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**How is an attitude toward a newly learned skill formed?
An inter-domain interaction study.**

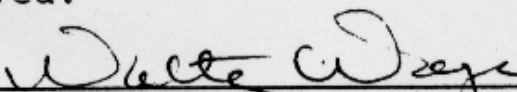
**THE FLORIDA STATE UNIVERSITY
COLLEGE OF EDUCATION**

by Katsuaki SUZUKI

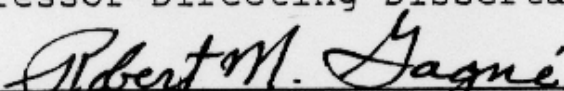
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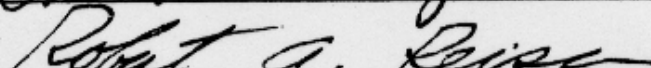
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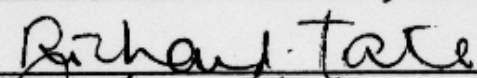
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HOW IS AN ATTITUDE TOWARD PRACTICAL USE OF A NEWLY LEARNED SKILL FORMED?

AN INTERDOMAIN INTERACTION STUDY

(Publication No.)

Katsuaki Suzuki, Ph. D.

The Florida State University, 1987

Major Professor: Waiter W. Wager, Ed. D.

This study explored supportive relationships among objectives from different domains of learning outcomes, namely, the learning of a concept classification skill, information, and attitudes toward the skill. Two versions of an instructional module on the ARCS motivation model were randomly assigned to pre-service teacher-education students. One version contained examples of problem solving, using teachers as models, whereas the other version used business training as the context of the module. Together with the "relevance" of the instruction, self-concept of ability, attitude toward learning of the ARCS model, actual level of skill acquisition, and final attitude toward the practical use of the ARCS model formed a hypothesized path model of causal inference, which was to be empirically confirmed in this study.

The results indicated that the relevant version of the material had a positive effect on the pre-instructional motivation for personal commitment. Such an effect, however, was not found on the acquisition of the skill and on attitude formation favoring practical use of the ARCS model. The hypothesized path model was not found to fit the data in this study. Among the variables in the path model, a positive relationship was found between the level of skill acquisition and favorable feeling toward the learned model. In contrast, the level of skill acquisition was not related to the behavioral intentions in a statistically reliable manner. Some alternatives to the hypothesized model were identified, although the specification of these models needs to be supported by future research. Results are discussed in light of the hypotheses, as well as theoretical frameworks so that the hypothesized model may be confirmed, or revised, in future research. Implications for instructional design practices are also discussed.

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TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
LIST OF TABLES	vii
LIST OF FIGURES	viii

CHAPTER

I. INTRODUCTION	1
Statement of the Problem	

II. REVIEW OF THE LITERATURE	4
Domains of Learning Outcomes and Interactions	
Gagne's Taxonomy of Learning Outcomes	
Integration of Cognitive and Affective Domains	

Instructional Strategies: Essential and Supportive Prerequisites	
Intellectual Skill Learning	
Attitude Learning	

Use of Path Analysis for Interdomain	
Interaction Research	
Ordering Theory for Hierarchy Validation	
Multiple Regression Techniques	
Path Analysis for Causal Modeling	

III. CONCEPTUAL FRAMEWORK	45
Hypotheses	
The Experimental Manipulation and its Hypothesized Effects	
The Hypothesized Causal Model	

IV. METHODOLOGY	57
Participants	
Materials	
Measures	
Procedures	
Data Analysis	

V. RESULTS	69
Descriptive Statistics	
Experimental Analysis	
Path Analysis	

VI. DISCUSSION	82
The Effects of Relevance	
The Causal Model	
Limitations of the Study and Suggestions for Future Research	
Instructional Implications of the Study	

REFERENCES	101
----------------------------------	-----

APPENDICES	110
----------------------------------	-----

VITA	141
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[↑](#) List Of Tables

Table

1. Essential and Supportive Prerequisites for Five Kinds of Learning Outcomes.....	8
2. Possible Ranges, Group Means, Standard, Deviations, and Reliability Coefficients.....	70
3. Bivariate Correlation Coefficients among Predictor Variables.	72
4. Summary Of the Effects in the Hypothesized Path Model.....	77

[↑](#) List of Figures

Figure

1. Briggs-Wager Matrix for Interdomain Interaction.....	10
2. Martin-Briggs Taxonomy for Affective Learning.....	13
3. Unit-level ICM Using Twin Objectives.....	17
4. A General ICM for A Intellectual Skill Terminal Objective.....	27
5. A General ICM for Learning of An Attitude toward Practical Use of a Newly Learned Intellectual Skill.....	33
6. Relationships among Motivation, Skill Acquisition, and Post-instructional Attitude toward Skill Use.....	40
7. Bloom's Model of School Learning.....	47
8. Hypothesized Path Diagram Showing Interdomain Relationships.....	52
9. Path Diagram of Effects of Relevance Groups and Academic Self-concept on Attitudes and Performance.....	75
10. An Alternative Path Model with All Path being Statistically Reliable.....	79
11. A Temporally Revised Path Model which has Marginal Statistical Reliability. Page.....	81

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CHAPTER ONE

INTRODUCTION

Numerous techniques and procedures in the area of instructional design and development have been developed with an emphasis on the cognitive aspects of learning (Reigeluth, 1983). Little is known, however, about introducing these cognitive skills so that they will be utilized in practical situations. The learning of cognitive skills is not automatically accompanied by a Positive attitude toward their use (Krathwohl, Bloom, & Masia, 1964). Many researchers (e.g., Bloom, 1976., Mager, 1968) have pointed out the importance of development of a positive attitude toward what is learned. Such an attitude may influence the future uses of the skills, as well as further learning in the same subject area. Therefore, it is important for designers to understand how strategies to foster a positive attitude may be built into instruction.

Frameworks for integrating cognitive and affective domains have been discussed in accounts of instructional design models. Based on Gagne's (1985) taxonom of learning outcomes and his notion of the conditions of learning, Briggs and Wager (1981), Gagne and Briggs (1979), and Martin and Briggs (19B6) have proposed conceptual frameworks for integrating various domains of learning outcome. Recent advancement of a motivational design model (Keller, 1983b) for enhancing the appeal of cognitive instruction also suggests integration of the affective and cognitive domains.

In the field of instructional research, very little research has been conducted to examine the interactive relationships among learning in various domains of outcome. One exception is a study by Hurst (1980) that has demonstrated hierarchical relationships among cognitive and affective objectives. Using the framework of "interdomain interactions" (Briggs & Wager, 1981), another study has been conducted (Young, 1986) to examine the effectiveness of sequencing among instructional units for intellectual skills, verbal information, and attitude learning. Reflecting on the lack of empirical support, Briggs (1982; Martin & Briggs, 1986) has called for research in interdomain interactions as one of the prospective fields of instructional design research for the future.

Statement of the Problem

This study explored interdomain relationships among the learning of an intellectual skill, information on its potential usefulness, and attitudes toward learning of the skill and toward its practical uses. More specifically, using the conventional experimental paradigm, the purpose of the study was to examine the effects of an introductory presentation and use of concrete examples that make the context of the skill learning "relevant" on motivation to learn, skill acquisition, and attitudes toward the practical use of the learned skill. A path model for causal relationships among self-concept of ability, relevance group assignment, skill acquisition, and attitudes was hypothesized and tested in this study, With a special interest on the relationship between initial success in skill acquisition and attitudes toward practical use of the skill.



CHAPTER TWO

REVIEW OF THE LITERATURE

This study was drawn from research in instructional strategies for both cognitive and affective objectives. This review is presented in three parts: (1) the interaction among the five domains of learning outcomes, (2) factors influencing the effectiveness of instruction aiming at both intellectual skills and attitudes, and (3) the use of path analysis for causal inference.

Domains of Learning Outcomes and Their Interactions

The purpose of this subsection is to review Gagne's five domains of learning outcomes and their interactions. The relevance of Gagne's taxonomy as the framework for designing instruction and the need for investigating interactions among the domains will be discussed.

Gagne 's Taxonomy of Learning Outcomes

Because instructional research seeks to identify factors that facilitate learning, any Proposed instructional design strategies should have their basis in learning theory. Current information-processing theories within educational psychology have provided the strongest models hypothesizing how human learning may take place. Consequently, a number of instructional strategies that support one or more stages of information-processing have been proposed. Such instructional strategies, when effective, may well be transferable to the teaching of a variety of other similar skills.

Gagne's (1985) taxonomy of learning outcomes has been widely employed in the context of instructional design for its special attention to instructional design applications and its firm underpinnings in current learning psychology. It provides a way to categorize human capabilities for which instruction may be designed. For each category, Gagne hypothesizes a set of ideal conditions of learning. These in turn may be employed in instructional strategies for each of the learning outcomes. In other words, each category of Gagne's taxonomy represents a different kind of learning for which different sets of external and internal conditions would be optimal. According to Gagne, the categories of human capabilities, or learning outcomes, are: Intellectual skills, Cognitive strategies, Verbal information, Attitudes, and Motor skills.

Among these five domains of learning outcomes, instructional strategies for intellectual skills have been the most widely studied. The intellectual skills domain consists of concept learning, rule or procedural knowledge, and problem solving skills. Research of Gagne (1968), White (1973), and White and Gagne (1974) supports rules for sequencing intellectual skill objectives based on prerequisite relationships among the subordinate enabling skills. Designers employing these rules for sequencing intellectual skills can develop more effective instruction than those who are unaware of the hierarchical structure.

This emphasis of research on intellectual skills has been partly because their importance as building blocks in school learning (Gagne & Briggs, 1979). A more practical reason may be that intellectual skills are more clearly organized and easier to assess than capabilities in other domains.

The verbal information domain requires a different set of instructional strategies from the intellectual skills domain. Verbal information consists of declarative knowledge, presumably in the form of propositions. Whereas learning of an intellectual skill is facilitated by recall of specific subordinate skills, the learning of verbal information is facilitated by recall of a more general, meaningful contextual knowledge structure, into which new information may be subsumed. Instructional strategies for verbal information learning include the use of advance organizers (Ausubel, 1960) and various mnemonic strategies.

Attitudes are defined as "internal states that influence the individual's choice of personal action [toward some category of objects, persons, or events]" (Gagne, 1985, p. 219). They constitute the learning outcome of the affective domain in Gagne's taxonomy. Although an attitude has been considered to have cognitive, affective, and behavioral components (e.g., Rosenberg & Hovland, 1960), little is known about the supportive functions of cognitive skills for attitude learning. Gagne emphasizes the behavioral component of an attitude for its importance in instructional implications: "however important they may be in understanding the essential nature of attitudes, [cognitive and affective components] give few clues regarding the function of attitudes" (p. 240). Instructional strategies known to be effective for attitude learning include the use of human modeling (Bandura, 1977) and the experience of success in an activity.

Integration of Cognitive and Affective Domains

Expanding the notion of prerequisites for learning, Gagne (1977, Gagne & Briggs, 1979) has identified both essential and supportive prerequisites for each domain of learning outcomes. Table 1 lists the kinds of prerequisites that indicate possible contributions across the domains when one designs instructional strategies. As Gagne has already pointed out, learning hierarchies deal only with essential prerequisites for intellectual skill learning. For example, attitudes, cognitive strategies, and verbal information may aid in the learning of intellectual skills, but they are not essential. Further examples include essential prerequisites for attitude learning. Intellectual skills and verbal information related to the choice behavior are sometimes necessary as prerequisites for the learning of attitudes.

A more elaborate framework for integration of Gagne's Table 1

Essential and Supportive Prerequisites for Five Kinds of Learning Outcomes

Type of Learning Outcome	Essential Prerequisites	Supportive Prerequisites
--------------------------	-------------------------	--------------------------

Intellectual Skill	Simpler Component Intellectual Skills (rules, concepts, discriminations)	Attitudes Cognitive Strategies Verbal Information
Verbal Information	Meaningfully Organized Sets of Information	Language Skills Cognitive Strategies
Cognitive Strategies	Specific Intellectual Skills(?)	Intellectual Skills Verbal Information
Attitudes	Intellectual Skills (sometimes) Verbal Information (sometimes)	Other Attitudes Verbal Information
Motor Skills	Part-skills (sometimes) Procedural Rules (sometimes)	Attitudes

From: Gagne,R.M. Analysis of objectives. In L. J. Briggs (Ed.) , **Instructional Design: Principles and applications**. 1977 Educational Technology Publications.

five domains of learning outcomes has been suggested by Briggs and Wager (Wager, 1976,. Briggs & Wager, 1981) as a matrix of domain interaction (Figure 1). Domain interaction is defined as "how the objectives in different outcome domains may be expected to support each other" (Briggs & Wager, p. 89). These authors have also pointed out the lack of attention to the affective domain in the context of instructional design: "It is probably Safe to say that very little attitude instruction is consciously designed—if it were, the nature of instructional materials would likely be quite different from materials typically produced" (Briggs & Wager, p. 45). Use of "twin" objectives is recommended to emphasize the importance of attitude objectives in designing instruction, pairing an attitude objective with the terminal intellectual skill objective of each unit of instruction.

The contribution of the work by Briggs and Wager was strengthened by their operational tool for interdomain interaction called Instructional Curriculum Maps (ICMs). ICMs provide a way to describe how the objectives in different domains may Support each other in the learning process. By utilizing ICMs for designing a lesson, unit, or course, interrelationships among the component objectives within an instructional sequence can be diagrammed. The ICM presumabl Serves as a visual analytic tool for instructional design that facilitates planning for domain interaction to make the instruction more effective. Examples of ICMs can be found in the remaining parts of the paper.

		Inputs		
Outputs		Cognitive Strategies	Verbal Information	Motor Skills
	Cognitive Strategies	One might develop strategies for developing new strategies. (speculation)	Verbal information may mediate a transfer of learning, allowing learner to adapt old strategies to new situations.	
	Verbal Information	Strategies for memorizing work strings, facts, or organizing meaningful knowledge, e.g., megamemory research by Rohwer (1975).	A number of studies show that the learning of one set of information influences the learning of a second set (Ausubel, 1968). Many theories imply organization into propositions "associative" in nature.	Reading may be dependent upon motor coordination (Wilson and Geyer, 1972, p. 160). Clinical application (directional orientation).
	Motor Skills	Strategies for learning new motor skills may exist, e.g., patterning, faded cues, successive approximation, cognitive routines.	Provides cues for the sequencing of a motor performance.	Developed in a progressive manner so that part skills may be combined to form more complex skills.
	Attitudes	The ability to self-analyze one's attitudes may be facilitated by learning a cognitive strategy, e.g., strategies for resolving dissonance.	May input directly into some attitude objectives; gives learner expectation of reinforcement available for making certain choices.	The attainment of a skill leads to a more positive attitude towards the use and value of that skill.
	Intellectual Skills	Affects ways learner can approach task of learning new skills.	Input into I.S. at any level; serves to clarify terminology and mediate learning transfer; also may serve as advance organizers. Defined concepts may first be learned as verbal information.	

*A domains/function matrix
various domains may interact*

Figure 1. Briggs-Wager matrix for interdomain interaction. From: Handbook of procedures for the design of instruction (2nd ed.) Educational Technology Publications.

From the perspective of motivation to learn, Keller (1979, 1983a, 1983b., Keller & Dodge, 1982., Keller & Kopp, in press., Keller & Suzuki, in press) has provided instructional designers with the conceptual framework of, and concrete strategies for, enhancing the motivational property of instruction. Motivation is defined as "the choices people make as to what experiences or goals they will approach or avoid, and the degree of effort they will exert in that respect" (Keller, 1983b, p. 389). Keller's ARCS model conceptualizes human motivation using four factors:

Attention, Relevante, Confidence, and Satisfaction. The concepts and strategies included in the model aim to specify the learning conditions so that instruction can be not only effective and efficient, but also appealing.

The two psychological constructs, motivation and attitudes toward learning, seem to share a great deal of common external and internal conditions of learning, making motivational research valuable in integrating cognitive and affective domains. In other words, when motivation for further learning (or “continuing motivation”, Maehr, 1976; Martin & Briggs, 1986) is used as an accompanying learning outcome of cognitive instruction, it should be treated as an attitude objective, as Briggs and Wager (1981) suggested by the use of “twin objectives.” Keller’s ARCS model (1983a) includes procedures for specifying motivational objective along with the cognitive objective, in order to enhance the motivational property of cognitive instruction. Thus, the ARCS model offers a useful conceptual and practical framework for the integration of cognitive and affective domains in instructional design.

