method. The scientific method, which was previously illustrated in Chapter I of this dissertation, has been proven to be both an objective and verifiable method of attaining knowledge. The knowledge of insight or intuition, a priori knowledge, may lack credibility in the scientific realm but seems to be an active determinant in the decision making and activity of everyday life. Knowledge gained from reason and logical analysis tends to make data from inferences and facts separated from opinions more plausible. The Oxford English Dictionary (1989) equates empirical knowledge to that knowledge which is acquired by methods of observation and experience. Phrased more succinctly, empiricism is gaining knowledge through the senses. Revelation refers to knowledge that has been revealed as truth, usually by a religious group or leader. Knowledge gained from sages, historical leaders, or other guardians of authoritative knowledge such as books is yet another way of knowing. Schubert (1986) has thus reasoned that curriculum theorists and developers act on various assumptions which may be deeply founded in epistemology.

Philosophical assumptions are continually present and there is evidence to support the belief that they also directly influence the assumptions and decisions of curriculum theorists who operate from positions grounded in any one of the various philosophical camps. Dobson and Dobson (1981) have identified three prominent philosophical camps--existentialism, experientialism, and essentialism--and have carefully examined the nature of their respective influence upon curricular decisions and educational practices.

The philosophical camp of essentialism (Dobson and Dobson, 1981) has produced educational movements such as behaviorism and realism, which have origins in Aristotelian thought, for it was Aristotle who fabricated the concept of disciplines which is currently being used. According to Schubert (1986), curricularists of this philosophical camp support systemized procedures of teaching, a predetermined and rigidly structured curriculum, and highly technical modes of evaluation. Dobson and Dobson (1981) concluded that the focus of this curriculum would be toward product rather than process.

The philosophical camp of experientialism (Dobson and Dobson, 1981), or pragmatism as it may also be called, has produced educational movements typical of the progressive era which was characterized by an emphasis on individual differences and a curriculum centered around experiences, problem solving, and scientific inquiry.

On the other hand, the philosophical camp of existentialism (Dobson and Dobson, 1981) is at the root of a curriculum which can be characterized by its flexibility, emphasis on relationships, learner-directed activities, and multiplicity of techniques. Unlike the essentialists' curriculum, which is oriented toward product, the curriculum of the existentialist is focused on process.

The deep roots of philosophical beliefs may be found in the decisions and activities regarding all fields of study, all areas of curriculum, and in the use of language as well. Philosophy, in the generic sense, gives perception and frames of reference to all areas of life.

Effects of Language

Schwab (1978, p. 149) wrote, "Language is treated as if it were a battery of flawless and focused lenses. . . ." There are some who consider language but one tool of human communication; however, it is the method most frequently used to convey knowledge. Language consists of invented words, symbolizing objects, actions, or concepts, which are then combined into syntax for elucidation and meaning. The transference of meaning is often limited and problematical, as Dobson and Dobson (1981) have concluded:

> Words serve to produce a paradoxical situation; both the freezing and unfreezing of reality. . . . Humans invented words to serve as a tool and now they are controlled by this tool. Language which was intended to explain or describe reality has become our reality. What we can't explain we tend to ignore and ultimately dismiss (p. ix).

This view is also similar to one expressed by Schwab (1978), when he advised, "I suggest that language is not transparent and, though capable of leading a reader to water, not capable of making him think" (p. 150).

In support of the inadequacies and limitations of language, Wittgenstein (1953) also shared a belief that language was responsible for generating problematical issues, even though he regarded language as a mode for understanding the world. The meanings assigned to certain words in one place may take on an entirely different meaning in another place. As a point of illustration, a specialist in one field or area of study may give meaning to a word which is not the same meaning given that word by a nonspecialist or a specialist in a different field of study.

Additionally, the physicists, in their study of atoms, have realized the limitations and inadequacies of language to express the realities of quantum theory. Heisenberg (1958) admitted:

> The problems of language here are really serious. We wish to speak in some way about the structure of the atoms . . . but we cannot speak about atoms in ordinary language. The most difficult problem . . . concerning the use of the language arises in quantum theory (p. 177).

The dualistic nature of light, as a particle and as a wave, presented a paradoxical puzzle which escaped the confines of both imagination and common language.

Words are merely symbols which present a representation of the real thing; nevertheless, these descriptions are often mistaken for actual realities. Try as one may, it is impossible to describe freedom. Freedom is a state of being based upon direct experience, and the word freedom is a symbol representing this indescribable state. The state of being free or the experience of freedom and the description of freedom are two completely different things.

The realm of description began to frustrate physicists as they battled the limitations of language to describe the realm of experience in quantum reality. Zukav (1979, p. 260) alleged, "Quantum theory is not difficult to explain because it is complicated. Quantum theory is difficult to explain because the words which we must use to communicate it are not adequate for explaining quantum phenomena." It is as Dobson and Dobson (1981) concluded--man appears to be hindered rather than helped by the tool of words.

In addition, physicist Max Born (1957) also noted the limitations of common language when he wrote:

> The ultimate origin of the difficulty lies in the fact . . . that we are compelled to use words of common language when we wish to describe a phenomenon. . . . Common language has grown by everyday experience and can never surpass these limits. Classical physics has restricted itself to the use of concepts of this kind. . . . There is no other way of giving a pictorial description of motions. . . (p. 97).

Physicists seem to agree upon the inadequacies of common language to describe subatomic phenomena; however, there are some who believe descriptions and explanations in terms of mathematical analysis would not be as restrictive as the use of common language. Zukav (1979) draws a comparison of language and mathematics, noting that, like English, mathematics is also a language constructed of symbols. To substantiate his point, Zukav quoted David Finkelstein (1978):

> The best you can get with symbols is a maximal but incomplete description. A mathematical analysis of subatomic phenomena is no better qualitatively than any other symbolic analysis, because symbols do not follow the same rules as experience. They follow rules of their own. In short, the problem is not in the language, the problem is the language (p. 261).

It is evident that language is being used to elucidate complex phenomena and processes, often in an inadequate and inappropriate manner. Curriculum, a complex phenomenon is frequently conceptualized in metaphoric terms which may be neither adequate nor appropriate. Metaphors are words or phrases which may be used to depict analogies. Kliebard (1972) referred to three prominent curricular metaphors of schooling which include a travel model, a growth model, and an industrial model. In the travel metaphor, the teacher assumes the role of travel guide, assisting and guiding the students along the journey of learning and discovery. The plant metaphor depicts the learner as a growing and living plant which thrives from the nurturing of the nurseryman teacher. The industrial metaphor is similar to the factory model previously discussed in this chapter. Similarly, Dobson, Dobson, and Koetting (1985) identified three metaphors which they determined to represent a limited vision regarding children and the educational process. Those identified curricular metaphors are military, industrial, and disease. The disease metaphor is typically representative of current day special education practices where learners may be considered diseases awaiting some miracle cure. The language of special educators is saturated with medical terminology, including referral, testing and diagnosis, prescription and treatment, monitoring and remediation. All too often students with difficulties are considered impaired and deficient rather than special and different.

The language of classical science is ostensibly prevalent in the curriculum of today. Words which are reminiscent of the scientific method and typically associated with the current paradigm of schooling include: observation (passive learning), deterministic (prestated objectives), mechanistic (structured sequences), measurement (evaluation), cause-effect (grading), results (learner outcomes), control (rigid curriculum), efficient (time-on-task), verifiable (accountability), categorizing and classifying (labeling/ability grouping), analysis (part-to-whole), reductionistic (fragmented disciplines/isolated classrooms).

Individual curricularists may not be conscientiously aware of their own philosophical roots; nevertheless, the language they choose to use concerning schooling is a revelation of embraced values rooted in a particular philosophy (Dobson, Dobson, and Koetting, 1985).

In the following chapter, this study will explore the paradigmatic curriculum perspectives of eminent theorists and investigate their respective realities of nature, curriculum, and language.

CHAPTER III

EMINENT CURRICULAR THEORISTS AND THEIR CURRICULUM PERSPECTIVES

Introduction

As was stated earlier, the genesis of fundamental curriculum questions may be found in Spencer's (1902) axiological question, "What knowledge is of most worth?" (p. 5). And although most curricular theorists would acknowledge the value of determining what knowledge should be taught in schools, they may also stress the importance of inquiry into additional areas of curriculum which might include questions of how, when, where, to whom, and for how long that knowledge should be taught.

Questions of this nature often guide curriculum workers as they nurture and formulate their individual curriculum perspectives. These individual perspectives may ultimately become powerfully influential in the process of curriculum theorizing; however, there may be varying degrees of consensus and disagreement as to the curricularists deemed the most influential in the formulation of curriculum theory.

The Delphi Survey

Background

A Delphi procedure is a method of eliciting a collective consensus of opinion among recognized experts by having them complete a series of questionnaires. The traditional method of pooling individual opinions has been face-to-face encounters, which do not allow for respondents' anonymity even though confidentiality may have been maintained. The respondents' identity in a Delphi survey, on the other hand, may be completely anonymous and may additionally provide some degree of controlled feedback to the respondents.

Purpose of the Survey

Most curriculum scholars can readily mention the names of several prominent curriculum theorists whom they believe have been significant contributors in the area of curriculum theory. Nevertheless, there may not always be a consensus of opinion as to which specific curriculum theorist has had the greatest degree of influence in the formulation of curriculum theory. The purpose of this Delphi survey was to ultimately make that determination.

Definition

For purposes of this study, a curriculum theorist was defined as one whose work dealt primarily with what could be classified as curriculum studies.

Methodology

This particular Delphi survey involved the mailing of two sequential questionnaires to 169 members of the Society for the Professors of Curriculum. The recognized experts in this Delphi study were those distinguished and knowledgeable professors of curriculum.

The initial mailing asked the respondents to identify those curriculum theorists whom they considered to have been the most influential in the formulation of curriculum theory in America since the beginning of this century.

The response to the initial mailing was 68.04%, with 115 of the professors responding. The responding professors mentioned the names of 131 individuals whom they felt had been the most influential in curriculum theorizing. Some respondents mentioned only one individual, while others mentioned as many as 36. The frequency of mention ranged from 1 to 80.

The most frequently mentioned curriculum theorists included the following: Michael Apple, Franklin Bobbitt, Hollis Caswell, John Dewey, Elliot Eisner, John Goodlad, William Kilpatrick, James MacDonald, William Pinar, Hilda Taba, and Ralph Tyler. A complete listing of names submitted by the respondents in the first mailing may be found in Appendix A of this dissertation.

A follow-up survey, which contained the most frequently mentioned names in the initial survey, was mailed to the curriculum professors. The second mailing requested the respondents to select the five persons whom they believed to be the most influential in developing curriculum theory from a list of 11 most frequently mentioned names. The response to the second mailing was 74.55%, with 126 of the curriculum professors responding. The frequency of mention ranged from 21 to 109.

The curricularists receiving the most frequent mention and deemed to have been the most influential in the formulation of curriculum theory included the following: John Dewey (109), Ralph Tyler (108), Hilda Taba (69), and Franklin Bobbitt (62). A complete listing of names elicited in the second mailing may be found in Appendix B of this dissertation.

<u>Incommodious Incursion</u>

The execution of this survey posed no particular problem or difficulties. Nevertheless, the untimeliness of the first mailing did pose a minor inconvenient situation for both respondents and surveyor. It was unfortunate that the first survey letter was mailed to the university professors near the close of the summer session. With only a few weeks of the term remaining, they were understandably preoccupied with the routine activities of a semester's end. There were a great number of survey letters returned during the first few weeks following the mailing, but there were many responses that were not returned until a few months later. The untimeliness of this first mailing may account for the marginally lower percentage of responses as compared to the slightly higher percentage of responses for the second mailing.

The second survey letter was mailed a few weeks after the beginning of the subsequent fall semester. It is assumed that the routine activities and the traditional rush of beginning a new term had been completed, allowing the university professors a somewhat greater degree of time to respond.

Conclusions

The curriculum professors who participated in this Delphi survey offered a variety of names representing the persons whom they considered to be influential in the formulation of curriculum theory. It was not surprising to note that the persons mentioned by the respondents representing a variety of philosophical camps ranging from realism to reconceptualism, from Thorndike and Schwab to Pinar and MacDonald. Neither was it a surprise to discover that the persons the curriculum professors deemed to be the most influential in the development of curriculum theory (Dewey, Tyler, Taba, and Bobbitt) also represented philosophies commensurate with the traditionally dominant scientific model of curriculum.

