Predicting prospective teachers second- or third-wave achievement on a computer based lesson planning task using cognitive and affective measures
by Christine Hespen Lamb

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
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Abstract:
Instructional computing is at a crossroads, searching for the appropriate place for the computer- in the classroom. In one classroom, the computer is the object of instruction or a supplement to traditional instruction (second-wave). In another, the computer is an integrated part of the content area and a means to teach information processing and reflective judgment (third-wave).

Research suggested that the choice of one approach over the other is related to the following factors: teachers' anxiety about technology and teachers' epistemological view of information processing and learning.

The problem of this study was to determine the degree to which prospective teachers' second- or third-wave achievement on a computer-based lesson planning task could be predicted from knowledge of the following set of variables: level of epistemological maturity, level of computer anxiety, and selected attribute variables. Level of epistemological maturity was based on a measure of the Perry Scheme of Cognitive development; level of computer anxiety was assessed using a computer attitude scale. Achievement was assessed on a computer-based lesson planning task designed by the researcher and the course instructor to measure both the type and the degree of integration of computer applications into prospective teachers' instructional planning. Participants in the study were prospective teachers enrolled in Montana State University's required teacher preparation computer course during Autumn quarter 1987 or Winter quarter 1988.

Regression analyses indicated that epistemological maturity and age were significant predictors of second- or third-wave achievement. Approximately 35% of the variance in achievement could be accounted for by level of epistemological maturity. Level of computer anxiety was not significantly correlated with achievement.

Based on the analyses, the following conclusions and recommendations were drawn. In the affective domain, it was suggested that less time should be spent in pre-service education addressing issues of computer anxiety and more time should be spent promoting epistemological maturity. In the epistemological domain, it was concluded that the conditions of learning which promote epistemological maturity should be systematically integrated into the required computer course to promote higher level thinking and third-wave applications of computers.

PREDICTING PROSPECTIVE TEACHERS' SECOND- OR THIRD-WAVE ACHIEVEMENT ON A COMPUTER-BASED LESSON PLANNING TASK USING COGNITIVE AND AFFECTIVE MEASURES

by

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ABSTRACT

Instructional computing is at a crossroads, searching for the appropriate place for the computer in the classroom. In one classroom, the computer is the object of instruction or a supplement to traditional instruction (second-wave). In another, the computer is an integrated part of the content area and a means to teach information processing and reflective judgment (third-wave). Research suggested that the choice of one approach over the other is related to the following factors: teachers' anxiety about technology and teachers' epistemological view of information processing and learning.

The problem of this study was to determine the degree to which prospective teachers' second- or third-wave achievement on a computer-based lesson planning task could be predicted from knowledge of the following set of variables: level of epistemological maturity, level of computer anxiety, and selected attribute variables. Level of epistemological maturity was based on a measure of the Perry Scheme of Cognitive development; level of computer anxiety was assessed using a computer attitude scale. Achievement was assessed on a computer-based lesson planning task designed by the researcher and the course instructor to measure both the type and the degree of integration of computer applications into prospective teachers' instructional planning. Participants in the study were prospective teachers enrolled in Montana State University's required teacher preparation computer course during Autumn quarter 1987 or Winter quarter 1988.

Regression analyses indicated that epistemological maturity and age were significant predictors of second- or third-wave achievement. Approximately 35% of the variance in achievement could be accounted for by level of epistemological maturity. Level of computer anxiety was not significantly correlated with achievement.

Based on the analyses, the following conclusions and recommendations were drawn. In the affective domain, it was suggested that less time should be spent in pre-service education addressing issues of computer anxiety and more time should be spent promoting epistemological maturity. In the epistemological domain, it was concluded that the conditions of learning which promote epistemological maturity should be systematically integrated into the required computer course to promote higher level thinking and third-wave applications of computers.

CHAPTER 1

INTRODUCTION

It appears that the field of instructional computing, especially in the area of teacher preparation, has reached a crossroads (Maddux & Cummings, 1986; Siegel & Davis, 1986). The profession is faced with the following dilemma: to resolve not if the computer should be used in instruction but rather how it should be used (Loyd & Gressard, 1984). Several factors over the last twenty years have contributed to the evolution of the dilemma. Each, in its own way, has contributed to the arguments surrounding the appropriate ways to integrate instructional technology into the classroom. The following three factors provide a basis for understanding the complexity of the situation: the epistemological implications of the information explosion, the affective consequences of interacting with technology in the Information Age, and the ways in which teachers have been prepared to deal with these facets of the Information Age.

Over ten years ago the Carnegie Foundation reported that education was entering into a phase dominated by technology (Carnegie, 1972). This phase, the so-called fourth revolution, has been referred to both in

intellectual circles as well as in the popular press as the Information Age or Information Society. In order to understand the educational implications of the Information Age, it is necessary to examine its scope, its effects on society, and its components.

The scope of the Information Age is three-fold. First, it extends and shapes the traditional processes of production and consumption. In other words, the Information Age does not "replace, it overlaps, the growing, extracting, processing, manufacturing, recycling, distribution, and consumption of tangible things" (Cleveland, 1985). Second, the Information Age has been characterized by what has been referred to as an information explosion. Jarvis (1985, p. 5) reported the following estimates for the next decade:

> 30 billion original documents are created each year, with 630 billion pages of print going through the postal system and 100 billion pages coming off photocopiers. For each employed person, this is enough paper to fill four filing cabinets, containing twelve miles of paper. These figures will probably double in five years.

Third, the Information Age has forced educators to deal with the epistemological implications of the information explosion. Students can no longer be held responsible for assimilating the body of knowledge in a particular discipline. The information explosion precludes that capability. The Information Age requires

that the concept of information processing be redefined. Rather than being defined as a body of knowledge, information must be defined in terms of a continuum. The continuum has as its end points data and wisdom; information falls at approximately the midpoint. The points can be defined as follows (Hartoonian, 1984; Cleveland 1985):

> data: undigested observations, uninterpreted facts;
> information: data which has been organized by someone other than oneself;
> knowledge: organized information which has been internalized by self and integrated into other knowledge;
> wisdom: integrated knowledge made useful by theory.