Another conceptual framework for integrating affective and cognitive domains has recently been suggested by Martin and Briggs (1986). It includes a new affective taxonomy for instructional research and design, internal and external conditions of learning of each component of the taxonomy, and the “capability verb.. (Gagne & Briggs, 1979) for each component. The affective domain taxonomy consists of well- studied psychological constructs that may have implication for instructional design. Self-development is placed at the apex of the taxonomy that contains ten additional subordinate components as shown in Figure 2.

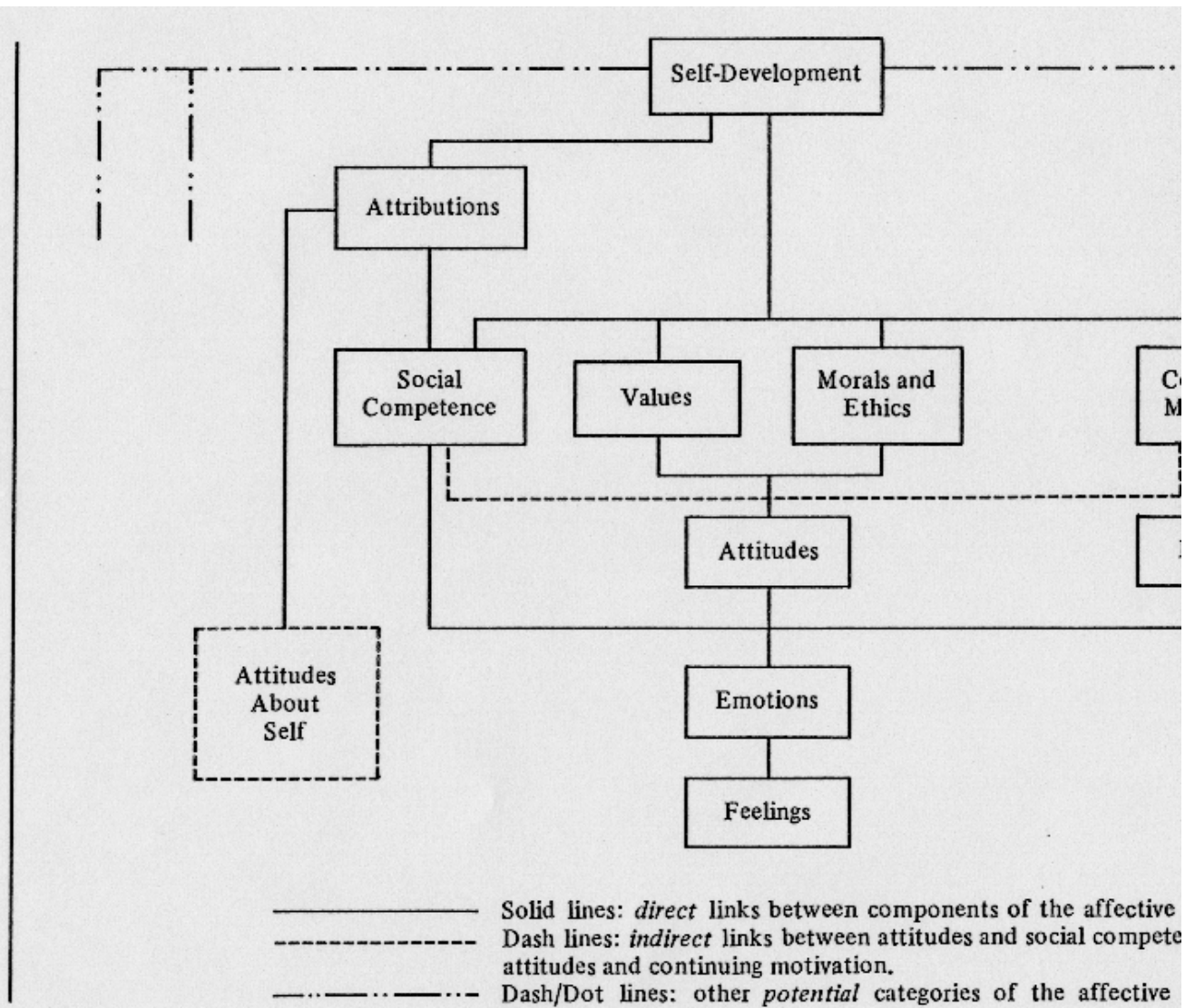


Figure 2. Martin-Briggs taxonomy for affective learning. From: Martin, B. L., *The affective and cognitive domains: Integration for instruction and research*. Educational Technology Publications.

Martin and Briggs (1986) consider their work an expansion of Gagne's work in the cognitive domains (Gagne, 1985) to the affective domain, as the basis for integration between the two. Martin and Briggs have listed a total of 230 external conditions that facilitate either a cognitive or an affective objective, for each of their categories of learning outcomes. Through the work of Martin and Briggs, which has been derived primarily from the vast research in social psychology and communications, instructional researchers may now have an easy access to a list of instructional strategies for affective learning. Their taxonomy of the affective domain has also provided possible interrelationships of major psychological constructs, each of which has long been studied by different researchers in an isolated manner.

Martin and Briggs's work has resulted in an expansion of Gagne's (1985) work within affective domain in terms of numbers of constructs covered and numbers of conditions of learning listed. However, the nature of the affective domain has not yet fully been revealed, including its possible interaction with the cognitive learning. It is still uncertain, for example, whether instructional strategies can be or need to be designed distinctively for each subdomain in the Martin-Briggs's affective taxonomy. It may well be that conditions for attitude learning identified by Gagne are commonly applicable across most affective learning normally covered by instructional design effort. It should be kept in mind that dividing learning outcomes into subdomains is necessary and useful only when each divided subdomain requires a distinctive set of internal and external conditions of learning.

which can be facilitated by different instructional strategies.

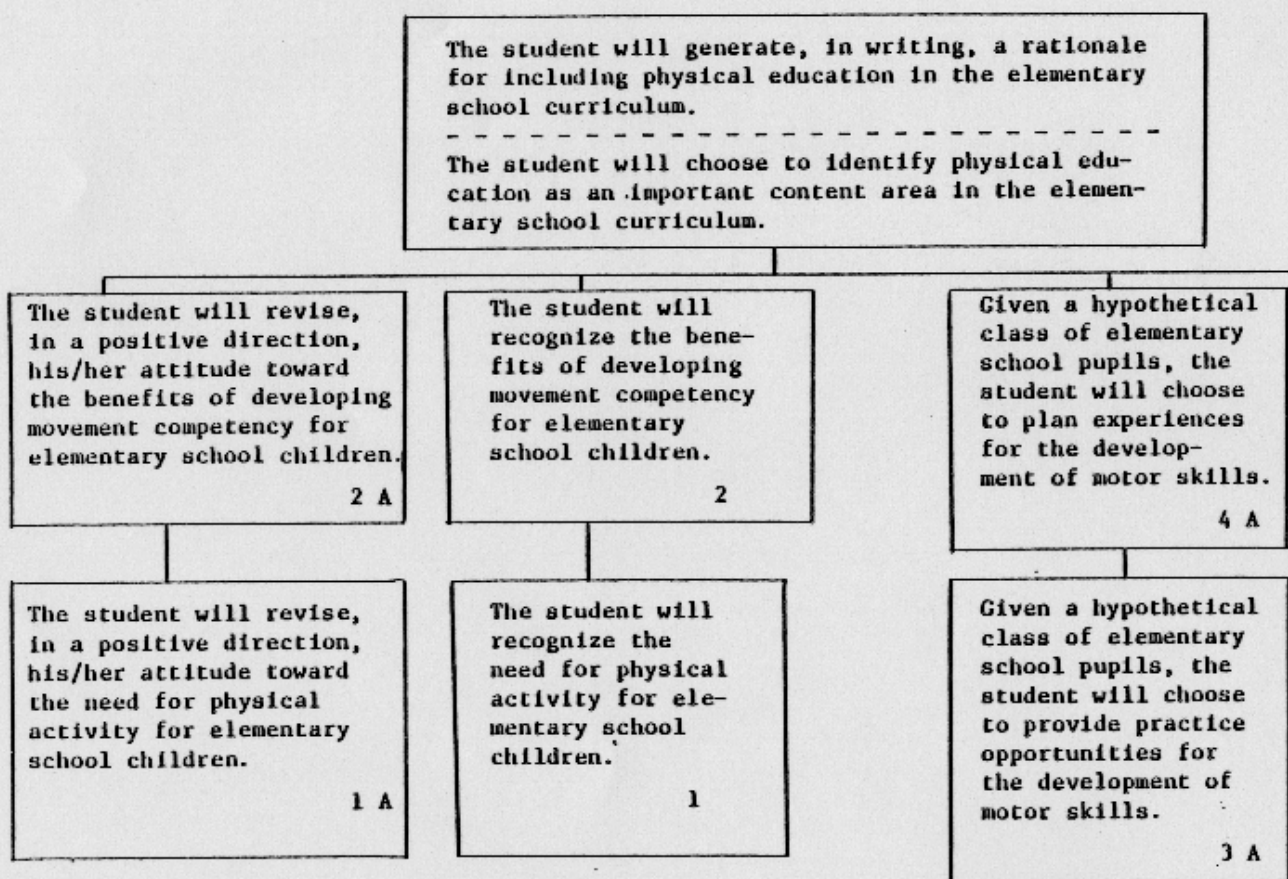
There are two empirical studies (Hurst, 1980,. Young, 1986), recognized to date in the field of instructional design, that have examined the integration of cognitive and affective domains. In Hurst's (1980) study, both cognitive and affective objectives were arranged hierarchically. The terminal objective was to voluntarily implement Individually Guided Education (IGE). Twenty-nine elementary school teachers who were in the process of implementing a new curriculum, IGE, were observed, interviewed, and tested regarding attainment of the objectives related to the terminal objective. No instruction took place to facilitate the learning of the terminal objective; only the assessment data were collected and analyzed in the study.

The hypothesized hierarchical relationships and empirically derived ones were "moderately similar to each other" (p. 299), supporting that "cognitive skills and attitudes were integrally related" (p. 299). More specifically, empirically derived ordering of the objectives indicated: (1) Affective skills that are not heavily dependent on cognitive knowledge (e.g., awareness, interest, willingness to receive information) form the bottom layer of the ordering. (2) Affective skills with substantial cognitive components (e.g., voluntary engagement for learning and application of the IGE) are built on the acquisition of at least some of those cognitive components. Hurst's study was a pioneering effort in the investigation of integrated relationships among objectives in both cognitive and affective domains.

Using the Briggs-Wager (1981) framework for the interdomain interaction research, Young (1986) has conducted an empirical study regarding the sequence of the objectives of verbal information, intellectual skills, and attitudes in her college physical education course. Young did not find any significant difference in achievement over a five week period among three treatment conditions: (1) verbal information and intellectual skill were taught before attitudes, (2) attitudes were taught before cognitive task, and (3) the three domains were integrated in each lesson. Young did not find any statistical difference of attitudes toward physical education as measured by a semantic differential scale and a behavioral differential scale among the treatment groups at the end of the experimental unit. It was found, however, that the attitude-first group retained the positive attitude more than the cognitive-skill-first group until the end of the course.

It was demonstrated by Young's (1986) study that the Briggs-Wager's (1981) ICM can be utilized effectively to plan and implement instruction for objectives in more than one domain of learning. The "twin objectives" were used at the unit level to plan not only the cognitive aspects of instruction, but also the attitudes toward what was to be learned. Figure 3 shows the ICM with the "twin objectives" produced for Young's study.

Objectives for the Experimental Unit



In this ICM the unit was constructed so that each attitude objective has a matching informa-
objective. The attitude objectives are designated by an (A).

Figure 3. Unit level ICM using twin objectives. From: Young, J. F. The effects of sequences of instruction on student performance and attitudes in a team course. © J. F. Young, 1986.

Although Young's (1986) study intended to apply the Briggs-Wagerls framework of "interdomain interaction", it was weak in distinguishing the domains of verbal information and intellectual skills. As may be seen in Figure 3, most of the cognitive objectives in Young's study belonged to the verbal information domain. Further examination of the enabling objectives in each of the lessons reveals that cognitive instruction was mainly targeted to the acquisition of verbal information. Thus, it is unclear whether or not her findings are also applicable to the interactive effects of cognitive and affective domains when the emphasis of instruction is an intellectual skill. Theoretically, the conditions of learning for a verbal information objective and an intellectual skill objective are distinctive. Thus, it may well be that the nature of interdomain interactions would be different between domains of attitudes and intellectual skills and those of attitudes and verbal information. Further research is needed to investigate the interdomain interaction between domains of intellectual skills and attitudes.

In addition to the two studies mentioned above, which are directly concerned with the integration of cognitive and attitude learning, assessment of attitudes has been included as of secondary interest in some studies dealing with instructional strategies for cognitive learning. For example, Ross and his associates (Ross, 1983, 1984, Ross & Bush, 1980; Ross, McCormick, Krisak, & Anand, 1985) have conducted a series of studies to adapt the context of mathematical instruction to students' background. The major concern of their studies was the posttest performance that was designed to measure acquisition of mathematical concepts. Additionally,

they reported the participants' "reactions to the learning task" (Ross, 1983, p. 521) as measured by a semantic differential scale. Although the manipulation of the instructional context was intended to have, and actually did have, an effect on cognitive learning, Ross and his associates have found that using familiar examples and practice questions may also have an effect on the attitude toward what was being learned. This type of research indicates that one instructional strategy, or an external condition of learning, may have an effect on both cognitive and affective learning, regardless of the designer's intention.

Instructional Strategies: Essential and Supportive Prerequisites for the Learning of Intellectual Skills and Attitudes

The purpose of this subsection is to review the instructional strategies for intellectual skill acquisition and attitude formation. Essential and supportive prerequisites for learning of intellectual skills will be reviewed with a focus on a concept classification skill, which will be followed by a review of instructional strategies for attitude learning.

Instructional Strategies for Intellectual Skill Learning

According to Gagne and Briggs (1979), only the essential prerequisites for learning an intellectual skill are subordinate intellectual skills that are included in a learning hierarchy (Table 1). This indicates that the domain of intellectual skills can be self-contained in and by itself. It is the basic premise of Gagne's learning hierarchy that all of the essential prerequisites can be identified for any given intellectual skill objective by constructing a learning hierarchy. Thus, design of instruction for an intellectual skill may be built around the hierarchy, covering all of the minimum requirements for the skill acquisition. The limitation of components of a learning hierarchy to intellectual skills was empirically supported by White (1974b), where validation of a learning hierarchy for a rule using skill in physics revealed that verbal information objectives needed to be excluded except at the very bottom of the hierarchy.

The most important instructional strategy for intellectual skill learning is, therefore, to assure that all of the subordinate skills are brought into the learner's working memory. Thus, it is critical to facilitate recall of those prerequisite subskills before presenting a new learning task. It is also effective to provide instructional feedback that is tailored for remediation of the missing subordinate skill(s) when an incorrect response occurs. Thus, the use of instructional media, such as computers, which have capability to provide precise feedback depending on the learner's response are recommended (Reiser & Gagne, 1983).

It is claimed that cognitive strategies and verbal information have supportive relationships with skill learning (Table 1). Verbal information may provide labels for the concepts, contextual cues for retrieval, or a linkage between concepts previously learned and the new concept, thus facilitating the learning of a new intellectual skill. Cognitive strategies, when initiated by a learner at the right moment in skill learning, may speed the learning process of the skill, aid recall of the skill, or help transfer the skill to a new situation. Thus Gagne and Briggs (1979) recommend the inclusion of these supportive prerequisites when designing intellectual skill instruction.

A conceptual framework for the supportive relationships of verbal information to learning of intellectual skills can be found in instructional research. White and Mayer (1980) have proposed a classification system for knowledge associated with a skill. According to this framework; a learner has an expanded capacity which is known as understanding of the skill, and which is manifested in greater ability to apply the skill in new situations" (p. 102) when verbal and visual knowledge of the productive type is associated with the learned skill. They have listed the possible types of "productive knowledge": analogies, concrete examples, definitions of concept, and explanations of rules. In contrast, they have suggested that formal statements of the rule, historical facts, and computation may be "unproductive" in aiding understanding of the skill.

Empirical studies have also demonstrated the supportive effects of related verbal information on skill acquisition. Beeson (1980) has reported that meaningful learning and retention of most complex skills were enhanced by treatment with relevant anchoring context. That is, participants learned and retained the target intellectual skill better when additional verbal instructions were given to provide a more familiar context to the skill learning than when the skill was taught in isolation. Similar results have been obtained in the studies of

advance organizers for the learning of intellectual skills (e.g., Mayer & Bromage, 1980). Although the distinction between the two domains as the learning outcomes remains to be important, adding instruction for related verbal information may be an effective instructional strategy for intellectual skills learning.