Curricularists of the Scientific Model

The efficiency of the industrial age, Darwin's theories of evolution, and the countless applications of scientific methodology to various aspects of society have impacted the practices and theories of numerous curriculum leaders of this century. Social and educational efficiency were commensurate with the precision, efficiency, and productivity of Henry Ford's assembly line. "Work up the raw material into that finished product for which it is best adapted," demanded curricularist, Bobbitt (1912, p. 269). Bobbitt was not addressing industrial shop managers, as his edict might indicate; instead, he was addressing elementary school teachers, and his finished product was not in reference to automobiles but to children.

Bobbitt (1912) incorporated the theories and practices of scientific management into school administration by proposing a division of labor and job specialization. Administrative and curriculum supervisors were analogous to the industrial shop managers, who were charged with producing quality products according to predetermined specifications. This hierarchical arrangement of rank and order progression was congruent with the logical sequencing practices of classical science. Moreover, the obsession with predetermined specifications and end products was also reminiscent of the mechanistic and rational logic of Newton's world machine.

Bobbitt (1918) believed that education was in need of a scientific technique for the development of curriculum congruent with the technical methodology of the scientific age. He was determined to eliminate the guesswork in curriculum making by developing a scientific method of inquiry for analyzing results and diagnosing situations so that remedies might then be prescribed. Analytic survey would become the means to accomplish that end.

Bobbitt (1924) compared the task of determining a curriculum to that of constructing a railroad. The initial responsibility of the construction engineer would be to conduct a broad overview of all inclusive factors, analyze those factors, and ultimately formulate the direction of the railroad route.

Bobbitt (1918) believed that the curricularist must, in like effort, analyze all inclusive factors of human nature and human affairs to first determine which ideals of social efficiency should be taught. Once these activities were identified, they would constitute the full range of curricular goals which would then necessitate further analysis. Bobbitt concluded that this analysis would need a scientific technique. As in linear Newtonian physics, the individual component part would be segmented and isolated from the whole for the purpose of observation and analysis.

Consequently, with the scientific precision of an engineer, Bobbitt (1918) endeavored to develop a scientific model of curriculum for activity analysis. Colleague and eminent curricularist W. W. Charters (1924) supported Bobbitt's belief that it was necessary to provide an analysis of each activity that was to be taught. Charters (p. 40) cautioned, "Without such analysis we are entirely at a loss to know how to proceed in building the curriculum." Once the activities had been identified, the most minute curricular objectives were thoroughly analyzed. The analyzed objectives were subsequently placed in a hierarchy of importance for social efficiency.

The decision to prioritize objectives in a predetermined fashion eliminates the option of student choice regarding their own learning and gives the freedom of these choices to persons in authority. Classical scientists considered matter to be an essentially passive element in a deterministic world.

Likewise, Bobbitt (1924) considered learners to be passive participants in a predetermined curriculum. True to the factory model, students were being regarded as inanimate objects, the end result of quality control.

This predetermination process ultimately leads to labeling and tracking of individual students down divergent curriculum paths. Contemporary writer Michael Apple (1990) addressed this practice of tracking students for social efficiency. As was previously illustrated in Chapter II, it is Apple's contention that stratification of students serves to perpetuate a hierarchical society. Apple (p. 33) postulated, "Schools, therefore, process both knowledge and people." Prominent intellectual leaders like Bobbitt had begun to perceive social reform, social control, and behavioral conformity as primary in the responsibilities and purposes of schooling.

Control, precision, and predictability are major tenants of Cartesian-Newtonian thought and congruent with the methodology of classical science. One characteristic of the scientific method was a predetermined series of precisely controlled analyses very similar to Bobbitt's (1918) scientific activity analysis of curricular objectives. He firmly believed in the employment of scientific methodology to formulate curriculum theory and practice. Bobbitt (1924, p. 32) stated, "The first step in curriculum-making is to decide what specific educational results are to be produced." His concern for predetermined objectives was reflective of his allegiance to the deterministic tenets of classical science. The contemporary curricular practice of establishing predetermined learner outcomes appears to be as firmly entrenched in quality product control as the factory metaphor implies.

As the classical scientists use predetermination and control in their methods, Bobbitt (1924) also believed in the use of determination and control in the making of curriculum, and suggested, "The curriculum-maker will take the objectives . . . and discover what the pupils should do and experience by way of achieving the desired results" (p. 44). The deterministic control of classical science is ostensibly represented by the establishment of predetermined, teacher-directed objectives in the manner he suggested. Bobbitt's (1924) plan for curriculum definitely appears to have its roots deeply embedded in the realities of Newton's classical science.

Bobbitt's (1924) concrete guidelines for developing curriculum encouraged other theorists to produce various practical cookbook type, how-to-do manuals for the development of curriculum. Hilda Taba and Ralph Tyler are but two of the theorists who have penned classical guide manuals of this nature.

Taba (1962), a distinguished curricularist and student of Ralph Tyler, believed that curricularists should do an in-depth analysis of the learner, knowledge, society, and culture prior to the planning of curriculum. Taba, as did Bobbitt, contended that curriculum development needs to be a rational and scientific procedure based upon valid and predetermined criteria. These criteria may come from various sources which she believed should include the analysis of society and culture, and also studies regarding the learner and the learning process.

This type of curriculum development would require, according to Taba (1962), orderly and sequential thinking in the examination of needs and decisions to be made. The scientific precision of orderly and sequential practices involved in the decision-making process she described are consistent with the rational and sequential procedure of the scientific method used in classical science. Taba (1962) acknowledged that her book, Curriculum Development, was based upon the assumption that there is indeed such an order. She postulated that the pursuit of such an order would produce a more "thoughtfully planned and a more dynamically conceived curriculum" (p. 12).

Some dominant characteristics of classical science include rigid mechanistic determinism. The how-to-do manual style curriculum suggested by Taba (1962) provides a rigid and mechanistic approach to the formulation of curriculum theory which is extremely reflective of the dominant scientific method.

Taba's (1962) steps to curriculum making were as rigid and exact as Newton's fixed laws. The seven steps which Taba provided as guidelines for the development of curriculum are as follows:

Step 1: Diagnosis of needs
Step 2: Formulation of objectives
Step 3: Selection of content
Step 4: Organization of content
Step 5: Selection of learning experiences
Step 6: Organization of learning experiences
Step 7: Determination of what to evaluate and of the ways and means of doing it (p. 12).

As was previously illustrated in this chapter, the classical Newtonian vision of reality permeated the logic of Bobbitt, and obviously it permeates Taba's curricular logic as well. Taba (1932, p. 10) contended, "All disciplines . . . are centered around certain elements, certain specific functions and aspects, which can be analyzed out of the gross total of the given phenomenon of experience." Typical of Newtonian physics, the whole has been fragmented and dissected into segments for the purpose of analysis and observation. The individual components of culture, society, learners, and learning have been dissected for scrutiny and their individual behaviors will thus shape the nature of the curriculum. In Newtonian physics, it is the function and behavior of individual component parts that determine the behavior of the whole. Similarly, in Taba's curricular approach, it will be the behavior of the individual component parts that ultimately determine the behavior of the whole.

Clearly, Taba's (1962) approach to curriculum is reminiscent of the scientific model: mechanistic, rational, sequential, deterministic, and systematic. Commensurate with Newtonian logic, Taba proposes the mechanistic use of linear and sequential steps in the formulation of a deterministic curriculum. Taba (p. 13) believed that, "[W]orking at curriculum change becomes a systematic enterprise to be broken down into smaller enterprises . . . undertaken as a series of steps." In this light, curriculum is not viewed as a whole entity but as a collection of component parts.

Taba (1962, p. 413) acknowledged that, "Any enterprise as complex as curriculum development requires some kind of theoretical or conceptual framework of thinking to guide it. . . . What is lacking is a coherent and consistent conceptual framework." To fill that conceptual void, Taba proposed the following systematic questions as that conceptual framework:

1. What is a curriculum; what does it include and what differences are there between the issues of a curriculum and those of a method of teaching?

2. What are the chief elements of the curriculum and what principles govern the decisions regarding their selection and the roles that they play in the total curriculum?

3. What should the relationships among these elements and their supporting principles be, and what criteria and principles apply in establishing these relationships?

4. What problems and issues are involved in organizing a curriculum and what criteria need to be applied in making decisions about the patterns and methods of organizing it?

5. What is the relationship of a curriculum pattern or a design to the practical and administrative conditions under which it functions?

6. What is the order of making curriculum decisions and how does one move from one to another? (p. 421).

Taba's suggested set of systematic questions to guide curriculum thinking has been regarded as a major influence in the field of curriculum. This practical, atheoretical guide has been highly valued by many curricularists. However, in times of rapidly changing circumstances, the lockstep, how-to-do manuals for curriculum making have rapidly become dated, and as old paradigms, they too begin to fail.

The study conducted by Shane (1980) revealed Tyler's (1949) Basic Principles of Curriculum and Instruction to be equally as influential in the area of curriculum development as John Dewey's (1944) Democracy and Education. The findings of the Delphi study conducted as a portion of this dissertation are commensurate with those of Shane. Similarly, the eminent professors of curriculum surveyed in this study agreed that Dewey and Tyler were nearly equal in their degree of influence regarding the development of curriculum theory.

One inherent danger in the sharing of a theory is the distortion and misapplication of that theory due to misinterpretation by others. Tyler's theory may have been such a victim. In the introduction of Tyler's (1949) book, he stated:

> It is not a manual for curriculum construction since it does not describe and outline in detail the steps to be taken by a given school or college that seeks to build a curriculum. This book outlines one way of viewing an instructional program. . . (p. 1).

In the final chapter of his book, Tyler further cautioned:

> Another question arising in the attempt at curriculum revision by a school or part of a school is whether the sequence of steps to be followed should be the same as the order of presentation in this syllabus. The answer is clearly 'no' (p. 128).

The simplistic design of Tyler's (1949) rationale, combined with the aura of a technological society, may have been the justification used by curricularists for their conversion of Tyler's rationale into a curricular recipe. In spite of the cautions provided by Tyler, there are those who religiously follow the sequential and systematic logic of his rationale without variance. For several decades, Tyler's rationale has continued to remain the dominant model for the development of curriculum (Schubert, 1986).

In his rationale, Tyler (1949) posed four questions which he believed to be fundamental in providing the parameters for the development of curriculum. Those queries included the following:

1. What educational purposes should the school seek to attain?
2. How can learning experiences be selected which are likely to be useful in attaining these objectives?
3. How can learning experiences be organized for effective instruction?
4. How can the effectiveness of learning experiences be evaluated? (p. 1).

Tyler's (1949) emphasis on purposes, goals, and educational objectives is reflected in the criteria established by subsequent authors of curriculum works. Taba (1962) noted:

> The chief functions of . . . objectives is to guide the making of curriculum decisions on what to cover, what to emphasize, what content to select, and which learning experiences to stress . . . the statement of desired outcomes sets the scope and the limits for what is to be taught and learned (p. 197).

The rigid parameters visibly noticeable in the curricular logic of Bobbitt, Taba, and Tyler are characteristic of the deterministic and unchanging laws of classical science. This type of rational curricular logic, with its notion of limit setting, does not provide flexibility for teachers or learners, nor does it allow for the pursuit of spontaneous interests by the learners. Bode (1927, p. 237) clearly made that point when he stated, "We put shoes on a child to protect his health and not to bind his feet."

Tyler's (1949) devotion to prestated objectives appears to mesh perfectly with the deterministic nature of the mechanistic scientific model of Newtonian physics. In classical science, every cause had an effect. Nothing was left to chance, for it had been predetermined. This was the deterministic nature of Newton's clockwork universe.

Likewise, in Tyler's (1949) rationale for curriculum, nothing is left to chance, for it has all been predetermined. The cause and effect of prestated objectives and student achievement is equivalent to the cause and effect of Newton's laws. Major curricular contributions which have been ostensibly based upon the Tyler rationale conformed to the linear and sequential characteristics of a rigid and mechanistic model. Tanner and Tanner (1975) made a point for thought when they reasoned that there could be no limit to the number of objectives that would result from the continual dissecting of curriculum into infinitesimal steps and objectives. Ostensibly, the numerous objectives would be a tremendous burden for both teacher and learner, but more importantly, Tanner and Tanner believed that this unbridled practice of fragmentation destroys the conceptualization of a unity of knowledge.