Defining information in this manner implies that learning consists of at least two processes: evaluating the ways information has been organized or interpreted by others and reorganizing information into knowledge. In fact, it has been suggested that one of the major problems facing society is what has been described as a "technological dialectic": technology, in making information more easily accessible, has put the onus of interpretation and verification on the learner -- a burden which requires a high level of critical/creative thinking (Broudy, 1986, p. 235). In addition to these processes, optimum use should be made of the information resource which entails the "interdisciplinary, interdepartmental,

interpersonal, interdependent, and international" exchange of information (Cleveland, 1985, p. 197).

The social implications of the Information Age are equally complex. Harlan Cleveland has suggested that the availability and the power of information would alter the hierarchies of society which have been based primarily on the notion of scarce resources. These hierarchies included the following (Cleveland, 1985, p. 16):

1. hierarchies of power based on control (of new weapons, of energy sources, of trade routes, of markets, and especially of knowledge);
2. hierarchies of influence based on secrecy;
3. hierarchies of class based on ownership;
4. hierarchies of privilege based on early access to valuable resources;
5. hierarchies of politics based on geography.

Students today are being educated in a substantially different world than their parents. Information is instant, global, and only loosely controlled. This condition has raised serious ethical questions concerning issues of ownership, privacy, and abuse of technology. A recent study of children attending a summer computer camp found that children operated as if "all information were open and accessible to anyone who wished to view it" (Diem, 1985. p. 319). In addition, it was concluded that the children "had not previously thought through the ramifications of the use and misuses of technology, and of the information spawned by it" (Diem, 1985, p. 320).

Concurrent to the deep pedagogical changes implicit in the Information Age, there is a deep affective reaction to the demands of coping with and adapting to the technological revolution. Sherry Turkle (1984) of MIT conducted an extensive study of people's reactions to and comments about technology: ranging from elementary school children, to video-game players, to eminent computer scientists. She found that computers were frequently the objects of a great deal of anxiety and that that anxiety was manifested in the ways people personified computers and referred to them as if they were alive.

The most illustrative response came from the children. When quizzed about their computerized toy, Merlin, they responded that Merlin was "sort of alive." When pressed, they commented that Merlin's aliveness was a consequence of the fact that he "cheated" (result of alternative strategies programmed into the toy which won't allow a child to always begin a tic-tac-toe game by placing his/her mark in the middle square). His "unaliveness" was attributed to the fact that, in the children's words, he really didn't care that he cheated (Turkle, 1984).

The educational implications of unprecedented interactions with technology has been the onset of a new malaise: computerphobia (Jay, 1981). Loyd and Gressard

(1984) corroborated other research which has indicated that one of the major factors stymying the infusion of computers into education has been teacher anxiety. Students, growing up in a technological environment, often knew more than their teachers about computers and were also less anxious about using computers in their learning (Anatasio, 1972; Kritek, 1976; Cooper, 1978; Stevens, 1980; Rohner & Simonson, 1981).

Preparing teachers to deal with the knowledge explosion and the concomitant affective response to that explosion has focused, to a large extent, on making teachers aware of and comfortable with the presence of the microcomputer in the classroom (Lesgold, 1986). In the educational arena, technology has generally been in the form of the microcomputer (White, 1983). The pervasiveness of the microcomputer in education was reported in a 1985 survey of 2,300 public and private schools in the United States (Valdez, 1986, p. 5):

> There are one million computers in American elementary and secondary schools. Most elementary schools have five or more computers, and half of all high schools have 15 or more computers. One-fourth of the nation's school teachers -- over 500 thousand -- are using computers. The number of computers in schools has quadrupled in the last two years. The best projections are that there will be 3 million computers in elementary and secondary schools by 1990 -- even given the national decline in the purchase of personal computers.

To a lesser degree, preparation of teachers has focused on teachers' philosophical approaches to technology. It is becoming increasingly evident that the presence of a computer did not guarantee that students would learn the appropriate uses or capabilities of technology (Foell, 1983; Fetler, 1985; Walker, 1986). Rather, teachers' philosophical approaches to technology dictated the ways computers would be integrated into the classroom (Davies & Shane, 1986). This problem has generated a dilemma: advances in technology continue to occur while educators struggle with an adequate definition of "computer literacy." The evolution of this dilemma involves the examination of how technology has developed as well as how education has tried to define what is essential knowledge about and experience with technology.

The development of technology has occurred in three stages: the TV stage, the computer stage, and the electronic environment stage (White, 1983, p. 51). Currently, schools tend to be in the computer stage, concentrating on the computer as the object of instruction. However, the rest of society is moving into the electronic environment stage which is characterized by such activities as electronic banking, shopping, and data processing (Fetler, 1985). In addition to these activities, there has been an increase in what has been

termed "telematics": the combination of computers and other forms of electronic communication (Knapper, 1982). Accessing national and international databases and electronic bulletin boards has become part and parcel of today's business world (Cleveland, 1985).

Education finds itself at a crossroads in the search for the appropriate place for the computer in the classroom (Maddux & Cummings, 1986; Siegel & Davis, 1986). Siegel and Davis (1986) have characterized this crossroads as second and third-wave computing. Each philosophical approach defines the appropriate use for computers in the classroom.

Second-wave computing is grounded in nineteenth-century epistemology which characterized information processing as collecting "discrete bits of information (facts) in a manner that leads to objective conclusions (truth)" (Bowers, 1988, p. 44). Pedagogically, second-wave computing involves teaching about the computer in the sense that the computer is the object of instruction and that the power of the computer to process information determines the kinds of applications. Programming, rote drill and practice exercises, and other applications based on binary logic (right/wrong) are commonly found in the second-wave classroom. Primarily, pedagogical questions concerning

the integration of computers into the classroom center on ways in which the computer can enhance traditional instruction and curricula (Siegel & Davis, 1986).

