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ABSTRACT

The implications of the 1994 Seels and Richey domain structure for instructional technology (IT) conceptual theory and classification systems, in general, for theory construction are explored. The historical evolution of domains in definitions of the field, the formulation of theory, the nature of taxonomies, the role of conceptual frameworks and theoretical systems, and the development of classification systems in IT with seven examples are discussed. It is concluded that without a taxonomic structure, it is impossible to progress towards conceptual frameworks or theoretical systems. The following recommendations are made to insure that 1994 definitional theory will meet the criteria of significance and usefulness: (1) sponsor an Association for Educational Communications and Technology (AECT) invitational symposium to address reactions to the domains, relationships between them, and taxonomic issues; (2) continue the relationship with Professors in Instructional Design to explore taxonomic issues; (3) arrange divisional discussions concerning domains and taxonomic development; (4) identify research needs and pursue through integrative research reviews, cognitive mapping, or descriptive research; and (5) practitioners with domain expertise should pursue taxonomic issues. Five illustrative figures are included. (Contains 65 references.) (MAS)

Classification Theory, Taxonomic Issues, and the 1994 Definition of Instructional Technology

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Introduction

There have been many pleas over the years for greater attention to development of a theoretical base for the field (Richey, 1986; Schuller, 1962; Winn, 1989). In 1953 Jim Finn, an early advocate of the term "instructional technology" and the systems approach, wrote:

> Without a theory which produces hypotheses for research, there can be no expanding knowledge and technique. And without a constant attempt to assess practice so that the theoretical implications may be teased out, there can be no assurance that we will ever have a theory or that our practice will make sense. (p. 63)

While progress has been made in research and procedural theory, there are still many links or relationships to be illuminated through conceptual theory. One example of this phenomenon is the research on learning from television, which is voluminous but difficult to understand, apply, and relate because of the lack of conceptual theory. The many guidelines for procedures in message design are often not applicable because ways to link principles are inadequately conceptualized.

In order to further the development of conceptual theory, the 1994 definition of the field (Seels & Richey) offers an associated domain structure which is shown in Figure 1 of the introductory article to this section. This domain structure is an evolution of earlier domain structures which appeared with definitions of the field; all of which were attempts to provide a theoretical framework through classification.

The purpose of this article is to explore the implications of the 1994 domain structure and of classification systems in general for theory construction. The article will discuss the historical evolution of domains in definitions of the field, the formulation of theory, the nature of taxonomies, the role of conceptual frameworks and theoretical systems, and the

development of classification systems in instructional technology (IT). The article will conclude with recommendations for continued development of the 1994 definition of the field.

Domain Structures in Definitions of IT

Bruner (1967) said that the structure of any domain of knowledge can be presented in three ways: enactively (by appropriate actions), iconically (by images), and symbolically (by verbal propositions). Each of these means of representation affects how understandable the structure is and how easily it is comprehended. Each of the Association for Educational Communications and Technology (AECT) endorsed definitions of the field presents the domain structure in the form of figures (iconically) and propositions (symbolically through verbal definitions). None of the definitions proposes actions to achieve goals unless one assumes that enactive representation can be inferred from discussion of functions performed by professionals in the field. This section will address the history of the domain structure associated with AECT definitions.

History of the Domain Structure

Each of the AECT definitions has had an associated structure for the components of the definition. As early as the 1963 definition, leaders were thinking about the major areas of study and practice in the field. The conceptual framework associated with each definition will be discussed next. These frameworks are reported in the literature published to disseminate each definition and in more detail by Januszewski (1994), who presents a history of the ideas which have influenced the definitions.

1963. The 1963 definition was based on a model presented in the 1962 dissertation of Sidney Eboch which was completed at the University of California under Jim Finn's supervision. Eboch reviewed and critically analyzed literature in the field in order to determine a theoretical base for audiovisual (AV) communications as a specialized field within education. Eboch synthesized literature in order to develop a model of audiovisual communication which was used by the Commission of Definition and Terminology working under the aegis of Finn's Technological Development Project. The model presented the role of audiovisual communications as one

of designing presentations. The associated domain components presented by the model were: AV Design (messages, media-instrumentation, men, methods and environment), Instructional Situation (presentation/reception, response/evaluation), Learning Communicant System (stimulus, response, organism), and Educational Communicant System (message selection, goal specification, feedback analysis). This framework represented a merger of the instructional systems orientation with a communication/ learning process orientation (Ely, 1963). The definition was explained through several visuals, one of which is shown in Figure 1. AV relationships to the educational-communication process.

Insert Figure 1 about here

It is important to note that neither the word domain nor the word taxonomy was used in the document. The authors do use the phrase "conceptual framework."

