

A DESCRIPTION AND CRITIQUE OF DAVID  
P. AUSUBEL'S MODEL OF LEARNING

by

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A DESCRIPTION AND CRITIQUE OF DAVID

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### ABSTRACT

This thesis describes and criticizes Ausubel's controversial assimilation theory of cognitive learning. Conflicting claims have been made about the explanatory value of Ausubel's theory and about the facilitative effects of related pedagogic techniques. Critics claim that Ausubel's pedagogic technique, the advance organizer, cannot be designed and implemented with consistency. The resulting inconsistency in empirical support for advance organizers renders assimilation theory an inadequate explanation of cognitive events.

Supporters claim that inappropriately designed advance organizers result from researchers' inadequate understanding of assimilation theory and that properly designed organizers have facilitative effects on learning. Thus the debate concerns logical and empirical aspects of Ausubel's theory.

A description and critique of assimilation theory is impeded by Ausubel's style of writing. His use of many synonyms for theoretical terms conceals the inadequacies of assimilation theory. Ausubel's style also obscures distinctions that should be made between assumptions about learning, preconditions for learning, a theory of learning, and techniques designed to facilitate learning. This thesis makes categorical distinctions between components of Ausubel's theory in order to better describe it and to isolate assimilation theory from the other components. Articulating

distinct categories also allows just one term to be used for each construct of assimilation theory.

A simplified theory is presented and assessed in two ways. The simplified theory is examined for consistency of application of theoretical terms across four modes of cognitive processing described by Ausubel. This is followed by a search for potentially operable theoretical variables.

This examination of assimilation theory shows that Ausubel describes only one mode of information processing that conforms to his basic assumptions about learning. The other modes are inadequately developed, demonstrating that much of assimilation theory conflicts with Ausubel's fundamental assumptions about learning. Further, empirical testing of assimilation theory requires that threshold values be established for various stages of information processing. Finally, research using advance organizers does not test assimilation theory. Rather, organizers create the cognitive structure believed to facilitate retention and transfer of knowledge.

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## CHAPTER 1

### Controversial Issues in Ausubel's Model of Learning

#### Introduction

A cognitive approach to the study of learning from instruction involves understanding interactions between the learner's cognitive processes and instructional treatments and materials. Developments in both theory and research focus on the cognitive processes of acquisition, retention, retrieval, and transfer of new learning, areas of fundamental importance to school learning. One primary concern of cognitive learning theory is to describe and explain how information becomes meaningful and memorable for the learner.

David P. Ausubel (1960; 1963; 1968; Ausubel, Novak & Hanesian 1978) has developed a theory of meaningful verbal learning that purports to respond to these concerns. Ausubel's model appears to be a carefully constructed, logically coherent theory that describes cognitive processing of information. The model also prescribes specific ways to design instructional materials to strengthen the assimilative links between what the learner already knows and related material to be learned. Implementation of these specifically designed instructional materials will presumably prolong the retention period and enhance the learner's ability to retrieve new material that has been learned.



Despite the seeming promise of the model it is decidedly controversial, having been the subject of much debate in the literature. The controversy centres on a number of issues that pertain to both the theoretical and empirical aspects of Ausubel's work. First, there is confusion about Ausubel's theory of meaningful verbal learning (Anderson, Spiro, & Anderson, 1978; Ausubel, 1978; Ausubel, 1980). Second, the way in which the theory articulates appropriate design of instructional materials, notably advance organizers, is unclear (Barnes & Clawson, 1975; Hartley & Davies, 1976; Luiten, Ames, & Ackerson, 1980). Finally, confusing the logic of theory construction with the results of research when judging the predictive power of the theory appears to have led some authors to regard Ausubel's theory as a poorly constructed explanatory model of human learning (Anderson, Spiro, & Anderson, 1978), while others regard it as logically inviolate (Lawton & Wanska, 1977) and thus not amenable to empirical verification.

In investigations of Ausubel's theory, the most frequently cited problem is the difficulty of appropriately designing advance organizers. Consequently, research results concerning the facilitative effects of advance organizers on learning have been equivocal (Barnes & Clawson, 1975; Hartley & Davies, 1976; Luiten, Ames, & Ackerson, 1980). Much attention has been devoted to discussing the various ways in which the design of advance organizers can be improved (see for example Lawton & Wanska, 1977, pp. 241-243). Research testing

Ausubel's theory has been primarily concerned with demonstrating the facilitative effects of advance organizers on learning. Thus it appears that research on advance organizers, one of Ausubel's pedagogic techniques, is generally accepted as one means of testing Ausubel's meaningful verbal learning theory.

Rather than seek to improve on what appears to be well-covered ground concerning research on advance organizers, this thesis will investigate the possibility of finding other directions for research testing of the explanatory power of Ausubel's assimilation theory. This will involve first clarifying the controversial issues pertaining to the theory as such, and research on Ausubel's theory. Second, it entails describing and analyzing Ausubel's theoretical variables in order to discern whether the source of the controversy lies in the assimilation theory of meaningful verbal learning rather than in the design of advance organizers.

### Issues

Reexamination of the literature on the facilitative effects of advance organizers has not resolved the controversies surrounding Ausubel's descriptions of the most effective and efficient means to enhance school learning. It has however, sharpened the issues involved. An important first task then is to clarify and compare controversial claims made about Ausubel's theory and about advance organizers.

A survey of review articles reveals much diversity among researchers about the meaning of theoretical claims made by Ausubel. As a result, the operationalization of various theoretical variables and interpretations of research results have been problematic. For example, Barnes and Clawson (1975) analyzed 32 studies in terms of their empirical support for hypotheses based on Ausubel's theory, and found 12 that claimed advance organizers facilitated learning and 20 that did not. A second part of their review organized the 32 studies according to various descriptions, such as length of study, subject matter, grade level, abilities of students, cognitive levels of learning tasks, and type of advance organizer employed. A category by category analysis resulted in the claim that "no clear patterns emerged regarding the facilitative effect of advance organizers" (p. 561). They further concluded "that advance organizers, as presently constructed, generally do not facilitate learning" (p. 652), and, "Ausubel has not operationally defined the advance organizer" (p. 652).

Hartley and Davies (1976) compared research findings on four preinstructional strategies: pretests, behavioral objectives, overviews, and advance organizers. They concluded that advance organizers appear, along with behavioral objectives and overviews, to provide some advantages for the learner but that it is not possible to specify them with any precision, nor is it clear that claims about such advantages

are not confounded by methodological flaws in the design of the studies.

Hartley and Davies found that in many studies using undergraduates as subjects, advance organizers appeared generally facilitative. In other studies, above average school children appeared to benefit as well. In still other studies, advance organizers were not found to facilitate learning where the subjects were high and low ability airmen, some undergraduates, and educable mentally retarded adolescents. However, it also appeared that children with poor verbal and analytical skills benefitted from the use of some types of organizers. Finally, the use of organizers presented after instruction has been found to be facilitative in some cases but not in others. It is not surprising that Hartley and Davies concluded that "at the present time, most of the research seems confused" (p. 256). They further stated that "despite a seemingly sound theoretical base, it is now recognized that there is currently no acceptable way of generating or recognizing advance organizers" (p. 256).

Lawton and Wanska (1977) criticized the review by Barnes and Clawson (1975) for both the theoretical and empirical perspectives taken by them. They claimed that Barnes and Clawson's presentation of Ausubel's theoretical description of meaningful learning was confused about the purpose of an advance organizer. According to Lawton and Wanska, the organizer does not, as Barnes and Clawson believe, relate

potentially meaningful materials to be learned to existing cognitive structure. Rather, "its function...is to induce, through a particular form of learning, organizing and explanatory concepts, propositions and principles" (p. 235). During the preliminary learning process, the concepts induced by the advance organizer become a part of cognitive structure.

Lawton and Wanska further pointed out that Barnes and Clawson's isolation of selected variables from the reviewed studies was an inadequate way of comparing the studies because many other variables, not specifically comparable, were grouped together (p. 236). Also, their mode of presenting the studies tended to underscore some comparisons but obscure others, thus "stacking the evidence against the facilitative effects of advance organizers" (p. 237). Under these conditions, Lawton and Wanska concluded that it was doubtful that Barnes and Clawson could answer the question they posed as to whether advance organizers facilitate learning.

The remainder of Lawton and Wanska's review analyzed Ausubel's description of correlative subsumption learning to clarify basic assumptions regarding the function of advance organizers and subsequent implications for their design and use. Any further analysis of results from research, they claimed, should be modified in accordance with the theoretical specifications of advance organizer functions. Designing advance organizers further requires that they be constructed

to promote certain types of learning (representational, conceptual, propositional). Further, the interface between the function of the advance organizer and related instructional design needs to be developed. Finally, Lawton and Wanska provided a ten-step procedure for developing organizers which included suggestions for adequate measures of their facilitative effects.

Mayer (1979) discussed the inadequacies of Barnes and Clawson's review (1975) in terms of its poor presentation of Ausubel's theory, poor analysis of research results, and the failure of the studies reviewed to provide for adequate experimental control. He did not, however, attempt to present Ausubel's theoretical position as Lawton and Wanska had done. Mayer developed a number of theoretical postulates closely related to aspects of Ausubel's theory to predict and explain the effects of advance organizers on cognitive structure. Mayer then analyzed nine of his own studies, derived from his postulates, to show that the use of advance organizers, when appropriately designed and measured, generally facilitated learning.

Luiten, Ames, and Ackerson (1980) examined 135 advance organizer studies. They concluded that "the average advance organizer study shows a small, but facilitative effect on learning and retention" (p. 217). They further stated that the facilitative effects of advance organizers tend to increase over time, and that organizers are effective with

subjects of varied abilities but particularly those of high ability (p. 216).

The reviews and articles cited above present an array of claims, both theoretical and empirical, about the ability of advance organizers to facilitate the acquisition and retention of new learning, and the ability of Ausubel's theory to explain how learning takes place. A number of observations can be made about them.

Selective quoting. Examinations of Ausubel's theory have tended to be largely confined to selective quotes about only one aspect of learning described by his model, that of correlative subsumption. Other modes, notably derivative subsumption, superordinate learning, and combinatorial learning, have been ignored to the extent that subsumption itself is often used interchangeably with assimilation theory (see for example Lawton & Wanska, 1977).

Logic of theory construction and research. Lawton and Wanska (1977), citing Ausubel (1963, p. 76), claimed that "Ausubel's theory is inherently logical. Superordinate concepts always subsume related subordinate concepts. Therefore it is impossible to disprove the existence of the single crucial cognitive variable in the theory--that is, stable, clear, hierarchically organized subject matter knowledge."

The connection made by Lawton and Wanska between the impossibility of empirical verification of theoretical variables and the inherent logic of the theory is confused.

Logical construction of a theory is judged by a different set of criteria than those used in empirical verification of given hypotheses derived from theoretical postulates (Dubin, 1978).

Lawton and Wanska have not distinguished between theories, or more accurately, propositions of theories, and the hypotheses or operational analogs that can be generated from them (Dubin, 1978). Validation of a theory involves two kinds of proof: empirical and logical (Dubin, 1978; McGuigan, 1968). Research is undertaken to confirm or disconfirm hypotheses, resulting in subsequent modification of a theoretical model to enhance its ability to explain accurately empirical events, real (directly observable) and inferred. The validity of a theoretical proposition, on the other hand, will depend on its logical relationship to other theoretical propositions contained in the model. All propositions constituting the theory and taken together must exhibit logical fit in an interlocking network.

Further, knowledge gained by empirical tests "is limited only to the fact...that the model does link in some useful way with an empirical domain" (Dubin, 1978, p. 230). Empirical disconfirmation of single hypotheses generated from theoretical postulates would not necessarily invalidate the entire theory.