On the other hand, third-wave computing is characterized quite differently. Epistemologically, information processing takes on the characteristics of reflection and evaluation (Bowers, 1988). Computers are less likely to be the subject of instruction and more likely to be a tool of instruction (Watts, 1981). Focus on the computer itself is minimized. Of concern is what is referred to as "computer imagination": the ways in which the computer can be used to "exploit the medium in order to enhance the message" (Siegel & Davis, 1986, p. 91). Engaging in computer imagination requires an understanding of the capabilities and limitations of computer technology but does not require that the computer itself be the object of instruction. Rather, pedagogical concern is with the ways in which the computer impacts the nature of instructional tasks, an exploration of the ways in which the computer may change the nature of classroom activities and interactions and ways in which those differences can be maximized to do things in ways that have never been done before in traditional instruction.

The educational implications of these two approaches to instructional computing impact the ways teachers are

prepared to integrate technology into education. On the bases of those approaches, educators have defined what behaviors and experiences constitute a "computer literate" person. The second-wave focuses almost entirely on reading and writing computer programs, using computer documentation, using computer terminology, and using computers in traditional learning tasks (Taylor et al, 1980; Bitter & Camuse, 1984; Alessi & Trollip, 1985; Siegel & Davis, 1986).

The third-wave has deemphasized programming competencies and has suggested that teachers and students be facile in the following kinds of competencies (Bruwelheide, 1982; Rawitsch, 1982; Anderson, 1983; Adams, 1985; Hawkins & Sheingold, 1986; Maddux & Cummings, 1986; Siegel & Davis, 1986): integration of the computer into subject areas; identification, use and evaluation of applications of computer technology; application of problem solving/decision making aspects of computers and appreciation of the social, moral and global implications of technology. In light of those competencies, Lesgold suggested the following definition of computer literacy (1986, p. 8):

> In a sense, "computer literacy" has little if anything to do with handling computers. It is, rather, a set of broad cognitive capabilities that allow one to think deeply, creatively, and efficiently and to communicate the results of that thinking.

One challenge facing education in the Information Age involves preparing teachers "to cope with the gap between technological progress and the human capacity for change" (Knapper, 1982, p. 84). In order to meet this challenge, teachers must adapt to the technological world (Walker, 1985) and identify outcomes and methods more compatible with the Information Age. Teaching may take on the form suggested by Cleveland (1985), Diem (1985) and Shane (1982) which involved the following:

1. "integrative brainwork" -- the ability to efficiently and effectively solve problems, make decisions, and critically evaluate information;
2. focus on social goals, public purposes, costs and benefits of openness;
3. self-analysis and metacognition;
4. practice in "real world" negotiation;
5. integration of global perspectives with issues of personal responsibility;
6. focus on social and citizenship skills which emphasize the use and abuse of information systems;
7. development of ethical standards for information creation and utilization.

Whatever form education will eventually take is beyond the scope of this study. Nevertheless, any change or need will occur within the context of the Information Age. The scope, societal effects, attributes of information, and development of technology will all shape the architecture of education and the demands made on those who deliver instruction.

Statement of the Problem

The problem of this study was to determine if second- or third-wave achievement in a computer-based lesson planning task in a required teacher preparation computer course at Montana State University could be predicted from knowledge of the following set of variables: level of epistemological maturity, level of computer anxiety, and selected attribute variables. The attribute variables of interest included age, gender, class standing, level of preparation, and level of prior computer experience.

Need for the Study

The justification for this study has been derived both from the research on the approaches to instructional computing as well as from the results and recommendations of previous research in the fields of epistemological maturity and computer anxiety.

First, researchers, in their discussions of second- and third-wave computing, have contended that the two attitudes which underlie the two approaches were reflective of alternative philosophies of education which were generally unreconcilable (Siegel & Davis, 1986; Walker, 1986). However, Broudy (1986) contended that one's attitude toward instructional computing was a function of his/her perception of and reaction to a

technological world: an epistemological response to the Information Age.

Therefore, the research focusing on the ways in which teachers' levels of epistemological maturity and computer anxiety affected the ways in which they approached learning and their students was examined. As will be discussed, the concept of epistemological maturity provides insight into the ways in which teachers perceive technology and information processing; the concept of computer anxiety will elucidate the ways in which teachers react affectively to technology.

In the area of epistemological maturity several studies discussed the relationship between teachers' epistemological maturity and their approachs to teaching. Beers and Bloomingdale (1983) examined the relationship between the epistemological maturity of twenty teachers at a small liberal arts college and their perceptions of student difficulties. Generally, these teachers attributed student difficulty to effort, personality characteristics, talent, study skills, and concreteness. Those teachers who were assessed as Dualists on the Perry Scheme of Cognitive Development attributed student difficulties to personality characteristics and talent. In other words, the more rigid a teacher was in his/her thought, the more apt he/she was to attribute a student's

difficulty to stable, inherent characteristics which were less amenable to remediation.

Hunt and Germain (1969) observed that teachers who demonstrated more relativistic thought patterns asked twice as many convergent, evaluative, and divergent questions. They were also more supportive of students' learning. Recommendations of this study included a strong argument for the integration of critical thinking skills development in teacher preparation programs.

Research on the relationship between epistemological maturity and critical thinking skill development has also been suggested on the grounds that some of the essential questions concerning the integration of critical thinking into the curriculum were epistemological (Facione, 1984). In addition, it has been suggested that cognitive research include studies of how teachers think (Cuban, 1984).

Examinations of how teachers think must include consideration of the level at which they think and the level of their epistemological maturity. Perry (1970) discussed at length the concept that critical thinking skill was mitigated by the level of epistemological maturity. That is, a Dualist thinker interpreted critical thinking as getting the Right answer. The Multiplistic thinker interpreted critical thinking as including as many points of view as possible with the hope that the Truth

would be included. The Relativist thinker demonstrated behaviors which were considered demonstrative of critical thinking: analysis and evaluation of information. Truth was a matter of personal commitment and judgment. Perceptions of self, others and knowledge affected the way problem-solving or inquiry was approached.

Another factor teacher preparation programs must take under consideration are teachers' level of computer anxiety. A Rand Corporation Task Force emphasized the relationship between attitudinal variables and teachers' successful use of computers across the content areas (Shavelson, et al, 1984). In a general sense, teacher anxiety has been correlated to a number of dysfunctional teacher behaviors such as low rapport with students, less verbal support of student learning, more hostile behavior towards students, increased dogmatism, increased pupil anxiety, increased avoidance of risk, and increased feelings of inferiority, uselessness, loneliness, and betrayal (Keavney & Sinclair, 1978; Youngs, 1978).