The fourth area of emphasis in Tyler's (1949) rationale is evaluation. The scientific method of empirical inquiry necessarily involves that of evaluation and some of the strongest advocates of measurement and evaluation were the psychologists Wundt, Simon, and Binet. The impact of intelligence testing may be noted especially in the area of special education. Educational evaluation and measurement has evolved into a major concern for both students and educators. Stated learner outcomes predict a desired result that will be measured in scientifically verifiable terms. As the factory model product is subjected to the rigors of quality control standards, the students is likewise subjected to the rigors of testing and evaluation standards. As with Newton's absolute time and space, there seems to be an absolute body of information that all students should obtain.

The Cartesian-Newtonian thought that produced the scientific model has influenced the development of a fragmented curriculum. This fragmented curriculum represents a rigid structure guided by lockstep procedures which tend to be oriented toward learner outcomes or the quality of the final product, rather than toward the very process by which that achievement is attained. Learning appears to be a product, a destination. The priority tends to be on performance.

The priority for John Dewey (1944) was experience. Dewey was a pragmatist and believed that students create knowledge through the reconstruction of experience; however, he believed these experiences should be well ordered and true to the scientific method. The use of the scientific method had brought about many advances in science, and Dewey interpreted those advances of science as a possible means of controlling nature for the betterment of humankind.

In this light, Dewey (1944) felt that if democracy was to become a working reality, then an educational reform was imminent. His work was the impetus behind the Progressive Education Movement, which was responsible for developing a notion of curriculum saturated with problem solving through classical scientific inquiry. Though rigidly structured according to scientific procedure, the child-centered curriculum differed from the traditional curriculum. This curriculum was based on the theory that learning best occurs by doing; therefore, learners should be active participants in that learning rather than passive observers. Dewey compared the passive learning of formulas, rules, and terms to the passive learning of parts of a machine without fulfilling comprehending what function those individual parts perform. As Dewey (p. 221) concluded, "When learned in this condition it remains a body of inert information."

In 1896, Dewey established The Laboratory School, which served as a laboratory for testing his theories. Dewey's hypotheses for the school were that life itself should be the curriculum and that freedom of expression was a necessary condition for growth (Hendley, 1986). His school confirmed both hypotheses, and since Dewey (1897, 1900) felt that the purpose of education was to build a better society, it was a genuine attempt of education at social reform. The social reconstructionists emphasized the role of schools in societal reform as opposed to the perpetuation of current societal standards (Schubert, 1986).

In an analytic manner unlike that of Bobbitt and Taba, Dewey believed that the concerns of curriculum should be scientifically based upon societal changes to achieve social reform and also upon the predetermined needs of that changing society and the learner. However, as in the instance of Tyler, Dewey may have been a victim of the misapplication of theory.

The followers of Dewey (Schubert, 1986) failed to heed his theory that the major components of curriculum (learner, society, and content) were to be considered as separate yet dependent entities of a working whole. The progressive schools, however, became obsessively involved with the individual learner, nearly to the point of exclusion of Dewey's other two curricular components.

Dewey was perhaps at the forefront of change. The static traditional schools, in which knowledge seemed to exist for its own sake, were the schools which society had grown to embrace. Even though Dewey professed the importance of experiences to individual student learning, the experiences were parallel to that traditional scientific method. Dewey (1902) did not believe in the sheer existence of an activity, for he maintained that all activity occurs in a medium referenced by its conditions. Experiences were valuable extensions to the acquisition of factual information; however, Dewey was dedicated to the notion of structure of activity related to traditional scientific inquiry.

These progressive ideas and humanistic characteristics of Dewey's child-centered curriculum did not obtain full acceptance by society or curricularists. Without the credibility of empirical evaluation and scientifically verifiable results, the progressive theories gave way to more traditional ones like that of Ralph Tyler and Hilda Taba.

For those who continue to view curriculum as a complex machine for transforming the student into a predetermined and quality finished product for societal efficiency, the how-to-do handbooks of curriculum will undoubtedly remain essential.

Suggestions for Further Studies

The eminent professors of curriculum participating in this Delphi study were asked to indicate which curricularists they deemed to be the most influential in the formulation of curriculum theory. The curricularists mentioned most frequently included: Tyler, Dewey, Bobbitt, and Taba. It is my recommendation that separate follow-up studies be conducted on each individual curriculist in order to provide a more in-depth profile of their respective philosophies.

CHAPTER IV

A TRANSFORMATIONAL PARADIGM: AN ALTERNATIVE CURRICULUM PERSPECTIVE

Vehicles of Curriculum Reality

Reality, that ultimate and absolute truth, requires a vehicle of conveyance if one wishes to share a particular vision. Curricular theorists have permeated the literature with their use of models and paradigms to convey their visions of reality.

A model may refer to an example for imitation, a design to be copied, a pattern to be followed, a representative to be matched, or an ideal for attainment. Connotations of this nature naturally lead to notions of a certain predetermined structure without flexibility, one that is static and with well-defined parameters. Model, therefore, represents stability, and because a model can be evaluated and measured against the norm, it further implies rationality. The technical format of models is one of linearity where stages of sequential steps must be precisely followed. Thus, the nature of model would include a controlled and systematic linearity based on an established pattern.

Additionally, the use of model bears a familiar resemblance to current curricular practices which have been traditionally rigid and inflexible, as the term model infers. Curricular models are typically held as ideals for attainment. Blind dedication to the attainment of that particular ideal and mindless following of the linear and sequential steps to those predetermined patterns may well be the etiology of the present educational state. Present circumstances in curriculum reflect the deterministic nature of model. Students have not been afforded the freedom of flexibility of choices to meet human variabilities, nor have they been provided opportunities for creative expression within the rigid and mechanistic structure in which they now exist.

Model has long been a traditional vehicle for the expression of one's vision of reality, yet other viable means of expression are constantly emerging. The term paradigm is one more vehicle of reality communication, a term used by Kuhn (1970) to denote a loosely connected pattern of ideas. Kuhn identified what he believed to be three important components of a paradigm: symbolic generalizations, shared commitments, and shared values. Kuhn acknowledged that even though scientists may share the same values, their application of those shared values may be diverse. He claimed, "Shared values can be important determinants of group behavior even though the members of the group do not all apply them in the same way" (p. 186).

Kuhn (1970) further implied that a paradigm "stands for the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community" (p. 175). He continued to note that a "community consists of men who share a paradigm" (p. 176).

Various authors, including Schubert (1986), have given enhanced meaning to the term "paradigm." Schubert referred to paradigms as "conceptual lenses" through which problems may be perceived. Ferguson (1980) used paradigm as a framework of thought for explaining reality. Zukav (1979) expressed paradigmatic reality in the form of a syllogism when he wrote:

Reality is what we take to be true.
What we take to be true is what we believe.
What we believe is based upon our perceptions.
What we perceive depends upon what we look for.
What we look for depends upon what we think.
What we think depends upon what we perceive.
What we perceive determines what we believe.
What we believe determines what we take to be true.
What we take to be true is our reality (p. 310).

Evidence was presented in Chapter II of this dissertation that illustrated the importance of philosophical and epistemological assumptions in shaping curriculum reality. For that reason, the nature of each individual's conceptual lenses may vary and the resulting paradigm of curricular reality, therefore, tends to be unique to that individual.

Thus, the concept of paradigm infers variance and deviation, implying no predetermined structure or design. The nature of paradigm would reveal flexibility without defined parameters and spontaneity as opposed to control. Kuhn (1970) reinforced the notion of flexibility when he claimed, ". . . a paradigm is rarely an object for replication. Instead . . . it is an object for further articulation and specification under new and more stringent conditions" (p. 23). Curricular paradigms, as opposed to curricular models, would afford students the flexibility of choices to meet their distinctly different variabilities and provide vast opportunities for individual creative expression. Unlike models, paradigms do not govern communities or disciplines of thought by a rigid set of rules; instead, paradigms provide alternative ways of viewing reality.

Models and paradigms are two frequently used, yet two distinctly different vehicles for the conveyance of curriculum reality. In sum, models are examples for imitation. Paradigms, however, are rarely examples for replication (Kuhn, 1970). Due to their clearly diverse natures, confusion and misinterpretation may result if these two terms should be used interchangeably.

Paradigm Shift

As was stated in the above text, Kuhn's (1970) vision of paradigm represents a loosely connected pattern of assumptions which are shared by a community of people. In the community of science, the classical scientists would research and experiment to verify that which is known. Sometimes an experiment would produce a novelty or a deviation from the norm known as an anomaly. Oftentimes, novelties are ignored when they first appear and, as Kuhn pointed out, they meet much resistance and emerge with great difficulty. Kuhn indicated that when old rules begin to fail and anomalies become profuse to the point of causing unrest within the scientific community, new and divergent theories will begin to emerge. Old and tested theories will become challenged. This period of debate and unrest, this emergence of crisis, is what Kuhn (1970, p. 6) referred to as a "shift in professional commitments," and this transition to the new paradigm he called "scientific revolution." The result of a paradigmatic shift is progress and perhaps ultimately a forward acceleration in the direction of truth.

Ferguson (1980) identified this paradigm shift as a "distinctly new way of thinking about old problems" (p. 26). From old data, scientists can formulate new questions and draw new conclusions. Emerging anomalies serve to open up new fields, new ways of thinking, while changing those fields that are already in existence. Anomalies are not easily accepted and there is much resistance to paradigmatic change. Established paradigms offer some measure of assurance and strong commitments to lifelong assumptions, and are therefore not easily abandoned. However, as Kuhn (1970) concluded, the decision to reject one paradigm and accept another must be as the "switch of the gestalt" (p. 85), suddenly and completely, without vacillation between the two.

Although the new paradigm is often more effective than the old in that it provides for a new mode of thinking, it is not without limitations. The new paradigm may be able to solve the problems that led the old paradigm to crisis; however, it may not necessarily solve all the problems. Kuhn (1970) believed that the locus of a new paradigm is created by problems resulting from the old, accepted paradigm. The new paradigm, therefore, blends with previously established theory and reconstructs and reevaluates the prior assumptions.

Scientific Revolution: Quantum Mechanics

At the beginning of the twentieth century, humankind's continued search for the realities of nature led researchers into a new area of inquiry called "quantum mechanics." As anomalies emerged, physicists determined those separate, isolated particles of matter to be mere abstractions and not the "basic building blocks" of classical Newtonian mechanics. As a result of these perplexing anomalies, physicists began to delve deeper into the constituency of the universe and the reality of its functioning.

In <u>The Dancing Wu Li Masters</u>, Zukav (1979) used a layman's approach in his attempt to demystify the aura which tends to surround physics and its undecipherable mathematical equations.

> Physics, in essence, is simple wonder at the way things are and a divine . . . interest in how that is so. Mathematics is the tool of physics. Stripped of mathematics, physics becomes pure enchantment (p. 4).

Quantum mechanics may seem somewhat controversial in that it is concerned with what may appear to be the nonexistent. To provide clarity and an understanding of quantum mechanics, Zukav (1979, p. 19) defined quantum as ". . . a quantity of something . . ." and mechanics as ". . . the study of motion. . . ." The branch of physics known as quantum mechanics is, therefore, the study of the motion of quantities.

Finkelstein (1978), in his foreword to Zukav's (1979) book, elucidates the relationship of quantum mechanics to classical mechanics. Finkelstein reasoned:

> . . . it is important to mention in defense of quantum theory that in spite of indeterminacy, quantum mechanics can be entirely expressed in yes-or-no terms about individual experiments, just like classical mechanics, and that probabilities can be derived as a law of large numbers and need not be postulated. . . . Once sufficient data is given, classical mechanics gives yes-or-no answers for all further questions while quantum mechanics simply leaves unanswered some questions in the theory, to be answered by experience (p. xxv).

In summation, Finkelstein described Newtonian theory as a complete theory, one in which all things could be predicted. He further contrasted it to quantum theory, which he described as a maximal theory, one in which as much as possible is predicted.

Similarly, Wolf (1981) illustrated and further elucidated the conflicting theories of Newtonian physics and quantum physics. In Newtonian physics, movement was perceived to be a smooth and continuous flow, as is demonstrated by the smooth, continuous movements of an arrow in flight. Conversely, quantum physics indicates that all particles in matter move in tiny but chaotic, explosive jumps and that it is impossible to determine or predict, with absolute certainty, their movements. The explosive jumps of the atoms were radically different from the smooth, flowing movements the scientists were predicting, and as a result of these new findings, scientists could no longer simply accept the classical assumptions regarding the motion of matter. Further inquiry and experimentation led to the development of new realities of nature as scientists began to change their thinking about certainty, determinism, and fragmentation.