Another interpretation regarding how these three cognitive learning outcomes may interact with each other can be found in the schema theory (e.g., Rumelhart, 1980) of human memory structure. According to the schema theory, human memory is the network of the units called "schemata." A schema is formed around a central concept, which provides a structure (containing "slots") for incoming information. A schema is therefore composed of; (1) one or more concepts, (2) cognitive strategies that indicate how the schema is to be used or related to other schemata, and (3) accompanying information. Thus, all three kinds of cognitive learning outcomes may be found in a schema (Suzuki, 1987).

Although the schema theory is too young to fully explain the learning process of a schema (Bransford, 1984), several schema theorists (Rumelhart & Norman, 1978, Anderson, 1982) have proposed that there is more than one stage in schema acquisition, which seem to be in correspondence with Gagne's (1985) learning outcomes. That is, incoming information may be learned as verbal information (accretion; declarative stage) until schema structure is forced to be altered or another schema is formed (tuning or restructuring; procedural stage) as the result of intellectual skill learning. Therefore, it may be that not only Verbal information learning can be facilitated by activating existing schema structure as in Ausubel's advance organizers, but also intellectual skill learning Would be facilitated by recalling relevant information or by initiating related cognitive strategies, as well as by recalling subordinate skills. This notion seems to have been partially Supported by the studies that adapted context to students backgrounds (e.g., Ross, 1983) and that trained students in the use of cognitive strategies prior to skill learning (e.g., Derry & Murphy, 1986).

It may be interpreted that the demonstrated facilitative effects of advance organizers in learning of an intellectual skill (e.g., Mayer & Bromage, 1980) Would have been obtained by this "supportive" effect of schemata activation. It should not be overgeneralized that domains of intellectual skills and verbal information require the same conditions for the instruction to be optimal. Contextual clues may only be "supportive" in intellectual skill learning, while they may be "essential" in verbal information learning to be meaningful. only after all the subordinate skills are considered in instructional design, should other cognitive domains be considered as supportive prerequisites.

It is also noteworthy that the interdomain relationships among the three domains of cognitive learning outcomes are no less important than the relationships between an attitude objective and an objective in one of the cognitive domains. When integration of cognitive and affective domains is planned, it is critical to classify the cognitive objective into one of the three domains of learning outcomes to examine the nature of the cognitive task. Until this classification of the cognitive objective is made, integration of the task and affective consideration cannot continue.

Attitudes have been recognized as supportive prerequisites for skill learning (Table 1). Bloom (1976) has identified various "affective entry characteristics" that may have an effect on cognitive school learning: interests, attitudes, motivation, subject-related affect, school-related affect, and academic self-concept. In his review of related literature, Bloom concluded that "academic self-concept is the strongest of the affect measures in predicting school achievement...it accounts for about 25 percent of the variation in school achievement after the elementary School period" (p. 95).

The strong correlation between academic self-concept and cognitive learning may be because academic self-concept is based on the cumulative effect of achievement in relation to a learner'sv peer group. The more successful a learner has been, compared to his or her classmates, the higher academic self-concept is likely to be. Therefore, academic self-concept may represent not only the affective entry characteristics of a learner, but also the cognitive capability of the learner in general sense. However! it has a limited usage as far as instructional design at post- secondary level goes because academic self-concept is relatively stable once established through the experiences in school.

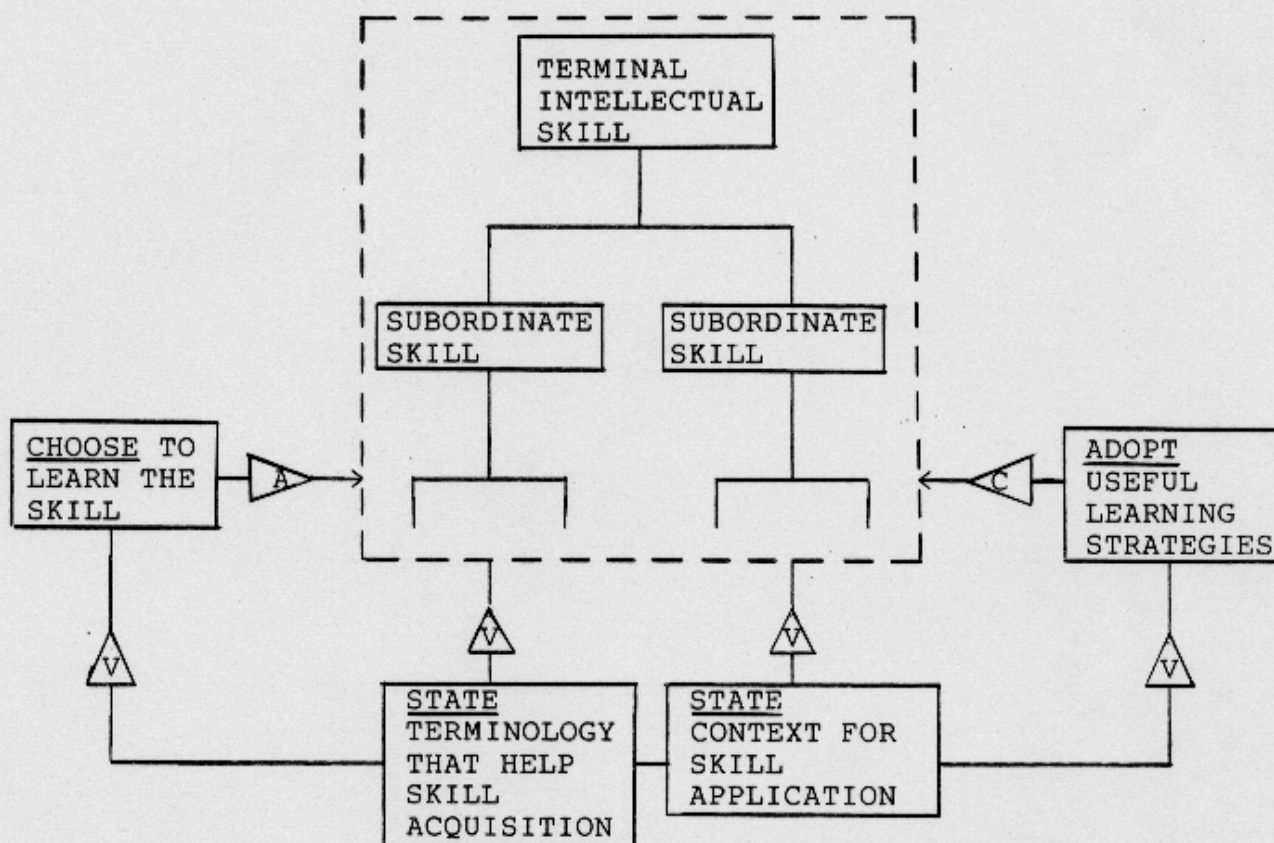
The expectancy-Value theory (Atkinson, 1964; Keller, 1983b) of motivation to learn has postulated that the value the learner sees ina learningtask is also an impbrtant factor that determines how extensively a learner exerts hJLS or her effort to learn the given task. Academic self- concept is considered to represent the "expectancy" of the learner with regard tohis other success in learning the task. on the other hand, the learner

needs to be convinced that the task is worth learning (i.e., “value”) before becoming fully involved. The expectancy–Value theory has proposed relating the two factors in a multiplicative manner, rather than an additive manner (Keller, 1983b).

That is, if either of the two factors were lacking, then learner motivation would be zero. It is therefore recommended to take both aspects of motivational strategies into account in order to assist the cognitive learning through supporting attitudes.

The trend in motivational research has been to place the emphasis mainly on the expectancy aspect. A recent review of instructional psychology has described that attribution theory (Weiner, 1985) has been strongly influencing the motivational research, but that “task value has not been included in most attributional models” (Pintrich, Cross, Kozma, & McKeachie, 1986). Some research has nevertheless shown the effect of manipulating the perceived task relevance on cognitive learning by adapting the context to learners’ backgrounds (e.g., Ross, 1983), or connecting the new material to more familiar concepts (e.g., Mayer, 1979). Keller (1983a, 1983b, Keller & Dogge, 1982; Keller & Kopp, in press; Keller & Suzuki, in press) has provided a list of instructional strategies to generate relevance (value factor) as well as to build confidence (expectancy factor) in various instructional situations. Further empirical examination of the effects of task relevance on the cognitive learning is still needed.

In summary, the essential and supportive prerequisites for intellectual skill learning are reviewed in this section. Subordinate intellectual skills are essential to the learning of an intellectual skill. This has been well established by the past research. Although verbal information, cognitive strategies, and attitudes have been identified as supportive prerequisites, further research is needed to examine the effects of various instructional strategies on acquisition of intellectual skills. Figure 4 depicts a generic ICM (Briggs & Wager, 1981) that shows prerequisites relationships among the various domains for intellectual skill learning.



NOTE:

- ← A → ATTITUDE
- ← C → COGNITIVE STRATEGY
- ← V → VERBAL INFORMATION

THE ARROW INDICATES INPUT FROM OTHER DOMAINS.

DOTTED BOX REPRESENTS INTELLECTUAL SKILL LEARNING HIERARCHY.

Figure 4. A Generic ICM for an Intellectual Skill Terminal Objective.

Instructional Strategies for Attitude Learning

Attitude instruction, in contrast with intellectual skill instruction, has obtained little attention in instructional design literature (Briggs & Wager, 1981; Reigeluth, 1983). Much of the rationale for the instructional strategies in attitude learning has originated from the fields of social psychology (e.g., Ajzen & Fishbein, 1980; Bandura, 1977, McGuire, 1969) and communications (e.g., Rogers, 1983; Rosenberg & Hovland, 1960).

Martin and Briggs (1986) have reviewed the vast literature related to attitude and attitude change, mostly in the fields of social psychology and communications. They identified the following eight external conditions that span all types of affective learning:

1. Provide cognitive information that is new to the learners, or that is presented in a new way.
2. Use successive approximations either to break a task into smaller units so success can be achieved, or to gradually increase the learners' cognitive base or tolerance for an idea.
3. Model attitudes, values, emotions, etc., that are consistent with the desired behavior.
4. Use group discussions or social interactions (one-to-one, small groups, role plays, etc.) to assist learners to (a) see another position, (b) take another's perspective, (c) verbalize their own position, and/or (d) solve problems.
5. Use direct reinforcement to (a) establish attitudes, emotions, values, etc., when there is consensus on the desired attitude, emotion, value, etc., and (b) reward cooperation, participation, independence, success, etc.
6. Match the learners' task to their abilities; strive for a moderate level of difficulty.
7. Provide opportunities for learners to take an overt action.
8. Use the principle of contiguity to help learners associate learning in general (school, training sessions), and specific learning (affective or cognitive knowledge and skills) to a pleasant, stimulating environment. (p. 457 – 458)

Similar strategies and more have been included in Keller's ARCS motivational model (Keller, 1983a, Keller & Kopp, in press, Keller & Suzuki, in press). Keller has identified four factors that pertain to human motivation to learn: Attention, Relevance, Confidence, and Satisfaction. Keller has suggested the analysis of motivational characteristics of learners according to the ARCS four factors to match the motivational property of the instruction with learner characteristics. Motivationally enhanced instruction should not only facilitate cognitive learning, but also help the learners attain higher level of motivational characteristics at the end of instructional activity. Thus, audience analysis using the four factors and consequent formation of motivational objectives is recommended as a part of the ARCS model.

Based on the paradigm of expectancy-value theory, Keller's relevance category includes such strategies as making instruction familiar to the learner using a human model, orienting the learner to a meaningful goal, and matching instructional situation to learner's motives and needs (i.e., needs for power, achievement, and affiliation). The relevance factor is designed to create "value" of instruction. In contrast, confidence category is represented by "expectancy" building strategies. It includes strategies to arrange the learning requirements from attainable to more difficult to provide success opportunities. Instructional strategies such as giving personal control over the learning situation and attributing success to learner's effort and ability are also considered to have an effect on the "expectancy" aspect for continuing motivation.

Gagne (1985) has identified three major situations for attitude learning: classical conditioning, perception of success in behavior, and human modeling. Classical conditioning for attitude learning refers to the pavlovian type Conditioning of paired association learning, where unconditioned unpleasant stimuli causes an affective reaction. Reinforcement contingencies also provide attitude learning because they let the learner perceive "experience of success" with some object. Gagne has stated: "Positive attitudes toward mathematics or English or public speaking follow one or more experiences of success in these activities. Conversely, attitudes of dislike result from repeated instances of failure" (p. 231). Finally, observational learning of an attitude can be facilitated by vicarious reinforcement (Bandura, 1977), where a learner observes a human model being reinforced for his or her positive behavior toward the attitude object.

Based on these situations for attitude learning, Gagne (1977, 1985; Gagne & Briggs, 1979) has identified prerequisite capabilities for attitude learning. First, "the learner must possess the concept of the class of object, event, or person to which the new (or newly changed) attitude will be directed" (Gagne, 1985, p. 347). Another type of intellectual skill may be required so the learner will be able to take an action of personal choice favoring an attitude object. When a human model is employed as an instructional strategy, the learner must recognize the model as a credible source of information. Similarly, the learner has to be able to comprehend the content of the persuasive communication for the message to be effective.

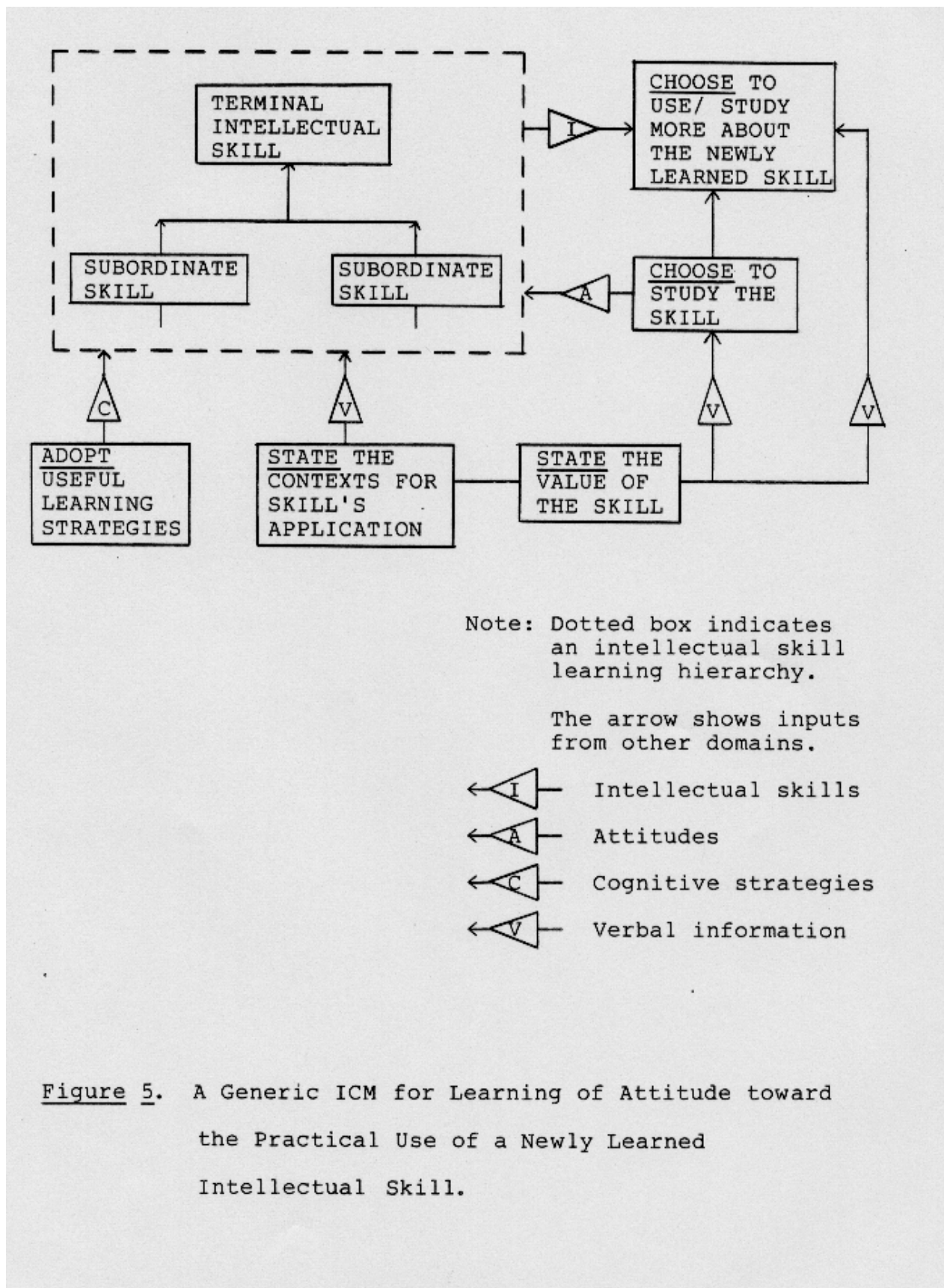
As indicated in Table 1, intellectual skills and verbal information are sometimes, but not always, essential

prerequisites for some type of attitude learning. In other words, prerequisites for attitude learning are dependent upon the kind of cognitive learning involved to comprehend . attitude instruction and to be able to make a personal choice in favor of the attitude object, person, or event. Thus, when an attitude to be learned is to voluntarily employ a new problem solving technique for motivation in school learning, for example, the learner must be able to recognize what motivation is (i.e., a concept learning). The learner also has to realize the problem situations to which the technique can be applied (i.e., verbal information prerequisite). Then the learner must be able to use the technique (i.e., the higher-order rule to use the problem- solving technique.) A presentation of a school teacher who has been successfully using the technique may be employed as human modeling, in which case the learner must recognize the model as a respective or familiar figure.