Finally, if the logical relationships of a theory are inadequately developed, or are misunderstood, the probability



of generating inappropriate operational analogs of elements in the theory is increased. Thus, evaluating a theoretical model in terms of the logic of its construction is not the same thing as empirically testing its predictive power in the real world.

Selective applications of theoretical terms. The tendency to discredit Ausubel's theoretical propositions by selective reference to unsupportive research findings is often apparent in the literature. For example, because Ausubel states that advance organizers are only potentially subsumable under various conditions, Lawton and Wanska (1977) claim that research results would not necessarily disprove their efficacy (p. 240). Anderson, Spiro, and Anderson (1978) refer to advance organizers as "a few abstractly worded sentences" about which unsupportive research results render "the theoretical justification for the advance organizer...quite flimsy" (p. 439). Further, West and Fensham (1974) point out that it cannot be assumed that meaningful learning only follows presentation of advance organizers, and that learners may not use those subsumers available to them. These comments refer to the idiosyncracies of particular learners and Ausubel (theoretically) accounts for such situations when he discusses the phenomenological aspect of the emergence of new meanings. It is doubtful that he intended the concept of phenomenological meaning be used to disclaim research findings. It is more likely meant to explain individual variations in the

quality and amount of material acquired and retained over time (Ausubel, Novak, & Hanesian, 1978, p. 49).

Classroom implementation. Despite these controversies some curriculum specialists and instructional designers advocate using Ausubel's model for classroom instruction (Eggen, Kauchak, & Harder, 1979; Joyce & Weil, 1980). Most claims made for the model in terms of facilitating cognitive assimilation and hierarchical storage of knowledge currently are questionable, and it is not known with certainty that advance organizers facilitate learning. Thus, while the model is potentially applicable to classroom instruction, its implementation requires a great deal of careful planning (see for example, Joyce & Weil 1980). The amount of work required may not necessarily be rewarded by the actual facilitation of new learning.

In sum, research on Ausubel's work has resulted mostly in arguments by his readers and by researchers testing the facilitative effects of advance organizers. There is general agreement among his critics that the theoretical variables pertaining to advance organizers are difficult, if not impossible to operationalize with consistency. Thus, no claims can be made with respect to their facilitating effects on learning and the theory itself appears suspect.

Ausubel's supporters contend that most researchers have not understood the variables well enough to operationalize them appropriately, and for this reason, the efficacy of these variables has not been demonstrated. It also has been

claimed that research has not found facilitative effects of advance organizers because of the idiosyncracies of particular learners, and further, that the inherent logic of the theory renders it impossible to disprove in any case.

If Ausubel's model can neither be operationalized nor empirically validated, nor inferences made from research findings on learning outcomes, then clearly the model is little more than a metaphorical description of learning.

Further, theoretical discussions of Ausubel's work generally have been confined to the notion of correlative subsumption, and it is correlative subsumption that typically has been used to describe cognitive processing. Research derived from Ausubel's work almost entirely has attempted to demonstrate the efficacy of advance organizers which typically are designed in accordance with the premises of correlative subsumption. As such, organizers have been regarded as providing the only empirical means of investigating the explanatory value of Ausubel's entire model.

#### Purpose

The claims and counterclaims made by Ausubel's critics and his supporters appear to have resulted in an impasse that has not yet been resolved by continued research on advance organizers. Therefore, the purpose of this thesis is to explore other possibilities for research on assimilation theory. This will involve a number of related tasks.

The first task is to describe Ausubel's model. A model that purports to explain particular events should contain some basic assumptions about the nature of the phenomena in question, and also should clarify the conditions under which the phenomena are most likely to occur. The actual description of particular events constitutes the theoretical component of the model, and means of implementing the phenomena in specified settings is a function of the prescriptive component of the model. Thus Ausubel's work will not be considered here solely as a theory of meaningful verbal learning. It will be described as a four-component model of human learning that consists of assumptions about the nature of human learning, specified antecedent conditions that facilitate the occurrence of meaningful learning, an assimilation theory about the cognitive processing of information, and an instructional technology developed to facilitate meaningful learning in the classroom setting.

Describing the various components of Ausubel's model of learning will allow precise specification of those theoretical terms and related variables of which assimilation theory is composed. From this, a critical analysis of assimilation theory, unencumbered by possible confusion with other components of the model, can be undertaken. Therefore, a second task will be to examine Ausubel's definitions of those theoretical terms and related variables that constitute the theory. Concomitant with this is the necessity for critically examining the interactions among variables of assimilation in

the theory. This should identify any logical inconsistencies that may exist in the theory, and identify those theoretical variables that may be defined inadequately. Suggestions for modification of the theory and possibilities for research can then follow.

## CHAPTER 2

### A Description of the Components of Ausubel's Model of Learning

#### Introduction

The task of analyzing Ausubel's approach to meaningful learning requires that some decisions be made at the outset. First, because of the similarities of his three major works on educational psychology (Ausubel, 1963; 1968; Ausubel, Novak & Hanesian, 1978), the following discussion is based on the 1978 text unless otherwise indicated. All parenthetical references to page numbers that do not have indications of authorship refer to Ausubel, Novak, and Hanesian (1978).

In addition to his descriptions of meaningful learning, Ausubel analyses many aspects of child growth and development that influence classroom learning. These include stages of cognitive development (developmental readiness), subject-matter readiness, intellectual ability, motivation, attitude and personality factors, group and social factors, pedagogic techniques, and teacher characteristics that affect classroom performance (pp. 29-30). Thus, a second problem encountered when attempting to describe Ausubel's approach to learning is one of focus.

Fortunately Ausubel provides an appropriate focus in his descriptions of concept acquisition. According to Ausubel,

there are two processes involved in concept acquisition: concept formation and concept assimilation. Formation of concepts occurs primarily during the preschool years (p. 57). Concept assimilation is the dominant form of school learning in older children and adults (pp. 92-3; p. 109; p. 127). The focus of Ausubel's work is on cognitive learning in school settings. This is the case notwithstanding the recognition of important social and affective factors in the classroom setting. According to Ausubel

although we recognize the importance of emotional or affective experience...the predominant task of school learning to which the book is addressed is the acquisition of knowledge....Our focus has been to elucidate processes involved in the acquisition of knowledge or cognitive learning. (p. 159)

and:

in older children and adults, very few new concepts are learned by the process of concept formation. Much of this book is therefore devoted to discussion of the processes and conditions that facilitate concept assimilation. (p. 57)

Ausubel also asserts (p. 115; p. 118) that most school learning is typified by verbal reception learning, and that methods of expository verbal instruction used to facilitate reception learning have fallen into disfavour due to "the absence of an appropriate theory of meaningful learning" (p. 118). He is therefore concerned with developing a theory of meaningful verbal reception learning and related pedagogic techniques that will facilitate classroom learning.

Thus the description of Ausubel's model presented here is not directly concerned with the social, affective, motiva-

tional, or cognitive developmental aspects of his approach to learning. Rather, the following discussion focuses on the two aspects of Ausubel's work that he has identified as most important. These are describing those cognitive factors crucial to the acquisition, assimilation, and retention of new learning, and describing appropriate pedagogic techniques that will facilitate meaningful verbal reception learning in the classroom setting.

Finally, a description of Ausubel's model is encumbered at the outset by Ausubel's adherence to his criterion for instructional design called substantive relatedness. The notion of substantive relatedness states (p. 44) that "an ideationally equivalent symbol or group of symbols could be related to cognitive structure without any resulting change in meaning". According to Ausubel, many synonyms for a given term should be employed in presenting a body of information because this facilitates acquisition and retention of the substantive information rather than the more difficult to retain detailed aspects of a body of information (p. 44). Thus Ausubel's different theoretical terms may have only one meaning. Therefore, a preliminary task to describing the model is to identify those groups of terms referring to a single meaning, and to select one term that is adequate to convey the intended meaning. This will simplify the description of the five components of the model and variables associated with the assimilation theory of meaningful learning.



The various synonyms employed by Ausubel to represent a theoretical meaning and the terms chosen to represent each set of synonyms in this thesis are detailed in Appendix One.

For the purposes of this thesis there are only two theoretical terms that need be employed when discussing the contents of cognitive structure. First, the term anchoring concept(s) is adequate to refer to one or more specific concepts of a given discipline present within cognitive structure. Second, the term general background information designates cognitive content of a subject-matter area that is relevant, but not specific, to new material to be learned.

The variables used to describe the state of anchoring concepts or general background information within cognitive structure are referred to as the cognitive structure variables. These are availability of anchoring concepts or general background information, their clarity and stability within cognitive structure, and their relevance to, and discriminability from concepts in new material to be learned. Ausubel's instructional technology is specifically designed to strengthen anchoring concepts and general background information for a particular subject-matter discipline by enhancing this information in cognitive structure through the learner's interaction with pedagogic techniques. New material refers to appropriately organized textual material not yet acquired, and new meanings refer to recently acquired material. Ausubel sometimes refers to new material to be learned as "new subsuming

concepts and principles to be learned" (p. 194). It is confusing to refer to new material as containing subsuming concepts and principles because in this case, these are subsumers only in that they have the potential to become subsumers following acquisition.

The term new meanings does not refer to recently acquired new material that has not yet been assimilated (p. 130). Rather, new meanings are concepts in new material that have been subsumed and modified by interacting with relevant anchoring concepts. As a consequence, they exhibit modified meanings.

When describing how new meanings are acquired, Ausubel most frequently uses the terms anchoring, subsuming, relating, and assimilating. As used here anchoring will denote the function of specific concepts in cognitive structure. Anchoring concepts subsume related concepts in new material just learned. In order to avoid confusing the assimilation process with assimilation theory, subsumption or subsuming will denote the process whereby an anchoring concept assimilates related new learning. Thus the term subsumption will refer to the act of one thing subsuming or being subsumed by another (p. 58). The cognitive act of relating concepts in new material to relevant anchoring concepts in cognitive structure is called subsumption. It is distinct from the property that concepts in new material exhibit called relatability. Relatability is used here in

the sense of a property, i.e., where concepts in new material are similar in content to anchoring concepts in cognitive structure. Thus, anchoring concepts are relevant to new material, and concepts in new material are relatable to anchoring concepts.

The various terms used to denote assimilation as acquisition and retention-reduction are also used by Ausubel to describe the phases of cognition. The term acquisition, and the term retention-reduction will be used here when referring to stages of acquiring, retaining, and storing meanings within cognitive structure. Acquisition and retention-reduction refer specifically to the subsumption of information from the point of initial acquisition to the subsequent meaningful forgetting that occurs over time. Retention refers to the learner's ability to sustain new meanings in memory. Reduction refers to the gradual subsumption of new meanings to relevant anchoring concepts with the result that what is retained over time is an increasingly less available new meaning. The term retention-reduction will be used here to refer to this two-fold process of remembering and forgetting.

The variables associated with the phases of acquisition and retention-reduction are progressive differentiation, integrative reconciliation, dissociability, and threshold of availability. These variables describe the effects subsumption has on concepts in new material just learned and their relevant anchoring concepts, in a given period of time.

Immediately after new material has been acquired there are presumably two distinct products: the new meanings resulting from the subsumption of concepts in new material just learned with relevant anchoring concepts, and, the anchoring concepts. After the retention-reduction phase, only the modified anchoring concepts would be available for retrieval. The variable associated with anchoring concepts, general background information, new meanings, concepts in new material to be learned, and modified anchoring concepts is inclusiveness. Inclusiveness refers to the number of criterial attributes of a given concept compared to other concepts, and/or to the level of generality and abstraction of concepts or general background information. Degree of inclusiveness of concepts in cognitive structure is determined by the particular mode of cognition involved (to be discussed presently) in the acquisition and retention-reduction of information.