These major changes began occurring in 1900, when Max Planck (1949), whom some consider the father of quantum mechanics, began exploring black body radiation and discovered Planck's Constant, a changeless number which was used to calculate quantum, the size of energy movements. Newtonian physics assumed that heated electrons generated energy both smoothly and gradually, but Planck (1949) was able to determine that heated electrons emit energy only in specific amounts and only in sudden and explosive spurts. As a result of his work, Planck concluded that nature could no longer be viewed as changing in a smooth, rational, and predictable fashion.

Physicists further discovered that any attempted observation of these tiny atoms and subatomic particles had decidedly disruptive effects. The simple act of observing interfered with the observed. For centuries, scientists had been accustomed to viewing nature in a detached, orderly, and totally objective manner; however, quantum physics indicated that the very act of observing interfered with what was being observed, and that the tools the observer used might determine what was observed. One elementary example of this would be light rays passing through different colored lenses. A ray would appear red when passing through a red lens but blue when passing through a blue lens. The lens the observer chose to use would determine what the observer would actually observe.

The appearance of anomalies began to undermine the foundations of the traditional Newtonian world view. Planck (1949) had discovered the quantum and a brilliant physicist named Albert Einstein produced yet another anomaly with his Theory of Relativity. The concept of space and time in classical Newtonian physics was of two totally separate and absolute entities; however, according to Einstein's Relativity Theory, space and time have a relationship in a space-time continuum (Gribbin, 1984). A continuum would represent an unbroken wholeness which can neither be divided for analysis nor objectively measured for accuracy. Newton believed in time as an absolute, as constantly marching forward and always flowing continuously. In Newton's mechanistic world, time could be dissected into portions, analyzed, measured, and labeled such as hours, months, and years according to the forward flow of motion. Absolute space could also be analyzed and measured for comparisons.

Nevertheless, Einstein's (1955) Theory of Relativity proved absolute time and absolute space to be nonexistent, but the appearances of time and space to always be relative to one's frame of reference. The term "appearances" is used because it is those appearances that are relative. For example, the appearance of the white divider stripe painted down the center of a modern highway may appear to be eight feet in length to an observer standing by the roadside; however, the white stripe may appear to be only three feet long to an observer riding in a car that is traveling at a high rate of speed. The appearances of the white median stripe are relative to the frame of reference of the observer.

Einstein (1955) discovered that two observers in two different frames of reference could utilize their differing states in a meaningful manner relative to each other, and to illustrate this point he used the example of a broken elevator cable. Zukav (1979) gave a perspicuous elucidation of Einstein's mental experiment in which an elevator located in a tall building begins to plummet toward the ground at an accelerating rate as the elevator cable suddenly snaps. The perspective of the observers outside the elevator watching the rapidly plummeting elevator descend to the ground is relative to their state in time and space and is opposingly different to the perspective of the observers located inside the elevator, whose perspective is also relative to their state in time and space.

Einstein's Theory of Relativity forever abolished the Newtonian concept of absolute time and space. In addition, Einstein (1955, p. 30) pointed out, "It is neither the point in space nor the instant in time, at which something happens that has physical reality, but only the event itself."

Henceforth, emerging anomalies began challenging the nature of Newtonian reality. The clockwork universe, which had previously supplied simplistic solutions, was becoming increasingly complex and producing answers that seemed to defy coherent explanation. Einstein (1955) had discovered that light could display two opposing qualities. One quality was that of a particle and the second quality was that of a wave. While further investigating this wave-particle duality of light, Louis Victor deBroglie discovered that matter, which is composed of particles, could likewise exhibit wave-like characteristics (Wolf, 1981). Complementarity was the principle developed by Bohr (1934) to explain this paradoxical concept of wave-particle duality which, without exception, is evident in all matter.

Bohr's (1934) interpretation of complementarity revealed nature to be a single unbroken wholeness which, when observed, may appear paradoxical to the observer during any attempted analysis or observation. Again, the disruptive results of observation had come into play.

Bohr (1934) reasoned that the particle quality and the wave quality were two complementary views of the same reality. This same complementarity may be compared to what happens when a two-sided coin lands tails up. The complementary side remains hidden and unreal until the coin is inverted and the heads side is revealed. Bohr further concluded that each quality, the wave quality and the particle quality, was essential to atomic reality.

Wolf (1981) provided a brilliant elucidation of complementarity which tends to demystify the abstractedness of the concept. Wolf reasoned that to experience the particle nature of matter, one merely needs to physically touch an object. His object of example was an ordinary wooden lead pencil. The physical contact with that pencil can provide the observer with certain knowledge regarding pencilness. Wolf continued this elucidation by noting that pencils are made of stuff and that a further examination of the inside of the pencil would merely reveal more pencil stuff. However, if the observer desired to delve more deeply into the basic building blocks of pencilness, the stuff would then be heated to permit the atoms more freedom of movement, which would make a closer examination of those individual atoms possible. As the atoms come boiling out of the heat, they are collected on a screen, where each individual atom leaves a small spot. Observation indicates that the atoms are not traveling along a straight line, thus it is determined that the escape opening onto the collection screen may be too large. Nevertheless, the smaller the opening becomes, the more deviations the atoms take, until it ultimately becomes apparent that the small spots left by the impact of the atoms have created a circular halo much like the ripples caused by throwing a stone into a pool of water.

It is determined, therefore, that these wave patterns did not occur by individual atoms acting separately or independently, but by the separate and individual atoms acting interdependently. In conclusion to his perspicuous elucidation, Wolf (1981, p. 137) reasoned, "It is the overall pattern of all the atomic spots that tells us something else is going on. These wave patterns are complementary pictures to the individual particle spots." The existence of an interdependency and interrelatedness within the complexities of nature was gradually becoming apparent.

Moreover, the scientists' role was changing from that of passive observer to one of active participant. Initially, the early human observations consisted of passively observing the nature of human existence in a nondisruptive manner. However, as human observations progressed to objects outside their being, the observations became active experiments. It was ultimately discovered that within the infinitesimal world of atomic particles, the mere act of human observation disrupted that which was being observed. Scientists eagerly began to measure the location and velocity of atomic particles. The atomic reality in Heisenberg's (1958) Uncertainty Principle, however, was that these two properties could neither be measured accurately nor simultaneously.

The classical concept of motion traditionally described actual observations involving the motion of large objects, but that same concept of motion would not be feasible when involving the motion of objects which the naked eye could not see. Because atoms and subatomic particles had not been seen, the physicists could only make assumptions concerning the atoms' movements and the velocity of those movements. Subatomic particles move in quick, sporadic jumps and the more diligently and accurately the physicists would try to measure the velocity of those jumps, the farther away from determining the particle's position they would become. Heisenberg's (1958) contention was that there would always be uncertainty in the measurements regardless of the accuracy of the attempts, because the observer would always disturb what was being observed.

Thus, the act of observation would appear to be meaningful only if participation and interaction with the object had occurred. This point was emphasized by Heisenberg (1974, p. 81) in his statement, "Natural science does not simply describe and explain nature; it is part of the interplay between nature and ourselves." He further concluded, "What we observe is not nature itself, but nature exposed to our method of questioning" (p. 58). The world which Newton had perceived to be deterministic and static was ostensibly uncertain and full of motion and change.

The traditional rules had begun to fail and the classical assumptions were being challenged. Those frequently occurring anomalies initiated the emergence of a paradigmatic shift, a revolution within the scientific community.

Einstein (1955) still was not convinced. He believed it possible to predict the position or motion of an object without disturbing the object (Wolf, 1981). Einstein continued to believe in an orderly universe, one in which God did not play dice, as he so stated to Niels Bohr during one of their many discussions on quantum physics. Einstein believed quantum theory to be an incomplete theory because it failed to describe certain aspects of physical reality (Einstein, Podolsky, and Rosen, 1935). According to Einstein, there must be a one-to-one relationship between physical theory and actual physical events in order for a theory to be complete. Without fail, classical physics had maintained this theory/event relationship. Since quantum theory did not have a theoretical basis for every individual physical event that occurred, it could not accurately predict the occurrence of those individual events, only the probabilities of occurrence.

Probabilities and accurate predictions are affected by hidden variables, and it was assumed that those mechanical controlling hidden variables in classical physics were due to local causes. However, in the world of quantum physics, it was assumed that those influential hidden variables were nonlocal connections to the universe. Einstein (Capra, 1975; Wolf, 1981) resisted the concept of nonlocal hidden variables affecting reality. Because quantum theory dealt in probabilities rather than theoretical elements for reality, Einstein concluded that quantum theory was incomplete. His belief was a reaffirmation of classical causality, determinism, and continuity.

Niels Bohr, on the other hand, believed quantum theory to be a complete theory, even though the theory provided no view of physical reality separate from that which was observed (Zukav, 1979). For Bohr, there was no absolute reality of the existence of subatomic particles, only their tendencies to exist (Wolf, 1981). Consequently, his interpretation of quantum theory dealt in probabilities which, he believed, were influenced by nonlocal hidden causes.

In quantum theory, any analysis of a subatomic particle was interpreted as an observation, and it had been determined that the very act of observing was disturbing to the particle and constituted a discontinuous act. For this reason, Bohr (1934) believed the world to be an unbroken wholeness, an interconnected web of realities where isolated particles could only be observed by their interaction with others.

Both Bohr and Einstein held firm, and the debates continued. According to Wolf (1981, p. 124), ". . . the debate between Bohr and Einstein has still not ended, though both are now dead. Indeed, the battle of continuity and discontinuity may never end." The classical Newtonian view of reality had used the human senses, including those senses of sight and touch, to confirm the existence of material objects. As was previously illustrated in this text, the color of lens the observer chose to use would determine what the observer would actually observe. Thus, the view of reality presented by quantum theory appeared dualistic and paradoxical because it seemed to be dependent upon what and how the observer chose to observe.

In am attempt to settle the quantum theory debate, distinguished physicists met in Belgium in 1927, in an effort to determine precisely what reality quantum theory was actually describing. Zukav (1979) noted that the meeting together of those eminent physicists, in what became known as the Copenhagen Interpretation, helped to initiate the genesis of acceptance of the new physics.

This interpretation of quantum physics created a new lens for viewing the world of Newton. It abolished the former classical one-to-one theory/event ratio, and although Einstein failed to fully accept the interpretation, he and many other physicists agreed that quantum theory was consistent in all experimental situations and presented a viable means of explaining subatomic phenomena (Zukov, 1979).

In summation, the Copenhagen Interpretation determined that quantum theory could be used to explain general or universal behaviors and could also be used to predict the probabilities of specific characteristics. In opposition to classical physics where the behavior of the individual parts determined the nature of the whole, quantum physics reveals a totally different circumstance. It is the behavior of the whole that determines the nature of the individual parts. Put in other words, it is the nonlocal connection to the whole that determines the behavior of individual parts. This basic quantum interconnectedness is a most important tenet of new physics.

Likewise, Capra (1975) noted that this interpretation of quantum theory implies an essential connectedness of nature and further believed this to be the most significant revelation of modern physics. Capra (p. 124) continued, "Quantum theory forces us to see the universe not as a collection of physical objects, but rather as a complicated web of relations between the various parts of a unified whole." The notion of a universal interconnectedness of organisms was further supported by the eminent physicist David Bohm (Bohm and Hiley, 1975), as he concluded:

> One is led to a new notion of unbroken wholeness which denies the classical idea of analyzability of the world into separately and independently existing parts. . . . We have reversed the usual classical notion that the independent elementary parts of the world are the fundamental reality. Rather, we say that inseparable quantum interconnectedness of the whole universe is the fundamental reality, and that relatively independently behaving parts are merely particular and contingent forms within this whole (p. 96).

To recapitulate, classical physics alleged that behaviors and properties of the individual parts defined the whole; conversely, quantum physics implied that the whole determined the properties and behavior of the individual component parts.

In 1964, John Bell (Gleick, 1987), a European physicist, provided mathematical proof that some of the previously conceived classical Newtonian notions of the world were erroneous and intensely deficient. Bell's Theorem proved that the effects of hidden variables, known as nonlocal causes, make accurate predictions impossible. Local variables would be in contrast to nonlocal variables. A local variable would be one of extremely close proximity to an event, on the spot, figuratively speaking.

For further elucidation regarding hidden local variables, consider the event of candy making. All the necessary ingredients for the making of divinity had been carefully and accurately measured, the syrup was boiled to the precise degree, the egg whites were beaten into voluminous clouds, and the mixing instructions were fastidiously followed, yet the finished divinity was not light and fluffy as anticipated; instead, it had a heavy and sticky consistency. All obvious precautions had been taken. Was it possible that some unforeseen element wreaked havoc with the candy making project and affected the consistency of the divinity? A local hidden variable had ostensibly affected the desired outcome. In the instance of the divinity candy, the local hidden variable was the degree of increased humidity in the atmosphere which consequently necessitated increased syrup temperature.