For the attainment of the “twin objectives” of an intellectual skill and an attitude toward the use of the skill, Briggs and Wager (1981) have proposed a sequence of instruction among the prerequisite objectives..

“With regard to changing an attitude, the learner may be stating the value of something, the rationale for something, etc....The most efficient instructional decision would be to elicit the verbal information behavior first, since a more positive attitude should facilitate attainment of the intellectual skills, and it takes far less time for the learner to attain the verbal information objective.” (p. 94).

This can be seen a situation where a verbal information objective is serving as an essential prerequisite for attitude learning, and at the same time as a supportive prerequisite for intellectual skill learning. A generic ICM can be drawn to represent this situation as in Figure 5.



Alternatively, if the attitude to be learned is heavily social in nature (e.g., toward minorities, toward birth control), the emphasis of the instruction may be different. Ajzen and Fishbein (1980) have proposed the “theory of reasoned action”, in which behavioral intention is affected by the relative importance of attitudinal and normative components. In other words, behavioral intention and actual behavior are affected not only by the attitude toward an action, but also by the way important referents are perceived and by a motivation to comply with the referents. For instruction of this type of attitudes, use of a human model and social interaction should become a more important determiner of the effectiveness of instruction than of attitudes toward cognitive skill learning.

Another factor that may be operating to determine the nature of attitude instruction is whether or not the learner has already acquired the attitude in an undesirable direction. It may require different instructional strategies to try and change the existing attitude than to merely form a new one. Wager (1975) has suggested that the age of the learner and whether or not the attitude is to be established or changed may affect the selection of media. To establish attitude in adult or change the attitude of young people, almost any medium may be effective, but to change attitudes of adult or establish attitudes in younger people, enriched and more concrete messages may be more effective. Wager's rationale for this distinction is that the adult is mature enough to "formulate attitude from purely 'abstract' messages" and that "the adult is more critical of the credibility of the source of verbal message" (p. 11). Wager has also pointed out that "'established' attitudes will be, in general, more difficult to change than recently formulated attitudes in adults or attitudes in children (that have not had as long a history of reinforcement)" (p. 11).

Although human modeling as an instructional strategy for attitude learning usually includes a physical being, human modeling can still be adopted in an abstract message. For example, a description of human behavior may be used in an anecdotal fashion. Reiser and Gagne (1983) have recommended the use of motion-visuals for selecting instructional media attributes for attitude learning so that motion of a human model can be displayed. However, as Gagne (1985) has pointed out, "[p]resumably, human modeling represents the basic psychological process involved in the acquisition of values from the reading of history and literature" (p. 239). Although forms of human modeling may differ for different task-learner situations, human modeling can be an effective strategy for any type of attitude learning.

In summary, two general categories of effective instructional strategies for attitude learning are (1) experience of success and (2) human modeling. An attitude may be formed by generating relevance of the desired personal action in relation to personal motives or needs (i.e., value aspect) and by building confidence for successful experience (i.e., competence aspect). Two intervening factors for the effects of instructional strategies are the learner's age or maturation and whether or not the attitude is to be newly established or to be changed. Interrelationships among the prerequisites for attitude learning are represented as an ICM in Figure 5.

Use of Path Analysis for Interdomain Interaction Research

The purpose of this subsection is to review the methodology for research into interdomain interaction. ordering theory, multiple regression technique, and path analysis will be reviewed in turn.

Ordering Theory for Hierarchy Validation

Ordering theory (Airasian & Bart, 1973, Bart & Krus, 1973) has been used as a technique to validate a hypothesized learning hierarchy. It was also used in the study by Hurst (1980), which demonstrated the hierarchical relationships among the objectives in cognitive and affective domains. Ordering theory was chosen by Hurst because it "analyzes all intertask relationship (therefore generating hierarchical sequences that were not hypothesized) and has the special capability of defining nonlinear sequences" (p. 299). Each pair of the subtasks is examined for the percentage of "disconfirmatory" responses, in which a higher level task is passed without passing a lower level task. When the ratio of disconfirmatory response to the whole sample does not exceed the preset "tolerance level" (e.g., 7% in Hurst's study), it is said that a prerequisite relationship exists.

Ordering theory, however, has limitations as it was used in Hurst's study. First, it uses only dichotomous data (i.e., passing or failing for each objective). Data would be lost if more than one item was used for an objective by deciding the passing criterion. Assignment of pass or fail seems to become arbitrary especially for attitude objectives.

Second, no statistical test of significance is applied to the data obtained from a sample, which makes the interpretation of the results deterministic (Hurst, 1980). In other words, errors of measurement and sampling distribution are not taken into account. Similar points have previously been identified by White (1974a) in his review of traditional techniques for hierarchy validation.

More importantly, hierarchical arrangement of the cognitive and affective components of a terminal objective

may be misleading in terms of the nature of prerequisite relationships among the components. A learning hierarchy consists only of "essential" prerequisites, which are "required" for the learning of a superordinate skill. Thus, one can utilize a learning hierarchy to determine the subordinate skills that, "the absence of which would make it impossible [for a learner] to learn the new [skill]" (Gagne, 1985, p. 272). In contrast, it does not seem to be adequate to conclude that "either cognitive or affective terminal skills could be analyzed to determine the cognitive and affective elements **required** to reach any given terminal skill" (Hurst, 1980, p. 302, emphasis added), based on the lack of disconfirmatory data without any statistical inference. The elements that are analyzed by ordering theory may have supportive relationships with each other, but it is not necessarily the same relationships as originally meant by the use of learning hierarchies. Thus, it may be concluded that ordering theory as used in Hurst study lacks appropriateness as the measurement model for interdomain interaction research.

Use of Multiple Regression Analysis

An alternative to ordering theory to investigate interdomain interactions is the use of multiple regression analysis, which was adopted in the study by Young (1986). Young selected the multiple regression analysis "because the study contained a mixture of attribute and treatment variables" (p. 59). By applying the multiple regression technique, each of the identified "predictors" can be put in an equation to predict the theoretically expected value of a dependent variable, indicating how much variability of the dependent variable is explainable by each predictor.

Multiple regression is, in this sense, parallel to analysis of variance with covariates.

When the theoretical argument that all predictors that have a direct effect on the dependent variable are included in a multiple regression equation is defensible, not only the correlational interpretation, but also a causal interpretation of the results may be possible. For example, a researcher might manipulate experimental conditions to motivate learners to study an intellectual skill to see the effects of motivational enhancement on skill acquisition. If a task-specific pretest score is entered in a multiple regression equation with the level of motivational enhancement (i.e., 0 or 1), one can analyze the effect of motivational treatment by controlling prior skill differences. However, this technique may not be able to provide theoretically adjustable causal interpretation because it does not take into account "entry affective characteristics" that have been argued to have a strong effect on performance (Bloom, 1976). one way of accounting for entry affective characteristics is to add a measure of academic self-concept to the regression equation, then a significant contribution of motivational treatment would be hypothesized to have caused the skill acquisition.

One limitation of the multiple regression analysis is that complex causal flows that are usually embedded in interdomain interaction research cannot be considered due to the lack of independence among predictor variables. For example in the motivational treatment, an attitude outcome is likely to be of interest, which concerns the learners' attitude toward the use of the learned skill (i.e., Briggs- Wager's (1981) twin objectives, Bloom's (1976) affective outcomes). The attitude would be claimed to be formed by skill acquisition as well as motivational treatment that stresses the usefulness of the skill as shown in Figure 6-a. A regression analysis on this model, however, does not address the fact that the skill acquisition is affected by the motivational treatment. The actual relationships among the three variable should be represented as shown in Figure 6-b, which cannot be analyzed using multiple regression per Se.

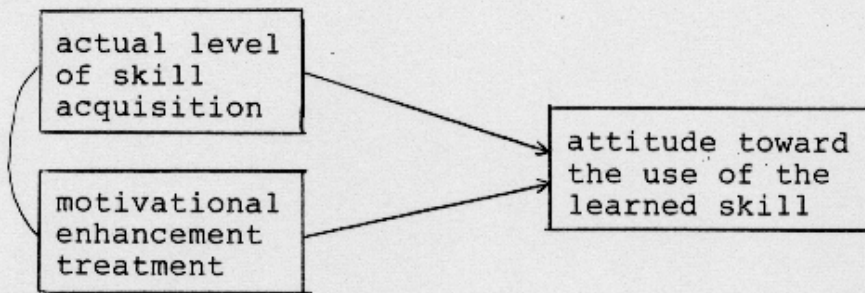


Figure 6-a. Relationships among motivation, skill acquisition, and post-instructional attitude toward skill use as implied by multiple regression equation.

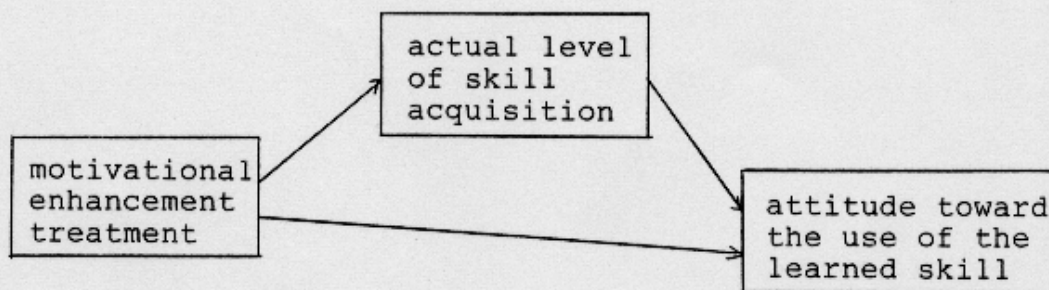


Figure 6-b. Actual relationships among motivation, skill acquisition, and post-instructional attitude toward skill use.

Path Analysis for Causal Modeling

As an extension of the multiple regression analysis, path analysis (Asher, 1983; Wolfle, 1980) has been developed for causal modeling. By employing path analysis technique, a factor may be perceived as both dependent and independent variable simultaneously. For example, motivational treatment may have an effect on the amount of skill acquisition, which in turn may affect the extent of positive attitude toward the use of the skill acquired. Furthermore, the motivational treatment may inform the learners of how useful the to-be-learned skill would be. If this is the case, then the motivation level in itself may have a direct effect on the post-instructional attitude toward skill uses, regardless of the extent of actual skill acquisition (Figure 6-b). It can be seen that the extent of skill acquisition is treated as both dependent and independent variables, for which the path analytic technique is most appropriate to be employed.

The implied correlation coefficients by the path model may now be presented to clarify the difference between the multiple regression model (Figure 6-a) and the path analysis model (Figure 6-b). Since there are only direct effects in the multiple regression model, the implied correlation coefficients are the standard regression coefficients, which are obtained by regressing the attitude on skill acquisition and motivational treatment, plus unanalyzed bivariate correlation between the two independent variables. In contrast, in the path

model, indirect effects are taken into consideration, which are added to the direct effects to derive the implied correlation coefficients. Therefore, the relationship between the motivational treatment and skill acquisition is implied by the path model, but not by the regression model. The structural equations for multiple regression runs and implied correlation coefficients for both models are as follows:

Regression model

Structural Equations

$$X_3 = P_{31} X_1 + P_{32} X_2 + R$$

Implied Correlation Coefficients

$$r_{13} = P_{31} + r_{12} \times P_{32}$$

$$r_{32} = P_{32} + r_{12} \times P_{31}$$

Path model

$$X_3 = P_{31} X_1 + P_{32} X_2 + R$$

$$X_2 = P_{21} X_1 + R$$

$$r_{13} = P_{31} + P_{21} \times P_{32}$$

$$r_{32} = P_{32} + P_{21} \times P_{31}$$

$$r_{21} = P_{21}$$

Note: X_1 : Skill acquisition, X_2 : motivational treatment,

X_3 : attitude toward skill usage

p: standardized regression coefficients

r: implied correlation coefficients.

By employing path analytic technique, three types of causal effects may be assessed (Wolfle, 1980). First, direct effects are indicated by the unidirectional arrows. For example, motivational treatment has a direct effect on skill acquisition in Figure 6-b. Second, indirect effects are the extent to which intervening variables account for the relationships between predetermined and subsequent variables. An example from Figure 6-b is the effect of motivational treatment on the attitude toward uses of the skill through the extent of skill acquisition. Finally, spurious effects are the extent to which antecedent variables account for relationships between other variables. The effect of motivational treatment on the relationship between skill acquisition and the attitude is an example. Thus, more complex causal flows can be examined by using a path analytic model than a cumulative use of multiple regression analyses.

Although path analytic techniques were originated in non-experimental research traditions (e.g., Anderson & Evans, 1974; Werts & Linn, 1970; Wolfle, 1980), applications have been seen in the experimental paradigm. For example, Covington and Omelich (1984) have utilized path model to determine the effects of retesting opportunities and criterion- versus norm-referenced grading on end-of-semester achievement, taking students' motivational reactions into account. One of the hypothesized causal links was supported by the path analysis, including the effects of retesting on the end-of-semester achievement directly and indirectly through motivational reactions. Thus, they concluded that "the performance superiority of a task-mastery system arises not only because of its inherent instructional properties (retesting), which account for some 62.7% of the explained variation in end-of-semester performance, but also because of an enhanced motivational climate (14.0%)..." (p. 1046).

In summary, path analysis would seem to be a powerful tool in interdomain interaction research, which involves complex flows of interrelationships among objectives in various domains of learning outcomes. Not only the direct effects, but also indirect and spurious effects can be included in the causal inference using path analysis.