The learner's ability to retrieve the products of subsumption is depicted in a variety of terms. This is evident when Ausubel defines dissociability strength as:

the extent to which an acquired meaning can be separated or retrieved from the anchoring idea(s) in relation to which it is learned and stored, that is, the extent to which it is retrievable or available as an identifiable ideational entity. (p. 626)

Thus dissociability, separation, availability, and retrieval are all used interchangeably and appear to refer to new meanings only, and not to the differentiated anchoring concepts

either during or after the retention-reduction phase. As used here, dissociability will refer exclusively to the retrieval of new meanings, and the term availability refers to anchoring concepts available in cognitive structure.

The prolific use of theoretical synonyms, partially illustrated by the above descriptions, represents Ausubel's way of employing his instructional criterion of substantive relatedness in presenting his model of learning. While having many synonymous referents for a single theoretical meaning may or may not facilitate a reader's understanding of Ausubel's work, it can be potentially confusing to a researcher who may wish to isolate certain variables for study. Thus the selection of single terms for particular meanings, and associated variables is a perhaps risky, but useful task if Ausubel's assimilation theory is to be potentially tested or testable.

Ausubel's model is presented here as composed of five related components: (a) basic assumptions of the model, (b) conditions antecedent to the occurrence of meaningful learning, (c) assimilation theory of meaningful verbal learning, (d) modes of cognitive processing, and (e), instructional technology associated with implementing meaningful learning in the classroom. This approach is taken for two reasons. First, distinguishing between the components of Ausubel's model will prove useful in making distinctions between research that tests the soundness of Ausubel's theory (descriptive research), and research that tests the utility of the pedagogic

techniques believed to facilitate classroom learning (prescriptive research). Second, because Ausubel has presented his model in accordance with one of his own principles of instructional design, namely substantive relatedness, it is difficult to grasp the separate aspects of it for purposes of discerning those variables that may be potentially operable for descriptive research. A description of the components of the model will facilitate identification and definition of these variables.

#### Ausubel's Model of Learning

Ausubel's application of the principle of substantive relatedness, used in a progressively differentiated format, has had the effect of obscuring the meanings of particular theoretical terms. The practice has also obscured the fact that Ausubel has constructed a well developed, highly consistent explanatory model of information processing in human learning in the correlative mode of cognition. Ausubel's assumptions about the nature of human learning as it pertains to correlative cognition are explicitly stated. However, his assumptions about the nature of human learning apply only in part to the superordinate and combinatorial modes of cognition. Further, the use of substantive relatedness obscures the fact that terms defined in correlative cognition are not readily transferable to these other modes. Therefore relationships between variables in superordinate and combinatorial cognition are poorly developed. This problem will be discussed in Chapter 3.

### Basic Assumptions Underlying Ausubel's Model of Learning

Ausubel, as previously discussed is almost exclusively concerned with concept assimilation, especially the assimilation of concepts in school learning. Ausubel assumes that concept formation is "characteristic of the preschool child's inductive and spontaneous (untutored) acquisition of generic ideas...from concrete-empirical experience" (p. 93). As concept formation does not characterize most school learning as defined by Ausubel it will not be discussed in the following.

Understanding Ausubel's explanation of meaningful verbal learning begins with his assumptions about the conceptual nature of human learning. Ausubel states (p. 88) that we "cannot escape the fact that we live in a world of concepts rather than in a world of objects, events, and situations". Direct contact with the environment is "experienced through a conceptual or categorical filter" (p. 88). Ausubel claims (p. 86) that "it is...self-evident...that human beings interpret 'raw' perceptual experience in terms of particular concepts in their cognitive structures". The essential nature of all human learning then, it is assumed, is concept learning.

Following from this, Ausubel claims that the concepts in cognitive structure not only filter, but also categorize related sensory data. He says:

by setting up equivalences, that is, by grouping related items of experience into categories defined by the criterial attributes of their members, concepts therefore standardize and simplify the environment and hence facilitate reception learning, problem solving, and communication. (p. 89)

Therefore, concepts within cognitive structure are generic in nature (p. 96), and constitute the framework for perceptual categorization of all incoming related data that follow. Thus, they "serve as anchoring foci for the assimilation and discovery of new knowledge" (p. 89). In this way, concepts in cognitive structure facilitate "the meaningful reception learning of propositions...and the generation of meaningful problem-solving propositions" (p. 86).

Concomitant with Ausubel's assertions about the conceptual nature of human learning are his assumptions that assimilated information is hierarchically organized in cognitive structure from the most to the least inclusive concepts (p. 190). Also, in the process of hierarchically ordering information, new learning becomes integrated with already established concepts available in cognitive structure (p. 124).

Put simply, Ausubel assumes that for meaningful verbal learning: (a) all learning is intrinsically conceptual (propositions consist of two or more concepts), (b) new learning involves concept formation and concept acquisition, (c) concepts in cognitive structure are generic in nature, (d) concepts in cognitive structure are hierarchically organized according to level of generality, inclusiveness, and abstraction, and (e) concepts in cognitive structure are used for assimilating, categorizing and organizing incoming related information. These assumptions constitute the basic beliefs underlying Ausubel's model of human learning.



### Antecedent Conditions to Meaningful Learning

The idea of meaningful learning is based on Ausubel's assumptions about the nature of concept learning. Meaningful learning refers to the process of acquisition, retention-reduction, and retrieval of meanings derived from the interaction of concepts in new material learned with relevant anchoring concepts already available in cognitive structure (p. 149).

Ausubel uses several terms to describe conditions necessary for maximizing the probability of meaningful learning, and minimizing the probability of rote learning. (Rote learning is defined as learning that occurs in the absence of logical meaning and/or a meaningful learning set [p. 116, p. 629]). The terms used to describe antecedent conditions that maximize the probability of meaningful learning are meaningful learning set, logical meaningfulness, potential meaningfulness, and psychological meaning.

The learner must possess a meaningful learning set or disposition "to relate a learning task nonarbitrarily and substantively to relevant aspects of his or her cognitive structure" (p. 628). The material to be learned must exhibit logical meaningfulness. That is, it is "a learning task that is sufficiently 'sensible', plausible, or nonrandom to be nonarbitrarily and substantively relatable to correspondingly relevant ideas that lie within the realm of human learning capability" (p. 627). The logical meaningfulness of new

learning is one of two conditions that enhances the potential meaningfulness of the learning task. The other condition requires that the learning task be "nonarbitrarily and substantively relatable to the learner's structure of knowledge" (p. 43). That is, the availability of relevant anchoring concepts in the learner's cognitive structure is a prerequisite to the acquisition and integration of new material and the subsequent generation of new meanings. The resulting new meanings are the products of the meaningful learning process for a particular learner. New meanings are referred to as psychological (phenomenological, idiosyncratic) meanings (p. 142). The notion of psychological meaning does not preclude the emergence of shared meanings within a culturally homogenous group, but does describe variability across learners.

There are several recurring terms in Ausubel's discussion of the meaningful learning process. These are nonarbitrariness, substantiveness and relatability. These variables are bases for some of the criteria to be applied in the design of instructional materials. Nonarbitrariness refers to the plausible and nonrandom properties of a learning task "that makes it relatable to human cognitive structure...on some 'sensible' basis" (p. 628). Nonarbitrariness then, is a synonym for logical meaningfulness. Ausubel applies the property of substantive relatedness liberally in his own writings, and some implications of this have been discussed

above. The relatability of new information to relevant anchoring concepts in cognitive structure, as already noted, refers to similarity of subject-matter content between them.

### The Assimilation Theory of Meaningful Learning

Meaningful learning of new information occurs when the learner is able to relate new material to relevant anchoring concepts. Assimilation theory describes the various phases of cognitive processing of this information, and describes the various forms of cognition in which different modes of information processing can occur. The three phases of cognitive processing are acquisition, retention-reduction and retrieval. The four modes of the subsumption process are correlative and derivative cognition, superordinate cognition and combinatorial cognition (pp. 58-60). The two types of learning with which Ausubel is concerned are concept and propositional learning (pp. 56-7). These are described in the following.

Ausubel asserts that the processing of new information involves only one cognitive process that is characterized by the temporal sequencing of the acquisition and retention-reduction of new meanings (pp. 116-17, p. 151). This process, where "new concept or propositional meanings come into being", will be described in order of the temporal sequence of events within cognitive structure. Conditions for retrieval will also be discussed, along with the overall importance of the cognitive structure variables.

Acquisition. During the acquisition phase, concepts in new material to be learned must be related to, or become juxtaposed with, existing relevant anchoring concepts or relevant general background information within cognitive structure. New content becomes linked to relevant anchoring concepts where it extends, modifies, or qualifies the anchoring concepts. In this way "new meanings are acquired by the interaction of new knowledge with previously learned concepts or propositions" (p. 127, emphasis in original).

The acquisition of concepts in new material is theorized to be facilitated by adhering to the antecedent conditions (see pg. 26 above) necessary for meaningful learning to occur.

Retention-reduction. To explain retention-reduction, Ausubel posits a principle of dissociative equilibrium. This describes meaningful forgetting in three stages of decreasing dissociability strength from maximal, to residual and finally zero levels.

Dissociability strength refers to "the extent to which an acquired meaning can be separated or retrieved from the anchoring idea(s) in relation to which it is learned and stored, that is, the extent to which it is retrievable or available as an identifiable ideational entity" (p. 626). In all modes of cognition, new meanings are distinct from relevant anchoring concepts immediately after learning. This is the point of maximal dissociability because new meanings evince the highest degree of dissociation or separation from

the existing relevant anchoring concepts to which they are becoming subsumed (p. 129). At this point, the learner recognizes that the new meanings are both distinct from, and have criterial attributes in common with the relevant anchoring concepts.

Over time, new meanings become further subsumed and less dissociable from relevant anchoring concepts until they are no longer retrievable. Then the newly learned meanings are said to have fallen below the learner's threshold of availability where they are no longer available for retrieval unless hypnosis or relearning are used (p. 133). This is the point of residual dissociability. Eventually it becomes no longer possible to retrieve the new meanings as separate items in any way. This is the point of zero dissociability. At this point, new meanings have become obliterated as distinct entities, having been completely subsumed or gradually reduced into relevant anchoring concepts (p. 116-117).

At the point of zero dissociability, anchoring concepts are considered as "normally more differentiated than... previously. Thus although 'meaningful forgetting' [of the new meaning] has occurred, there is a net gain in cognitive differentiation [of the anchoring concept] and an added potential for facilitation of learning for any new, relevant materials" (p. 138, emphasis in original). Further learning of other relevant material results in the progressive differentiation of cognitive structure.

Ausubel claims that "most learning, and all retention and organization, of subject-matter is hierarchical in nature, proceeding from the top downwards in terms of level of abstraction, generality, and inclusiveness" (p. 116). In this way, the learner's cognitive structure becomes progressively differentiated with respect to the subject-matter being meaningfully acquired and integrated with relevant prior learning (p. 124). This is underscored by a law of invariance implied by the reduction process. As Ausubel states (p. 134), "in the absence of intervening practice delayed retention cannot possibly surpass immediate retention". That is, there can be no later increase of dissociability strength without overlearning. If delayed retention appears to surpass immediate retention it is due to temporary fluctuations in the threshold of availability that may occur for various reasons (p. 130; p. 134; p. 141). Thus, the process of reduction of new meanings is unidirectional, linear (except for minor fluctuations), and, by definition, invariant.