Similarly, ice cream manufactured in the state of Oklahoma and shipped to Colorado would arrive at its destination in what might appear to be an unsatisfactory condition. In Oklahoma, cartons of ice cream would be methodically filled according to specified weight and volume, then tightly sealed and loaded on a refrigerated truck for shipment to various parts of the country. However, upon arrival in Colorado, it was discovered that the cartons were no longer sealed. The cartons previously filled and sealed in Oklahoma had arrived in Colorado with broken seals and popped lids as a result of increased expansion which occurred within the ice cream product. The local hidden variable affecting the ice cream product and resulting in its expansion was the increased atmospheric pressure of a higher elevation.

In both of the previously considered instances, the events were influenced by local hidden variables, which appear to be more reasonable and easier for the human mind to accept. Bell's Theorem has proven that nonlocal hidden variables also make accurate predicting impossible. For example, consider the planning of a family budget. Careful consideration has been given to all areas of expense and precise allotments have been designated for each item. The family determined that with strict adherence to their budget, it would be possible for them to purchase a new home and comfortably assume the existing payments. However, midway into the year, fuel costs began to skyrocket, the local economy plummeted, and the family budget was in crisis. As a result, sufficient funds for the house payments were no longer available; therefore, the lending institution ultimately reclaimed the house. The nonlocal hidden variable affecting the family budget in this circumstance was the action and behavior of a leader of an oil-producing country in a distant part of the world. Causality is not always singular. This nonlocal variable had a hidden influence upon the local fuel prices which, in turn, affected the economy, finally devastating the family budget. The affect of this nonlocal, hidden variable ultimately resulted in the loss of the family's home. Accurate and absolute predictions regarding the success of the family budget would not have been possible. Conversely, due to nonlocal hidden variables, the family could only predict probabilities and infer tendencies.

The nonlocal variables involved in the microscopic quantum world appear to be very strong and instantaneous, and seemingly have changed what were once considered absolute certainties into hypothesized tendencies and probabilities. Because it is impossible to predict the sporadic and chaotic movements of atomic particles or to determine a single causality, it is the dynamics of the whole that determine the properties and behaviors of the individual components.

In sum, it had been determined that events occurring in one place were instantaneously connected to events occurring elsewhere. Edward Lorenz discovered the sensitive dependence on initial conditions which eventually became known as the Butterfly Effect. The concept Lorenz developed stressed the oneness of the universe as an interrelated web of physical and mental relations. This interconnectedness of nature may be illustrated using Gleick's (1987) analogy, which compares the insignificant and minute flapping of a butterfly's wings on one side of the globe producing significant and even drastic changes in weather systems on the opposite side of the globe. This analogy could be translated to infer that minute differences in initial conditions could result in overwhelming differences in the final results. Thus, it would seem that all things are interdependent and inseparable parts of a dynamic world.

The traditional assumptions of classical science continued in their failure to produce reasonable solutions and logical answers to the emerging puzzlements of nature. As Kuhn (1970) indicated in his explanation of a paradigmatic shift, the failure of traditional assumptions and conventional methods produces a crisis which ultimately initiates the rejection of the old paradigm and the emergence of a new one. A new paradigm of scientific thought was indeed emerging and it would appear that Einstein, Bohr, Heisenberg, Bell, Lorenz, and eminent others had changed forever the deterministic and mechanistic clockwork world of Newton and Descartes.

CHAPTER V

SUMMARY AND SPECULATION

An Historical Overview of Scientific Realities

The nucleus of the dominant world view prior to the sixteenth century was primarily organic in that its focus was on the world as a complex living structure comparable to that of a living being. The scientific framework had been constructed by Aristotle and the Church, and in those times, scientists considered the world to be an organic and living, spiritual universe.

The intention of this early scientific thought was the acquisition of wisdom through the understanding of nature's laws. The early realities of nature were organic relationships and an interrelatedness of material and spiritual phenomena. Humankind appeared to be driven by a desire to understand, yet live in harmony with nature. This philosophy could be contrasted with the philosophy of Newtonian science whose goal is to predict and to control. Capra (1982, p. 56) too, lamented this fact when he claimed, "Since Bacon, the goal of science has been knowledge that can be used to dominate and control nature."

Bacon's (Schopen, 1989) method of scientific inquiry drastically influenced the nature and purpose of the ancient scientific endeavors. As a result, the sixteenth and seventeenth centuries were to be designated as the Age of the Scientific Revolution (Schopen, 1989).

The scientific revolution was initiated as Copernicus began to subvert the popular belief that the earth was the center of the universe. As early scientists began to redirect their thinking and began perceiving the earth as one of many planets orbiting within the galaxy rather than existing as the center of the universe, the notion of a living world began to deteriorate. In its place emerged a new vision of the world, a world machine. This mechanistic vision of the reality of nature was to remain the dominant paradigm for several centuries.

To substantiate this new position of reality, scientists began collecting data. An empirical procedure of scientific inquiry was developed by Francis Bacon, who was to become known as the father of the scientific method. It was Bacon's contention that information should be systematically obtained, objectively categorized, and critically analyzed, then empirically verified. This procedure of scientific discovery was an inductive method founded on part-to-whole logic and was characterized by the formulation of generalizations or universal laws on the basis of observed instances. Use of this systematic scientific method facilitated researchers in their attainment of results which they believed to be empirically replicable, scientifically verifiable, and totally devoid of error and personal human biases.

This scientific revolution resulted in a paradigmatic shift which was fostered by philosopher Rene Descartes and physicist Isaac Newton. The founder of contemporary philosophy, Descartes, believed that nature functioned according to precise mechanical laws; also, that the nature of the universe could be determined by the functioning of single individual component parts.

The concept of separateness, of independently functioning component parts of nature, evolved from Descartes' belief in the dualism of mind and body. Descartes believed it necessary to separate mind from matter and that by doing this, all things could be placed into either one of those two categories and, in addition, neither one category could influence nor benefit from the other (Livingston, 1973).

This division of thought was the beginning of the dualism between mind and matter, man and nature, science and religion, fact and value, and object and observer (Wolf, 1981). Descartes' doctrine of dualism created a fragmenting and reductionary mentality that continued to dominate intellectual thinking for centuries. Furthermore, Descartes held a supportive and unwavering conviction regarding the absolute certainties in scientific knowledge and held a contemptuous disregard for knowledge obtained via intuition and probabilities.

The eminent classical physicist Isaac Newton set about to develop mathematical formulations to substantiate Descartes' vision of reality. Newton's mathematical theorems became the stalwart foundation for classical physics. Through mathematical calculation, Newton was able to explain the processes of the mechanistic world and scientifically verify the deterministic picture of the universe as an elaborate, self-regulating, mechanistic system operating in a logical and predictable manner.

For centuries, this mechanistic determinism continued to remain the dominant paradigm of intellectual thought governing Western civilization. Central to the philosophy of Descartes was the uncertainty of science and the scientific method. That Cartesian conviction of faith in absolute scientific truth continues to remain apparent in the scientism of contemporary culture as well as dominant curriculum theories.

Nevertheless, the assumptions of Newtonian physics began to fall into question as physicists of the twentieth century (Planck, Einstein, Bohr, Heisenberg, Bell, Lorenz) and eminent others discovered anomalies that refused to reinforce those prior assumptions of mechanistic determinism. After the discovery of subatomic particles, the isolated building blocks of nature could no longer be regarded as complete and independent entities. The notion of a separate and distinct particle could only have significance when perceived in relation to its connection with the whole. In the subatomic world, these connections were defined in terms of statistical wave probabilities rather than certainties.

Bohr (1934) referred to Newton's isolated particle building blocks as abstractions. The abstract concept of separateness began to fade and a consciousness of the unity and mutual interrelatedness of all things began to develop. The concept of universal connectedness is a recurrent theme of quantum theory and it demands that the universe not be viewed as a collection of individual components parts, but as a complicated web of interrelations between the parts of a unified whole (Capra, 1975).

Additional conclusions regarding the inadequacies of existing theories became evident with Einstein's Theory of Relativity. The unfathomable notion that space and time have no absolute fixed realities but are intimately connected to form a space-time continuum, was nearly beyond the realm of human intellectual understanding. It certainly did not reinforce the position of classical science.

Additional blows to the stability of Newtonian physics were dealt by Heisenberg's Uncertainty Principle and Bohr's Principle of Complementarity. The previously unchallenged principle of cause and effect, which was considered to be a stalwart tenet of the scientific method, had seemingly produced knowledge with absolute certainty. However, there was no reality of strict causality within the subatomic world and the line of demarcation between the observer and the observed, between the knower and the known, was becoming blurred. In quantum physics, the scientist could no longer be a passive and objective observer, for it had been determined that the very act of observing distorted the object of observation. This obvious interdependence between the observer and the observed demanded an awareness of the human consciousness in the act of scientific inquiry.

Bohr's Complementarity principle further implied the impossibility of knowing all things about the world simultaneously, because the circumstances for knowing one thing necessarily excluded the knowledge of other things. This principle dealt a deadly blow to the classical reality of determinism and initiated a theory of indeterminism, probability, and chaotic randomness.

According to Pagels (1982), quantum reality required the changing from a reality which could be seen and felt to a reality which could be perceived only intellectually. Pagels further maintained that quantum reality may be considered an observer-created reality. He compared the complementarity picture of a vase made of two profiles, which is used by gestalt psychologists, to the Principle of complementarity and observer-created reality. Pagels observed:

> You cannot see it as both simultaneously. It is a perfect example of observer created reality--you decide the reality you are going to see. And yet the definitions of what is the vase and what is the profile depend on each other--you cannot have one without the other. They are different representations of the same underlying reality--here simply a piece of black and white paper (p. 163).

Likewise, an unidentified sage once noted, "No phenomenon is a phenomenon until it is an observed phenomenon." This observer-created reality of phenomenon, to which Pagels (1982) referred, is in direct conflict with the reality of Newtonian physics, where the realities of the physical world could be revealed through invariable fundamental laws.

The rejection of objectivity and determinism by the scientific community initiated what Kuhn (1970) referred to as the blurring of the old paradigm. The classical framework of reality was characteristically constructed of concepts that reduce, quantify, categorize, and segment organisms into independently separate fragments. Conversely, the quantum theory framework of connectedness is characteristically constructed of concepts that embrace unity, wholeness, relatedness, integration, and interaction.

The traditional methods of Newton's classical physics had failed to provide perspicuous solutions to the newly emerging complexities of nature. The assumptions of Cartesian philosophy had failed the test of absolute scientific certainty. Consequently, after centuries of dominance, the Cartesian-Newtonian vision of reality fell into question and thus began to crumble.

An Historical Overview of Curricular Activities

There is abundant evidence in the literature (Capra, 1975, 1982; Dobson and Dobson, 19 ; Doll, 1989; Engel, 1977; Ferguson, 1980; Livingston, 1973; Lodge, 1983; Lyng, 1988; Pirsig, 1974; Rifkin, 1983; Toffler, 1984; Wolf, 1981; Zukav, 1979) to support the contention that the vision of reality held by Newton and Descartes dominated Western intellectual thought for centuries. Natural science is not the only area influenced by classical Cartesian-Newtonian reality, for it is a driving force in the social sciences as well. The classical concepts of rational determinism, analytical reductionism, and cause-effect problem solving is embraced by various curriculum leaders.

English philosopher John Locke (Schubert, 1986) believed that children were born with a blank slate devoid of prior or innate knowledge.

He further attributed the differences in the development and achievements of children to the differences in their respective and various environments. It was assumed that teachers could, through external means, motivate children to learn what the teacher had predetermined them to learn. In addition, Locke believed that the predetermined laws of nature which govern the physical world also influenced human behavior.

French philosopher Jean Jacques Rosseau and educational reformer Johann Heinrich Pestalozzi (Schubert, 1986) were advocates of learning through direct experience. Rousseau believed learning should occur through sensory experiences with the concrete as opposed to learning through abstract means. Likewise, Pestalozzi taught only subjects that could be learned through sensory experiences and, through his studies of child development, introduced what Schubert called the first scientific principles of teaching. Pestalozzi saw education's goal as that of social improvement and the implementation of his scientific methods enabled him to reach vast numbers of disadvantaged children and youth for that purpose. Similarly, Kant believed that the primary aim of education was the production of "good men" and held a firm conviction in the belief that education must become a scientific discipline (Frankena, 1965).