1972. The 1972 definition used the functional structure of the *Jobs in Instructional Media* (JIMS) study (Wallington, Hyer, Bernotavicz, Hale, and Silber, 1970). This definition had originally been published by Silber (1970). The structure was presented as two functions of the field of educational technology (Ely, 1972): the management function and the learning resources development function which included many of the operations now classified as instructional systems design. In addition, there was the object of these functions, the learning resources produced by design and utilization through the functions of management and development. This structure, which is shown in Figure 2. The domains of the 1972 definition, consists of three bars proceeding from management functions to development functions to learning resources.

Insert Figure 2 about here

1977. The 1977 definition presented a domain structure that was also based on the JIMS report. This structure was called the Domain of Instructional Technology (DIT) and was referred to as a theoretical framework

(AECT Task Force on Definition and Terminology, 1977). The DIT was also organized around functions and was very similar to the 1972 structure. As with the 1972 definition there was an instructional management function and instructional development functions. However, the Learning Resources product component of the 1972 definition was changed to Instructional Systems Components acted on by management and development/design functions and affecting the learner. This structure, which is shown in Figure 3. The Domain of Instructional Technology, was presented as four bars proceeding from management functions to development functions to system components to the learner.

Insert Figure 3 about here

The functional areas in the 1977 definition became part of instructional technology, a domain within educational technology, and educational technology was presented as a domain within education. Thus, three domains were presented as boxes within boxes: education, educational technology, and instructional technology. The Domain of Instructional Technology was further divided into subcategories presented in Figure 3.

1994. As shown in Figure 1 in the first article of this special section, the conceptual structure proposed by the 1994 definition of the field is five knowledge bases called domains shown in a non-linear relationship. Each knowledge base evolves from theory, practice, and research and interacts with other domains. The 1994 definition links theory and practice through associating functions (designing, developing, utilizing, managing and evaluating) performed by specialists in IT with each of the domains. Thus, the 1994 functions of IT evolved from those in the 1977 definition: management and instructional design/development.

The Role of IT Definitions

From 1963 to 1994 each AECT definition presented a classification system that suggested domains of theory and practice. The components of each definition had similarities with the preceding definition but also introduced a new perspective through differences. These classification systems were essential to the effort to define a field because they organized

and identified relationships emerging from practice. In addition to providing a basis for categorizing concepts, they offered a common conceptual structure and agreement on terminology that allowed for communication across many areas in the field of IT. A structure for identifying and organizing the relationships emerging from theory and practice was developed by each of the definitions through iconic and verbal representation.

The Formulation of Theory

Theories formally conceptualize the relationship of variables (Marx, 1967). Hoover (1992) defines theories as consisting of concepts and propositions that describe the linkages among concepts. He lists four roles for theory in social science: providing "patterns for the interpretation of data," linking "one study with another," supplying "frameworks within which concepts and variables acquire special significance," and allowing "us to interpret the larger meaning of findings" (p. 35). Language is the basis of theory because through clarification of semantic relationships theory creates a tool for communication with others. Bruner (1967) describes language as mankind's powerful technology for encoding reality, one which makes it "possible for him to express and amplify his powers" (p. 24). Thus, theories are definitional in nature.

Classifications, Taxonomies, and Domains

In order to explain theory building, it is necessary to first clarify the meanings of "classification," "taxonomy," and "domain" which are often used synonomously. The most general of these concepts is domain. Domain comes from "-dom," an old English suffix referring to kingdom. When we speak of someone's domain, we refer to their kingdom and what is in their kingdom. Domain has come to mean an area encompassing its own laws, rules, expertise. When used in cognitive science and information processing it refers to an area of knowledge. Cognitive scientists believe that expertise in problem solving comes from "domain-specific" knowledge (Gagne, 1985a). By this they mean knowledge in subject matter areas or areas of expertise. They have concluded that novices have a different knowledge structure in a domain than experts do. This may have implications for domain development. For example, if experts have a more hierarchical knowledge

structure, does this mean that domains need to be organized more hierarchically for the expert?

Domains are identified areas of knowledge which are usually too general to serve as taxonomic devices. Domains do not convey conceptual relationships except at the most basic of classification levels, the ad hoc level based on arbitrary divisions which organize empirical observations (Frankfort-Nachmias & Nachmias, 1992) or the taxonomic level based on "an orderly schema for classification and description" (Zetterberg, 1965, p. 26). Within the social sciences, models are described as having narrow, medium-sized or large domains. Dubin (1978) notes that although the models employed in a discipline will represent both large and small domains, often there is a pattern of large domains in the initial phases of the development of a discipline with subsequent attention given to narrower domains. The work of B. F. Skinner and the growth of operant conditioning theory is an example of an exception to this pattern.