CHAPTER THREE

CONCEPTUAL FRAME:WORK

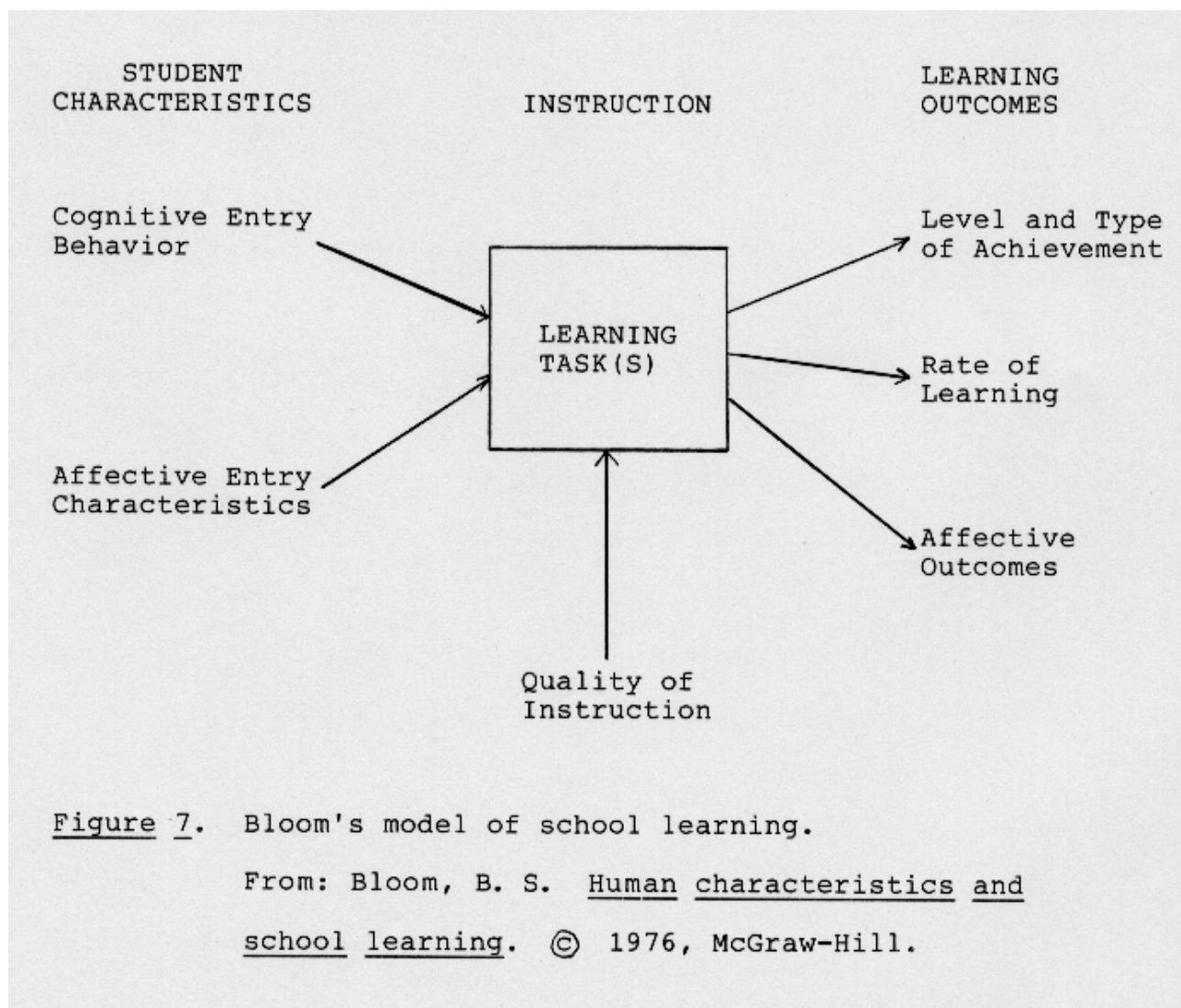
This study was based on the conceptual framework of interdomain interaction research proposed by Briggs and Wager (1981). Instructional Curriculum Maps (ICMs), which are to be referred in the design of instructional events, represent a way to identify possible interdomain relationships. By integrating various domains of learning outcomes, it is the goal of interdomain interaction research to provide instructional strategies that facilitate learning to its fullest extent.

Intellectual skills have been advocated as the building blocks of school learning (Gagne & Briggs, 1979). This was also the basic assumption of this study. Intellectual skills have some advantages as the building blocks of school learning. First, they cannot be simply looked up as verbal information, and they are “typically learned over relatively short time period” (Gagne & Briggs, p. 13). The hierarchical structure within the domain of intellectual skills is also advantageous in forming school curricula. It is easier, compared to other learning outcomes, to determine if an intellectual skill has been learned. The structure of the intellectual skill domain has been clarified by the work of Gagne (1985), White and Gagne (1974), and others. It was a natural next step to integrate the intellectual skills domain with other domains, extending the notion of utilizing prerequisite relationships for better design of skill learning.

A further premise of this study was that the integration among the domains of learning outcomes might contribute to a shift from a narrow viewpoint of instructional design to a longer and broader perspective. Typically, designers consider the end of lesson objective a “terminal” objective in the design effort. In contrast, Briggs and his associates (Briggs & Wager, 1981, Martin & Briggs, 1986) have stressed the linkage of lesson objectives to unit, course, and life-long objectives. In this perspective, the end of lesson objective is only a “target”, not “terminal”, leading to other objectives at other levels.

Martin and Briggs (1986) have pointed out that integration of affective objective to the cognitive counterpart may require the planning of instruction in a longer range. Learning cognitive strategies may also take a long period of instruction, which is possibly incidental, or indirect, in nature (Derry & Murphy, 1986). Whereas the unit of design effort may still be a lesson level, a designer should take into account that the “terminal” objective of a lesson must serve as an enabling objective for the next lesson. Thus, it is important that the learner leave an instructional unit with not only a newly learned skill, but also a positive attitude toward what has been learned.

In order to conceptualize a unit of instruction in the flow of school learning, Bloom (1976) has offered a process model of school learning as shown in Figure 7. He conceives a unit of instruction as having such student characteristics as input variables, learning task and quality of instruction as process variables, and learning outcomes as output variables. It is parallel to the framework of interdomain interaction in that Bloom has identified both cognitive entry behaviors and affective entry characteristics as the input, as well as level and type of cognitive achievement and affective outcomes as the output of an instructional unit.



Bloom (1976) has also recommended investigating the causal relationships among the input, process, and output variables so that a more precise prediction of the output variables can be made. He has stated:

“The theory attempts to make explicit the ways in which the learners’ previous characteristics and the quality of instruction determine the outcomes of the learning process whether the outcomes be different levels of learning, different rates of learning, or such affective outcomes of learning as attitudes toward the learning or attitudes about the self. The causal system described by these variables is amenable to modification at a number of points with consequent changes in the outcomes of learning” (p. 202 – 203).

Thus, in terms of the research methodology, path analytic procedures were used to examine the flow of causal relationships. path analytic procedures were employed to provide an empirical support of Bloom’s model of school learning at the general level, as well as to validate the ICMs derived from the theoretical assumptions and past research. Where complex interdomain relationships are expected, it should be advantageous to use path analytic procedures to examine the model and the ICMs as a whole.

In this study, the path analytic procedures were combined with an experimental manipulation of the “relevance” of a skill to be learned. This experimental manipulation enabled the researcher to construct another level of interpretation of the results, namely, a traditional experimental paradigm. Should the data fail to support the hypothesized causal model as a whole, the data could still be interpreted in terms of direct effects of the “relevance” treatment, as in a traditional two group analysis of covariance. Considering the two levels of interpretation of the results, hypotheses were derived as follows.

Hypotheses

This study explored interdomain relationships among the learning of an intellectual skill, information of its potential usefulness, and attitudes toward learning the skill and toward its practical uses. Following the traditional experimental paradigm, the purpose of the study was to examine the effects of “relevant” context of the learning of a skill on motivation, skill acquisition, and attitudes toward the use of the learned skill. It was also the purpose of this study to examine a hypothesized path model that depicted relationships among supporting instructional objectives from various domains of learning outcomes. Among the relationships included in the path model, the effect of success in skill acquisition on the formation of positive attitude toward practical use of the skill was of special interest in this study.

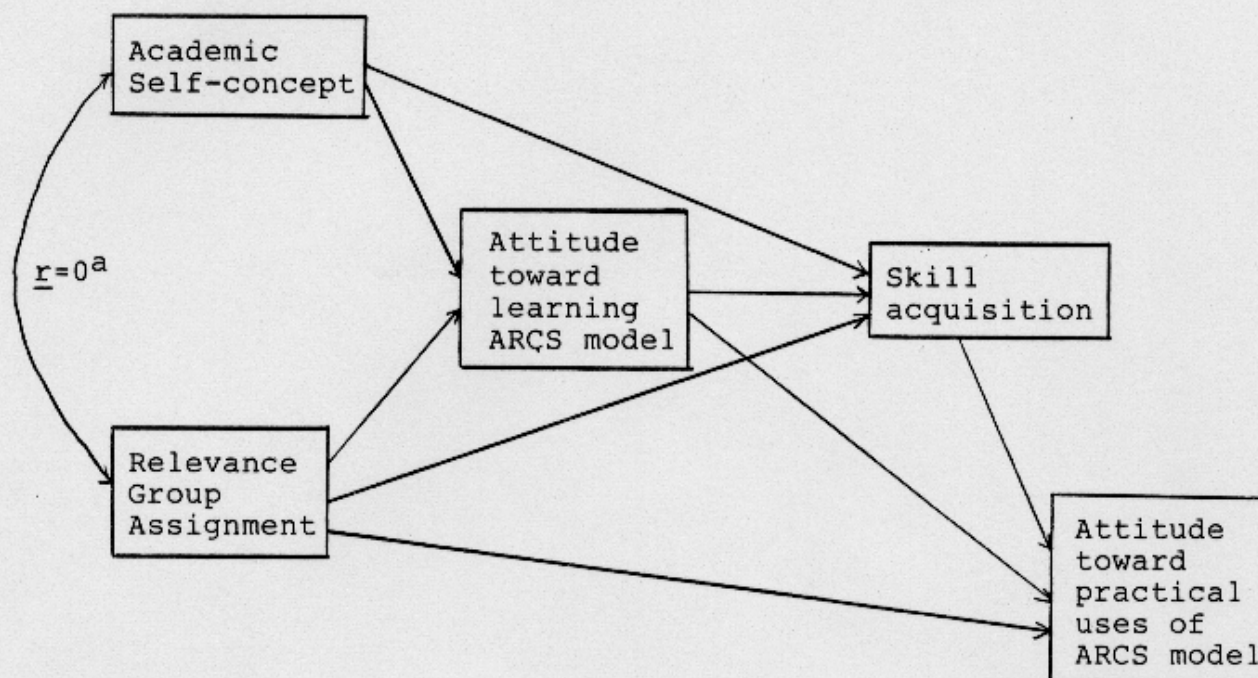
The Experimental Manipulation and its Hypothesized Effects

Two levels of the to-be-learned skill—Relevant and Irrelevant—were introduced in this study. This was done by adapting the context of the instruction (Ross, 1983) to the learners’ prospective profession (classroom teachers) and to an irrelevant profession (business managers). In each version of the instruction, two concrete examples of the skill’s application were described to provide a modeling condition. The usefulness of the skill and potential benefits of learning the skill were discussed as a preinstructional introduction. Further, each version used practical examples from typical situations in classroom teaching (Relevant treatment) and business training (Irrelevant treatment) when the learning of the skill took place. Therefore, the Education version was expected to be more meaningful and attractive, thus more “relevant,” to the participants of the study (preservice teachers) than the Business version.

It was hypothesized that the Education version would be more effective than the Business version in facilitating motivation to learn the model, acquisition of the skill, and formation of an attitude toward the use of the skill. In Ross’s study (1983), where the emphasis was to adapt the context to student background knowledge, the adaptive context (classroom) was more effective than either a non-adaptive (nursing) or an abstract (numerical) context in learning of probability rules by preservice teacher education students. Schema theory (Rumelhart, 1980) and research in advance organizers (e.g., Mayer, 1979) have also indicated the effects of a more meaningful context on cognitive learning. Increasing relevance of instruction has also been claimed to be one of the most effective motivational strategies (Keller, 1983b) for aiding both cognitive and affective learning. With respect to the effects on attitude learning, knowing “the situations in which choices of action are likely to be made” would facilitate the learning of an attitude (Gagne, 1985, p. 237). Furthermore, the perceived usefulness of the skill by the learner may provide expectation of reinforcement available for actually utilizing the skill (Briggs, & Wager, 1981).

The Hypothesized Causal Model

In order to make a causal interpretation of the results theoretically defensible, a measure of self-concept of ability was included as an additional predictor that presumably has a direct effect on some of the dependent variables of interest in the study. The importance of causal inference in research of affective learning has been pointed out (e.g., Bloom, 1976) so that the process by which an attitude is developed and the way in which it influences learning may be explored. Self-concept of ability has been claimed by many researchers (e.g., Bloom, 1976; Byrne, 1984; Hansford & Hattie, 1982; Uguroglu & Walberg, 1979) to have the strongest predictability among measures of affective entry characteristics of learners.



Note: ^acorrelation between academic self-concept and relevance of the material is expected to be zero due to the random assignment of participants to two relevance conditions.

Figure 8. Hypothesized Path Diagram Showing Interdomain Relationships.

The interrelationships among the variables of interest are shown in Figure 8 as a hypothesized path model. Causal hypotheses are indicated by the unidirectional arrows showing the various pathways of influence to be tested. Using path analysis allows for the relative contribution of all of the determining factors as specified in the model (direct, indirect, and spurious) to be estimated with regard to variations in both cognitive and affective outcomes.

Although path analytical techniques were originated in non-experimental settings (Asher, 1983; Wolfe, 1980), applications in experimental research have been increasingly reported (e.g., Covington & Omelich, 1984).

Two causal networks were of interest in this study. The first network concerned the various pathways of influence of the "relevance" of instruction, which was manipulated in the study. The Education version was expected to influence motivation to learn the skill (i.e., an attitude toward learning of the skill), which in turn was likely to have an effect on skill acquisition. The use of relevant context was also assumed to affect skill acquisition directly, which would in turn aid formation of a positive attitude toward the skill's practical uses. By providing information about the contexts for which the skill could be applied, the relevant version was expected to have a direct effect on attitude formation concerning its practical uses.

The second network stemmed from self-concept of ability. Representing the general expectancy for success in college learning, self-concept of ability was expected to have a direct effect on learner motivation for learning the skill. Moreover, because self-concept of ability had been built upon a learner's perception of the academic performance relative to his or her peers (Bloom, 1976), it was likely to have an indirect influence on the skill acquisition. Because practical use of the skill would be out of the college context, no direct effect of

self-concept of ability on the attitude toward practical uses was expected; the effect was thought to be only indirect through motivation for learning and actual skill acquisition.

Among the bivariate relationships in the hypothesized path model, a special attention was given to the effect of the learner's initial success in skill performance on the formation of positive attitude toward practical uses of the skill. The more skillful a learner becomes at using the newly-presented technique, the more likely he or she is to develop a positive attitude toward its uses. This may be because the attainment of the skill is, in itself, reinforcing (Briggs & Wager, 1981), and because a skillful learner who feels comfortable using the skill may exhibit stronger intention of actual uses (McClelland, 1985).

The specification of the causal model was defensible using Bloom's (1976) process model of school learning. Bloom has identified two input variables having direct effects on the process of school learning: cognitive entry skill and affective entry characteristics. It was assumed in this study that cognitive entry behavior does not have a direct effect on either motivation to learn or acquisition of the to-be-learned skill because the instruction assumed no specific prerequisite skill and because the to-be-learned skill was new to the learners. Affective entry characteristics were represented by the self-concept of ability, Which has been claimed to be the most powerful predictor among the affective measures of the school learning. Although general cognitive capability of the learner (e.g., that measured by IQ and other demographic factors) has also been identified to have a direct effect to the effectiveness of instruction (Dick & Carey, 1985), this was assumed to be represented by the self-concept of ability. Thus, it was claimed that important identifiable causes of the dependent variables of interest in this study were included in the hypothesized path model.

In order to avoid the bias in model specification, all variables having direct effects must be included in the model. If any direct cause were left out, the hypothesized model would be questioned for its specification, and any causal interpretation using the model would be invalid. Three direct causes that were identified, but that were excluded were: (1) teaching experiences in the public education settings, (2) perceived likelihood of becoming a classroom teacher, and (3) knowledge about motivational design of instruction.

These variables were excluded based on the assumption that they were constant throughout the population of this study. That is, it was assumed that the target audience had little experience in teaching, and that they intend to become a teacher (i.e., pre-service teachers). The instructional treatment consisted of CAI courseware containing an introductory lesson, which required no prior knowledge about the topic, motivational design of instruction. Although these three factors presumably had direct effects on the variables in the model, they did not have to be in the model if they were constant across the members of the population. To ensure the consistency, data were obtained in the proposed study so that the participants were checked against these criteria to be included in the subsequent analyses. This enabled the causal interpretation of the results using the hypothesized path model.



CHAPTER FOUR

METHODOLOGY

Participants

One hundred and twenty-two pre-Service teacher education students were recruited from two sections of an educational psychology Course at the Florida State University. The students were awarded extra credits toward their grades for their participation in the experiment. Sixteen students were excluded because they indicated that they do not intend to become classroom teachers. Also excluded were two students assigned to the business group (irrelevant treatment) who had business backgrounds. Two other students were excluded due to insufficient data. A total of 102 participants remained in the analyses.

Statistical power of this study was calculated to be .72 for the preset $\alpha = .05$ and a medium effect size (eta square = .06, Cohen, 1969, using the table of two group ANOVA).

For the results of this study to be generalized to a wider population than the pre-service teacher-education

students at The Florida State University, Some biographical data of the participants were described as follows. Among the 102 participants analyzed in this study, 82 were females and 20 were males. Fourteen were majoring in special education, seven in early childhood education, 47 in elementary education, 29 in secondary education, and five in other categories such as physical education. Most of the participants had either no teaching experience (49) or limited experience through a pre-internship (42). Majority of the participants were naive in studying via a computer, due to their limited exposure to this type of learning experiences.

Materials

The materials for this study were an introductory lesson on the ARCS model for motivational design (Keller, 1983a; Keller & Dodge, 1982; Keller & Kopp, in press; Keller & Suzuki, in press). The instructional goal of the lesson was to be able to classify motivational strategies used in instructional plans into one of the four categories of the ARCS model: Attention, Relevance, Confidence, and Satisfaction. The lesson consisted of two types of materials: (1) A two page introduction of the ARCS model, which was included in a booklet, and (2) A computer-assisted instruction (CAI) courseware as a main body of instruction Which had 41 instructional screens.