The Industrial Age of the twentieth century ushered in an era of dynamic, industrial, social, and economic development which had tremendous influence in the area of curriculum. The wondrous efficiency of this age of industry and the countless applications of scientific methodology encouraged numerous advancements in both technology and business. Western civilization became even more enthralled with the seemingly unlimited potential of the scientific endeavor. Because of its rigidly structured, sequential procedure, the methodology of classical science was meticulously efficient. The predictable results of this scientific model were not only replicable, they were irrefutable and scientifically verifiable as well. Few could doubt the validity or reliability when this scientific method was used.

All of the characteristics of the scientific method, including those of structure, rigidity, sequential steps, efficiency, and replicable and verifiable results, were extremely appealing qualities to curriculum leaders. They reasoned that curriculum could, likewise, be rigidly structured into a predetermined sequential rationale. Curricularists naturally assumed that the results produced by this type of curriculum theorizing would be replicable as well as scientifically verifiable. This conclusion was based, understandably, upon the successful implementation of the scientific method by the business and industrial communities. If this scientific method was efficient and effective in other areas, logically, it would work as well in the area of curriculum theorizing.

It was this line of rational thinking that popularized the scientific method and perpetuated its use as a dominant model for curriculum theorizing. As divergent ethnic groups migrated into urban areas to become workers in the world of industry, social and curricular efficiency became immediate priorities. As with business and industrial leaders, scientific organization and productivity also became the primary aims of curricularists like Bobbitt (1912) and Charters (1924). Bobbitt and Charters believed that education was in need of a scientific curriculum congruent with the scientific era, and their reliance upon the realities of the past were greatly noted in their establishment of a scientific approach to curricula. They stressed the structured development and rigid use of goals and objectives based upon needs which had been precisely established and predetermined through their scientific method of activity analysis. They also emphasized the importance of the scientific method of verification through the processes of evaluation. Clearly, the curricular emphasis was on product and control.

Also sharing the convictions of social efficiency and of a science of education was philosopher and eminent educational leader, John Dewey (1944, p. 326), who believed "Knowledge is science: it represents objects which have been settled, ordered, disposed of rationally." Like Rousseau and Pestalozzi before him, he believed learning could best occur through experience and he advocated the use of the scientific method of inquiry to provide those structured learning experiences. Dewey (1900) perceived the primary purpose of the school to be one of social efficiency and social improvement, and through that means he was determined to build a better society. An era of social reconstructionism was the impetus fostering the complexion of curriculum, which maintained that schools should strive to improve society rather than perpetuate the existing state. In support of what he perceived to be society's imperative involvement in the schooling process, Dewey (1900, p. 19) declared, "What the best and wisest parent wants for his own child, that must the community want for all of its children."

Dewey also shared Bobbitt's (1912) and Charter's (1924) dream of a science of education, but differed in the means to that end. Dewey (1929, p. 12) held that a "command of scientific methods and systematized subject-matter liberates individuals" in the pursuit of new problems and procedures. It was Dewey's belief that the scientific method of inquiry, when applied to any range of knowledge, would facilitate a perspicuous understanding of the facts.

In like effort, twentieth century curricularists Harold Rugg (Schubert, (1986) and Ralph Tyler (1949) proceeded to establish rigidly structured, sequentially ordered sets of guidelines for the scientific development of curricula. They seemed determined to formulate a scientific process for developing curriculum that would be comparable to the effectiveness and efficiency of the technical processes successfully used by business and industry. Rugg (Schubert, 1986) proposed a lengthy series of 18 questions he considered central to the making of curricula; however, Tyler's (1949) more streamlined version for the formulation of curricula was an offering of four. In the process of curriculum making, there were two elements which Rugg (Rugg and Shumaker, 1928) advocated be planned in advance of instruction. These primary elements were the establishment of desired educational outcomes and the sequences of optional activities designed to produce those anticipated student learner outcomes. Rugg was determined to achieve verifiable results through the efficient use of precisely structured scientific methods.

Once more, the predictability of Newton's gigantic clockwork rears its ugly head. Rigidly structured steps that have been predetermined are predictable. The teacher has no freedom to be spontaneous, only mechanistically predictable. Predictable methods might essentially produce somewhat predictable results. Results that could obviously be irrefutable and scientifically verifiable. The characteristics of mechanistic determinism are obviously the same as those of Newton's mechanistic and deterministic world view.

Similarly, in his rationale, Tyler's (1949) emphasis was on purposes, goals, and educational objectives reminiscent of the scientific method and Newtonian mechanistic determinism. For several decades, Tyler's rationale has continued to remain the foundational model for the development of curriculum (Schubert, 1986). Ostensibly, this mechanistic approach to curriculum, which was supported by the advancement of science and America's enchantment with technology, had abysmal roots in Cartesian-Newtonian reality.

This classical science reality of curriculum reflects the same concept of rigid causality and mechanistic determinism that Newton's clockwork world possessed. Newton's mechanical world was rational and predictable; for every cause there was an accountable effect. After all, machines, by nature, are very predictable. The machine of Tyler's (1949) rationale was also very predictable. The unfortunate reality of this situation is that teachers, students, and the learning process are not mechanistically predictable. Tyler's systematic and sequential methodology involving predetermined educational goals, purposes, and objectives, tends to reflect that same rigid causality and mechanistic determinism displayed by Newton's clockwork world.

Russia's launch of Sputnik in 1957 positioned America in second place in the space race and consequently generated a massive outcry for educational reform. The educational system shouldered a major portion of the blame for allowing America to fall behind Russia in the advancement of space technology. The disciplines of mathematics and science became more heavily emphasized as the aims of education became ostensibly more socially and politically oriented. The techniques and methodology of teaching and the evaluation process of schooling and the curricula developed an even deeper allegiance to the scientific method.

Americans became obsessed with the notion of quality control within their schools. The prime priorities for the communities of business and industry have always been efficiency, productivity, and their bottom line, profit. The realignment of priorities for American schools also included efficiency, productivity, and their bottom line, test scores. To successfully accomplish these priorities that resembled the major characteristics of classical science, the curricularists became even more stringent and more dedicated in their use of the scientific method. Predetermined learner outcomes and accountability regarding those outcomes were new attempts at quality product control. The reliance upon systematic and sequential steps, predetermined objectives, and irrefutably validated results was congruent with the philosophical base of classical physics and the scientific method of inquiry. These procedures had been successful in other areas; surely they would be as successful in curriculum.

In 1983, shock waves reverberated throughout America as its citizens read in disbelief, <u>A Nation at Risk: The Imperative for Educational Reform</u> (National Commission of Excellence, 1983). This report was prepared by the National Commission on Excellence in Education, an 18-member committee established by the Educational Secretary of the United States. The report disclosed 13 educational dimensions of risk which the Commission considered indicators of crises. Among those reported areas of impending crises were low achievement test scores, declining student achievements in the areas of the sciences and mathematics, and the alarming numbers of functionally illiterate Americans.

The educational reform methods of tighter controls and tougher standards, outcomes and accountability, seemingly had not produced the anticipated degree of improvement. The determined extent of improvement reflected in the results was perceived as meager and inadequate. The logic that if a little bit does a little good then a lot will do a lot of good was applied to the area of curricular reform. In recent years, the classical concept of evaluation and verifiable results has ballooned into an accountability movement, which essentially has required teachers to rigidly conform instruction to predetermined student learner outcomes and thus be responsible and accountable for any deviations.

Ostensibly, America had become obsessed with the classical notions of scientific measurement and empirical evaluation, and it proceeded down a path that led to intense evaluation of both its teachers and its students. Standardized testing of students' achievements became a matter of routine, and the results of those tests were commonly used as a means of evaluating teacher performance in the classroom. In like manner, the results of standardized achievement tests were used as a means of comparison (Schubert, 1986). Some students found themselves in situations where it was possible for them to be treated as unfeeling objects held up for observation and comparison to other students. Some school districts used the test results to compare and contrast individual schools within the district. Likewise, states and nations joined in the competition for the attainment of academic excellence and superiority.

State legislatures also have joined the educational bandwagon of scientific measurement. Some states are requiring students to pass proficiency tests in order to progress from grade to grade and as a prerequisite to high school graduation (Goodlad, 1984). Various states, like Oklahoma, have implemented a program of competency testing for graduating student teachers prior to their becoming licensed. In addition, entry-year teachers, those who are embarking on their first year of teaching, must undergo a series of observations and evaluations before they can qualify for a teaching certificate. Similarly, veteran teachers must endure the scrutiny of observations and evaluations which are based upon a predetermined minimum teaching criteria established by state legislators, who frequently possess limited professional knowledge of the learning process.

The minimum teaching criteria used for teacher evaluation is based upon the mechanistic determinism of Madeline Hunter's (1984) theories. Hunter's model of teaching involves a linear and sequential series of procedures representing a mechanistic lockstep approach. Hunter's designs for teaching follow the scientist's roles for preconceived purpose, task analysis, evaluation, and verification of results. Her method of direct instruction involves the use of predetermined objectives that can be scientifically measured and compared to student achievement. Hunter's scientific cause and effect model of teaching is ostensibly commensurate with the characteristics of a Newtonian vision of reality.

The mechanistic simplicity and the scientifically efficient characteristics of the Hunter and Tylerian models continue to have a strong enticement for many educational leaders and curricularists. As can be seen, the development of curriculum had been transformed into a technological technique. From Descartes and Newton to Hunter and Tyler, the scientific model has remained a dominant force in Western intellectual thought and a stalwart in curriculum theorizing.

Speculation

Consequences of Scientifically Based Curricula

The universal nature of the scientific model could be categorized as rigorous mechanistic determinism. More specifically, this example for imitation is characteristically rational, linear, sequential, causal, and fragmenting.

Cartesian-Newtonian reality reasoned that events which occurred at one place did not essentially involve other events occurring elsewhere. That same thought may be one of the underpinnings of current curriculum designs. As a result, the concept of isolated events ultimately may have led to the notion of isolation and fragmentation throughout the entire field of education. Even the physical plants commonly facilitate the isolation of teachers and students by means of the stereotypic "egg carton" architectural design.

Goodlad (1984) also observed this fragmentation and isolation during his comprehensive study of schools, in which he noted, "Education is a badly segmented profession" (p. 9). Consequently, "[T]eachers, like their students, to a large extent carry on side by side similar but essentially separated activities" (Goodlad, 1984, p. 188). The typical classroom may present a rigidly formal setting with its ruler-straight rows of desks where students perform their similar tasks in group isolation. In many classrooms, students as well as teachers spend their days alone in a crowd. It would appear that teachers commonly find themselves isolated from other professionals, seemingly without encouragement in communication with fellow teachers or cooperative support in collaborative efforts.

Professional staff development programs have been offered by school districts in an attempt to provide opportunities for professional growth and support. It was the intended goal of such programs to provide professionals opportunities for increased communication and collaboration. However, in his research, Goodlad (1984) discovered that no one staff development program provided simultaneous interest and participation of all teachers.

In addition, Goodlad (1984) disclosed the segmenting contribution of the hierarchial system of authority within the schools which, he contends, may have resulted in a degree of mistrust between those who formulate policies and those who follow those policies as they work with children. Goodlad recognized the importance of trust and mutual support between administrators and teachers, but alleged that the division between these two groups may be a result partly due to aggressive collective bargaining efforts. Furthermore, Goodlad's research concluded that the autonomy most teachers experienced was in the realm of isolation, both physical and professional, rather than in the pursuit of challenging and expanding initiatives or in the establishment of educational alternatives.

This isolation and fragmentation is apparent also in the segmented curriculum. Lodge (1983) clearly had made a similar observation when he stated, "Schools too often are disconnected from society, teaching separate packages of knowledge. . . ." (p. 51). It would appear that the scientific model has ostensibly reduced curricula into small, isolated unit offerings. Typically, the curriculum offerings have been perceived as a collection of individually segmented content areas rather than as a unified generic whole. Congruent with linear classical scientific thought, the curriculum offering constituted a collection of individual component parts, whose independent functioning determined the nature of the whole.

As was presented in a prior section of this chapter, the scientific method of inquiry has traditionally followed a rigid set of sequential steps. Commensurate with this dominant model, the formulation of content areas, those individual components of curricula, was also guided by a similar linear and lockstep, sequential procedure. This scientifically based procedure, presented in greater detail in Chapter IV, was similar to the methodology for curriculum making that had been advocated by Bobbitt, Dewey, Taba, and Tyler. It is clear to see that this rigid and mechanistic method of arbitrarily establishing competency-based objectives and of performing tenuously specific skills was profoundly rooted in the theoretical tenets of classical scientific methodology.