Taxonomic classification requires division into groups on the basis of shared characteristics. When you classify things you arrange them in categories. You identify their shared characteristics verbally. In theory construction, classifications are ways of organizing concepts that allow grouping by pre- identified categories. Domain structures are classification systems at a very general level; while taxonomies are classification systems at a more specific level.

A taxonomy "consists of systems of categories constructed to fit the empirical observations so that relationships among categories can be described. Often the categories are interdependent" (Frankfort-Nachmias & Nachmias, 1992, p. 38). Shera and Egan (1956), who outline approaches to classification, describe a taxonomic approach as one based on likenesses and differences. They contrast taxonomic classification with these schemes: general, special, natural, artificial, geometric, historical, and hierarchical which divides into semantic, topical, and taxonomic classes (Shera & Egan, 1956 cited in Butler & Liske, 1972).

Bloom differentiates between a taxonomy and a simpler classification scheme. According to Bloom, a taxonomy (a) may not have arbitrary elements, (b) must correspond to some phenomena represented by the terms,

and (c) must be validated through consistency with the theoretical views of the field. "The major task in setting up any kind of taxonomy is that of selecting appropriate symbols, giving them precise and usable definitions, and securing the consensus of the group which is to use them" (Bloom, 1956, pp. 10,11).

Krathwohl, Bloom and Masia (1964) differentiated between a general classification scheme and a taxonomy on the basis of principles for ordering.

> A true taxonomy is a set of classifications which are ordered and arranged on the basis of a single principle or on the basis of a consistent set of principles. Such a true taxonomy may be tested by determining whether it is in agreement with empirical evidence and whether the way in which the classifications are ordered corresponds to a real order among the relevant phenomena. The taxonomy must be consistent with sound theoretical views available in the field. Where it is inconsistent, a way should be developed of demonstrating or determining which alternative is the most adequate one. Finally, a true taxonomy should be of value in pointing to phenomena yet to be discovered. (p. 11)

When these quotations are compared, Krathwohl's criterion for a taxonomy seem more stringent than Bloom's because a single or consistent set of ordering principles is required. Domains and taxonomies are both types of classifications. Domain classification structures can function either as ad hoc classification systems or as taxonomies depending on how extensively the definitional and categorizing structure is developed. There can be different levels of taxonomies as well as different levels of classification systems (theories).

Theory Building

Theory starts with concepts which require classification on both the conceptual and the observational level. Over the years many of those who construct "theory" about theory development have agreed on the importance of classification to clarify the relationships presented in a theory (Frankfort-Nachmias & Nachmias, 1992; Hoover, 1992; Kaplan, 1964). Concepts are used in several ways in theory construction. They provide building blocks that can clarify relationships among phenomena. Because concepts classify, they facilitate generalizing, categorizing, and structuring or ordering.

Concepts, whether they are constructs, operational definitions, principles, variables or attributes, must be clear, precise and agreed-upon. Frankfort-Nachmias and Nachmias (1992) describe the definitional transition from the conceptual to the observational level as progressing through these levels:

- conceptual level
- conceptual components
- conceptual definitions
- operational definitions
- observational level.

The first three levels are theory-based and the last two research-based.

A construct is a concept that "refers to relationships among things or events, and their various properties" (Marx, 1963, p. 10). Constructs can be theoretical or operational in that they are more or less specific. Similarly, definitions, which give the meaning of constructs and other concepts, can be theoretical, operational or neither. For example, the distinctions among visual literacy, visual thinking, visual learning, and visual communications can be made on the basis of concepts and theoretical constructs (Seels, 1994).

There is more to theory development than classification of concepts. Fawcett and Downs (1986) describe the components of theory analysis as:

- concepts: word or collections of words expressing mental images of phenomenon
- definitions: meanings given to concepts
- propositions: statements about one or more concepts
- hierarchies of propositions: arrangements of propositions according to their level of abstraction
- diagrams: pictorial representations of concepts and their connections
- conceptual-theoretical-empirical structures: diagrams depicting the connections between conceptual model concepts, concepts of a theory, and empirical indicators. (pp. 94, 95)

Theory is formulated this way so that it links concepts to operational definitions and both of these to empirical indicators. Theory is a way of making sense of practice by providing connections. This is why theorizing

becomes less ambiguous as one moves from a domain classification through constructs and operational definitions to propositions which explain research findings.