More specifically, a number of studies over the last two decades have indicated that children were eager to experience what a computer had to offer, but their teachers resisted integration of the computer into education (Anatasio, 1972; Kritek, 1976; Cooper, 1978; Jay, 1981). Rohner and Simonson suggested that "computer

anxiety among teachers was one factor that was inhibiting the potential benefits of computer technology in education" (1981, p. 551).

More recently, teachers tended to recognize the need for computer skills and methods of integration across the content areas. However, teachers still frequently exhibited anxiety about using computers in their classrooms (Woodrow, 1987). Even after being involved in a five-year implementation plan, teachers resisted integrating computers into instruction and tended toward second-wave perceptions of computers as "a non-threatening addition to tried and true approaches to instruction" (Woodward & Mathinos, 1987, p. 7).

The study provided an opportunity to examine the relationship between the epistemological maturity and computer anxiety of prospective teachers and their subsequent performance on a computer-based instructional planning task. The task was based on the objectives and competencies identified in the instructional computing literature and was designed to determine both the degree and type of integration of computer software into the content areas.

General Questions to be Answered

In order to determine whether second- or third-wave achievement in a computer-based lesson planning task in a required teacher preparation computer course at Montana State University could be predicted from knowledge of the following set of variables: level of epistemological maturity, level of computer anxiety, and selected attribute variables, the following general questions were addressed. These questions fell into two general categories: those dealing with the interrelationships among the predictor variables of interest and those dealing with the prediction of the criterion variable of achievement. The questions were as follows:

1. Are there significant differences in mean levels of computer anxiety with respect to gender and levels of prior computer experience?

2. Are there significant differences in mean levels of epistemological maturity with respect to gender and age?

3. Is there a significant R-Square between the set of predictor variables and the criterion variable of achievement?

4. What are the contributions of the predictor and attribute variables to the criterion variable of achievement?

5. What significant increments to R-Square are associated with the inclusion of the independent variables of level of epistemological maturity, level of computer anxiety, level of prior computer experience, level of preparation, gender, age, and class standing?

General Procedures

Solution to the problem involved several procedures. These procedures included the following: appropriate identification of a population and subsequent sampling, a systematic method for measuring the predictor variables, a systematic method for obtaining appropriate attribute variable information, and a controlled exposure to a computer-based lesson planning task and subsequent measurement of achievement. An overview of these procedures follows.

Population and Sampling

The population for the study included all Montana State University students who met the following criterion: prospective teachers coded in one teacher preparation or teacher certification curricula during Autumn quarter 1987 and Winter quarter 1988. Teacher preparation curricula included the following general categories: elementary education, secondary education, K-12 education, teaching options of curriculum other than education, and teacher certification. Prospective teachers coded in the first four curricula listed were classified as undergraduate students; the last, teacher certification candidates, were classified as graduate students.

The sample for this study consisted of those prospective teachers who met the specified population criterion and who were enrolled in EDIM 251, Foundations of Instructional Computing, either Autumn quarter 1987 or Winter quarter 1988. The number of prospective teachers who met the criterion during Autumn quarter 1987 was 100; the number of prospective teachers who met the criterion during Winter quarter 1988 was 112. The total combined sample of 212 prospective teachers was used.

Preparation for Assessment

Preparation for Assessment involved: training raters, and establishing inter-rater reliability coefficients. These procedures were conducted following Winter quarter of 1988.

Training of reliable raters entailed training raters for the following tasks: rating the Measurement of Epistemological Reflection (Baxter-Magolda & Porterfield, 1985) and holistic rating of achievement on the computer-based lesson planning task.

Rating of the Measurement of Epistemological Reflection was done by the researcher. During the course of the study, the researcher completed the training program developed by the authors of the instrument and certified as a rater with an inter-rater correlation coefficient of .87.

Establishing inter-rater reliability for the computer-based lesson planning task was completed by the researcher and designated EDIM 251 instructor following Winter quarter 1988. A random sample of ten lesson planning tasks was drawn from the course projects and normed.

Measurement of Predictor Variables

Measuring the predictor variables of epistemological maturity and computer anxiety involved the following instruments. Epistemological maturity was measured with the Measurement of Epistemological Reflection (Baxter-Magolda & Porterfield, 1985). Computer anxiety was measured with the Computer Attitude Scale (Loyd & Gressard, 1984).

Measurement of Attribute Variables

Obtaining information on the attribute variables of gender, age, class standing, and prior computer experience involved the following procedures. Prospective teachers self-reported their gender, age, and prior computer experience. Class standing and level of preparation were determined from official class rolls.

Treatment and Measurement of Achievement

As part of the requirements for EDIM 251, prospective teachers completed a computer-based lesson planning task. The lesson planning component of the task entailed standard instruction procedures (Davis, 1979): identification of objectives, evaluation of resources, description of methodologies, description of management strategies, and identification of lesson evaluation procedures. The computer component of the task entailed the degree and type of integration of computer software into the content areas as evidenced in the lesson plan task. Measurement of achievement on that task was based on holistic scoring of the final product of the task.

Limitations

There were several limitations to the study. These were as follows:

1. The sample for this study was not drawn randomly but was drawn from intact groups of prospective teachers who enrolled in the teacher preparation curriculum at Montana State University, Bozeman, Montana, as well as in EDIM 251 during either Autumn quarter 1987 or Winter quarter 1988;

2. Although lesson planning involved both process and product, achievement was determined solely on the basis of the product;

3. Choice of software was limited to that which was available in the Instructional Computing Lab of the Montana State University College of Education;

4. Since the literature was not in agreement concerning the definitions of predictor variables of interest, the choice of definition and subsequent mode of measurement limited the study (Beyer, 1985; Fetler, 1985).

Definition of Terms

The following terms were defined as follows for the study.

Achievement: the degree and type of integration of computer software into the content areas as evidenced in a computer-based lesson planning task. Tasks were rated on a four-point holistic rating scale.

Computer anxiety: "resistance to thinking about computer technology, fear of computers, and hostile or aggressive thoughts about computers" (Loyd & Gressard, 1984).