The Cartesian-Newtonian vision of reality was not only mechanistic, but deterministic as well. The scientific method of inquiry was governed by a predetermined hypothesis and a rigid set of parameters commensurate with the predetermined curricular objectives and suggested learner outcomes of contemporary curricular practices. As Wolf (1981) perspicuously illustrated, classical science believed that for every effect there was a cause and for every cause there was an accountable effect. This ends-means predictability of scientific thought upon which curricularists have traditionally relied had been perceived as the best method for developing curricular practices in the classroom. This scientific method was both efficient and effective. The end results, the final product, subsequently could be analyzed and scientifically verified. The scientist's unquivering faith in irrefutable numerical validation had been duplicated by divergent segments of Western culture and by curricularists as well.

The classical practice of fragmenting is even extended to that all-important final product. The end results of student learning were commonly isolated from the very process by which they were obtained. Concerns regarding student achievement test scores began to preempt concerns regarding human variabilities and the need for divergent instructional practices. Ends triumphed over means and, ultimately, product became more important than process. Historically, the wisdom of parental guidance commonly stressed process over product, as young children were admonished by their elders that the winning of a game was secondary to the manner in which one played the game. As students, however, these children have experienced a dichotomy of reality.

The fragmenting characteristic of the dominant scientific model was also emphasized by Crowell (1989). He summarized the comprehensive degree of curricular fragmentation and isolation by noting that each and every aspect of the educational and curricular process is isolated from the other. Crowell maintained:

> Schools isolate kids from experience. Teachers are isolated in classrooms. Principals are isolated from students, teachers, and other principals. Staff evaluation is isolated from professional growth. Schools are isolated from each other. Subject matter is often separate and thus isolated. And skill development is almost always isolated (p. 62).

This fragmented perspective has permeated many aspects of society. A fragmenting mindset formed by classical science has forced adults to deal with discrete tasks of specialization in a departmentalized world of work. As workers assume highly specialized and segmented responsibilities, they may never become cognizant of the entire structure nor fully understand how their specialized contribution relates to the whole entity.

In similar manner, the scientific method of reducing wholes into separate and isolated parts for the purpose of categorization, analysis, and evaluation is ostensible in contemporary curricular practices. The contemporary linear instructional approach divides and reduces concepts into tiny isolated units for instructional analysis and learner assimilation. As a result, students may accomplish mastery of splinter skills without accomplishing mastery of the application of those specific skills.

Lodge (1983), also cognizant of this problem, charged that the educational system was not instructing students in the comprehension of the relationships between specific skills and concepts. Lodge alleged that the ability to envision the whole and to integrate the fragmented components appears to be a weakness of contemporary Western students and, in addition, may be illustrative of Whitehead's (1925, p. 197) reference to "minds in a groove."

Critical components of information, which typically are isolated and fragmented, must be interrelated to the concrete world as students know it to be, in order that they may determine a degree of relevancy. Dobson and Dobson (1981) have noted that curricularists who believe education to be a process accomplished in union with children, as opposed to a process of doing to or for children, may also share this premise of wholism and relevancy regarding learning and knowledge. These curricularists believe, as Dobson and Dobson (1981) have stated:

> Intellectual development proceeds from 'wholes' to 'parts' or from a simplified whole to more complex wholes. . . . Knowledge is personal . . . . Information becomes knowledge only when it takes on personal meaning for the individual (pp. 53-54).

The scientific method of classical science has remained the dominant paradigm for curriculum theorizing. However, the consequences of scientifically based curricular approaches to the learning process are clear. Changes appear imminent. The scientific community has revised their classical vision of absolute truth based upon Newton's fixed laws and expanded that realm to include a vision of realities founded in the theories of quantum physics (Capra, 1975, 1982; Ferguson, 1980; Schopen, 1989, Wolf, 1981).

It is my contention that, in like effort, some curricularists appear to be revising their visions of reality, and their traditionally scientific approach to learning and the schooling process by expanding that realm to include an alternate vision of reality that will be founded in the theories of quantum physics.

Is Transformational Theory A Viable Alternative Paradigm?

As was previously discussed in greater detail throughout this study and within this particular chapter, the classical scientific framework of reality is characteristically constructed of concepts that tend to reduce, quantify, categorize, and fragment organisms into independently separate segments.

However, this dominant classical vision of reality can be contrasted with the alternate vision of reality presented by the various theories of quantum physics. Those theories which were presented in greater detail in Chapter IV of this dissertation include the following: Einstein's Theory of Relativity, Heisenberg's Principle of Uncertainty, Bohr's Principle of Complementarity, Bell's Theorem, and Lorenz's Butterfly Effect. The alternative vision of reality presented by these quantum theories is supported by a framework of connectedness, which is characteristically constructed of concepts that tend to embrace unity, wholeness, interrelatedness, integration, interaction, and interdependence.

Traditionally, curricular theorizing has been based upon the theories of classical science (Lodge, 1983) and the consequences are clear. However, the consequences of curriculum theorizing based upon the theories of quantum physics is both unclear and highly speculative. Nevertheless, it is my contention that the alternative vision of reality presented by quantum theories may ultimately provide a viable alternative paradigm for curriculum theorizing.

Perhaps the genesis of this investigation into an alternative paradigm for curriculum theorizing might be an exploration of the recipient organisms of curriculum theorizing. The organisms involved would typically include teachers, students, and curriculum. An organism is considered to be an extremely complex object or structure whose parts are so intricately integrated that their relationship to one another is thus controlled by their relationship to the whole (Oxford English Dictionary, 1989). Based upon the preceding definition of an organism, the intra-structure of that organism may be comprised of individual separate parts performing separate functions but which are nevertheless mutually interdependent in their relationship to one another.

The concept of organism, however, is not restricted to living beings. Therefore, various aspects of curriculum may also be included within the realm of organism. As one deliberates the fundamental concept of organism, an adverse argument may be made regarding the dualistic theories of isolation and fragmentation (which are representative of classical scientific thought) and their effects upon the organisms involved.

The Oxford English Dictionary's (1989) definition of organism is commensurate with the quantum theory characteristics of interrelatedness and interdependence as determined within the realm of quantum reality. An interaction of parts is a mutual, reciprocal action, a condition in which everything influences everything else.

The very essence of organism establishes the existence of a basic oneness, an interconnectedness that refutes prior concepts of separateness and of isolated and fragmented parts. "One is led to a new notion of unbroken wholeness which denies the classical idea of analyzability of the world into separately and independently existing parts" (Bohm and Hiley, 1975, p. 96). This was Bohm and Hiley's conclusion regarding one of the fundamental features of quantum reality. Similarly, Capra (1975) reiterated that conclusion by stating, "Quantum theory has abolished the notion of fundamentally separated objects" (p. 129).

Regarding the complexities of organisms, Prigogine and Stengers (1984, p. xxvii) also have noted, "Our vision of nature is undergoing a radical change toward the multiple, the temporal and the complex." Quantum theories present a notion of complexity which may be more characteristic of reality than is simplicity. Complexity would suggest multiple forces representing a reality that is an interconnected web of networking unit.

The notion of complexity and the interaction of multiple forces may also present some degree of uncertainty. Heisenberg's Principle of Uncertainty revealed the disruptive affects of observation upon what was being observed. Because of this disruptive nature of observation and the quick, sporadic movements of atomic particles, there would always be uncertainty in the measurements of atomic particle location and the velocity of their movements.

This quantum vision of reality is in opposition to the reality of classical science where the observer and the observed are separate and detached, and the learner and the content are separate and detached. Contrary to the dominant scientific model, the alternative paradigm envisions the learner and the content activity intertwined. As Heisenberg's (1958) Principle of Uncertainty implies, the act of observation would appear to be meaningful only if participation and interaction with the object occurred.

This characteristic of quantum reality would promote active learning as opposed to passive learning, and students would cease to be empty vessel recipients for information disseminated by the teacher through means of direct instruction. As a result of active learning practices (which might include activities such as cooperative learning groups), there would be increased student-teacher interaction, according to Johnson and Johnson (1987), and learning would be a state of mutual inquiry as opposed to the transmission of information.

Bohr's (1934) Principle of Complementarity revealed nature to be a single, unbroken wholeness which may appear paradoxical to the observer during any attempted analysis or observation. Bohr reasoned the particle quality and the wave quality of light to be two complementary views of the same reality. The existence of complementarity implies an interdependency and interrelatedness within the complexities of nature. However, unlike matter in classical science, which could be detected with the human senses, there was no absolute reality of the existence of subatomic particles, only their tendencies to exist. Consequently, observations in quantum theory dealt in probabilities and uncertainties.

The varied interactions of multiple forces within a complex and changing network makes the prediction of development and outcome somewhat difficult. Newton's static and simplistic world was deterministic and predictable. Because the world of quantum physics is complex and constantly changing in a random and chaotic manner, absolute predictability is relegated to chance probability.

Likewise, the complexity of organisms and the interactions of multiple forces within a complex and changing network of life experiences makes the prediction of development and outcomes difficult. Students, teachers, and curricula are extremely complex organisms intertwined in multiple interactions; thus, any predictions on the development of learning may be relegated to probabilities rather than absolute certainties. The interaction of multiple variables upon students, teachers, and the curriculum may necessitate a change in focus. The focus in this changed situation clearly may be more wisely placed upon process rather than product, upon means rather than ends.

Multiple interactions also suggest a networking unity. One tenet of quantum reality is that of unity and interconnectedness, a sense of oneness. Despite the randomness and sporadic interactions within this complex and dynamic universe, the human element is not separate from, but is very much a significant part of, this unity (Capra, 1975). This point was also emphasized by Heisenberg (1974, p. 81) in his statement, "Natural science does not simply describe and explain nature; it is part of the interplay between nature and ourselves."

The notion of unity and humankind's oneness with his environment may offer a new dimension to curriculum theorizing. Jantsch (1975) used a metaphor of a stream to illustrate the relationships between the learner and that which is being learned. Commensurate with classical scientific logic, learners have been regarded as passive, similar to detached and independent observers idly viewing the flowing stream from its banks. This new world view, provided by the quantum theories, suggests a need for unity, integration, and an active involvement between inquiry and learning. Analogous to Jantsch's (1975) stream metaphor, the observer becomes the stream by taking an active responsibility in the movement and direction of the stream.

Thus, the essence of unity and oneness, interconnectedness and interrelatedness may be fully experienced. In similar effort, the learner achieves unity and oneness with the curricula by assuming an active role in the process of inquiry and the transformation of information into knowledge. As an empowered participant with a sense of efficacy, the learner no longer remains a sideline observer in the learning process but becomes an actively involved and integral participant in the process.

The alternate paradigm of quantum reality would encourage active learning. This concept is in direct opposition to the notion of passive learning, which is associated with the traditionally dominant paradigm.

The acceptance of this notion of oneness and unity, of interrelatedness and interconnectedness, may be contingent upon individual philosophical perspectives. Schubert (1986, p. 116) posited, "Philosophy lies at the heart of educational endeavor. This is perhaps more evident in the curriculum domain than in any other."

It is my contention also that the perceptions and actions of individuals regarding curriculum theorizing are commensurate with individual philosophical perspectives. Furthermore, the manner in which an individual chooses to approach curriculum, students, and the various processes of schooling ultimately may be contingent upon the philosophical perspective from which that individual operates.

Dobson and Dobson (1981) have explored various philosophical perspectives and provided analyses of the uniqueness of each perspective with regard to curriculum theorizing and the schooling process. For example, a curricularist with philosophical roots in classical science may perceive curriculum as a predetermined series of sequential steps, whereas a curricularist with philosophical roots in quantum physics may perceive curriculum as emerging and dynamic.

The two philosophical perspectives may also hold divergent views regarding the nature of learning and the nature of knowledge. The individual guided by the scientific model tends to believe in the existence of a universal body of absolute truths, facts, and information imperative for all humankind to know. Conversely, the individual guided by the realities of quantum theory tends to believe that truths are unique to each individual and occur on a personal level through interactions (Dobson and Dobson, 1981).

The emergence of quantum realities challenged the existing structure of classical scientific thought, resulting in a paradigmatic shift within the scientific community (Wolf, 1981). To contend that quantum theory will likewise challenge or even replace the dominant scientific model for curriculum theorizing would be purely speculative. Nevertheless, exploration into a newly emerging term, Whole Language, would seem to intimate that a paradigmatic shift might be within the realm of possibility.