The definitional process must become more and more specific until it either reaches the level of research if deductive, or if inductive, generates theory. "The relationship between theory and research is complementary; theory is not useful unless it is verified by research and research findings which have no relationship to a theory are trivial" (Watson & Johnson, 1972, p. 12). Research can destroy an old theory, lead to new conceptualization, or verify a new theory.

The Nature of Taxonomies

Taxonomies provide researchers with relationships among variables and questions about relationships that need testing. Taxonomies stimulate research which tests the categorizing used. References to taxonomies in scholarly literature are often confusing because the word is used to describe classification schemes, rational ordering of elements, and categorical systems. The word taxonomy is used here to mean a classification system which offers an orderly schema for specifying relationships at many levels.

Taxonomic Schema

To some extent, the question of taxonomic classification is a question of schema. What schemata will duplicate the way people structure their thoughts about the field or will be consistent with the way information about the field is assimilated? Which comes first, the taxonomic schema or the personal schema? Harvey, Hunt, and Schroder (1961) describe a concept as a schema.

> A concept is a system of ordering that serves as the mediating linkage between the input side (stimuli) and the output side (response). In operating as a system of ordering, a concept may be viewed as a categorical schema, an intervening medium, or program through which impinging stimuli are coded, passed, or evaluated on their way to response evocation...
>
> A concept in its most general sense is a schema for evaluating impinging stimulus objects or events. (pp. 1, 10)

If Harvey, Hunt, and Schroder are correct, the concepts used at all levels of generality in theory formulation serve as schemata.

The construct schema has been studied extensively by cognitive scientists. Several theories of communication, including symbolic interactionism, present the interactive process that occurs when communication takes place as a schema.

> It appears that communication requires an other-schema as well as a self-schema and a representation (frame) of the topic being discussed. To communicate with the other, the program must have a concept (frame, schema) of what the other already knows or believes about the topic, plus some of the others' background knowledge. The other will interpret statements in terms of what he already "knows" about a topic, so all effective communication will have to adapt to that context... (Diesing, 1991, p. 263)

Blake and Haroldsen (1975) used a schema of the communication process to develop a taxonomy of concepts in communication. Reasoning that communication is largely a descriptive discipline, they developed a body of descriptive information concerning various aspects of the field through definitions related to the elements, forms and functions of the process of communication. Several models associated with IT, such as the systems design model and the communications process model, may serve as schema for theory construction because they are so integrated in the knowledge base of the field.

Another basic question in relation to the schema represented by a taxonomic classification structure is whether groupings should be represented hierarchically or not. An hierarchical structure demands that there be super and sub-concepts. A non-hierarchical structure, on the other hand, can use discrete clusters or groupings. To use a non-hierarchical structure there must be freedom to reallocate to groups after the initial grouping is done and to regroup (Barker, 1974). An example of a hierarchical grouping would be the *Taxonomies of Educational Objectives* (Bloom, 1956; Krathwohl, Bloom, & Masia, 1964). The 1994 definition of the field is an example of a non-hierarchical clustering. Although some believe that taxonomies must be hierarchical, distinctions between disciplinary and domain areas require

flexibility in taxonomic approaches. Mathematics is an example of an area which uses both hierarchical and non-hierarchical grouping methods for taxonomic analysis.

Taxonomic Classification Principles

There are different approaches to taxonomic classification. The great debates about taxonomic theory have taken place in the sciences, particularly biology. One of the foremost issues of the nineteenth century was the argument of Louis Agassiz against Darwinian classification principles in his 1857 "Essay on Classification." Aggassiz, a highly respected and contributing naturalist, took the position that Cuvier's morphological approach which classified based on four distinct branches of the animal kingdom was correct, not Darwin's. The branches were declared to have been formed through divine creation rather than natural selection or adaptation. Thus, the war of words between the evolutionists and creationists escalated. Agassiz supplied empirical demonstrations for metaphysical assumptions. He claimed his adventures into taxonomy would furnish reliable standards of comparison. His taxonomic forays were based on the assumption that:

> ...idealism was objective and the finite operations of the human mind mere approximations of truth. The task of the modern naturalist, therefore, was to contrive to reflect in his descriptions and classifications the reality of the natural world that comprised the operations of the Deity. He did this by understanding the fundamental rationality of a divinely ordained world, planned in perfect fashion from the beginning, always exemplifying the wisdom of creative intention. (Lurie, 1962, p. xx)

Agassiz exemplified the use of Aristotelian classification in which groups are defined by purposes or functions first. Then these categories are subdivided by physically obvious subcategories. This process is called successive division and redivision and is important because it allows for convenient classification because only one point of differentiation is needed, the last one, because it implies all others. This system, which is also called existentialist classification, was used by Linnaeus to classify botany in the Eighteenth Century (Ridley, 1986). However, it was not an adequate basis for classifying the ideas of evolution presented by Darwin. It was called

existential classification because the groups were defined by their essences or essential character, such as morphology or function.