Two versions of the lesson were systematically developed (Briggs & Wager, 1981) and formatively evaluated (Dick & Carey, 1985) with two different target audiences in mind: (1) preservice teacher education students (Education version), and (2) undergraduate business major students (Business version). Although the target objective and the basic structure of the module were identical in both versions, the two versions were different in (1) the preinstructional introductory “positioning” of the ARCS model, which was included in the two page introduction, and (2) the examples and practice items, which were used in the CAI courseware.

Each version was designed so that the ARCS model maybe perceived as “relevant” by each target audience. That is, business students would find the Business version relevant, and the education major students would find the Education version relevant. The version that was designed to be I relevant for business students was assumed to be irrelevant for the education students. Specifically, human modeling technique (Bandura, 1977; Gagne, 1985) was employed in the two-page introduction of the ARCS model, using classroom teachers as examples in the Education version, and business people as examples in the Business version. Two anecdotes of successful application of the ARCS model in on-the-job situations were used to encourage the target audience to learn the ARCS model. The two versions of the introduction are shown in Appendix A, with other pre-instructional assessment tools used in this study.

The main body of the lesson was CAI courseware, using a PLATO instructional computer system. After a four-page introduction to the courseware, a menu screen was presented, from which a learner selected five instructional sections and two assessment sections. Each of the instructional sections consisted of five to seven screens, explaining motivational problems and the four ARCS categories. In order to explain the ARCS four categories, examples and practice items were drawn from typical situations in business settings for the Business (Irrelevant) version, and in classroom settings for the Education (Relevant) version. Some sample screens are presented in Appendix B.

Measures

The following measures were employed in this study to operationalize the hypothetical path diagram shown in Figure 8. Two preliminary Collections of data (N = 27 and 16) were conducted in order to examine the measurement devices. The results of the preliminary data collection are also presented in this section.

Academic Self-Concept Scale

Self-concept of ability Was measured using the Academic Self-Concept Scale (ASCS) developed by Reynolds, Ramirez, Magrina, and Allen (1980). The ASCS consisted of 40 opinion statements concerning college-related personal expectancy of academic success, to each of which the participant selected either strongly disagree, disagree, agree, or strongly agree. Reliability of the ASCS has been reported to be $\alpha = .91$

in one study (Reynolds et al., 1980), and the construct validity of the scale has also been supported (Reynolds, 1981; Reynolds et al., 1980). The preliminary data collection has also supported the reliability of the ASCS to be high ($\alpha = .91$ in both pilot data collections). The ASCS scale is shown in Appendix A as a part of the pre-instructional booklet.

Criterion-Referenced Measure of Skill Acquisition

Acquisition of a defined concept was measured by a criterion-referenced posttest. The objective was that the students would be able to classify motivational strategies into the ARCS four categories. Four different sets of fifteen true-false items, one set for each of the ARCS categories, were given as the posttest as the first assessment section of the CAI courseware. Each set contained items indicating a true or false representation of a motivational strategy. Appendix C consists of the 60 posttest items used in this study.

A different form of the posttest was used in a pilot study, which turned out to have low reliability. The test asked the learner to classify sentence-long statements of motivational strategies into the ARCS's four categories. Reliability coefficients were $-.111$ for a difficult version and $.372$ for an easy version. There was a ceiling effect to which the low reliability is attributed. Thus, this old assessment scale was replaced with a new one as described above. Item specification procedures (Popham, 1980) were employed to ensure the content validity of the test in terms of the congruency to the instructional objective of the module. The new test was formatively evaluated in the second pilot study, in which items with less than fifty percent correct responses were examined for their clarity and were rewritten accordingly. A high reliability was obtained in the second pilot study ($\alpha = .93$, standard error of measurement = 3.2 with 16 participants).

Attitude Measures

Three types of attitude measures were employed to test the participants' attitudes toward learning the ARCS model and toward its practical uses: (1) Continuing Motivation Scale, (2) Behavioral Intention Differential Scale, and (3) Semantic Differential Scale.

Maehr's (1976) scale of Continuing Motivation (CM) was used to measure the attitude toward learning the ARCS model. The CM scale consisted of "three sequentially and hierarchically ordered items" (Maehr, 1976, p. 449) that asked willingness of the respondent "to sign up to work on the task at some point in the future" (p. 449). The CM was included in the pre-instructional booklet (Appendix A).

The first preliminary data collection showed high correlations of the CM scale with both the SDS and the BID scale ($r = .501$, $p < .01$ and $r = .535$, $p < .01$, respectively), indicating the CM scale may be valid when employed as a measure of attitude outcomes. Further, those who read the Education version of the ARCS model (Mean = 5.5, SD = 0.9) scored significantly higher on the CM scale than those who read the Business version (Mean = 4.2, SD = 1.3), $F(1,23) = 6.753$, $p < .05$, $\eta^2 = .227$.

Behavioral Intention Differential Scale (BID, Triandis, 1964) was employed to measure the participants' attitude toward practical uses of the ARCS model in terms of their intended uses as classroom teachers. The BID consisted of 20 four-point scales describing intent to apply the ARCS model in hypothetical school situations. Each of the items measures the extent to which the participant agrees or disagrees with the intent of such a personal action. The BID was administered in the second assessment section of the CAI courseware. The 20 items can be found in Appendix D.

The first preliminary data collection revealed that the initial form of the BID scale, which consisted of 10 items, had a low reliability Coefficient ($\alpha = .483$). Further, the BID scale did not relate to the extent of skill acquisition, or to the relevance of instruction.

Nonetheless, the BID scale as used in the first preliminary data collection was highly correlated with the SDS ($r = .517$, $p < .01$). Thus, the use of BID was decided to be valid as a measure of attitude toward the use of ARCS model. The BID scale was lengthened to consist of 20 items in the second pilot study, where the reliability increased to be $\alpha = .92$.

A Semantic Differential Scale (SDS; Osgood, 1965) was developed to measure the participants' feelings toward the ARCS model. The SDS intends to measure the meaning that people give to a concept. Thus, it was considered to be an indirect measure of the participants' attitude toward any action involving the ARCS model in this study. The SDS was used to support what the CM scale and the BID scale were intended to measure. The SDS consisted of 18 bi-polar adjectives with a seven-step scale in between each pair of the adjectives, which can be found in the Appendix A.

Reliability Coefficient of the SDS was .87 in the first preliminary data collection, and was .82 and .90 when administered in the second pilot study, before and after the participants went through the CAI courseware, respectively. In the first pilot study, it was also found that the participants' attitude measured by the SDS was high when they scored high on the skill acquisition test ($r = .45$, $p < .01$).

Procedures

Two sessions of a third and fourth year undergraduate Educational psychology class were asked for volunteers to participate in this study. The students made individual appointments with the experimenter for a block of two hours to come to a learning resource center. There were usually five to ten participants in each block of the time. Upon arrival, each participant was given a booklet, which included the demographical data collection sheet, the ASCS measure, one of the two versions of the introductory statement of the ARCS model, the SDS measure, and the Continuing Motivation (CM) measure. The assignment of the two versions of the introduction was made at random with the restriction that the two groups would have equal number of participants. The SDS and the CM measures assessed the affective entry characteristics prior to the intellectual skill instruction, but after the introduction of the skill in order to manipulate the relevance generating property.

When each participant finished with the booklet, he or she was introduced to the next activity, which was given regardless of his/her intention to study the ARCS model as expressed in the CM measure. The participants were directed to study the ARCS model using computer courseware. Based on the version of the introduction to the ARCS model, which was just shown in the booklet, each participant was assigned to either the Education or Business version of a CAI module to study the four categories of the ARCS model. An on-line posttest was administered when each participant reached the end of the CAI module at his or her own pace. The posttest was followed by a screen that showed how well the participants did on the skill test. Finally, the SDS measure and the BID measure concerning attitudes toward the ARCS model and toward its practical uses were administered as the last part of the computer courseware.

Data Analysis

Two kinds of statistical techniques were employed in order to answer the two types of research questions in this study.

Analyses for the Experimental Manipulation

Analyses of covariance were used to examine the effects of the experimental manipulation, the relevance group assignment, controlling for the initial difference among the participants as expressed by academic self-concept. Three separate analyses of covariance were employed to test the group differences on: (1) Attitudes toward learning of the skill as measured by the Continuing Motivation Scale, (2) Acquisition of the skill as measured by the posttest, and (3) Attitudes toward practical use of the skill as measured by the Behavioral Intentional Differential Scale. The score on the Academic Self-Concept Scale was used as a covariate in these analyses.

Analyses for the Path Model

This study employed path analysis techniques to examine the hypothesized model of causal inference shown in Figure 8. The hypothesized model was a recursive model (Asher, 1983), in which the causal flow of influences

between variables was unidirectional. Multiple regression runs were combined to confirm the hypothesized path model and to determine individual effects of each of the determinants. Since the path model employed in this study combines observed data (e.g., self-concept of ability) and experimental manipulation (i.e., relevance of instruction), results obtained by analyses of covariance using the experimental manipulation would still be valid even if the path model were not confirmed.

The approach for path analysis in this study was a mixed approach of confirmation and exploration, due to the limited availability of the theoretical support for the hypothesized model. Although the theoretical rationale for the model specification has been presented in the previous chapters of this paper, support from past research was limited to individual relationships among the adjacent variables. No empirical support could be identified for making adequate rationale for constructing the proposed model. Thus, when the proposed model was not confirmed by the collected data, alternative models, based on the empirical data, were explored.

The overall procedure of the data analysis used was to:

Step 1: Calculate observed bivariate correlation coefficients among all variables in the model.

Step 2: Run multiple regression for each of endogenous variables in the model using all direct causes, which resulted in the structural equations.

Step 3: Calculate the implied correlations by the model, using correlation decompositions.

Step 4: Determine the model fit by comparing the implied and observed correlations, by examining empirical support for each of the paths in the model, and by checking assumptions for the specified functional form.

Step 5: Modify the original model to look for an alternative model if the original model was not confirmed by the data.

CHAPTER FIVE

RESULTS

This study was designed for two levels of interpretations of the results as expressed in the two subcategories of the hypotheses: (1) traditional experimental paradigm with two levels of the manipulated variable, relevance of instruction, and (2) causal inference of the interrelationships among the predictor variables included in the hypothesized path diagram. Thus, the results of the study are presented in three subsections in this chapter: (1) descriptive statistics and verification of assumptions for inferential statistics, (2) the effects of the experimental manipulation, and (3) an examination of the hypothesized path model.

Descriptive Statistics

Table 2 shows possible ranges, group and grand means, standard deviations, and Cronbach's alpha reliability coefficients of the predictor variables for the sample of 102 included in the subsequent analyses. A check against scatterplots for normality of the score distribution within each group has revealed no major violation for any of the variables included in the table. Further, the F max tests confirmed that all measures had similar variances in the two groups.

Table 2.

Possible Ranges, Group Means, Standard Deviations, and Reliability Coefficients.

Measure	Possible Range	Group Means (SD) ^a		Grand Mean (SD)	Alpha (# of items)
		Educ.	Busi.		
Academic Self-concept	40 - 160	116.4 (12.3)	117.5 (13.1)	116.9 (12.6)	.935 (40) ^b
Semantic Differential (1st administ.)	18 - 126	94.2 (9.1)	92.5 (11.4)	93.4 (10.3)	.867 (18)
Continuing Motivation	1 - 6	5.0 (1.1)	4.5 (1.4)	4.8 (1.3)	N/A ^c (1)
Posttest	0 - 60	46.3 (5.5)	46.2 (6.2)	46.3 (5.8)	.704 (60)
Behavioral Intention Differential	10 - 80	59.9 (6.5)	59.5 (6.1)	59.7 (6.3)	.892 (20)
Semantic Differential (2nd administ.)	18 - 126	99.7 (12.8)	100.0 (13.2)	99.8 (12.9)	.896 (18)

Note: N = 102.

^a \bar{n} = 53 in Education; \bar{n} = 49 in Business.

^bFigures in parentheses are the numbers of items.

^cReliability coefficient cannot be applied to a single item instrument.

Other assumptions for inferential statistics were also tested. First, for the subsequent analyses of covariance, the product term of the Academic Self-concept and the groups was entered in multiple regression runs to test the homogeneity of slopes or lack of interaction effect on each of the dependent measures. It was found that no covariate by factor interaction was significant ($F(1,98): 0.00, 1.14, 0.00, 0.02, 0.12$ on CM, 1st SDS, posttest, BID, and 2nd SDS, respectively). Therefore, the Academic Self-concept could be used as a covariate. For multiple regression runs, which were used for the path analysis, the assumptions of a normal distribution and homoscedasticity of the residuals were examined. A scattergram plot (the residuals by the predicted values of the dependent measure) was depicted for each of the two relevance group whenever a multiple regression analysis was conducted.

The bivariate correlation coefficients among the predictor variables are shown in Table 3. First, the bivariate correlation coefficients were calculated for each of the two relevance groups to examine as to whether any large discrepancies exist. No major difference was detected between the group correlation coefficients. Thus, it was decided to pool the two groups in order to arrive at the bivariate correlation coefficients shown in Table 3.

Table 3.

Bivariate Correlation Coefficients
among Predictor Variables.

	(2) ASCS	(3) SDS1	(4) CM	(5) Posttest	(6) BID	(7) SDS2
1. Relevance Group ^a	-.045	.08	.21*	.00	.04	.01
2. Academic Self-concept Scale		.10	.10	.24**	.21*	.15
3. Semantic Differential Scale (1st)		---	.35***	-.13	.45***	.62***
4. Continuing Motivation			---	.08	.42***	.31***
5. Posttest				---	.16	.21*
6. Behavioral Intention Differential					---	.71***
7. Semantic Differential Scale (2nd)						---

Notes: $N = 102$.

^aDummy coded: Business = 0, Education = 1.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Experimental Analysis

The relevance of the instruction, which was manipulated in this study, was expected to have both affective and cognitive effects. The learners who studied Education (relevant) version were hypothesized to score higher on the Continuing Motivation (CM) Scale, posttest, and Behavioral Intentional Differential (BID) Scale than those who studied Business (irrelevant) version. one-way analyses of covariance were used to control for the initial difference of affective entry characteristics as measured by ASCS.

As expected, the relevance manipulation in the introduction had a statistically reliable effect on the attitude toward studying more about the ARCS model as measured by the CM scale, when the Academic Self-concept was used as a covariate, $F(1,100) = 4.618$, $p < .05$, eta square = .04. Although the difference was not as large as Cohen's (1969) definition of medium effect size (eta square = .06), the adjusted means of the Education group (5.0) was approximately four tenths of a standard deviation higher than the Business group (4.5). (Note that due to the small group difference on the ASCS measure, the adjusted and unadjusted means were

approximately the same.) The 95% confidence interval (95% CI) of the adjusted group mean difference was from 0.04 to 1.02. That is, the group difference on the CM scale may have been 3% to 78% of the standard deviation (a less than small effect to large effect in Cohen's definition). In contrast, such a group difference was not found to be reliable on the pre-instructional feeling toward the ARCS model as measured by the SDS scale, $F(1,100) = 0.792, p > .05$.

Although the Education version was expected to be more effective than the Business version, the difference between average performance on the posttest was not statistically reliable when Academic Self-concept was used as a covariate, $F(1,100) = 0.585, p > .05$. Also found to be not significant was the group difference on the post-instructional attitudes as measured by BID and SDS scales, with the Academic self-concept as a covariate. $F(1,100) = 1.12, p > .05$ for the BID scale, $F(1,100) = 0.35, p > .05$ for the SDS scale. Therefore, in this study, the effect of the relevance group difference was found to be limited to the pre-instructional, but post-introductory, motivation for further learning as measured by the CM scale.

Path Analysis

The hypothesized path diagram (Figure 8) was examined by combining multiple regression analyses, producing path coefficients shown in Figure 9. The path coefficients were obtained by multiple regression analyses including only the predictor variables that were assumed to have direct effects on the dependent variable in each analysis. All the hypothesized direct effects are shown as unidirectional arrows, of which statistically significant paths are indicated by thicker arrows in the diagram.