The theoretical underpinning for Whole Language may be philosophically rooted in the realities of quantum theory. However, the nature of Whole Language must be examined prior to the formulation of such an assumption.

Contrary to the misconception of some, Whole Language is neither a model for imitation, a specific procedure, nor a method of doing. Whole language is a philosophical perspective (Newman, 1985). Altwerger (Altwerger, Edelsky, and Flores, 1987), a professor at the University of New Mexico postulated:

> Whole Language is not practice. It is a set of beliefs, a perspective. It must become practice but it is not the practice itself. . . . [T]hese practices become Whole Language-like because the teacher has particular beliefs (p. 145).

Thus, Whole Language is a perspective, a pattern of beliefs. In accordance with Kuhn's (1970) premise, it is a configuration of values and beliefs shared by the members of the community, a paradigm. It is this paradigm that provides the underpinning of personal actions.

Whole Language is a way of thinking about language and language acquisition (Altwerger, Edelsky, and Flores, 1987). It is commonly known that young children acquire language native to their culture through incidental usage. This natural usage involves a simultaneous combination of phonetic, semantic, and syntactic skills. The extrapolation and repeated use of one skill would not be the same as the use of that skill within the entire activity of language, nor would it result in a more proficient usage of the language. Individual specific skills are interacting components of a networking unity. The linear characteristics of the dominant paradigm result in this very type of extrapolation. Adopting the alternate paradigm with its nature of unity and interrelatedness, the student would be involved in the meaningful use of interrelated skills simultaneously.

Altwerger, Edelsky, and Flores (1987) brilliantly illustrated this point by making language usage analogous to bicycle riding, which involves a simultaneous combination of steering, balancing, and pedaling. Likewise, the extrapolation and repeated practice of one specific skill would not be the same as the use of that skill within the entire activity of bicycle riding, nor would it result in a more proficient bicycle rider. As in language, the individual specific skills are interacting components of a networking unity and need to be practiced as such.

Clearly, the notions of interrelatedness and interconnectedness are significant in the activity of language usage, as well as in that of bicycle riding. A major theory of classical science maintains that the complexion of the whole is determined by the behaviors of individual component parts. On the other hand, congruent with the reality of quantum theories, independently functioning component parts are merely contingent forms of the whole. This interaction of parts is a mutual, reciprocal action, a condition in which everything influences everything else. Each skill is an essential and critical component interacting with and interdependent upon each other. As has previously been shown, major tenets of quantum theory include those same characteristics of interconnectedness, interdependence, and interrelatedness.

Classroom practices which may be congruent with Whole Language beliefs could typically include authentic life experiences in actual reading and writing (Edelsky and Smith, 1984). These experiences would be real and purposeful as opposed to the traditional practices of teacher-directed reading and writing drill exercises. Contrary to the scientific method of linearity, individual specific skills are not extrapolated for concentrated drill and practice in the false pretense of improving the student's overall ability to read or write. Rather, the total activity is experienced as all the skills interact in a networking unity, commensurate with quantum theory, to improve the student's ability to read or write. The classroom resource materials used would be limited only by the imaginations of the teacher and students involved, but would rarely include those published materials designed solely for the teaching of reading and writing.

This study has examined the realities of classical science and the realities of quantum theory. An attempt has been made to determine the philosophical roots of historical and contemporary curricular theorizing and to establish a relationship between that philosophical base and the tenets of classical science. This study has also explored the possibility of a newly emerging paradigm, which may be philosophically rooted in the tenets of quantum reality.

There has been evidence to conclude that curriculum theorizing has been abysmally rooted in classical scientific methodology. Whether or not the realities of quantum theory may provide an alternative paradigm for curriculum theorizing remains speculative. However, there is evidence to indicate that the emergence of a paradigmatic shift within the curricular community is within the realm of possibility.

Future studies could be focused upon the realities of quantum theory in an attempt to correlate the tenets of new science with tenets of curricular theory. The intent of future studies could also provide a further investigation into the interrelated areas of instruction and evaluation in the hopes of establishing new concepts which may be guided by the realities of quantum theory.

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APPENDIX A

FIRST MAILING: CORRESPONDENCE AND RAW DATA RESULTS

July 12, 1990

Dear Professor:

My name is Sandra Hayes. I am a doctoral student in Curriculum and Instruction at Oklahoma State University. Professor Russell Dobson is chairperson of my graduate committee. A segment of my dissertation requires identification of the major curriculum theorists (those whose work deals primarily with what could be classified as curriculum studies) in America since the beginning of the century. I am surveying eminent professors of curriculum to assist in that determination.

The expertise that you share will provide valuable data for this project; furthermore, your personal identity will remain anonymous.

In the space provided below, please indicate the persons you believe to have been the most influential in developing curriculum theory since the turn of the century.

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Please use the enclosed envelope to return your response. Your prompt participation and cooperation are greatly appreciated.

With sincere thanks,

Sandra Hayes

Dissertation Survey

First Mailing - Raw Data

Responses: 115/169 (68.04%)

Theorist	Frequency
Adler, Mortimer J.	1
Aoki, Ted	3
Apple, Michael	26
Alberty, Harold	11
Alexander, William	7
Bagley, W. C.	3
Beauchamp, George	20
Bellack, A. A.	2
Benjamin, Harold	2
Bent, R. K.	1
Berman, Louise	4
Beyer, Landon	2
Bloom, Benjamin	5
Bobbitt, Franklin	47
Bode, Boyd H.	13
Bossing, Nelson	1
Brameld, Theodore	4
Broudy, Harry	2
Bruner, Herbert	1
Bruner, Jerome	9
Butts, R. F.	1
Campbell, Daak	1
Carroll, John	1
Caswell, Hollis L.	31
Charters, W. W.	21
Combs, Arthur	1
Conant, James B.	1
Connelly, F. M.	1
Counts, George	15
Cubberley, E. P.	1
Davis, O. L.	1
Dewey, John	77
Edmonds, Ron	1
Eisner, Elliot	26
Eliot, Charles	4
English, F. W.	1
Foshay, Arthur W.	12
Freire, Paulo	2
Frymier, Jack	1
Gagne, R. M.	1
Gates, (UK)	1
Giroux, Henry	6
Goodman, Kenneth	1
Goodman, Yetta	1
Goodlad, John	25

Theorist	Frequency
Goodson, I.	1
Graves, Donald	1
Greene, Maxine	13
Grey, E.	1
Grumet, Madeleine	7
Gwynn, J. Minor	1
Hanna, Paul	4
Haran, Henry	3
Harris, W. T.	1
Havighurst, Robert	2
Herbart, Johanne	1
Herrick, Virgil	9
Hirst, Paul	2
Hollingworth, Leta	1
Hopkins, Momar	1
Hopkins, Thomas	7
Horn, Ernest	1
Hosford, Phil	1
Huebner, Dwayne	14
Hunkins, F. P.	1
Hunter, Madeline	1
Hymes, J. L.	1
Illich, Ivan	1
Jackson, Philip	1
Johnson, Maurice	2
Joyce, Bruce	1
Kilpatrick, William	25
Kliebard, Herbert	9
Klohr, Paul R.	7
Lee, D. W.	1
Lee, J. M.	1
MacDonald, James	31
Martin, J.	1
McMurry, Charles	3
McMurry, Frank	2
McNeil, Linda	1
Miel, Alice	12
Miller, Janet	2
Newlon, Jesse	1
Noddings, Nel	1
Olive, P. F.	1
Ornstein, Allan C.	1
Pagano, Joanne	2
Parker, Cecil	1
Parker, Francis	3
Passow, Harry	1
Pestalozzi, J. H.	1
Peters, C. D.	1
Peters, R. S.	1
Phenix, Philip	2
Piaget, Jean	2
Pinar, William	24

Theorist	Frequency
Ragan, William B.	1
Reid, William	1
Reynolds, William	1
Rugg, Harold	20
Saylor, J. Galen	7
Scheffler, Israel	1
Schwab, Joseph	20
Schubert, William	6
Shane, Harold	2
Shores, J. H.	3
Skinner, B. F.	2
Smith, B. Othanel	12
Snedden, D. S.	2
Spencer, Herbert	1
Stanley, W. O.	4
Stenhouse, Lawrence	3
Stratemeyer, Florence	12
Taba, Hilda	32
Tanner, Daniel	3
Tanner, Laurel	3
Thorndike, Edward	4
Tyler, Ralph	80
Uandinin, (UK)	1
Van Manen, Max	2
Van Til, William	3
Vars, (UK)	1
Walker, Decker	2
Washburne, Carleton	2
Whitehead, Alfred	1
Whiteaker, Jean	1
Willis, George	1
Wilson, Lois Fair	1
Zais, Robert	2
Zirbes, Laura	2

Cumulative Results - First Mailing

Theorist	Cumulative Score
Ralph Tyler	80
John Dewey	77
Franklin Bobbitt	47
Hilda Taba	32
James MacDonald	31
Hollis Caswell	31
Michael Apple	26
Elliot Eisner	26
William Kilpatrick	25
John Goodlad	25
William Pinar	24
W. W. Charters	21
Joseph Schwab	20
Harold Rugg	20
George Beauchamp	19
George Counts	15
Dwayne Heubner	14
Boyd Bode	13
Maxine Greene	13
B. Othanel Smith	12
Arthur Foshay	12
Florence Stratemeyer	12
Alice Miel	12
Harold Alberty	11

APPENDIX B

SECOND MAILING: CORRESPONDENCE AND RAW DATA RESULTS

October 10, 1990

Dear Professor:

My name is Sandra Hayes. I am a doctoral student in Curriculum and Instruction and Oklahoma State University. Professor Russell Dobson is chairperson of my graduate committee. A segment of my dissertation requires identification of the major curriculum theorists (those whose work deals primarily with what could be classified as curriculum studies) in America since the beginning of the century. I am surveying eminent professors of curriculum to assist in that determination.

The expertise that you contribute will provide valuable data for this project; furthermore, your personal identity will remain anonymous.

You previously received a survey from me in which you indicated the persons you believed to have been the most influential in developing curriculum theory since the turn of the century. The results of that survey indicated the following persons (listed alphabetically) to be the most frequently mentioned:

> Michael Apple, Franklin Bobbitt, Hollis Caswell, John Dewey, Elliot Eisner, John Goodlad, William Kilpatrick, James MacDonald, William Pinar, Hilda Taba, and Ralph Tyler

From the list of names provided, please indicate in the spaces below the five persons whom you believe to have been the most influential in developing curriculum theory since the turn of the century.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

Please use the enclosed envelope to return your response. Your prompt participation and cooperation are greatly appreciated.

With sincere thanks,

Sandra Hayes

Dissertation Survey

Second Mailing - Raw Data

Responses: 126/169 (74.55%)

Theorist	Cumulative Results
John Dewey	109
Ralph Tyler	108
Hilda Taba	69
Franklin Bobbitt	62
Harold Caswell	54
William Kilpatrick	51
John Goodlad	44
Michael Apple	33
James B. MacDonald	32
Elliot Eisner	31
William Pinar	21

VITA

Sandra Dierksen Hayes

Candidate for the Degree of

Doctor of Education

Thesis: TRANSFORMATIONAL THEORY: AN ALTERNATIVE PARADIGM FOR CURRICULUM THEORIZING

Major Field: Curriculum and Instruction

Biographical:

Personal Data: Born in Independence, Missouri, May 27, 1943, the daughter of Lucille and Albert Dierksen.

Education:

1960 - Graduated from Hennessey High School, Hennessey, Oklahoma
1964 - Received Bachelor of Science degree in Home Economics Education from Oklahoma State University
1986 - Received Master of Education degree in Learning Disabilities and Reading Specialist Certificate from Northwestern Oklahoma State University
1991 - Completed requirements for Doctor of Education degree from Oklahoma State University

Professional Experience:

1989 - Instructor in Teacher Education and in Special Education at Northwestern Oklahoma State University
1988 - Adjunct Professor teaching graduate Special Education classes at Northwestern Oklahoma State University
1985 - Four years as Learning Disabilities Specialist for grades K-5 at Chisholm Elementary School, North Enid, Oklahoma
1964 - Two years as Home Economics teacher at Garber High School, Garber, Oklahoma

Professional Organizations:

Learning Disabilities Association of Oklahoma
Oklahoma Federation Council on Exceptional Children
Higher Education Alumni Council of Oklahoma
Oklahoma Association of Teacher Educators
Oklahoma Association of Colleges in Teacher Education
Phi Delta Kappa

Awards:

1989 KOCO-TV Oklahoma's Best Teacher Honor Roll
1989 Star Teacher, Chisholm Elementary School