The Aristotelian system used by Linnaeus, one of the great taxonomists, was based on nomenclature. He was the first to apply uniformly and on a worldwide scale, "a new method for designating any species of plant or animal with just two words, the first a generic name and the second a specific epithet or 'trivial name'" (Heller, 1986, p. 41). This system of classification was called binomial nomenclature.

Darwin used an evolutionary classification system in which groups were defined on the basis of order of phylogenetic branching. In this system, characteristics of groups do not determine the order of branching although they may define groups and suggest branching. This assumption allowed a group to undergo an evolutionary change without altering the pattern of branching. Thus, biology came to use two principles for classification, phenetic (based on an observed set of characteristics) and phylogenetic (based on ancestral relationships) (Ridley, 1986).

Since then Darwin biologists have developed new approaches, such as transformed cladism which is based on shared characteristics without the assumption that groups represent Darwinian evolution. In addition to phenetic, phylogenetic, and transformed cladism approaches, there is the teleological method. This refers to classification of groups by their shared purposes or functions based on empirical observation rather than philosophical mandate.

> By teleological, I mean purposive; teleological classification seeks to group species according to their purpose in life, which in modern Darwinian terms means the function they are adapted to perform. Groups indicate not shared ancestry, nor shared simple similarity, but shared adaptation. A human analogy may help. We could classify human fabrications phenetically; but it might also be possible to identify the purpose for which each thing was made, and use that instead to define the groups. Take, for example, a pen, a word processor, and a television. The phenetic classification would, I imagine, group the television and the word processor; but a teleological

> classification might group the pen and the word processor, for both were invented for the purpose of writing. But it might not, it might group the word processor and television, because they have a shared purpose of making profits for electrical companies. And, indeed, practical ambiguity is the main difficulty with the teleological principle. Even if human fabrications do have unambiguous purposes, it is difficult to identify them. But be that as it may, a technological [teleological] classification is one that aims to classify groups according to shared functions. (Ridley, 1986, pp. 5-6)

Based on the use of domains in the AECT definitions, the taxonomic classification principle which seems most relevant to IT is teleological or based on function, although within domains other principles of classification seem possible, such as some of the learning classifications within the instructional design domain which seem to follow a variation on phylogenetic classification when they use cummulative learning principles.

Conceptual Frameworks and Theoretical Systems

The theory construction process also differs depending on the type of theory being formulated. Many have theorized about types of theory (Easton, 1966; Fawcett & Downs, 1986; Lewin, 1944; Parson & Shils, 1962). Frankfort-Nachmias and Nachmias (1992) list four types of theory that can be constructed: (a) ad hoc classificatory systems which are arbitrary divisions into categories, (b) taxonomies which are categories based on empirical observation, (c) conceptual frameworks which are broad structures of specifying relationships, and (d) theoretical systems which combine taxonomies and conceptual frameworks.

Explanatory Classifications Systems

This section will compare conceptual frameworks and theoretical systems.

Conceptual Systems. Fawcett and Downs (1986) describe "conceptual-theoretical-empirical structures" which are similar to conceptual frameworks. A "conceptual-theoretical-empirical structure" links:

- conceptual model concepts
- propositions linking conceptual model concepts with theory concepts

- concepts of the theory
- operational definitions
- empirical indicators.

These links are represented through diagrams.

As an example of a conceptual-theoretical-empirical structure, Fawcett and Downs analyze Neuman's Systems Model (Neuman, 1982), a conceptual model of nursing which links primary prevention and postoperative information, stressors and surgery, lines of defense and coping behaviors, and impact of stressors and postopertive symptions in order to form a model. Such a model can be verified only through testing the propositions inferred from it.

Rogers' Diffusion of Innovations Theory. Everett Rogers' Diffusion of innovations theory is an example of a conceptual framework relevant to education. Diffusion of innovations theory is familiar to instructional technologists because the concept of diffusion of innovations has been included in instructional design models. Rogers' theory provides a model which incorporates the four main elements of the process: channels of communication, characteristics of an innovation, phases in the process, and influence of the social system and personalities. These domain elements evolve from variables identified through research. He provides definitions of each of the concepts used in the model. In addition, there are theoretical constructs, such as trialability, compatibility, observability, and complexity, which are used to explain characteristics of an innovation. Each of the elements in the model has related constructs on a theoretical level. These constructs are linked to the operational definitions used in the research Rogers reports through case studies. For example, rate of awareness-knowledge and rate of adoption are defined as measured by a study. Concepts at the model, theoretical and operational level are related to principles (propositions) presented in the form of generalizations, for example, "Change agent success is positively related to extent of change agent effort in contacting clients" (Rogers, 1983, p. 317). Rogers' conceptual framework has provided the basis for much subsequent research by others in many fields. By building a basis for research questions through classification, he energized an area.