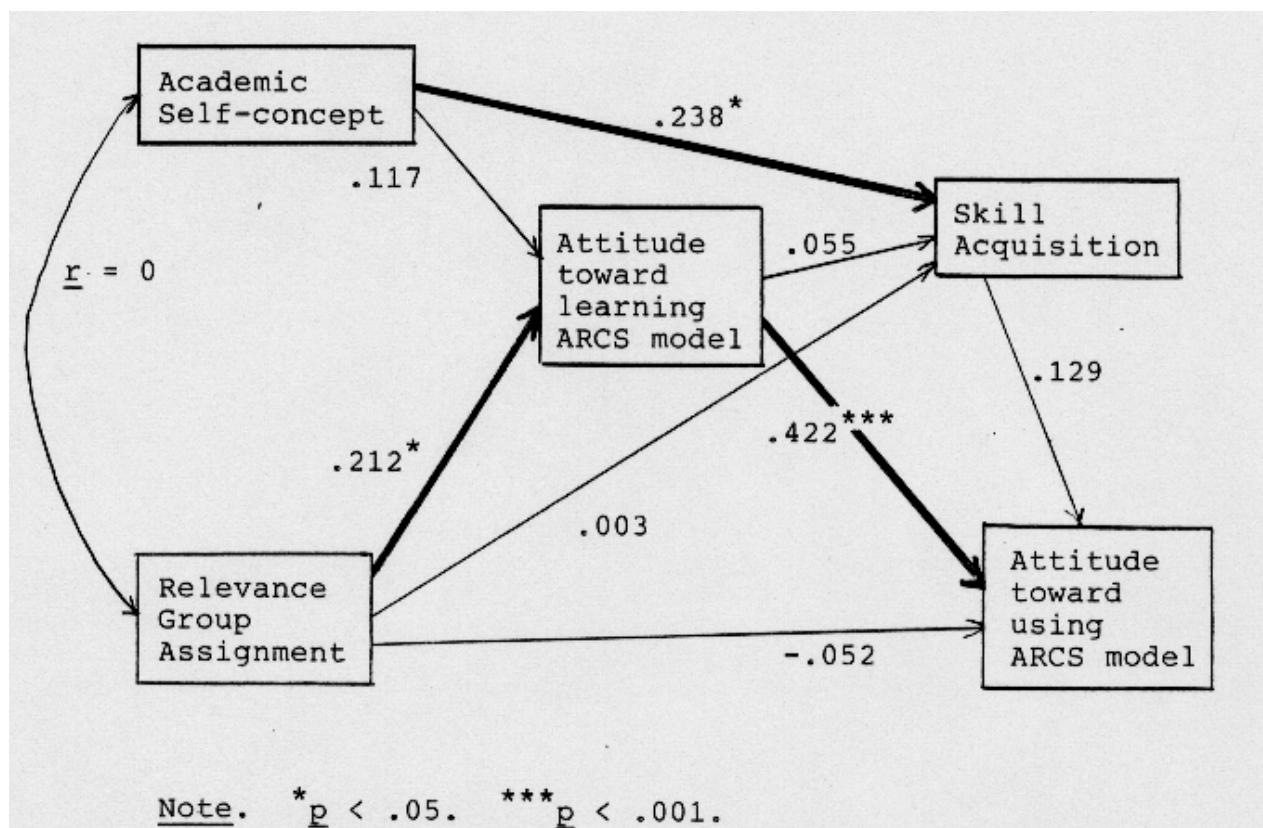


Figure 9. Path Diagram of Effects of Relevance Groups and Academic Self-concept on Attitudes and Performance.

In order to determine if the hypothesized path model fits the data obtained in this study, empirical support for the correlation among the predictor variables, each model path, and the functional form (i.e., residuals of the regression equation) of the relationships among the variables were examined. It was found that all but one of the observed correlation coefficients were similar (i.e., the difference smaller than .05) to the implied correlation reproduced by tracing paths of the model. That is, the data supported all the bivariate relationships between

each pair of the variables in the model except the one between the Academic Self-concept (ASCS) and Behavioral Intention Differential Scale (BID). The absence of the direct causal path from ASCS to BID was speculated to be related with this discrepancy. The direct and indirect effects in the hypothesized path model are summarized in Table 4.

Table 4.

Summary of the Effects in the Hypothesized Path Model.

Effects ^a	Path coefficients			\hat{r}^b	\underline{r}^c
	Direct	Indirect	Total		
ASCS on CM	.117	---	.117	.117	.107
Group on CM	.212*	---	.212	.212	.207
ASCS on Posttest	.238*	.006	.244	.244	.243
Group on Posttest	.003	.012	.015	.015	.003
CM on Posttest	.055	---	.055	.083	.081
ASCS on BID	---	.081	.081	.081 ^d	.212 ^d
Group on BID	-.052	.091	.039	.039	.036
CM on BID	.422***	.000	.422	.415	.422
Posttest on BID	.129	---	.129	.141	.163

Note: ^aEffects are expressed in terms of path coefficients, which is the equivalent of the standardized beta regression coefficients. CM: Continuing Motivation Scale; BID: Behavioral Intentional Differential Scale.

^bImplied correlation coefficients calculated by adding direct, indirect, and spurious effects.

^cBivariate correlation coefficients.

^dDifference exceeds the preset level of .05, representing misfit of the model with the data.

* $p < .05$. *** $p < .001$.
Probabilities apply only to the direct effects.

The functional form was also examined by looking for any peculiar pattern in the residual plots. No systematic pattern was found in the scatterplots of residuals in each of the regression analyses, supporting the functional

form of the hypothesized path model. In contrast, as indicated in Figure 9, several of the hypothesized paths of direct effects were not statistically Significant.

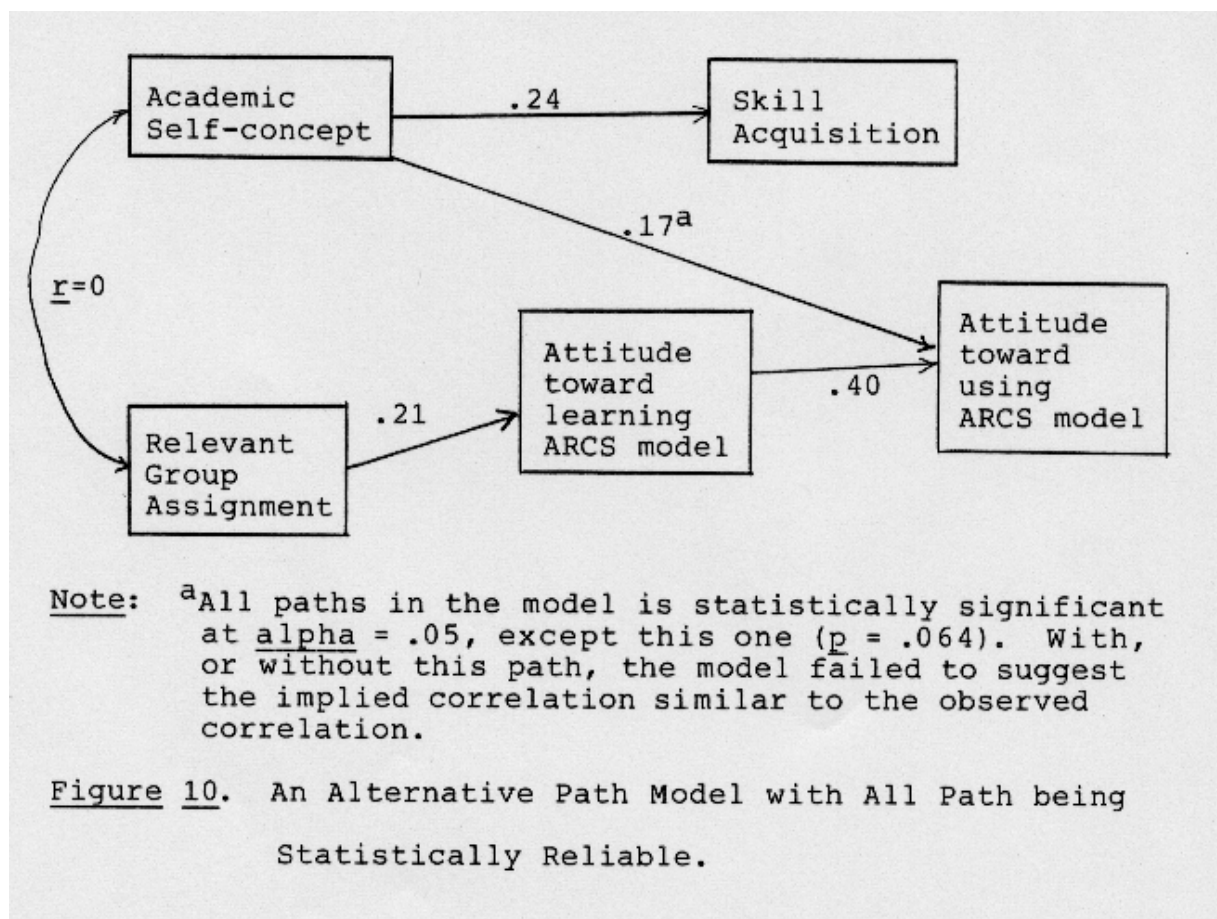
Thus, it was not confirmed that the hypothesized path model fit the actual data in this study. The hypothesized path diagram, as a whole, did not represent the way attitudes toward the newly learned skill were formed, in a statistically reliable manner.

The effect of actual success in learning, as expressed by the performance on the posttest, was of special interest in this study as it was related to the formation of positive attitudes associated with the ARCS model. As expected, bivariate correlation between the posttest performance and the scores on the SDS was found to be of moderate magnitude and statistically reliable ($r = .205$, $p < .05$). A multiple regression analysis also revealed that a reliable and moderate portion of the change in the feeling toward the ARCS model between the pre and post administrations of the SDS measure was attributed not to the version of the material studied, but to the actual degree of success in the posttest performance ($F(1, 98) = 15.302$, $p < .001$, $\eta^2 = .083$). That is, controlling for their groups and initial ratings of the model, those who scored high on the posttest expressed more positive feelings about the ARCS model than those who scored low.

The magnitude of this effect can be more concretely expressed by the shift of the SDS score by changes in the posttest. The SDS score increased 15 points, or 1.2 sigma, while the posttest score only changed from 35 points (mean posttest score - 2 sigma) to 58 points (mean + 2 sigma). This increase of the SDS score by 15 points may be considered to be a large effect, when compared with Cohen's (1969) definition of a large effect size (8/10 of a standard deviation). Ninety-five percent CI for the average increase of the SDS score was from 7.4 points to 22.5 points, representing six tenths and 1.8 times as large as a standard deviation, respectively.

In contrast, the relationship between the posttest performance and the score on the BID scale was not found to be statistically reliable in this study, although they were positively related ($r = .16$, $p > .05$). In a similar multiple regression analysis, the effect of the posttest performance on the attitude shift between pre and post instruction measures (using the CM and BID scales) was not found to be statistically reliable, $F(1, 98) = 2.0$, $p > .05$.

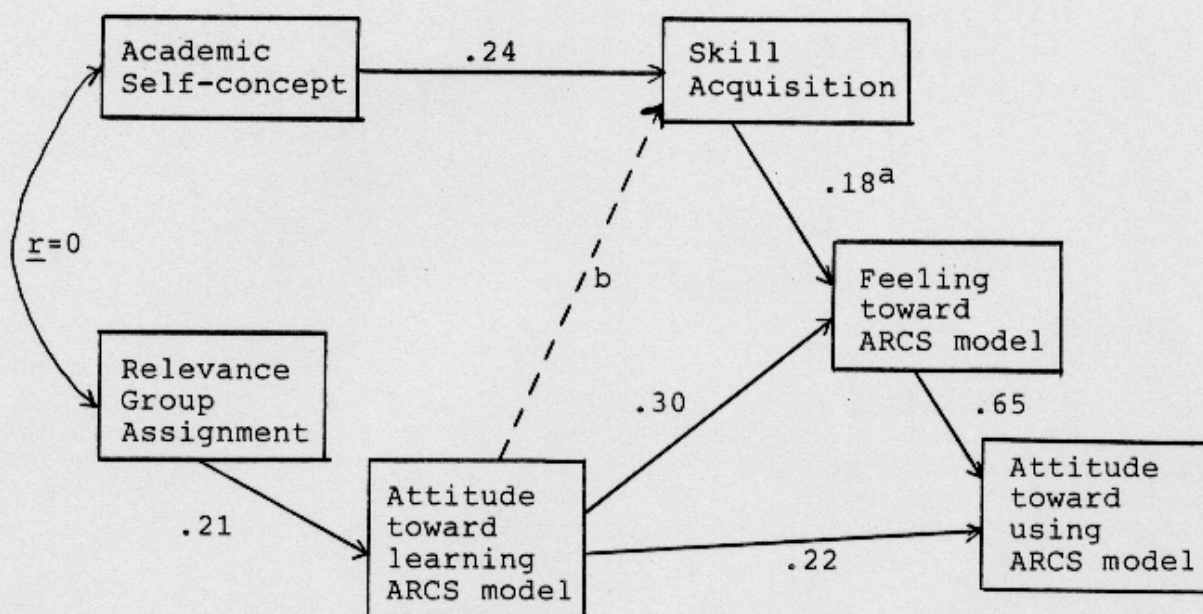
Although alternatives to the hypothesized path model were explored as planned, no temporal path model could be identified, in a statistically reliable manner, using the components in the hypothesized model. The direct effect paths that were found to be nonsignificant were deleted, one at a time, to identify a model with all direct effect being statistically Significant. Although a diagram was identified with every path being significant (Figure 10), the model suggested implied (or reproduced) correlation far apart from the observed correlation among the components.



Similarity between correlation reproduced by tracing the paths of the model and the observed correlation is one of the necessary conditions for the temporal model if it is to fit the data. Thus, no alternative model, which fit the data, could be found without changing the components in the hypothesized path model.

As the next step, alternative models were explored by adding some components to the hypothesized model, and deleting some paths from the model, again one at a time. When the post-instructional feeling toward the ARCS model (i.e., the second administration of the SDS) was added, a temporal model could be identified with a statistically marginal reliability. Figure 11 shows the alternative path model, which has all the direct effects being significant (one path at a marginal probability), and which fits the data under a more lax criterion for correlation similarity (i.e., the difference between observed and implied correlation among the components being .10, instead of .05).

It should be noted that this revised model needs further investigation for its confirmation. Also, theoretical adjustment for inclusion and exclusion of the components, as well as the direct pathways, are in order. However, this model may be useful to discuss the findings of this study in the next chapter.



Note: ^aAll paths were statistically significant at alpha = .05 except this one, p = .056.

^bNote that the direct effect of the attitude toward learning the ARCS model on skill acquisition is missing in this model. This may not be the same when the group difference is greater.

Figure 11. A Temporally Revised Path Model which had Marginal Statistical Reliability.

CHAPTER SIX

DISCUSSION

The hypothesized path model as a whole was not confirmed to represent the complex causal flows of the formation of attitudes toward practical uses of a newly learned intellectual skill. Results indicated, however, that some of the individual hypotheses were supported in this study. A temporal alternative to the hypothesized path model was also identified. In this section, the results will be first discussed in light of the hypotheses: (1) the experimental manipulation, and (2) the path model. Then, the limitations of the study, suggestions for future research, and instructional implications of the study will be identified.

The Effects of Relevance

The two versions of the materials were employed in this study in order to create cognitive, as well as affective, group differences. These differences were expected to be due to the difference in “relevance” of the instruction, which was a function of whether the instruction related to the specific career orientation of the target audience. For the pre-service teacher participants in the study who expressed classroom teaching as the first preference of their career, the Education version was expected to be more effective in aiding both

cognitive and affective learning than the Business version.

Looking at the results that indicate such effects of relevance groups to be limited to the pre-instructional motivation (as measured by the CM scale), it can be concluded that the effects of relevance groups were created only in the introduction via the use of human models. Note that there were two parts in the relevance manipulation: (1) different success stories using the human model technique, and (2) different examples and practice items in the courseware. The CM measure was administered after the introduction, but before the courseware. Only after the administration of the CM were examples and practice items introduced from different contexts. The difference, however, did not have any systematic effects on cognitive performance. In contrast, the initial motivational difference created by the human modeling technique was persistent until the end of instruction, which was the single reliable source of variance in the BID measure.

Why were the effects of relevance groups limited to the beginning phase of instruction? probably because that was where the relevance was being established for subsequent events of instruction. It is consistent with instructional design models (e.g., Dick & Carey, 1985; Gagne & Briggs, 1979) suggesting the utility of the target task emphasized at the beginning of an instructional activity. Once established at an early stage of learning, perceived relevance of the new skill may have been difficult to alter by the subsequent experiences. The expectancy-value theory (Atkinson, 1964; Keller, 1983b) suggests that the perceived relevance can be highly independent of the perceived confidence with the skill.