Computer-based lesson planning: integration of computer software into the content areas using the syntax of instructional planning.

Computer software: computer courseware used for direct instruction such as drill and practice, tutorials, and simulations (Taylor, 1980).

Computer imagination: "the degree to which a lesson exploits the strengths of the computer medium to enhance instruction, rather than merely imitating other teaching media" (Siegel & Davis, 1986, p. 91-92).

Critical thinking: "reasonable, reflective thinking that is focused on deciding what to believe or do." It involves both dispositions and abilities (Ennis, 1962).

Data: undigested observations, uninterpreted facts (Cleveland, 1985).

Dualism or Duality: "a bifurcated structuring of the world between Good and Bad, Right and Wrong and Others" (Perry, 1970).

Epistemological maturity: growth or progression from one structure to a higher structure as defined on the Perry Scale of Cognitive Development (Perry, 1970).

Information: data which has been organized by someone other than oneself (Cleveland, 1985).

Instructional planning: The systematic process of analyzing subject matter, selecting materials and methods, developing and managing delivery, and evaluating outcomes (Davis, 1979).

Knowledge: organized information which has been internalized by self and integrated into other knowledge (Cleveland, 1985).

Level of epistemological maturity: position on the Perry Scale of Cognitive Development which represents "the mode, or central tendency, among the forms through which an individual construes the world of knowledge and values at a given time in his life" (Perry, 1970). Positions ranged from one to five.

Level of computer anxiety: "resistance to thinking about computer technology, fear of computers, and hostile or aggressive thoughts about computers" (Loyd & Gressard, 1984).

Level of preparation: focus of prospective teacher preparation; categories of preparation included: elementary, secondary, and K-12 preparation.

Level of prior computer experience: number of weeks, months or years of computer experience prior to enrollment in EDIM 251. Type of experience was not a consideration.

Multiplicity: "a plurality of 'answers', points of view, or evaluations, with reference to similar topics or problems. The plurality is perceived as an aggregate of discretes without internal structure or external relation, in the sense, 'Anyone has a right to his own opinion' with the implication that no judgments among opinions can be made" (Perry, 1970).

Relativism: "a plurality of points of view, interpretations, frames of reference, value systems and

contingencies in which the structural properties of contexts and forms allow various sorts of analysis, comparison and evaluation in Multiplicity" (Perry, 1970).

Wisdom: integrated knowledge made useful by theory (Cleveland, 1985).

CHAPTER 2

REVIEW OF LITERATURE

In order to put the problem of this study in perspective and to determine its position in the current body of knowledge, it is necessary to examine the research salient to the variables of interest. The chapter is organized in the following manner: each section reviews research pertaining to the variables of interest; research focusing on the background, definition, expansion, validation, and assessment of the variables of interest is presented. Where applicable, research related to possible intercorrelations among variables of interest is discussed.

Epistemological Maturity

Perry Scheme of Cognitive Development - Overview

During a ten-year period between 1958 and 1968, William G. Perry and his associates at Harvard University's Bureau of Study Council hypothesized and validated a scheme of cognitive development. The scheme was based on the following assumptions: 1) that cognitive development entailed linear stages characterized by specific phenomenological perceptions; 2) that cognitive

development continued into the adult years; 3) that cognitive development was integrated with moral and ethical development; and 4) that students confronted the pluralism of academia in systematic ways (Perry, 1968, 1970).

The first assumption was grounded in what Perry referred to as "developmental phenomenology" (1970, p. 106). This philosophical stance provided an explanation for two basic components of the scheme. First, it addressed the notion that as maturation occurred, discernible stages could be identified. Second, it reinforced previous cognitive research which suggested that perceptions of reality and learning evolved over time and that each stage was characterized by specific ways of looking at self, others and knowledge (Piaget, 1950).

The second assumption was based on Perry's belief that stages of cognitive development did not end in adolescence with formal operational thought as suggested by Piaget (1950). Rather, he proposed that adults matured through nine additional stages, or positions. However, Perry did not reject Piaget's underlying constructs. He maintained that the processes of assimilation, accommodation, and equilibrium/disequilibrium explained the ways in which cognitive maturation occurred (Perry, 1970). Subsequent research confirmed that cognitive

maturation occurred concurrently with cognitive thought development (Porterfield, 1984; Perry, B., et al, 1986). In relation to teacher preparation, Sprinthall and Thies-Sprinthall (1983) discussed the implications of ongoing cognitive maturation in relation to viewing teachers as adult learners.

The third assumption evolved from what Perry perceived to be a lack of integration between the research conducted in the realms of moral/ethical development (Kohlberg, 1964) and cognitive development. Assuming perceptions of reality and knowledge were mitigated by cognitive development, it was logical that moral/ethical beliefs and actions were also related to epistemological maturity (Perry, 1970).

The final assumption provided the basis for a three-phase study which developed and validated the scheme. Each phase was characterized by a unique purpose and methodology (Perry, 1968). A brief examination of each phase will illustrate the process by which the Perry Scheme of Cognitive Development emerged.

Phases of the Study

Phase One was focused on describing what Perry and his colleagues surmised to be systematic patterns of development. Through their advising and counseling contacts with students, they found that students tended to

respond to the pluralism of higher education in particular ways. The students verbalized certain perceptions of self, others and knowledge which changed over the course of their education. These perceptions suggested the possibility of stages (Perry, 1968, 1970).

The following methodology was utilized to factor out and describe student perceptions in terms of stages of cognitive development: the Checklist of Educational Views (CLEV), an instrument designed to place students on a continuum ranging from dualistic to relativistic thought, was administered to a random sample of college freshmen in the fall and spring of 1958 (Perry, 1968).

In order to validate the continuum, phase two was initiated which involved recorded interviews with students. A sample was drawn from the following strata of the original group: students with extreme dualist scores, students with extreme relativist scores, students with mean scores, and students who showed the most change in fall and spring scores. These students were invited for interviews. Results of the CLEV and the subsequent interviews allowed Perry to sketch out nine stages of development, one condition of delay, and two conditions of alienation. The resulting Chart of Development and Glossary of Terms were the basis for the final phase of validation (Perry, 1968).