Theoretical Systems. When used in conjunction with conceptual frameworks, such as communication theory, taxonomies gain even more meaning due to the clarification of their relationship to other constructs and taxonomies. The power of the taxonomy is increased not by the power to predict, but rather by the clarification of links. A conceptual system combined with a taxonomy is called a theoretical system that provides an interrelated system of concepts. A theoretical system has more power than either the conceptual framework or taxonomy alone because it both explains and predicts. Theoretical systems can lead to axiomatic theory.

How do conceptual frameworks differ from theoretical systems? They do not have the explanatory or predictive power of a classification system that establishes propositions deductively. To a point conceptual frameworks and theoretical systems are similar. Both include interrelated concepts and propositions. Both systematically define relationships and guide empirical research. Theoretical systems, however, interrelate taxonomic description and conceptual models to the extent that propositions can be both deduced from each other and verified empirically (Frankfort-Nachmias & Nachmias, 1992).

As described, theory construction often proceeds from a general level through increasing levels of specificity or focus. Frankfort-Nachmais & Nachmais (1992) call this the transition from the conceptual to the observational level. The last observational level reached is specifying research questions or hypotheses and testing them out. This is why it can take many years, decades sometimes, to develop and test a complete theory, to move from taxonomic analysis to conceptual framework to theoretical systems. In the process "concepts gain empirical meaning from operational definitions and gain theoretical meaning within the context of the theory within which they are employed" (Nachmias & Nachmias, 1981, p. 39). Errors in theory construction can occur when theory is not related to practice and when moral philosophy is mistaken for theory.

Harvey's Theory of the Development of Conceptual Systems. O. J. Harvey's theory of the development of conceptual systems is an example of a theoretical system relevant to education (Harvey, Hunt, & Schroder, 1961).

In his work on belief systems and how they are formed, or as he calls them conceptual systems, Harvey postulated that "as one grows older, the systems one uses progress from a more concrete to a more abstract nature" (Wrightsman, 1977, p. 88). He and his associates proposed four conceptual systems differing in structure and content. The first system is a concrete and rigid belief system. It is characterized by extrinsic religiosity, authoritarianism, conventionality and extremes in judging others. The second system is a belief system that is characterized by rebelliousness towards authority. System 2 people are as inflexible and undifferentiated as System 1 people. System 3 people are open to more differentiation and integration of concepts. They are not as negative as System 1 or 2 people. In fact, they emphasize positive beliefs and see others as likable. They are dependent on others for approval and like others to depend on them. They can be manipulative. System 4 people are the most abstract. They establish interdependent relationships, are positive about themselves and others, remain open to change and are neither authoritarian nor accepting of authoritarianism. They are able to accept more cognitive complexity.

Harvey and his colleagues presented their conceptual framework and defined the concepts associated with each system. They related their model to research. Because concepts were ordered by increasingly complex belief systems, they provided taxonomic description with a conceptual framework, thus creating a theoretical system. By breaking each system into constructs and relating each system to stages in cognitive development, they presented a theory of personality development based on stages of arrestedness due to openness or closedness. The four personality organizations which evolved are reliable unilateral, unreliable unilateral, protective interdependent, and informational interdependent. They even used taxonomic language to discuss their principles of ordering:

> Let us consider the cases of an avid atheist and a zealous believer in God: in terms of many behavioral criteria or attitudinal classifications, these two persons might be viewed as opposites. This classification rests upon the phenotypic yardstick of directionality toward the referent God. If they were considered according to the more genotype aspects of their ways of relating to God, the atheist and the zealous

> believer might be seen as very similar to each other, more similar in fact than either would be to a person to whom the object, God, had little personal relevance. (Harvey, Hunt, & Schroder, 1961, p. 2)

Harvey, Hunt, and Shroder present a theoretical system with propositions that flow from each other and the research literature deductively. These propositions can be tested empirically.

Criteria for Classification Theories

Regardless of whether a classification system is at the level of conceptual framework or theoretical system, its value is judged by criteria for theoretical power. The most important criterion for evaluation of theory are significance and usefulness. A concept is significant only when it is related to other concepts. The more laws or propositions a concept engenders, the more significant it is. But "an array of concepts does not constitute theory; a theory emerges only when concepts are interrelated in the form of a scheme...isolated concepts are of no theoretical value" (Watson & Johnson, 1972, p. 11).