Retrieval. Retrieval of previously acquired new meanings is dependent upon dissociability strength, that is, the degree to which dissociability of new meanings exceeds the learner's threshold of availability. The availability threshold is defined as "that critical level of the dissociability strength of a learned idea above which it is retrievable and below which it is not" (p. 630).

Dissociability strength is a function of the availability, relevance, stability and clarity of anchoring concepts in cognitive structure. According to Ausubel (p. 135), the more stable and clear the anchoring concepts in cognitive structure, the higher the degree of associated stability of new meanings. Dissociability strength is also dependent on the learner's ability to discriminate between the similar and different criterial attributes of the anchoring concepts and newly acquired meanings.

Cognitive structure variables. Availability, relevance, discriminability, and clarity and stability are the variables used by Ausubel to describe the state of cognitive structure with respect to a given discipline. These are the variables that "enhance or detract from the initial acquisition of new meanings", and, "continue to operate similarly in the retention period" (p. 117). Ausubel's instructional technology is specifically designed to influence the cognitive structure variables and will be discussed presently.

The intent of the foregoing discussion of assimilation theory was to provide a simplified description of the process component of cognition as envisaged by Ausubel. Ausubel further posits four structural components of the subsumption process when he describes modes of cognition in which acquisition and retention-reduction may occur. The four modes of cognition are the correlative, derivative, superordinate, and combinatorial.

### Modes of Cognition

Each of the modes of cognition exemplifies conceptual or propositional learning. In concept learning, "objects, events, situations or properties that possess common criterial attributes and are designated by some sign or symbol" (p. 56) are acquired by the learner. In propositional learning the task is to acquire

the meaning of a new composite idea in the sense that: (1) the proposition itself is generated by combining or relating to each other multiple individual words, each representing a unitary referent; and (2) the individual words are combined in such a way (usually in sentence form) that the resulting new idea is more than just the sum of the meanings of the component individual words. (p. 47)

Ausubel further states that:

These two types of meaningful learning (conceptual and propositional) are different. In the former instance the criterial attributes of a new concept are related to cognitive structure to yield a new generic but unitary meaning, whereas in the latter instance a new proposition (or composite idea) is related to cognitive structure to yield a new composite meaning. (p. 48, emphasis in original)

The correlative and derivative modes generally typify the acquisition of concepts and propositions. The superordinate mode typifies concept acquisition and concept formation. The combinatorial mode can typify either conceptual or propositional learning.

Correlative and derivative cognition. The correlative mode generally occurs when analysis and differentiation of subject-matter areas are required, and the type of learning involves learning new propositions or principles.



Correlative cognition occurs when a new, less inclusive concept becomes related and linked, during the acquisition phase, to an already existing more inclusive anchoring concept within cognitive structure. "For example, recognition that displaying the American flag is an act of patriotism would be a common example of correlative subsumption" (p. 59).

Early in the retention phase, the newly learned less inclusive new meaning is dissociable from the related anchoring concept. Gradually, the similarities and differences of related criterial attributes become less distinct until only a more differentiated anchoring concept can be retrieved by the learner. As the new meaning will have been obliterated as a distinct entity, a genuine loss of knowledge will occur. "Forgetting thus represents a progressive loss in the dissociability of newly assimilated ideas from the ideational matrix in which they are embedded and in relation to which their meaning emerges" (p. 131).

In derivative cognition, new meanings typically constitute specific examples of the already learned more inclusive related anchoring concepts. Thus the new meanings represent a further case or example of the anchoring concept. An example of derivative cognition "would be to recognize that scarlet, aqua, and lavender are names for colors, albeit less common than red, purple, or blue" (p. 58).

In this mode of cognition, the newly learned meaning is theorized to be obliterated during the process of rapid sub-

sumption into the anchoring concept. The criterial attributes of the anchoring concept remain largely unchanged. Thus any differentiation of the anchoring concept would be minimal. No real loss of knowledge will have occurred when the new meaning falls below the threshold of availability because the learner can easily reconstruct the newly learned meaning from the concept. The newly learned meaning is adequately represented by the anchoring concept (p. 136). Maximal to zero dissociability appears to be functionally irrelevant in this mode of cognition.

Superordinate cognition. The superordinate mode of cognition results in propositional learning but more commonly describes situations involving conceptual learning where the learner is required to generalize or synthesize, or where use of inductive reasoning is required (p. 59). Superordinate cognition occurs when new material to be learned is relatable to, but is more inclusive than (i.e., is superordinate to) existing anchoring concepts in cognitive structure. An example of superordinate cognition occurs "when children learn that the familiar concepts of carrots, peas, beans, beets, and spinach may all be subsumed under the new term 'vegetable'" (p. 59).

As the subordinate anchoring concept is more stable in cognitive structure than the newly learned superordinate meanings, it is the latter that tends to fall below the learner's threshold of availability and is subsumed to the

more stable, less inclusive anchoring concept during the retention-reduction phase (p. 132). As the less inclusive anchoring concepts are inadequate to represent the subsumed superordinate meanings, a genuine loss of knowledge will have occurred.

Combinatorial cognition. Combinatorial cognition occurs when new meanings closely resemble concepts or propositions in cognitive structure in both inclusiveness and specificity (p. 59). In this mode new meanings do not subsume relevant pre-existing general background information nor are the new meanings subsumable by general background information. In this case, new meanings are said to be "generally congruent" with the learner's cognitive structure as a whole. "Most of the new generalizations that students learn in science, mathematics, social studies, and the humanities are examples of combinatorial learnings, for example, relationships between mass and energy, heat and volume, genic structure and variability, demand and price" (p. 59, emphasis in original).

Because of the generally congruent nature of related cognitive content in combinatorial cognition, new meanings are less anchorable to previously learned relevant knowledge making it more difficult for the learner to subsume initially, and to retain information than is the case in either correlative or superordinate cognition (p. 59). Also, over time, new meanings are subsumed into more inclusive and generalized relevant background knowledge which cannot adequately represent

them, hence a genuine loss of knowledge will have occurred. In the combinatorial mode, either propositional or concept learning may take place. The various modes of cognition are illustrated by Ausubel in Table 2.2 (p. 68) of the 1978 edition text.

### Instructional Technology

According to Ausubel, meaningful forgetting, or memorial reduction, constitutes the greatest threat to the retention of school learning. Therefore, the purpose of the prescriptive instructional component of Ausubel's model is to prescribe ways in which instruction should be designed so that new material can be acquired readily and can be retained over the relatively long periods of time required in the classroom setting.

Ausubel posits several principles of instructional design that he believes enhance school learning. These are based on his assumptions about the acquisition of concepts and propositions, and on his belief that prolonging the point of maximal dissociability enhances the retention of newly acquired information. The purpose of the principles of instructional design is to influence maximally the learner's cognitive structure variables as they relate to a given subject-matter discipline. This is accomplished by using specific pedagogic techniques informed by Ausubel's instructional principles.

Ausubel's instructional prescriptions focus on the acquisition of appropriately designed materials. When new

meanings are learned through instruction designed to reflect Ausubel's prescriptions, a stable, clear, cohesive, and hierarchically organized cognitive structure is formed. The availability, discriminability, and clarity and stability of concepts in cognitive structure prior to instruction are claimed to be the greatest influence on the learner's ability to acquire new, related meanings, and are the most important influence on the extent of transfer to new learning.

Thus there are two components to Ausubel's instructional technology: the principles of instruction, and the specific pedagogic techniques derived from them. The principles of instruction prescribe means by which cognitive structure can be strengthened by the design of materials to be learned in accordance with the needs of the learners.

Thus far Ausubel has developed principles of instructional design and related pedagogic techniques appropriate for meaningful learning only in the correlative or derivative modes of cognition. An instructional technology for the superordinate and combinatorial modes of cognition has yet to be developed.

Principles of instructional design. The state of a learner's existing cognitive structure in a given subject area reflects the strength of all prior learning in that area. Thus, when designing current instruction that is to support subsequent learning, a crucial task is to devise means for enhancing the strength and clarity of material retained, in

order to maximize transferability of knowledge to new and related learning situations. This can be done by direct manipulation of the cognitive structure variables (p. 187). To this end, Ausubel employs three specific principles of instruction: progressive differentiation, integrative reconciliation, and consolidation.

The progressive differentiation of concepts in new learning material involves the hierarchical organization of concepts to be learned from the most inclusive, general, and abstract to those involving increasing specificity and detail. Thus, the most inclusive concepts first learned become progressively differentiated as the material is organized for learning. This descending order of inclusiveness is intended to provide the learner with anchoring concepts or 'ideational scaffolding' for the progressively more detailed material to follow. Arrangement in descending order of inclusiveness applies to material within a given unit as well as across related units.

Ausubel assumes that this order of presentation of material corresponds to the learner's natural inclination to organize spontaneously and store learned material in an hierarchical manner within cognitive structure. In terms of assimilation theory, this means that correlative cognition tends naturally to be easier than superordinate cognition or combinatorial cognition.

The threefold function of integrative reconciliation is to make explicit the relationships between concepts, to point out their similarities and differences, and to explain real or apparent inconsistencies in the material. In this way the inherent logic of the material is preserved, and it becomes free from ambiguity or confusion with new meanings learned previously. When concepts in new material are organized in accordance with the principle of integrative reconciliation, the learner's ability to discriminate and dissociate new learning from relevant prior learning is presumably maximized. Delay of the reduction of new meanings into related anchoring concepts is also hypothesized to be facilitated.

The function of consolidation is to ensure that each component in the learning hierarchy is thoroughly learned or mastered before the learner proceeds to the next component of the material. In this way the newly acquired meanings are strengthened in cognitive structure, thus facilitating transfer to new learning.

In sum, progressive differentiation refers to the hierarchical ordering of concepts in new material to be learned. Integrative reconciliation refers to preserving the internal logic of material to be learned. Consolidation refers to the degree of mastery of new material. In general, these principles prescribe dimensions in which cognitive structure variables are influenced by the appropriate design of instructional materials.

Pedagogic techniques. To facilitate the strengthening of cognitive structure in accordance with Ausubel's principles of instructional design, certain pedagogic techniques are required to design instruction and present material. Specific techniques advocated by Ausubel include the use of expository advance organizers to provide anchoring concepts for the learner where preassessment indicates need; the use of comparative advance organizers to structure hierarchical materials; the provision of appropriate sequential organization in the presentation of a body of knowledge; and the consolidation of newly learned materials. There are two primary tasks in fitting instruction to a learner's cognitive structure. The first is to assess the availability (presence or absence), and clarity and stability (strength or weakness) of relevant anchoring concepts within a learner's cognitive structure. The second is to identify the basic organizational concepts in the subject matter area under consideration by a task analysis. Following this, instructional materials should be designed to provide anchoring concepts where already existing anchoring concepts are too weak to be recognized as relevant by the learner (Ausubel does not provide criteria for distinguishing between a weak and a strong concept). Instructional materials should also provide anchoring concepts where relevant general background information is present within cognitive structure but no particular concepts are available to serve as anchoring concepts. In these instances, instructional



materials should provide potential anchoring concepts drawn from basic organizational concepts identified by a task analysis. These should be presented in familiar terms based on what the learner already knows, thus making them clear and recognizable as anchoring concepts for new learning. This is the function of the expository organizer. It is a pedagogic aid that establishes more general and abstract anchoring concepts prior to the presentation of new or relatively unfamiliar learning materials (p. 170, 172).