The last phase of the process involved rating student interviews on the basis of the Chart of Development. A new random sample of students was drawn. These students were invited for interviews which resulted in 67 complete four-year reports. In order to verify the underlying stages of development, six lay raters were asked to rate the following: four-year protocols, single interviews, excerpts, and condensed four-year reports. Inter-rater reliability was calculated for each rating task. High correlations supported Perry's assertion that raters had identified underlying stages of development (Perry, 1968).

Chart of Development

The Perry Scheme of Cognitive Development incorporated nine positions, one condition of delay, and two conditions of alienation. Each position described the ways in which self, others and knowledge were perceived in the process of making sense of the world (Perry, 1968, 1970). A condensed overview of the nine positions illustrates the phenomenology of development.

Dualism. Positions 1, 2, and 3 were predicated on the assumption of a bifurcated world. Self was seen in opposition to others, especially those in power who knew the Truth. Knowledge was based on right vs wrong, or good vs bad. Getting an education entailed working hard,

doing what "they" said, and finding the right answers to questions (Perry, 1970).

Multiplicity. Positions 4 and 5 were predicated on the assumption of a pluralistic world. Self was seen as one of many having an opinion about an issue. While there were no absolutes, Authority - those in power - still knew the best Truth. Knowledge was based on pluralism but not on critical judgments about the worth of one stance over another. Getting an education entailed having the right to one's own opinion but also being subjected to evaluation by an external Authority (Perry, 1970, 1981).

Relativism. Positions 6, 7, 8 and 9 were predicated on the assumption of a pluralistic world and on the necessity of individual commitments. Self was seen as a decision-maker whose power rested in the ability to arrive at solutions after the examination of alternatives. Authority lost its status as the knower of Truth because the power of knowing shifted to the learner. Knowledge was mitigated by a dimension of commitment. Getting an education entailed individual investigation and acceptance of the relative nature of knowledge (Perry, 1970, 1981).

In addition to the nine positions, conditions which interrupted development were postulated. Temporizing involved a condition of delay in which growth was suspended for approximately a year and a holding pattern

was maintained. Escape involved two conditions of alienation: Dissociation which involved choosing to remain in a multiplistic mode in order to avoid taking responsibility and Escapsulation which involved tolerance of multiplicity in others as long as it did not impact dualism of self (Perry, 1970, 1981).

Limitations of the Perry Scheme

Perry and subsequent researchers have indicated that the original study which gave rise to the Chart of Development was limited in several respects. Perry listed the following: use of student volunteers and the possibility of interviewer influence (1968, p. 5). In addition, the restricted nature of the population may have accounted for the discrepancies between Perry's findings and more recent research. The population, freshmen attending Harvard between 1958 and 1963, may not have been representative of college freshmen in general. Students were generally of traditional age, all male, and subject to competitive entrance requirements (Perry, 1968).

Results of Perry's study indicated that a majority of college freshmen were identified as being in positions 3-5. In other words, the freshmen year was characterized by dualistic and multiplistic views. On the other hand, 75% of the seniors were placed in positions 6-8 which reflected relativistic thought (Perry, 1968, p. 15).

Subsequent research on college students in a large public university placed freshmen and sophomores at the 2-3 level, seniors at the 3-5 level, first year graduate students at the 3-5 level, and advanced graduate students at the 6-7 level (Knefelkamp & Slepitza, 1976, p. 52).

Additional research has also been recommended in the following areas: expansion and elaboration of the scheme, utilization of the scheme in instructional and curricular design, and development of instruments to assess stages of development (Perry, 1981, p. 98).

Expansion and Elaboration of the Scheme

Expansion and elaboration of the Perry Scheme has focused on clarification of the linear, vertical nature of the scheme and on correlations with other areas of human development. Perry, himself, dealt with the linearity issue. In his original work, he suggested the possibility of what he called horizontal decalage, the process through which "individuals mature in different areas of their lives" (Perry, 1968, p. 89). That is, lateral growth should not be confused with temporizing, a period of no growth. Later, he suggested that development not be seen as a strict, lockstep progression but as a "helix of development" with each stage spiralling up from another with a new twist (Perry, 1977, p. 51).

In their work with Ohio State college students in a career development course, Knefelkamp and Slepitza elaborated on the concept of lateral growth. The relationships among the behaviors associated with decision-making and levels of cognitive development were examined. Behaviors considered were as follows: locus of control, analysis of information, synthesis of information, modes of expression, self-processing skills, openness to alternative perspectives, ability to assume responsibility, ability to take on new roles, and ability to take risks with self (1976, p. 54). Evidence indicated that the level of epistemological maturity was related to the behaviors. For example, dualists tended to see career choice as motivated by external pressures and culminated with the one "right" career, while relativists viewed the choice as a personal one among alternatives (1976, p. 57).

Additional research which related level of epistemological maturity to the problem solving process characterized the process in terms of cycles through the entire spectrum of the scheme. In the absence of information, a problem was viewed dualistically, as having a "right" answer. In the presence of limited information, a problem was viewed in multiplistic terms, as having many possible and equally plausible solutions. In the presence of extensive information and critical judgment, a problem

was viewed relativistically, as having a defensible solution. Cognitive development "cycles across different areas or situations and . . . the nature of the cycling changes with experience" (Sheese & Radovanic, 1984, p. 16).

Expansion of the Perry Scheme has also been in terms of correlations with other aspects of human development. Heffernan focused his research on the upper positions of the scheme in order to examine the relationship between "forms of thought and styles of establishing values and personal identity" (1975, p. 493). The correlation between establishing identity through commitments was supported (Heffernan, 1975).

Utilization in Instructional and Curricular Design

Research into ways the Perry Scheme might be utilized in designing instruction and curriculum has focused on two aspects of instruction: intervention and environment.

Several studies have examined the effects of "developmental instruction", a method of instruction characterized by direct attempts to facilitate cognitive development (Knefelkamp, 1974; Widick, 1977). Widick hypothesized that academic performance and satisfaction in a college literature course would be higher when instructional components matched a student's level of epistemological maturity than when components and status

were mismatched. Two teaching approaches were designed and implemented in two sections of the course. Inferential findings were not significant. Differential performance and satisfaction could not be attributed to teaching approaches. However, descriptive findings supported previous research which indicated that students at different levels of epistemological maturity approached learning in qualitatively different ways (Widick, 1977).