A theory may be significant or useful but unaccepted by others in the professional community. The story of Jonas Salk and the development of the killed virus polio vaccine illustrates this. Prevailing wisdom was that you could induce lasting immunity to a viral infection only by first provoking a weak infection. Salk's work on influenza led him to believe that a killed virus vaccine would work and be less risky. He also believed the process of developing vaccines could proceed more quickly if the usual procedures were changed. He acted on these assumptions and proved himself right. In the process though he angered many fellow scientists. To this day he hasn't been elected to the National Academy of Scientists, the foremost honor for a scientist other than the Nobel prize. As a departure from the traditional concept of science in 1960 he founded the Salk Institute, which has become a pre-eminent facility for basic research in biology. His early work on an AIDS vaccine, which was dismissed by many other scientists, is showing promise (Heuck, 1994).

Even if peers fail to recognize relevance or explanatory power when a theory is introduced, a theory can be significant. Conversely, a theory recognized by peers as significant can prove to have little explanatory power when tested over time.

> Theories should reflect the phenomena of interest to a discipline...The criterion of significance requires that a theory not only address relevant phenomena, but also that it provide both precision in prediction and explanatory power...Explanatory power refers to the degree to which a theory contributes to understanding...
>
> A theory may gain wide acceptance in the public sector, yet be a misleading or even false explanation of a phenomenon. Gall's theory of phrenology and Reich's theory of orgone energy are examples. Conversely, a theory may be scorned by scientists and/or the public because it goes against current thinking or because it represents such a major leap in knowledge that it cannot be comprehended. An example of the former case is Darwin's theory of evolution; an example of the latter case is McClintock's theory of genetic variability. Everyone knows about Darwin's theory; McClintock's may not be so familiar. McClintock, the winner of a 1983 Novel Prize, found that genes are not fixed on the chromosome, but rather can move around in an unpredictable manner and cause unexpected changes in heredity. Although her 'jumping genes' theory was first published more than 30 years ago, its significance has been acknowledged only in the past few years. (Fawcett & Downs, 1986, p. 54, 56)

The explanatory power of a theory is not always given appropriate credence or criticism when it is introduced.

In addition to significance, Fawcett and Downs suggest that power of a theory to explain and predict can be determined by considering the internal consistency, parsimony, testability, and operational, empirical and pragmatic adequacy of the theory. Internal consistency requires logical and complete progression between each of the components of the theory from the conceptual level to the observational level. It should be remembered that a theory can be examined from one of two viewpoints, theory then research or research then theory (Frankfort-Nachmias & Nachmias, 1992). In either case, the criteria should include explanatory power and predictability; although predictability can be interpreted in different ways. Predictability may mean the agreement of experts with the theory. Thus, bias due to situation may enter through determination of explanatory power.

The criteria of testability requires that one be able to replicate the research that supports the theory. An example of theory in instructional technology that has yet to meet the theory of testability is Gavriel Solomon's theories about filmic codes and amount of invested mental effort (AIME) as they effect learning from television. Although some have tried to replicate his studies, their findings have not been consistent with his and remain unreported (C. M. Cambre, personal communication, November 28, 1994).

Classification Systems in Instructional Technology

Classification systems in instructional technology have been proposed for film and television attributes, computer-based instruction, media classification and research, cost evaluation, and learning outcomes. Examples of attribute taxonomies include content structure in television news (Schultz, 1982 cited in Gunter, 1987) and the formal features used in advertising (Young, 1990). Examples of other types of classification are given next. This section will cover some representative approaches to classification systems in IT and ways to promote further development of such approaches and the domain classifications presented in the AECT definitions.

Representative Approaches

These classification proposals are organized chronologically and identified by the name researcher who proposed the approach or by the area in which the classifications cluster.

Edgar Dale's Cone of Experience. In 1946 Edgar Dale published the first "Cone of Experience" model for media selection. Since then this model has been published in many languages and continues to be used around the world. The model presented a schema for classification with accompanying taxonomic information in the form of elaboration through discussion. This was one of the earliest explorations of classifications in the field. The cone classified media on a concrete to abstract continuum from direct, purposeful experiences to symbolic experiences.