Comparative organizers are used when the material to be learned is already familiar to the learner. That is, the learner already possesses available anchoring concepts. The functions of comparative organizers are to facilitate the integration of new concepts with similar anchoring concepts within cognitive structure, and to strengthen the discriminability between them. Since heightened discriminability presumably enhances dissociability, then each comparative organizer provides a clear and stable anchoring concept for the increasingly specific and more detailed concepts yet to be learned. Thus the explicit purpose of comparative organizers is to clarify the relationships between related concepts, making their similarities and differences salient. Both expository and comparative organizers are presented in advance of more detailed content and are more general, abstract, and inclusive than content that follows.

According to Ausubel, the use of organizers should be

restricted to material that is basically factual in nature as more abstract or ideational materials are already inclusive and would thus "contain their own built-in organizers - both for themselves and for related detailed items" (p. 172). That is, more abstract materials already provide their own hierarchical structure. Also organizers would serve no facilitative purpose in situations where consolidation of concepts had previously occurred, or where learning materials were already organized in descending order of inclusiveness of basic concepts.

Ensuring that meaningful learning will take place also requires that materials for learning which follow upon the establishment and/or strengthening of cognitive anchoring concepts be designed to parallel the presumed hierarchical organization of cognitive structure. As indicated above, Ausubel assumes that this type of hierarchical organization develops during the assimilative process. Hence, materials for learning must be designed hierarchically from the most to the least inclusive concepts. This would follow logically from the application of expository and comparative organizers in instructional design. A conceptual and task analysis of the subject matter to be learned then, besides making explicit the basic concepts of the discipline, would also allow for the arrangement of these concepts into sequentially organized learning hierarchies. Thus the general rule of progressive differentiation would apply both within and across units of the material. The importance of sequencing of instructional

materials is underscored by the transfer paradigm which states that understanding of newly acquired material is dependent upon, and usually presupposes, prior mastery of related learning (p. 195). In other words, each sequentially organized unit acts as an organizer for related units to follow, along with the comparative organizers contained within the units.

The progressive differentiation of hierarchies of concepts to be assimilated to cognitive structure requires that each step in the learning process be thoroughly mastered or consolidated before proceeding to the next step in the sequence (p. 197). Ausubel further states that "prior learnings are not transferable to new learning tasks until they are first overlearned." (p. 197). Overlearning involves repeated exposure to the material by providing many practice trials with feedback. The course of repetition and feedback provides clarification, correction, practice, and review of materials for the learner. According to Ausubel overlearning requires

an adequate number of adequately spaced repetitions and reviews, sufficient intratask repetitiveness prior to intra- and intertask diversification, and opportunity for differential practice of the more difficult components of a task (p. 197).

Through pedagogic techniques used in consolidation of concepts in new learning, the general rule of integrative reconciliation is applied. It should be noted that Ausubel's definition of overlearning differs from the accepted usage of the term. See Kreuger, (1929) for the more typical application of overlearning.

The purpose of applying these pedagogic techniques is to provide the learner with clear and stable anchoring concepts that are hierarchically organized within cognitive structure. A clear and stable cognitive structure presumably will facilitate transfer to subsequent new related material or to other different but related subject areas.

In sum, use of specified pedagogic techniques will parallel the learner's presumably spontaneous tendency toward hierarchical organization of material in cognitive structure. They also provide the means by which cognitive factors crucial to classroom learning are embedded within the instructional design and presentation of learning materials. Once assimilated, new meanings are believed to be more resistant to forgetting by the use of these techniques. The resulting enhanced dissociability prolongs the retention period and facilitates the strength of transfer to new learning.

Appropriately designed instructional materials presumably enhance the acquisition and retention of new learning both by paralleling the spontaneous assimilative cognitive processes as they are believed to occur, and by preventing or delaying the loss of knowledge which occurs during the retention-reduction phase of the subsumption process. In this way, the emergence of new meanings is believed to be facilitated.

Instructional technology provides directives for manipulating cognitive factors specific to correlative and derivative modes of cognition, and the acquisition and retention-

reduction phases of subsumption. Thus, precepts derived for the appropriate design and use of instructional materials and pedagogic techniques constitute the prescriptive component of Ausubel's model of learning.

### Summary

Ausubel's model of learning has been presented as consisting of five components: (a) the basic assumptions, (b) the antecedent conditions to meaningful learning, (c) assimilation theory, (d) the modes of cognitive processing, (e) an instructional technology developed to facilitate meaningful learning. Ausubel assumes that new learning involves the acquisition of concepts. Concepts present in cognitive structure are generic in nature and are hierarchically organized according to level of generality, inclusiveness, and abstraction. They serve to assimilate, categorize, and organize incoming related information.

On the basis of these assumptions about the nature of human learning Ausubel has devised a number of preconditions for a learning situation that are believed to make the learning experience more meaningful to the learner. Learners must be disposed toward acquiring new information relatable to knowledge they already possess. The new material to be learned must be plausible or make sense to learners, and must be clearly relatable to previous learning. These two conditions enhance the potential for meaningful learning to occur. Once new information has been acquired and processed by learners,

new meaning emerges that reflects a synthesis of the criterial attributes of anchoring concepts and concepts from new material. The new meaning bears the unique stamp of a particular learner.

Assimilation theory describes the processing of acquired information within cognitive structure. Concepts from prior learning subsume the newly related concepts to produce the new meaning. Without consolidation, the learner's ability to dissociate the criterial attributes of new learning from related anchoring concepts is gradually lessened. At some point these attributes are no longer available for retrieval. What is retained is the anchoring concept that has become differentiated by the learner's integration of the criterial attributes of the anchoring concept with those of the related concepts from new learning. Thus a modified anchoring concept is formed to subsume further related learning.

The cognitive act of subsumption can occur within the correlative, derivative, superordinate or combinatorial modes of cognition. Which mode occurs depends upon the degree of inclusiveness of concepts in new learning with respect to related anchoring concepts. The consolidation of anchoring concepts or consolidation of concepts in new learning can also affect the particular mode of cognition involved.

Ausubel has developed a number of pedagogic techniques designed to enhance learning. Expository organizers provide the framework for new unfamiliar material. Comparative

organizers facilitate integration of concepts in new material with already established related anchoring concepts. Organizers are arranged sequentially in an hierarchical manner from the most to the least inclusive of new concepts to be learned. Acquisition and retention of new learning for the learner is consolidated in cognitive structure by practice, repetition, and feedback.

All pedagogic techniques developed thus far are designed in accordance with the principles of progressive differentiation and integrative reconciliation as applied to the correlative mode of cognition. These principles are believed to parallel the way in which human learning is assumed to occur spontaneously. The principle of consolidation refers to the overlearning of information that is necessary to delay for a time the inevitable memorial reduction process.

## CHAPTER 3

### A Critique of Ausubel's Assimilation Theory

#### Introduction

Assimilation theory is that component of Ausubel's model which purports to explain internal cognitive processing of new information. New information is processed with already established, relevant anchoring concepts during the acquisition and retention-reduction phases of subsumption. The phases of subsumption occur within various modes of cognition. Put simply, assimilation theory describes internal cognitive events that occur during the course of extended concept acquisition. As such, assimilation theory constitutes part of the descriptive component of Ausubel's model of learning.

As part of the descriptive component of the model, assimilation theory should conform to the assumptions Ausubel makes about the nature of learning. Thus the theoretical terms employed and the various modes of cognition to which the terms are applied become the means for translating Ausubel's assumptions about human learning into a theory about the occurrence of particular cognitive events.

The question remains then as to the extent to which Ausubel's theoretical variables are adequately developed. Adequately developed theoretical variables must meet three criteria. First they must be precisely defined. Second, the way in which



theoretical variables are described as interacting should conform to the assumptions underlying the theory as exemplified by Ausubel's descriptions of the various modes of cognition. Third, at least some of the variables must be translatable into operable terms. That is, some variables should be amenable to definition "by reference to an observable condition or set of conditions" (Neale & Liebert, 1973, p. 43). Assimilation theory will be examined with these criteria in mind. They will provide the framework for the critical assessment undertaken here of the various modes of cognitive processing.

An initial task is to examine Ausubel's definitions of subsumption, progressive differentiation, and integrative reconciliation. These are the variables that Ausubel posits to describe the processing and organizing of information within cognitive structure. A further task is to examine how subsumption, progressive differentiation, and integrative reconciliation apply to the various modes of cognition. Each mode of cognition represents a particular way to assimilate information. Therefore the definitions of subsumption, progressive differentiation, and integrative reconciliation should consistently apply to the correlative, derivative, superordinate, and combinatorial modes of cognition.

An examination of Ausubel's application of variables describing information processing and organization in cognitive structure will demonstrate that inconsistencies exist

in the application of these three fundamental variables to the various modes of cognition. These inconsistencies contradict Ausubel's basic assumptions about the assimilative and organizational nature of human learning. For example, the following analysis demonstrates that there are two and not four modes of cognition. Correlative and superordinate cognition involve the subsumption (integration and reorganization) of new meanings. Derivative and combinatorial learning involve extensions and combinations, but not modification, of newly acquired concepts. Further, it will be shown that Ausubel has artfully preserved the ascendancy of correlative over superordinate cognition. In doing so he has failed to develop aspects of superordinate cognition that bear a contradictory relationship to his assumption about the hierarchical organization of cognitive structure.

Examination and clarification of inconsistencies in Ausubel's descriptive theory allows for a much simpler presentation of assimilation theory that still conforms to the conditions antecedent to meaningful learning. A simplified assimilation theory will make the task of searching for potentially operable variables easier.

#### Definitions of Theoretical Terms

The following discussion, for the purpose of assessment of theoretical variables, will assume that the preconditions (as discussed in chapter 2, p. 21 ff.) necessary to facilitate meaningful learning have been met.

Subsumption. Ausubel's fundamental assumption inherent in the act of assimilation of information is that some information always subsumes (absorbs) this information. Both new and existing information become modified in the course of continuous processing. Continuous processing of information is referred to as progressive differentiation and integrative reconciliation. This subsumptive movement of information within cognitive structure constitutes the basic 'logic' of learning upon which assimilation theory has been constructed.

According to Ausubel, the cognitive act of subsumption can take place in three distinct ways. One, concepts in new learning are subsumed by related anchoring concepts. Two, concepts in new learning subsume related concepts from prior learning and three, existing anchoring concepts can subsume one another in cognitive structure in the course of new learning. Ausubel restricts the third application of subsumption to superordinate and combinatorial cognition. He states that

in superordinate or combinatorial learning... established ideas in cognitive structure may become recognized as related, in the course of new learning. Thus new information is acquired and existing elements of cognitive structure may take on new organization and hence new meaning. (p. 124, emphasis in original)

The implications of this particular form of subsumption will be considered for superordinate, combinatorial, and correlative cognition.

The need to discuss the implications of subsumption of already established concepts for the meaningful learning process becomes apparent when considering Ausubel's basic premise that "the stability of an idea in memory tends to increase with its level of generality and inclusiveness" (p. 131). This is particularly the case when considering the cognitive events associated with reduction in the superordinate mode in meaningful reception learning and in meaningful discovery learning (problem solving). Combinatorial cognition, as currently defined, also presents special problems for subsumption and will be discussed presently.

Progressive differentiation and integrative reconciliation.