In a similar study, Knefelkamp hypothesized that instruction could be designed in such a way as to facilitate growth in epistemological maturity. Utilizing a design similar to Widick, she utilized two methods of instruction in two sections of a college course. One method was designed to facilitate movement of dualistic thinkers to relativistic thinkers. The second method was designed to facilitate movement of relativistic thinkers to commitment. Although 28 of the 31 students experienced cognitive growth, it was not conclusive that this was attributable to developmental instruction (Knefelkamp, 1974).

Another approach to the utilization of the Perry Scheme in instruction focused on the creation of a challenging but supportive environment in which growth could occur. In fact, Perry questioned the professionalism of direct intervention in student growth

and attributed resistance to growth "not as a sign of stubbornness but of integrity" (Perry, 1977, p. 52). He also suggested that the primary educational application of the Scheme would be in determining "what environmental sustenance most supports students in the choice to use their competence to orient themselves through Commitments" (Perry, 1970, p. 213).

Development of an environment which supported cognitive growth was examined in the context of traditional and innovative educational settings. Variables considered included: peer interactions, faculty-student interactions, curriculum structure and course-work, and extra-curricular activities (Heffernan, 1975, p. 502). It was found that the two environments did have differential effects on identity formation and epistemological maturity (Heffernan, 1975).

Assessment of Epistemological Maturity

The assessment of epistemological maturity has evolved from Perry's original method of interviews and written protocols to paper and pencil assessments. This evolution has also attempted to deal with some of the issues associated with different types of measurement.

Several methods of assessment have been patterned after the interview method. One such method required students to select a response from a predetermined set and

to justify or talk about their selection (Clinchy, et al, 1977). A similar assessment required students to paraphrase paragraphs from their own perspectives (Kurfiss, 1977). Taylor, in the discussion of the assessment instrument, remarked that these methods "rested on the assumption that respondents would be able to accurately discuss statements or paragraphs representative of their developmental level" (Taylor, 1983, p. 2).

Development of a paper and pencil assessment originated as an alternative method which would eliminate some of the drawbacks of the interview method. The interview was time consuming, required extensive rater training and was subject to interviewer bias (Erwin, 1983, p. 6).

The Knefelkamp-Widick, KneWi, instrument was one of the first paper and pencil instruments to evolve. It required students to complete five sentence stems and to write two essays which addressed students' thinking on a particular issue. A revised version of this instrument, the Measure of Intellectual Development (MID), was developed and used extensively in research dealing with developmental instruction (Knefelkamp, 1974; Widick, 1977; Taylor, 1983).

In an attempt to streamline assessment further, Erwin developed the Scale of Intellectual Development (SID).

SID assessed students on the following factors: Dualism, Relativism, Commitment, and Empathy (Erwin, 1983, p. 7).

Taylor developed an instrument, the Measure of Epistemological Reflection (MER), which addressed what she considered to be both the drawbacks of the MID and SID as well as of the complexity of assessment. Her critique indicated that the MID did not separate specific content from general epistemological maturity or provide follow-up questions designed to ascertain underlying reasoning patterns. Similarly, SID did not assess reasoning strategies (Taylor, 1983, pp. 1-2)

In addition to the drawbacks of these instruments, Taylor suggested that the complexity of assessment must be addressed. Drawing on the work of Loevinger and Wessler, she indicated that the following must be considered in assessment: "all kinds of development occur simultaneously, making separation of strands of development difficult . . . subjects exhibit behaviors representative of more than one developmental level . . . signs that appear in earlier stages reappear later in more complex forms and . . . all these factors lead to error in matching behavioral signs to underlying development" (Taylor, 1983, p. 2).

Based on these considerations of complexity, several criteria were suggested for evaluation of an assessment

instrument. These included: specific descriptions which distinguished intellectual development from other types of development; structured stimuli which elicited information about intellectual development without interference of content; and a comprehensive rating manual (Taylor, 1983, Taylor & Porterfield, 1984).

The Measure of Epistemological Reflection (MER) was based on these criteria and considerations. It measured epistemological maturity in six domains: decision making, role of peers in learning process, role of the learner, role of the instructor, evaluation, and the nature of knowledge (Taylor & Porterfield, 1984, p. 2). These domains were assessed by means of a general reference question which was followed by a series of follow-up probes designed to gather data about reasoning processes. The manual included general description of each position, examples of reasoning structures associated with that position, and example protocols. Reliability was established through inter-rater reliability procedures. Validity was established concurrently with the MID (Taylor, 1983; Taylor & Porterfield, 1984; Baxter-Magolda & Porterfield, 1985).

Epistemological Maturity and Age:

Perry noted in his study with Harvard students that as students matured, they tended to move into the higher levels of epistemological development. Freshmen were primarily found to be in the Dualistic stages, while seniors were found to have developed into the Multiplistic and Relativistic stages (Perry, 1970). Based on this apparent development, it could be assumed that level of epistemological maturity was directly correlated with chronological age.

However, additional research demonstrated that epistemological maturation does not always follow a predictable, linear pattern. Cameron (1984), in her work with adult learners, investigated the epistemological maturity of 46 nontraditional-aged college students. The mean age of these students was 41 years; the age range was 22 to 48. Through a protocol and interview method, Cameron ascertained the epistemological maturity levels of these nontraditional students. Results indicated the following: 63.3% of the sample were at the Dualistic stage; 26% were at the Multiplistic stage; and 10.8% were at the Relativistic stage. She concluded that the older, nontraditional student was more likely to be at a lower level of epistemological maturity rather than at a higher stage and that epistemological development was mitigated

by such factors as socialization and exposure to pluralism (Cameron, 1984).

Epistemological Maturity and Gender

One of the limitations to Perry's research cited in subsequent research has been related to the fact that Perry validated the Scheme of Cognitive Development on an exclusively male population (Clinchy, et al, 1977; Clinchy & Zimmerman, 1982; Belenky, et al, 1986; Baxter-Magolda, 1987).