An alternative explanation is that the Business Introduction did not avert the participants from further learning, but merely had a weaker impact on the formation of positive attitudes toward learning the skill than the Education Introduction. The concrete success stories in the Business version may have contributed to the credibility of the ARCS model, rather than persuading the participants that the model was irrelevant to them. On the average, the participants in both groups were willing to learn about the ARCS model, but the Business group was not sure if they would do this on their own time, whereas the Education group was (i.e., Means of 4.5 and 5.0 on the CM scale, respectively).

If a strong negative feeling toward learning the ARCS model was formed by the Business introduction, the participants in the Business group would have created a "perceptual screen (Briggs & Wager, 1981)", which prevented them from effective learning. Because the participants were still "pre"-service teachers, the irrelevant treatment group may have not been bothered by the business orientation of the material. A case of in-service teachers may be quite different. The in-Service teachers may have already acquired a belief that business motivation models do not apply to the school classroom settings.

The absence of a direct effect of the relevance group on final performance and attitudes may also be attributed to the relevant content of the learning task. The content (i.e., about motivation) was carefully chosen so that the learning task could be potentially perceived to be relevant for the pre-service teachers. However, it might be so attractive to the participants that the difference in relevance groups did not have visible effects. In Ross' study (1983; Ross & Bush, 1980), where the adapting contexts was effective, the learning task was basic statistics. The subject matter was relatively difficult to relate to the students' background without the contextual help built into the instruction. In this study, on the other hand, it may have been relatively easy for the participants to utilize their existing knowledge, even when the new skill was presented in an irrelevant context. Recently, Ross (Ross & Morrison, 1987) made a point that much of the effects of adapting the instructional context to student background could be attributed to the novelty effect, and that the place to use this strategy should be carefully selected.

The characteristics of the CAI courseware used in this study may also have weakened the effects of the relevance group. Although the examples and practice items were drawn from different contexts, both versions had the same, well-designed, structure. Regardless of initial differences in motivation, the courseware may have required all the participants to be "on task" via motivational properties such as frequent use of questions and the menu driven structure with short segments (Keller & Suzuki, in press). An average study time of about an hour may have also been too short to create any reliable effects of motivational differences among the participants. High averages and small standard deviations on the posttest performance indicate that both versions of the courseware were effective.

Finally, the research setting may have been another factor. That is, the obtrusive experimental situation,

together with the voluntary Participation, may have demanded the participants to exert more effort than they would normally in a learning situation such as in a class. If the experiment were unobtrusively conducted as a part of course activities over a longer period of time as was originally planned, the demand characteristics in the setting could have been lower. The participants were explicitly told that, regardless of the posttest score, they would be given the same amount of extra credits for the course. It was observed, however, that most of the participants studied the material very seriously. The interactive feature of the courseware was also likely to increase learning from both treatment.

In summary, it can be concluded that the unique combination of the learner, learning task, and situational characteristics seem to create less than anticipated effects of the relevance manipulation. Although the human modeling technique in either context was found to be effective, the effects of contexts themselves were likely to be different from situation to situation. One determiner may be the degree to which the learning of the skill is felt to be urgent and the application of the skill in the specific context is perceived to be immediate. Intrinsic interest value of the task may be another factor.

The Causal Model

The hypothesized path diagram was not supported by the data obtained in this study. The path diagram did not sufficiently explain the causal flows among the variables included in the model. The model fit was determined statistically by the magnitudes of bivariate correlation between each pair of the variables, as well as the specifications of the relationships among the variables. Thus, the reason why the hypothesized model could not be confirmed was either (1) the expected bivariate relationships between pairs of variables were different from the true relationships, or (2) the specification of the model was incorrect, or (3) both.

The absence of relevance group effects on both the posttest and post-instructional attitudes greatly influenced the causal flows in the model, which can be considered to be a discrepancy between the expected and actual bivariate relationships. In order for a path model to be confirmed, all of the hypothesized direct effects must be statistically significant. Among the three hypothesized direct effects of the relevance groups, only one (on the CM scale) was found to be significant. The unanticipated weak effects of the relevance group difference was sufficient to disconfirm the causal model.

Was the specification of the model incorrect? The answer to this question seems to be unknown at this point. Theoretical argument for each of the bivariate relationships exists, although the model as a whole may not be defended by prior research. If the magnitude of the effects of relevance group differs, the current model may be confirmed as a whole. The bivariate relationship between the academic self-concept and the attitude toward learning the ARCS model was hypothesized, but found to be nonsignificant in this study. A stronger difference between the relevance groups, however, may change this relationship, because the attitude was regressed by both the academic self-concept and the relevance group in the model. Thus, until different degrees of the magnitude of the group difference are tested, the hypothesized path model should not be determined to be misspecified.

A distinctive difference between experimental and non-experimental uses of the path model is the manipulation of a component in the path model when employed in an experimental setting. In non-experimental situations, the bivariate relationships between the components of a causal model are determined for a researcher. Thus, the main concern is to specify the causal model correctly, by determining which direct paths to include in the model. On the other hand, in an experimental setting, a researcher has a certain degree of control in the effects of the manipulated variable. Even if a model were confirmed in an experimental setting, the same model would not necessarily work when the magnitude of experimental manipulation changes. A special caution is required when generalizations of the results are made in terms of the causal inference. Similarly, when a proposed model fails to be confirmed, additional experiments are in order before any conclusion can be drawn in relation to the specification of the model.

The effect of successful performance on the formation of positive attitudes toward the newly-learned skill and its applications was of specific interest in the path model, which was partially supported in this study. On one hand, the posttest score was the only reliable source of variance explaining the shift between pre and post administrations of the SDS measures. On the other hand, however, the direct effect of the posttest

performance was not statistically reliable when the variation of the BID scores was examined. That is, whereas the initial success or failure in the learning of the model had a reliable and moderate effect on the shift of the participants' impression of the model itself ($\eta^2 = .083$), the effect on the attitude toward its actual use was not found to be reliable. Instead, the attitude toward model's actual use was strongly influenced by the initial motivation to learn the model ($\eta^2 = .170$).

It seems, at least in this particular case, that the introductory nature of the learned skill may in part explain the limited effects of posttest performance on the attitude formation. The instructional objective of the courseware used in this study concerned a classification skill, which is necessary to utilize the ARCS model to solve motivational problems. The courseware, however, covered only a prerequisite skill in order to be able to actually use the model in practical situations. Although successful performance in the courseware might have perceived as a good start in learning the model, less successful performance might also have perceived as "not a bad start". Because the linkage between the successful learning with the given material and the successful application was less than obvious, those who scored relatively low on the posttest could still say that they would use the model when they become teachers.

If the learners of the courseware had required a more immediate need for skills dealing with motivational problems, the effects of posttest performance on their behavioral intentions may have been stronger. This may be the case for in-service teachers. The in-service teachers, rather than their pre-service counterparts, are more likely to have urgent demands for a technique such as the ARCS model to solve their on-going problems. Thus, their evaluational decisions would likely be either negative or positive, reflecting their subsequent actual behaviors regarding the uses of the skill. In contrast, for the pre-service teachers, who were still outside of everyday teaching, all they could do was guess at future utility. The BID method may be better used in situations where an administration of the BID scale is followed by immediate actions rather than describing actions in distant future.

Looking at the alternative to the hypothesized path model, some arguments for refining the model seem to be worth mentioning here. The effects of relevance groups were found only on the pre-instructional motivation. It can be temporally Proposed that the direct effects of relevance manipulation may be limited to the beginning of an instructional activity. This would mean possible exclusion of the direct effects of the relevance manipulation on the posttest performance and post-instructional attitudes as Figure 11 suggests. The relevance manipulation may still have an effect on cognitive performance and the end-of-lesson attitudes, but it may be only indirect through the learner motivation. This is consistent with Keller's (1983b) position that the effects of perceived relevance and perceived confidence on performance are only indirect through motivation as measured by the amount of effort.

The other causal flow of interest stemmed from the academic self-concept. The academic self-concept has been claimed to be the most powerful predictor of cognitive performance among the affective entry Characteristics. This notion was supported in this study in that the ASCS was the only reliable predictor when the posttest performance was regressed. It was, however, found that the academic self-concept was not a reliable predictor for the pre-instruction motivation as measured by the CM scale.

It is possible that the academic self-concept, which presumably represents confidence or expectancy aspect of motivation, may not have a direct impact until experience with the new skill has been well underway. At the time of the CM measurement, the participants had read only an introductory description of the new skill. The solo source of the motivation at that point may have been how attractive the new learning task was in terms of perceived relevance. Thus, it is possible that the effect of confidence aspect of motivation does not become apparent until the learning with the new skill has been sufficiently experienced. In the case this position was taken, the direct effect of the academic self-concept on the attitude toward learning the new skill would be deleted from the path model.

In sum, the results regarding the causal flows are, at this point, inconclusive. Careful consideration should be given either to reject or accept the hypothesized model after additional empirical investigation. Although the alternative model could be identified only under a more lax statistical criterion, several modifications for the current causal flows are temporally Suggested with theoretical considerations.

Limitations of the study and suggestions for Future Research

Conclusions drawn from this study are limited to the individual relationships between the pairs of variables in the model, because the hypothesized causal model as a whole was not confirmed. Some interesting results were, however, found as to whether the hypothesized individual relationships may exist. Although it was not as strong as anticipated, the experimental manipulation did have a significant effect on the attitude toward learning the skill. In order to further examine the causal relationships among the predictor variables included in this study, as well as other related variables, more research studies are necessary.

It is suggested for future research that the current path model be tested as it now exists, by re-defining the differences between the two versions of the relevance manipulation. As discussed earlier in this section, the magnitude of the effects that the experimental manipulation has determines the causal flows in the path model to a high degree. Before the model is discarded, the experimental manipulation should be altered so that the relevant treatment can be perceived as something positive, and that the irrelevant treatment can be perceived as something negative. When such a difference is observed and the current model fails to be confirmed, then modifications of the model may be explored, taking the suggested refinement into account (note the previous discussion under the path model in this chapter).

In order to strengthen the manipulation in the study, replication of the present study with different target audiences is suggested. Ross (1983) replicated his study of adapting contexts of statistics so that his treatments could be counterbalanced. Employing nursing and education versions, Ross used teacher education students in the first study, then he used nursing students in his second study when he found opposite results. The same technique can be employed to this study if both Business and Education versions are tested using business major students in the subsequent study. Because the view of business students toward education version may be different from that of teacher education students toward business version, different attitudes may be formed, which are likely to result in a different flow of effects.

Another possible target audience is in-service, instead of pre-service, teachers. As discussed earlier in this section, in-service teachers are more likely to have strong attitudes toward a new technique or model than pre-service teachers, since their judgement are based on their own experiences in educational settings. The in-service teachers probably have a stronger identity as teachers than the pre-service counterparts, which may influence the acceptability of business oriented human models. A stronger difference might be expected between the two versions, leading to the effects hypothesized in the model.

Another modification for a future study is the content of the learning task. Any model dealing with motivational problems may be perceived to be useful by the pre-service teachers, because of their anticipation of motivational problems in school classrooms. Taking Ross' (Ross & Morrison, 1987) comment into account, the hypothesized path model may be re-tested with a less salient subject matter. If the learners have more difficulty relating the learning task to their interest or prior knowledge, the relevance manipulation may have a stronger effect.

It may be beneficial to break down the relevance manipulation in order to seek a way to make the difference more powerful. In this study, relevance manipulation was combined with the use of human models to create the largest possible difference between the two levels, based on the assumption that the human models in the irrelevant context would avert participants' interests to the material. The study Was further designed to determine which part of the relevance manipulation (either the introduction, the courseware, or both) had an effect on the posttest performance and post-instructional attitudes. Since this study Showed that only the introduction, which contained the human modeling technique, had an effect on the pre-instructional motivation, the effects of the introduction may be explored further. One possibility is a 2 x 2 design with the versions (relevant vs. irrelevant) of the material as one factor and the introduction (presence vs. absence, or human models vs. no human models) as the other factor.

Using the same target audience, it may be interesting to examine the effects of the irrelevant version without the human modeling technique in the introduction, or without the introduction at all. In such a case, the irrelevant version would be less likely to increase the credibility of the new skill, Which seemed to be the problem in the present study. It should be noted, however, that the counterbalancing technique, using business students as well as education students, cannot be employed if the human modeling technique, or the

introduction itself, is excluded from one version. The difference of the study time would also be a confounding factor in such design. Nonetheless, altering the relevance manipulation is needed, in one way or another, to test the adequacy of the hypothesized path model.

The measurement of attitudes has been the area lacking adequate development of research methodology and operationalization. The findings of this study are as Valid as the measurement instruments employed in this study. Based on Gagne's (1985) operational definition, personal choices of action, as represented by the CM and BID scales, were used to measure the attitudes toward the learning and practical application of the ARCS model in this study. Further, feelings toward the ARCS model, as expressed by the SDS scale, was employed as a supplement to the behavioral indications of the attitudes. Although the attitude scales were carefully created based on the currently available resources, and although the reliability coefficients were high, the attitude scores may have not represented the internal status of attitudes adequately.

Although it was confirmed that the three attitude measures (i.e., the CM scale, BID, and SDS) were highly correlated to each other, it can be speculated that the SDS may represent somewhat different aspects of an attitude From either the CM or BID, because each was related differently to other variables. For example, the posttest performance explained a moderate portion of the shift between the pre and post SDS measures, whereas such an effect was not found on the shift of the attitudes as measured by the CM and the BID scales. Further research is called for in order to examine the validity issue of each of the attitude instruments as it is related to the operational definition of an attitude (e.g., Gagne, 1985). The validity of the BID scale, when employed outside of the context of actual behaviors, also remains to be an issue for further investigation.

An additional limitation may be the nature of the skills posttest. The original format required the student to classify the statement given in to one of the four categories of the ARCS model. Because it is possible, out of context, that a particular statement may be correctly classified into more than one category, a forced choice test (yes or no) was developed where there would be only one correct answer. However, in doing this, it is possible that categorizations may have been made too obvious, and that student may have performed as well regardless of the instruction. This possibility should certainly be investigated if further research is done with these materials.

Instructional Implications of the Study

Although this study failed to confirm the hypothesized path model that describes how the attitudes are formed in relation to the learning of an intellectual skill, several findings may be of interest for instructional designers. The findings include (1) the effects of the human modeling technique, (2) roles of the entry affective characteristics in learning, and (3) importance of motivational properties of the instructional material.

First, the human modeling technique was found to be effective in the introduction of the new skill. The human modeling was employed in the form of success stories, using concrete names in a context relevant to the learners' career orientation. The success stories included positive consequences of the skill's application (i.e., vicarious reinforcement, Bandura, 1977). Although the introduction consisted only of two pages of text, it was found to be effective in creating a strong commitment for further leaning. Therefore, an effective instructional strategy may be to include a brief example of a successful application of the to-be-learned skill at the beginning of an instructional activity. This may help make the instruction more relevant.

Second, the affective entry characteristics (Bloom, 1976) played an important role in cognitive learning. The academic self-concept was found to be related to the posttest performance. The more confident a learner was about him or herself, the more likely he or she performed better on the posttest. On the other hand, the academic self-concept did not affect the pre-instructional motivation, probably because the introduced model was new to the learners. Although the self-concept itself was likely to be beyond an instructional designer's control, it may affect the learning substantially. Therefore, it is recommended to take the affective entry characteristics of the target audience into account when one designs an instructional activity. The extent and nature of past experiences related to the target task may be the determining factors of the affective entry characteristics, which includes the confidence aspect of learner motivation.

Finally, the use of the Instructional Curriculum Maps (ICMs, Briggs & Wager, 1981) was an effective way to structure the hypothesized path diagram, which presumably represents effective flow of instructional activities. The ICMs can be employed in finding a way that the affective components of a lesson influence the target

objective of the lesson, when it belongs to the intellectual skill domain. It is recommended the ICMs and the notion of interdomain interaction design in general be applied in designing various instructional activities.

An equally useful tool was the notion of motivational design of instruction (Keller, 1983b) and the ARCS strategies as applied to CAI courseware design (Keller & Suzuki, in press). The extent to which motivational enhancements are included in a instructional material should be based on the analysis of both the learners and the learning task. A systematic process should be followed making the instruction motivational at the optimal level. It is especially necessary to address both expectancy (Or confidence) and value (or relevance) aspects of motivation. Without increasing either of these two factors, motivation may not be enhanced.

It does not seem to be an overgeneralization to say that the affective learning (i.e., motivation and attitudes, however defined) influenced cognitive learning. The cognitive learning also influenced the affective learning. It is the researcher's hope that the important roles that interdomain interactions play be recognized by instructional designers and be planned for in instruction. It is also evident that more research is still called for in this area.



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[↑](#) Appendices

[↑](#) Vita