The process of subsumption occurring one or more times is reflected in the definitions of progressive differentiation and integrative reconciliation. These two variables depict the assumed physiological basis of human learning. Ausubel states:

let us assume that the human nervous system as a data processing and storage mechanism is so constructed that both the acquisition of new knowledge and its organization in cognitive structure conform naturally to the principle of progressive differentiation" (p. 190)

Ausubel's definition of progressive differentiation states that:

most learning, and all retention and organization, of subject-matter is hierarchical in nature, proceeding from the top downwards in terms of level of abstraction, generality, and inclusiveness. (p. 116, emphasis added)

When the learner recognizes similarities and differences

between anchoring concepts and concepts in new material just learned and resolves any apparent contradictions then the integrative reconciliation of information within cognitive structure has taken place (p. 116, p. 627). Progressive differentiation and integrative reconciliation are described as corresponding to:

the natural sequence of acquiring cognitive awareness and sophistication when human beings are spontaneously exposed either to an entirely unfamiliar field of knowledge or to an unfamiliar branch of a familiar body of knowledge. [Progressive differentiation] also corresponds to the postulated way in which this knowledge is represented, organized, and stored in the human cognitive system. (p. 190)

The progressive differentiation of information results in its integrative reconciliation within cognitive structure, making integrative reconciliation a concomitant occurrence with progressive differentiation during the meaningful learning process (p. 125).

In brief, the term subsumption denotes the assumed cognitive act of assimilation. Subsumption occurring one or more times is believed to result in the progressive differentiation and integrative reconciliation of information in cognitive structure. This produces a hierarchy of information as it is stored in cognitive structure arranged from the most to the least inclusive anchoring concepts for all subject-matter learned (p. 116).

Each mode of cognition represents a particular form of subsumption. Therefore Ausubel's definitions of subsumption,

progressive differentiation, and integrative reconciliation should relate consistently to all four cognitive modes. An examination of correlative, derivative, superordinate, and combinatorial cognition will show the extent to which Ausubel has had difficulties transposing these theoretical terms across all four modes.

### Modes of Cognition

Ausubel's definitions of correlative, derivative, superordinate, and combinatorial modes of cognition are presented in this section. Following each definition is an analysis of the applications of subsumption, progressive differentiation and integrative reconciliation to the respective modes of cognition. The effect of consolidation on subsumption is discussed, as well as the effect of memorial reduction on new meanings in superordinate and combinatorial cognition.

Correlative cognition. In correlative cognition the subsumption of concepts in new material just learned results in "subordinate learning in which the new ideas in the learning task are extensions, modifications, or qualifications of an existing relevant idea in cognitive structure" (p. 626). The term 'subordinate' means that the new meanings are less inclusive than the relevant anchoring concepts which subsume them. Ausubel uses the terms 'subsumptive' and 'subordinate' interchangeably, and states that subsumptive or subordinate learning "includes derivative and correlative subsumption" (p. 630).

Ausubel's definitions of assimilation theory (p. 125), the explanatory value of assimilation theory (pp. 128-9), dissociability (pp. 129-30), the threshold of availability (p. 130), and progressive differentiation (pp. 124-5), restate in various forms the movement of information in cognitive structure as exemplified by the process of correlative cognition. The term progressive differentiation, as it is currently defined by Ausubel, describes correlative cognition.

Integrative reconciliation in correlative cognition both enhances the discriminability of new meanings from the more inclusive anchoring concepts and promotes the further differentiation of the anchoring concepts over time. As this is believed to be a natural occurrence enhanced discriminability and differentiation would occur with or without consolidation of the new meanings or concepts.

Derivative cognition. Derivative cognition is defined as "a type of subsumptive or subordinate learning in which the new ideas in the learning task are supportive or illustrative of an existing relevant idea in cognitive structure" (p. 626). According to Ausubel derivative cognition is characterized by the rapid subsumption of new material. Also according to Ausubel, the production of new meanings is not of concern in this mode because "the meaning of the new material can be very adequately represented by...the established subsumer, and...this...is more efficient...than the actual retention of supportive or illustrative data" (p. 136).

New meanings are not only represented by anchoring concepts, they also can be reconstructed by "manipulating specific elements of past and present experience so that they exemplify the desired concept or proposition" (pp. 136-7).

If subsumption occurs as rapidly as Ausubel claims and no new meanings are formed because anchoring concepts are adequate to represent new material learned, then progressive differentiation and integrative reconciliation of new meanings with anchoring concepts does not occur. If anchoring concepts are not differentiated nor reconciled with new material just learned then it would be difficult to establish that subsumption had occurred. It is necessary for Ausubel to demonstrate the difference between a rapid and a normal rate of subsumption before derivative cognition could be considered as a mode of subsumption.

Superordinate cognition. There are two definitions of superordinate cognition. First, superordinate cognition is defined as "learning the meaning of a new concept or proposition that can subsume relevant and less inclusive particular ideas already present in cognitive structure" (p. 630, emphasis in original). Ausubel describes superordinate cognition as taking place "in the course of inductive reasoning or when presented material is organized inductively or involves the syntheses of component ideas" (p. 59). Second, superordinate cognition also occurs when already established anchoring concepts are recognized as related to



one another (p. 124), and reorganized accordingly (p. 96) during the course of learning. Thus one form of superordinate cognition involves the subsumption of anchoring concepts by a newly learned more inclusive, abstract, or general concept from new material. The other form involves the synthesis or integration of related anchoring concepts potentially occurring during the course of new learning. In both instances of superordinate cognition new meanings would be formed. First, in the event of consolidation of a newly learned, more inclusive concept that subsumed a related anchoring concept a new anchoring concept is formed. Second, the integration of related anchoring concepts during the course of learning would result in the formation of a new superordinate meaning.

In the absence of consolidation of a new superordinate meaning Ausubel claims that the anchoring concepts become integrated only initially. Inevitably they become separate but differentiated (see Table 4.2, p. 132). Thus the more stable concept, the anchoring concept, will always subsume a less stable, newly learned concept even if the more stable anchoring concept is less inclusive, abstract, and general.

A number of questions can be posed here for which Ausubel's theory provides no explanation. First, the distinction (if indeed there is one) between the two definitions of superordinate cognition is difficult to maintain. Ausubel needs to describe the difference between anchoring concepts that become integrated during the course of learning a related

superordinate concept from new material and those anchoring concepts that become integrated "during the course of learning". If Ausubel theoretically allows for the integration and reorganization of anchoring concepts during the course of superordinate (and combinatorial) cognition then why is this not considered as a possibility during correlative cognition? In other words, Ausubel gives no good theoretical reason why the subsumption of a less inclusive new concept by a more inclusive anchoring concept cannot also act as a catalyst to the reorganization of anchoring concepts.

The second question concerns Ausubel's description of the reduction process that occurs in the absence of consolidation of a new superordinate meaning. Ausubel claims that the initially integrated anchoring concepts become separated and further differentiated during the reduction process. This claim contradicts one of his theoretical claims about the nature of learning.

To reiterate, Ausubel makes two distinct claims. First, he states that the stability of an anchoring concept in memory tends to increase with level of generality and inclusiveness (p. 131). Second, he states that anchoring concepts can become integrated during the course of new learning. Anchoring concepts are more stable than new meanings. Therefore anchoring concepts that become integrated in the course of superordinate cognition should not lose their stability by virtue of becoming integrated. In fact their stability in

cognitive structure would be enhanced in two ways. First, they have jointly subsumed criterial attributes of a new superordinate meaning that has not been consolidated. Second, once integrated, the greater level of generality and inclusiveness would further increase their stability. When examined in accordance with Ausubel's claims, it seems more plausible that anchoring concepts which subsume a superordinate meaning would remain integrated and differentiated rather than become separated and differentiated. The result would be the formation of a relatively stable superordinate meaning that would undergo reduction in the form of a new single meaning.

It is curious that Ausubel would leave unexplained such an obvious contradiction in his theory. One plausible reason is that theoretical recognition of the potential for retention of integrated superordinate meanings may contradict one of Ausubel's fundamental assumptions about human learning. This is the assumption that all learning tends naturally to organize in a hierarchical structure from the most to the least inclusive concepts or propositions in a given body of knowledge. The top-down hierarchy assumption conforms to the acquisition and organization of information as exemplified by correlative cognition. The conclusion that can be drawn from this is that continuous superordinate learning, unlike correlative cognition is not a natural, spontaneous occurrence but is dependent upon consolidation to remain superordinate.

In other words the anchoring concept(s) will always assume the subsuming role in the absence of consolidation of new superordinate meanings. Thus the anchoring concepts are always more stable than new meanings. Given that this is what Ausubel has been claiming all along, this is not a remarkable conclusion. However it is problematic when considering the possibility that anchoring concepts will remain integrated after subsuming a new superordinate meaning.

Given the plausibility of continued integration of anchoring concepts, an argument can be made that superordinate cognition can proceed as naturally as correlative cognition. A new meaning that is superordinate to the prior established anchoring concepts that form part of its constituent elements can remain integrated in cognitive structure. I have argued that the new meaning enjoys a certain stability. Thus potential retention of a superordinate meaning is possible without immediate consolidation.

It seems equally plausible that continuous learning in the superordinate mode would result in a cognitive structure organized hierarchically from the least to the most inclusive anchoring concepts. This is in direct contradiction to Ausubel's claim that cognitive structure naturally tends to be organized from the most to the least inclusive anchoring concepts. I have demonstrated that it is theoretically admissible for already established anchoring concepts to become integrated, and hence more inclusive and stable. In

the course of continuous learning the result would be the progressive integration of information from the least to the most inclusive, abstract, and general anchoring concepts in cognitive structure. The implication for assimilation theory is that learning that involves generalization and synthesis of anchoring concepts in cognitive structure should be able to proceed as naturally and efficiently as learning that involves the analysis and differentiation of concepts in cognitive structure. Ausubel does not discuss this as a possibility in his assimilation theory of meaningful learning. The theoretical extension that I have just described violates one of the fundamental assumptions of assimilation theory. Thus, it is not difficult to see why Ausubel has failed to explore the possibility of continuous superordinate cognition.

Combinatorial cognition. Combinatorial cognition is defined as "learning the meaning of a new concept or proposition that cannot be related to any particular relevant idea(s) in cognitive structure but can be related to a broad background of generally relevant content in cognitive structure" (p. 625). The combinatorial mode is defined (Table 2.2, p. 68) as the case where

new idea A is seen as related to existing ideas B, C, and D but is neither more inclusive nor more specific than ideas B, C, and D. In this case, new idea A is seen to have some criterial attributes in common with preexisting ideas.

This definition suggests that the new concept to be learned is relatable to equally inclusive anchoring concepts in cognitive structure.

Ausubel's descriptions of combinatorial reduction include the different learning outcomes that occur when the new combinatorial concepts are acquired with and without consolidation. In the case of combinatorial cognition where no consolidation takes place, Ausubel states that

the less stable (and more specific) meaning of a combinatorial idea is...incorporated within or reduced to the more stable (and more generalized) meanings of the wider, less specifically relevant body of ideas in cognitive structure to which it is related. (p. 131, parentheses in original)

In this instance combinatorial cognition appears to be another case of correlative cognition. The more inclusive anchoring concept is simply replaced by more inclusive general background information that subsumes newly learned, equally inclusive and generally congruent concepts from new material. The so-called combinatorial meaning is in reality, then, a correlative meaning. Ausubel describes the acquisition of combinatorial concepts as

potentially meaningful because they consist of sensible combinations of previously learned ideas that can be nonarbitrarily related to a broad background of generally relevant content in cognitive structure by virtue of their general congruence with such content as a whole...they are not relatable to particular relevant ideas within cognitive structure. (p. 59, emphasis in original)

Ausubel further states that:

new combinatorial propositions, at the moment of incorporation, are neither subordinate nor superordinate to particular established ideas in cognitive structure. Almost inevitably, however, they either subsume or are subsumed by later learnings. Originally they are coordinate

in level of abstraction and inclusiveness with existing higher order concepts or propositions. (p. 139, emphasis in original)

Thus, correlative or superordinate reduction of the new combinatorial concept will occur in the absence of consolidation of the new combinatorial concept in the event of continued learning of new information. That is, the reduction process is described by Ausubel in reference to later learning. As Ausubel states

When newly acquired combinatorial concepts are consolidated, they manifest, once adequately established, the same inherent stability as any inclusive or superordinate (subsuming) idea in cognitive structure. Further elaboration of these ideas typically results in derivative or ✓correlative subsumption (analysis, differentiation) and less commonly in superordinate learning (generalization, synthesis). (pp. 59-60, parentheses in original).