A longitudinal study at Wellesley College was conducted to determine if women followed paths of epistemological development similar to established male patterns. Through the interview method, data were collected from 90 undergraduate women whose epistemological development was tracked through their four years of school. Generally, the researchers discovered that the women tended to conform to the same scheme of development as the males included in Perry's research (Clinchy & Zimmerman, 1982).

In an effort to expand the scope of epistemological maturity from the exclusive, private institution sphere, an extensive study of women's epistemological development was conducted with women not only from a state university environment but from social family agencies as well. Interviews with 135 such women revealed that women's

epistemological development followed a parallel but different pattern. Stages identified in the study were as follows (Belenky, et al, 1986):

> Silence: complete submission to authority;
> Received Knowledge: reliance on authority;
> Subjective Knowledge: reliance on personal intuition;
> Procedural Knowledge: reliance on problem solving;
> Constructed Knowledge: reliance on contextual criteria.

Closer inspection of these stages revealed a number of similarities with the Perry Scheme. Received knowledge was similar to the Dualistic stage. However, manifest behaviors of male and females in these stages differed. Dualistic men demonstrated a tendency to identify with authority and to lecture others about the rightness of their position. Women tended to be awed by authority and to listen to other's opinions rather than verbalize their own (Belenky, et al, 1986, p. 43).

Subjective knowledge and procedural knowledge stages were similar to the Multiplistic stage. However, as in the previous stage, manifest behaviors differed. When faced with a variety of interpretations, Multiplistic men tended to express that "they had a right to their opinion." Women, on the other hand, were more apologetic and expressed that "it was only their opinion." (Belenky, et al, 1986, p. 66).

The constructed knowledge stage was similar to the Relativistic stage. However, it was noted that women have traditionally not been allowed into the "fraternity of knowing" and have little opportunity in higher education to participate in the community of scholars which characterizes this higher level (Belenky, et al, 1986, p. 194).

The notion that epistemological maturity may be gender related rather than gender specific was investigated in a recent study. The Measure of Epistemological Reflection was administered to 50 undergraduate men and 50 undergraduate women at a state university. Subsequent comparisons revealed that there were no significant differences between the mean level of epistemological maturity of the males and the females (Baxter-Magolda, 1987).

However, separate patterns of responses were discovered when the reasoning structures of the two groups were compared. The women students tended to manifest reasoning patterns in five domains of the instrument as follows: role of the learner = receiving answers from authority; role of peers = support; method of instruction = interaction to reduce pressure on students; evaluation = numerous opportunities to demonstrate competence; and nature of knowledge = differentiation between fact and

opinion with an emphasis on personal interpretation (Baxter-Magolda, 1987).

Males tended to manifest other reasoning patterns in the same five domains. Their responses were as follows: role of learner = searching out answers; role of peers = source of argument; method of instruction = active argumentation and discussion; evaluation = feedback for correction; nature of knowledge = determining degree of detail with an emphasis on research (Baxter-Magolda, 1987).

Therefore, while there were no significant differences between the two groups with regard to mean levels of epistemological maturity, there were descriptive differences between the reasoning structures of the groups. Males were characterized by a more active, critical response to learning; females were characterized by a more supportive, personal response.

Computer Anxiety

Definition

Computer anxiety has been defined a number of ways by various researchers. In order to understand the implications of those definitions, it is first necessary to examine the concept of anxiety itself. Spielberger (1966) suggested that anxiety was a two dimensional

reaction to psychological stress. The first dimension was characterized by a temporary reaction to a stressful environment and was referred to as a state. The second dimension, characterized by a more permanent construct of the personality, was referred to as a trait. Definitions of computer anxiety tended to be grounded in this two-dimensional view of anxiety and to emphasize the state dimension of anxiety.

Powers (in Cambre & Cook, 1985) focused on physiological changes elicited by a state of anxiety. Such changes were in the following systemic functions: "systolic blood pressure, diastolic blood pressure, heart rate and electro dermal responses" (p. 41). Computer anxiety was defined, then, in terms of the physical reactions manifested when a person was anxious.

Other researchers concentrated their attentions on the psychological and affective manifestations of computer anxiety. Raub (in Cambre & Cook, 1985) defined computer anxiety in terms of a continuum which ranged from fear and mistrust of computers to appreciation of computers.

Rohner and Simonson (1981) defined computer anxiety as "the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer" (p. 551). This definition

also emphasized the state of anxiety elicited by technology.

Maurer and Simonson (1984) defined computer anxiety as "the fear and apprehension felt by an individual when considering the implications of utilizing computer technology, or when actually using computer technology" (p. 321). In this sense, computer anxiety was considered primarily a state which was evoked by either thinking about or interacting with technology.

Loyd and Gressard (1984) defined computer anxiety as "resistance to thinking about computer technology, fear of computers, and hostile or aggressive thoughts about computers" (p. 67). Similarly, the definition reflected the state of anxiety.

Although each of these definitions reflected similar concepts of the state dimension of anxiety, each served a different purpose and could not be used interchangeably. The primary distinction among these definitions was that each served as the operational definition for a specific computer anxiety assessment procedure.

Assessment of Computer Anxiety

The assessment of computer anxiety has taken two forms: physiological measurement techniques and self-report attitude scales. The first type was derived from the work of researchers such as Powers whose goal was

to validate the construct of computer anxiety through observational data. Powers (in Cambre & Cook, 1985) hypothesized that interaction with a computer would elicit specific changes in four major physiological functions. Results indicated that over time physiological reactions were less severe, and it was concluded that computer anxiety was diluted by continuous exposure.

The second type of assessment took the form of a self-report attitude scale. Raub (in Cambre & Cook, 1985) developed the Attitudes Toward Computers Scale which consisted of forty-two items. These solicited responses using a Likert scale to questions dealing with feelings toward computers. Questions focused on how one felt when thinking about a computer and how one felt when interacting with a computer. A high score on the scale indicated that the subject appreciated computers; a low score indicated that the subject feared and mistrusted computers.

Rohner and Simonson (1981) developed a computer anxiety scale, the Computer Anxiety Index, to measure both the construct of computer anxiety as well as to examine possible correlates with computer anxiety. The scale consisted of sixty-three items which dealt with attitudes concerning cognitive responses to computers, affective responses to computers, and behavioral responses to