Thus correlative or superordinate reduction occurs when the newly acquired combinatorial concept undergoes continued learning whether or not consolidation has taken place.

There is some difficulty with Ausubel's definition of a combinatorial meaning. A new meaning in meaningful learning is a product of the subsumption (integration and reorganization) of anchoring and related concepts from new material. In combinatorial cognition Ausubel states that

The meaningful learning of new propositions that bear neither a subordinate nor a superordinate relationship to particular relevant ideas in cognitive structure...gives rise to combinatorial meanings. (p. 59 emphasis in original)

The question is how do these new meanings arise? In this mode concepts from new material are less likely to subsume

or be subsumed by anchoring concepts. Thus they are "less relatable or anchorable to previously acquired knowledge" (p. 59).

Ausubel's description of the reduction of combinatorial "meanings" to generally congruent background information appears to be intended to preserve his belief in the subsumptive nature of cognitive learning. This it does, but Ausubel should acknowledge the fact that he is describing a particular form of correlative and not combinatorial reduction. Although not specifically stated by Ausubel, general background information becomes the anchoring concept in this case. In a case where concepts from new learning are not subsumable or do not subsume related particular anchoring concepts, the new meanings are not combinatorial. They become correlative or superordinate meanings when consolidated, and/or when subsuming or being subsumed by further learning of concepts in new material. Presumably when no consolidation or further learning occurs, combinatorial concepts or propositions in cognitive structure are subsumed by generally relevant background information. Thus there is no such thing as a combinatorial meaning.

Further, as is the case in superordinate cognition, combinatorial cognition can involve the integrative reconciliation of already present anchoring concepts in the course of new learning (p. 124). Anchoring concepts that may become integrated during the acquisition of combinatorial concepts are mentioned but not discussed by Ausubel. If anchoring concepts integrate and form a new meaning, the process would



be the same as presented in the foregoing discussion of superordinate cognition. That is, a new meaning formed in this way would be a superordinate meaning.

It is misleading to posit combinatorial cognition as a mode of assimilative learning as no new combinatorial meanings are produced. However there are ways in which combinatorial learning, combined with another mode of cognition, has value for learning that requires the generation of potential solutions for problem solving situations. This is illustrated in Ausubel's description of meaningful discovery learning.

Ausubel's discussion of meaningful discovery learning provides an example of superordinate cognition and combinatorial learning occurring together in a learning situation.

In meaningful discovery learning, the discovery part of the process involves cognitive transformations of what Ausubel refers to as substrate propositions. Substrate propositions consist of (a) problem-setting propositions that are acquired by meaningful reception learning and (b) background propositions already present within cognitive structure. Problem-setting propositions define "the nature and conditions of the current problem situation" (p. 61). Background propositions consist of "relevant aspects of previously acquired knowledge (information, principles) that bear on the problem" (p. 61). That is, they are relevant anchoring propositions. The acquisition of problem-setting propositions results in the "transformation (restructuring, reorganization,

synthesis, integration)" of the substrate propositions (p. 61). The product is the generation of a new problem-solving proposition which structurally would reflect the integrative reconciliation of the problem-setting propositions with the integration of the background propositions.

This is an example of superordinate learning whereby the learner is required to transform anchoring concepts when seeking a solution to a problem, as opposed to the superordinate learning that involves the meaningful reception learning of new generic concepts or propositions. Therefore, in the absence of stabilization of the newly generated problem-solving proposition, the integrated background propositions in meaningful discovery learning would be subject to the same reduction process as that described by Ausubel in meaningful superordinate reception learning.

In meaningful discovery learning the generation of the problem solving proposition is a process involving generation of several solutions until the correct one is found (p. 571). In this case the substrate propositions would remain combined, rather than undergoing reduction, until a correct solution, by trial and error or other means, is discovered. Once a correct solution emerges, other unsuccessful problem-solving propositions could simply be forgotten, their reduction to anchoring concepts serving no particular purpose. Thus, problem solving would proceed most efficiently on the basis of meaningful superordinate and combinatorial cognition.

Summary of the Modes of Cognition

A number of observations can be made regarding the movement of information within cognitive structure as it is exemplified in the correlative, derivative, superordinate and combinatorial modes of cognition. First, the correlative mode is precisely defined, and conforms to the logic of assimilation expressed by the progressive differentiation and integrative reconciliation of information from the most to the least inclusive concepts.

Ausubel believes that the hierarchical organization of information in cognitive structure resulting from the correlative mode typifies the way in which the human nervous system is naturally disposed to organize and store information. Ausubel's adherence to this assumption has led him to claim that meaningful reception learning in the correlative mode is more efficient, effective, and parsimonious than any other mode of cognition or form (rote, discovery) of learning (p. 60).

Second, Ausubel's rigid adherence to the assumed superiority of correlative cognition has had particular repercussions for theoretical development of the superordinate mode of cognition. The retention-reduction phase of assimilation in the superordinate mode has been made to conform to cognitive processing as exemplified by correlative cognition. Ausubel has accomplished this theoretically by maintaining the separation of integrated anchoring concepts that have subsumed the new

superordinate meaning in the absence of consolidation. Given that integrated anchoring concepts would share a greater stability than new meanings, their longevity in memory should in fact be enhanced. However, in Ausubel's description of superordinate cognition this doesn't happen. Further it can be argued that the explanation for retention of newly integrated anchoring concepts would be more parsimonious if Ausubel's theory allowed for continuous superordinate cognition.

The effect of Ausubel's separation of anchoring concepts that have subsumed the new superordinate meaning is to confine superordinate subsumption to discrete rather than continuous acts of cognition. This effectively reserves the privilege of continuous subsumption for correlative cognition. Discrete acts of superordinate cognition are appropriate to meaningful discovery learning where the task is completed with the emergence of a problem-solving proposition. In this case, further application of the new proposition to particular related problems is most likely to result in continuous correlative cognition.

It has been demonstrated here that superordinate cognition can proceed as naturally and spontaneously as correlative cognition. Continuous learning need not be confined to the hierarchical organization of cognitive structure in a deductively organized format. That is not to say that there is no innate predisposition favoring a particular format. If correlative cognition is in fact superior, as Ausubel assumes,

then this assumption must be given the status of a claim that needs to be substantiated by research.

Ausubel does not discuss the possible implications for assimilation theory of the organization of cognitive structure after continuous superordinate learning. Assimilation theory can accommodate an inductively organized cognitive structure that would result from continuous superordinate learning, but Ausubel's insistence on the superiority of correlative cognition appears to have precluded development of the superordinate mode. In doing so, assimilation theory as it is currently developed, does not describe those learners who may characteristically prefer to organize information within cognitive structure in an inductively organized format as demonstrated by McDade (1978), and Siegal and Siegal (1965).

In the combinatorial mode, new concepts can be subsumed by generally congruent background information. Newly learned combinatorial concepts that are equally inclusive to one or more particular relevant anchoring concepts do not become differentiated into new meanings. They remain juxtaposed within cognitive structure with those anchoring concepts possessing some criterial attributes held in common with them. A newly acquired combinatorial concept will undergo differentiation and integration in either the correlative or superordinate mode in the course of further learning.

Given that the definition of meaningful learning "implies that it is a characteristic process in which meaning is a

product or outcome of learning" (p. 149), the acquisition of combinatorial concepts from new learning material is not an instance of subsumption. Facilitation of combinatorial cognition, however, still requires that the conditions antecedent to the occurrence of meaningful learning be met.

The process of subsumption is purported by Ausubel to occur within the correlative, derivative, superordinate, and combinatorial modes of cognition. However an examination of the definitions of these modes has demonstrated that only two modes of cognition are described by assimilation theory. These are correlative and superordinate cognition. Derivative and combinatorial cognition produce no identifiable derivative and combinatorial meanings but do provide for extensions and combinations of prior and newly acquired information. In derivative cognition Ausubel does not explain what rapid subsumption is. When subsumption of combinatorial concepts does occur, it occurs through either correlative or superordinate cognition.

#### Simplification of Assimilation Theory

Ausubel's presentation of the assimilation theory of cognitive learning is a detailed and complex explanation of cognitive events. However, his reliance on the principles of progressive differentiation and substantive relatedness in describing his theory has created theoretical ambiguity. Assimilation theory can be recast without employing these two principles. The result is a clearer and simpler theory.

Ausubel's use of progressive differentiation has obscured the fact that the model has essentially five components. These are (a) assumptions about the nature of human learning, (b) antecedent conditions necessary to the occurrence of meaningful learning, (c) an assimilation theory of cognitive learning, (d) the modes of cognitive processing, and (e) some related pedagogic techniques. The theory, the antecedent conditions, and the pedagogic techniques reflect Ausubel's assumptions about how learning occurs within cognitive structure.

Ausubel's assumptions about the nature of human learning are:

1. all learning is intrinsically conceptual in nature.
2. new learning involves concept formation and concept acquisition.
3. concepts in cognitive structure are generic in nature.
4. cognitive structure is hierarchically organized from the most to the least inclusive, general and abstract concepts.
5. concepts in cognitive structure assimilate, categorize, and organize incoming related information.

The antecedent conditions necessary to facilitate meaningful learning are:

1. the learner must possess a meaningful learning set or disposition to learn.
2. new material to be learned must be logically meaning-

ful; it must make sense to the learner.

3. the new learning task must be relatable to information the learner already knows.

The assimilation theory of meaningful verbal learning describes information processing and organization within cognitive structure. The terms used by Ausubel to describe information processing are subsumption, progressive differentiation, and integrative reconciliation. Subsumption refers to the cognitive act whereby one concept is absorbed or incorporated by another. Progressive differentiation and integrative reconciliation are the variables that describe subsumption as a process from acquisition to retention-reduction of information.

Two terms describe the process of retrieval in meaningful learning. These are dissociability and threshold of availability. Dissociability refers to the retrieval of new meanings as distinct from their related anchoring concepts. Maximum dissociability occurs immediately after new information has been acquired. This level decreases to residual dissociability after an unspecified period of time. Zero dissociability has been reached when the new meanings are no longer retrievable. The threshold of availability refers to that level of reduction of new meanings where they are not available for retrieval without special cueing or some other intervention.

The process of assimilation occurs within the correlative and superordinate modes of cognition. Processes of assimila-



tion can be described in two theoretical statements:

1. a more inclusive, abstract and general concept, proposition, or principle will subsume a less inclusive, abstract, and general related concept proposition, or principle.
2. a more stable concept, proposition, or principle will subsume one that is related but less stable.

A concept refers to a single generic item. A proposition is composed of two or more concepts that are related in some way and a principle is composed of two or more propositions.

A set of propositions particular to the two modes of cognition can be derived by combining the variables in these statements in different ways. For the sake of simplicity, the term 'anchoring concept' will refer either to a principle, a concept, a proposition, or general background information.

Correlative Cognition:

1. A stable anchoring concept will inevitably subsume a new meaning if the anchoring concept is more inclusive than the new meaning, regardless of whether the new meaning is stable or unstable.

Superordinate Cognition:

2. If an anchoring concept is stable and less inclusive than a new meaning that is not stable and more inclusive, then the anchoring concept subsumes the new meaning.
3. If an anchoring concept is stable and less inclusive than a new meaning that is stable and more inclusive,

then the anchoring concept will be subsumed by the new meaning.

4. Stable anchoring concepts subsumed by a more inclusive newly learned concept become one undifferentiable concept.

These propositions hold if and only if the learner recognizes the relatedness of concepts or propositions in new material to be learned to those relevant anchoring concepts, or to relevant general background information available within cognitive structure. This is a shorthand way of saying that the antecedent conditions to meaningful learning have been met. No other statements or propositions about subsumption can be made given the current development of assimilation theory.

The pedagogic techniques devised by Ausubel are expository organizers, comparative organizers, sequencing, and consolidation. Their purpose is to prolong retention of new meanings. These techniques have been designed in accordance with progressive differentiation and integrative reconciliation as described in correlative cognition. Correlative cognition is the mode believed to parallel the processing of information as it would spontaneously occur within cognitive structure.

#### Conclusion: The Search for Operable Variables

The remaining question concerns the extent to which the variables of assimilation theory are potentially operable. This has already been answered in part, in the foregoing description (pp. 30-36) of the instructional technology

developed by Ausubel to implement correlative cognition in the classroom setting. In this mode, the subsumptive movement involving continuous differentiation, integration, and consolidation of cognitive structure from the most to the least inclusive anchoring concepts have been translated into principles of instructional design that inform the construction of various pedagogic techniques (expository organizers, comparative organizers, sequencing, overlearning). These techniques provide the conditions required for meaningful learning, and by doing so, translate the cognitive structure variables into operable terms. Thus it is correlative cognition that is operationalized by advance organizers.

Ausubel has not developed specific techniques for translating superordinate cognition into operable terms. However, given that it is (theoretically) the inverse of correlative cognition, a simple initial approach is to reverse the arrangement of those pedagogic techniques derived from the correlative mode. This potentially provides one means for testing the alleged ascendancy of correlative cognition over the superordinate mode that would be grounded in the antecedent conditions required for the occurrence of meaningful learning.

It is important to note the fallacy that has arisen regarding the ability of research using advance organizers to test assimilation theory. By itself, of course, the advance organizer can do no such thing. The advance organizer,

as currently developed, only exemplified cognitive structure as described in correlative cognition. As such, the organizer provides one means for testing correlative against superordinate cognition, or for testing correlative or superordinate conditions of meaningful learning against other techniques (overview, behavioral objectives, inserted questions, etc.) that are not designed in accordance with conditions Ausubel requires for the occurrence of meaningful learning. Put simply, Ausubel's pedagogic techniques allow for prescriptive research of their facilitative effects on the retention of learning. Supportive research results may demonstrate their effectiveness. However, these results could be explained by assimilation or other possible competing explanations. For example, the consolidation or mastery of recently learned material could alone account for the facilitative effects of advance organizers on retention. There may be no need to invoke an assimilation or any other theory of learning to explain results. Moreover, use of Ausubel's techniques may induce the very cognitive structure that assimilation theory claims occurs spontaneously. Thus Ausubel's pedagogic techniques cannot test the explanatory value of assimilation theory. This would require descriptive research designed to assess the adequacy of the explanatory value of a theoretical term.

Descriptive research testing the explanatory value of theoretical terms requires that those terms be operable.

Assimilation theory describes certain cognitive events that are believed to occur within cognitive structure in the course of acquisition, retention, retrieval, and forgetting of information. The acts of cognition described by Ausubel are subsumption by progressive differentiation and integrative reconciliation, dissociation, and slippage below the availability threshold. Assimilation theory claims these events occur under certain conditions but does not describe the particular conditions in which each cognitive event would occur. Although Ausubel's theory offers a general description of cognitive events it is currently not possible to make predictions about when these events take place. As information processing is unobservable, particular cognitive events would only be known to occur by the nature of the products of learning.

In the cognitive act of subsumption, for example, some form of assimilation of one concept by another is believed to occur immediately after new learning takes place. Ausubel's claim that subsumption always occurs in meaningful learning needs to be substantiated by research. However, subsumption is theorized always to occur under conditions designed to promote meaningful learning. Conditions that do not promote meaningful learning could not test subsumption because they are not meaningful. It is this kind of tautology that has retarded adequate tests of assimilation theory.

Even if the act of subsumption is accepted as a given, it is still a mystery. Ausubel states that the dissociable new meaning is retrievable immediately after new learning has taken place. He further states that the new meaning becomes less dissociable over time from the related anchoring concept. As the new meaning undergoes reduction, the anchoring concept is further differentiated because it subsumes information from new learning. Eventually only the differential anchoring concept is retrievable. The problem concerns Ausubel's failure to explain the structural differences between a dissociable new meaning and a retrievable further differentiated anchoring concept. The same attributes that make up the new meaning also make up the differentiated anchoring concept. The mechanisms that trigger the process are unknown. Ausubel's theory does not predict which attributes will subsume others under specified conditions, and why. Nor does his theory predict why some attributes would be subsumed before others over a given period of time. It is not known how variable the rate of subsumption would be in different learners under identical conditions of learning. Is there a difference between rate of subsumption and learning style, or learner's abilities? How would rate of subsumption be determined in the first place? This last question could only be answered by finding means of assessing the quantity and structure of the products of meaningful learning that are retrieved over a given period of time.

For learners to retrieve the attributes of concepts in new material first learned they have to retain the distinctions between these and criterial attributes of anchoring concepts once the subsumption process is underway. These attributes must be dissociable from anchoring concepts. It is unclear whether first the concepts from new material are dissociable, then the new meaning and then the differentiated anchoring concept or whether some other order is involved. Or, given that subsumption occurs immediately, whether only a new meaning or both a new meaning and related anchoring ideas are subject to retrieval at the maximal level of dissociability strength. Further, it is unclear what is retrievable at the residual level of dissociability strength before only the differentiated anchoring concept is retrievable at the zero level of dissociability.

It appears that the only means for operationalizing dissociability is to find a way to distinguish between the various levels of dissociation. To this end assimilation theory must be supplemented by a means for operationalizing measures of threshold values for each level and for identifying the points of discontinuity along the dissociability continuum when information changes from one level to another. The threshold of availability merely represents one threshold of a series and its current description says no more than information meaningfully learned is meaningfully forgotten at some point.

The threshold values and points of discontinuity for the range of dissociability strengths are unknown. Therefore it is not possible to predict or describe the quantitative or qualitative differences between criterial attributes of newly learned concepts and anchoring ideas as they undergo the integration and reorganization processes described by assimilation theory. This lack of description of the subsumption process constitutes the greatest weakness of assimilation theory.

In sum, underlying Ausubel's model of learning are some assumptions about the nature of human learning. These assumptions have been translated into a description of cognitive processing of information as exemplified by correlative cognition. This is referred to as the subsumption process involving the integration and reorganization of information within cognitive structure. Subsumption results in the production of new meanings.

Ausubel describes four modes of subsumption processing: correlative, derivative, superordinate, and combinatorial modes of cognition. Examination of Ausubel's definitions has demonstrated that derivative and combinatorial cognition do not result in the production of new meanings. Newly learned material processed in these modes results rather in extensions and recombinations of prior learning.

Subsumption processing occurs in only two ways: correlative and superordinate cognition. Correlative cognition



conforms to Ausubel's assumptions about learning. Superordinate cognition is inadequately developed by Ausubel. Extending the description of superordinate cognition to conform to Ausubel's theoretical claims about the way in which information is processed, results in a description of cognition that contradicts his basic assumptions about meaningful learning.

Ausubel believes that all learning is conceptual in nature. Already learned concepts, propositions, and principles of a given discipline are the organizers around which new related information is integrated, reorganized, and stored in cognitive structure. Information is believed to be stored in a top-down hierarchy of greater to lesser inclusive, general, and abstract concepts. In superordinate cognition it has been demonstrated that Ausubel's theory potentially accommodates the notion that information can be continuously processed and stored in an inverse hierarchical order to correlative cognition. I have also demonstrated that prior learned concepts involved in derivative and combinatorial cognitive processing do not, by Ausubel's definition, act as catalysts to the reorganization of new information. Though these modes conform to conditions required for meaningful learning, a subsumption process that results in an identifiable product (new meaning) does not take place.

The subsumption process itself is described as moving through various phases of integration and reorganization of

information. Subsumption is described as occurring by the progressive differentiation, integrative reconciliation, dissociation, and eventual below threshold loss of new information. The only means of verifying the occurrence of particular cognitive events is by describing the structure of the products of learning over time. To this end Ausubel's assimilation theory provides a general description of cognitive processing (subsumption) in various modes but lacks detailed descriptions of the particular cognitive events involved in the process. Assimilation theory should at least make some minimal predictions about the structure of a product of learning retrieved under specified conditions at a given period of time. For example, describing the structure of learning products as they are dissociated over points of a continuum could result in the establishment of threshold values for which further predictions about the nature of cognitive processing could be made. Assimilation theory provides one possible description of these events occurring within cognitive structure. Until the structure of particular products under specified conditions are theoretically predictable and verifiable, assimilation theory provides only a metaphorical description of cognitive information processing.

Appendix I

Samples of Theoretical Synonyms Used in  
Ausubel's Model of Learning

Terms	Synonyms	Sampling of Page Numbers	Terms Used	
Contents of Cognitive Structure (singular)	anchoring idea	169; 170; 189		
	subsumer	169; 172; 173; 184; 191		
	established idea	125; 168		
	existing idea	128		
	concept or proposition	124		
	superordinate concept or proposition	174	anchoring concept	
	Contents of Cognitive Structure (plural)	anchoring ideas	117; 183; 185	
		prior knowledge	183	
		general background knowledge	185	
		existing knowledge	169; 182; 185	
previously learned material		184; 194		
contents of a particular discipline		182; 190; 198		
already available concepts		254-5		
existing concepts or propositions		124; 125; 173; 252		
specifically relevant propositions		174		
concepts in cognitive structure		173; 182; 194; 252		
anchoring concepts		174		
established concepts		183		
antecedent elements		183		
antecedent material	184; 185; 197			

Appendix I Continued...

Terms	Synonyms	Sampling of Page Numbers	Terms Used	
Contents of Cognitive Structure (plural) Continued...	relevant ideas or elements	117; 169		
	learned elements	193		
	ideational scaffolding	172; 184; 191; 195		
	relevant ideational antecedents	174		
	presumed ideational contents	252		
	established principles	182		
	established meanings	182		
	established ideas	169; 172; 174; 183; 184; 193; 194		
	subsumers	174; 195; 199	anchoring	
	cognitive structure	125; 174; 185; 186	concepts or general background information	
	Newly learned material	subsuming concepts and principles to be learned	194	
		newly learned meanings	182	
		newly learned ideas	25; 182	
newly learned propositions		184; 193		
ideational material		195		
anchoring		58; 64; 125; 128		
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subsuming		124; 129; 174		
linking		58; 64; 116		
interacting		98; 125; 127	concepts in new material	
Assimilation (process)	incorporating	64		
	assimilating	67	subsuming	

Appendix I Continued...

Terms	Synonyms	Sampling of Page Numbers	Terms Used
Assimilation (theory)	assimilation theory assimilation hypothesis assimilation process principle of assimilation	128-9 128-9 128-9 128-9	assimilation theory
Retention-Reduction	meaningful retention memorial reduction obliterative assimilation obliterative subsumption selective forgetting meaningful forgetting	174 129 128; 174 117; 174 195 128	retention-reduction
Products of Meaningful learning	idiosyncratic meaning psychological meaning actual meaning modified anchoring ideas interactional products	49 49 49 130 127	Anchoring concepts New meanings Modified anchoring concept(s)
Retrieval	dissoeciability separation availability	626 626 626	Threshold of availability dissoeciability

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