Learning Classifications. Taxonomic development of learning classifications has relevance to several domains in instructional technology. One type of schema used in taxonomic theory is learning classifications. Within the discipline of education there have been many efforts to classify

types of learning. The most well known are the taxonomies of educational objectives by Bloom, Krathwohl and others and Gagne's classification of learning outcomes (Gagne, 1985b; Bloom, 1956; Krathwohl, Bloom & Masia, 1964; Harrow, 1972). However, there are many other classifications of objectives, several of which are described by Martin and Briggs (1986). The schema for the taxonomies of educational objectives was psychologically based by the division into cognitive, affective, and psychomotor domains.

Both the affective domain and the cognitive domain taxonomies were criticized for calling themselves taxonomies on the basis of the principle of complexity (cognitive domain) and principle of commitment (affective domain). Moreover, the taxonomies were attempts to classify phenomena not as easily observed or manipulated as phenomena in the physical and biological sciences. The cognitive domain taxonomy offers a case study of a successful heuristic framework. It is clear that the cognitive domain at least has stimulated thought and led to new insights and understandings. Its most important role has been to reveal the relative emphasis schools placed on memorization compared with higher order learning objectives (Krathwohl, 1994).

The taxonomy has been criticized as linear and behavioristic, rather than representing the views of cognitive science and cognitive development psychology. Rohwer and Sloane (1994) report that the cognitive science perspective would accept the representation of knowledge or learning as cumulative, but not hierarchical because the organization of learning depends on the structure of the domain being learned. From a cognitive science perspective the classification would be more valid if differences in knowledge of experts and novices was recognized through the taxonomy. Rohwer and Sloane also argue that if the taxonomy had been organized around a cognitive development perspective, it would have been organized by stages rather than knowledge domains, for example, spatial reasoning, verbal reasoning, social reasoning.

Another basis for criticism of the taxonomies of educational objectives is the lack of empirical evidence to support them. After forty years, the major research on the cognitive domain is a few studies correlating the opinions of experts with the levels of the domains (Furst, 1994). When trained, expert

raters do agree on categories, especially at the lower levels. Nevertheless, many believe that synthesis should be a higher level than evaluation, that sometimes analysis is no more difficult than comprehension, and that sometimes comprehension is more difficult than application. Postlethwaite (1994) summarizes these criticisms:

1. The distinction between any two levels of the Taxonomy may be blurred.
2. The Taxonomy is not hierarchical; rather it is just a set of categories.
3. The lockstep sequence underlying the Taxonomy based on any one dimension (e.g., complexity or difficulty) is naive. (p. 175)

These taxonomic models are offered as a way of viewing, explaining, and categorizing learner behaviors or mental processing. Learning classifications are used in many ways within the domains of instructional technology. They are tools for sequencing, for matching test items to objectives, for determining consistency between steps in the instructional systems design approach, and, for writing objectives.

Okey (1973) discussed the problems of developing and validating learning hierarchy taxonomies. He concluded that although intellectual skills have been shown to be hierarchical, there is little evidence to indicate other types of learning are hierarchical. He describes a variety of techniques for validating hierarchies. Martin and Briggs (1986) pointed out that while lower levels of the taxonomies of educational objectives have been validated, the upper levels have been found to classify less reliably. Martin and Briggs also noted that there has been little effort to integrate taxonomic concepts between domains although theory indicates relationships between domains. Douglas and Douglas (1972) proposed a way to related the taxonomies of affective and cognitive objectives by planning an ideal learning path. This path was developed by pairing the lowest levels of each domain and guiding the learner from lower to higher levels in each domain concurrently.

Despite problems of integration, validation and reliability, learning classifications provide important taxonomic tools for instructional technology. Furthermore, they may be tools appropriate to organizing domain subcategories in instructional technology.

Salomon and Snow's Classification of Film Attributes. Salomon and Snow (1968) clarified constructs that could be used in studying the psychological effects of media attributes. They argued that the information processing approach should be used to identify psycholinquistic factors in learning from films. They reviewed only a few of these attributes, such as simultaneous or linear presentation and information loads of long shots or close-ups depending on context. Their analysis was not complete enough to warrant the label classification system.

Butler and Liske's Classification System for Media. Over the years there have been attempts to develop classification systems for media that could support utilization and management of resources (Bretz, 1971). Butler and Liske (1972) established the need for an improved media resources classification and coding system by reviewing existing classification systems for various media and the principles they were based on, and then, identifying problems faced in developing such a taxonomy and proposed solutions. They did not offer a taxonomic structure.

Wilkinson's System for Costing Technology. Wilkinson (1973) proposed a typology for concepts related to cost evaluation of technology. This typology is presented in Figure 4. Classification system for costing terminology.

Insert Figure 4 about here

He then tied this classification system to determination of alternatives and decision making models. Although this approach provides an ad hoc classification system, it is not taxonomic.

Clark's Taxonomy of Media Attributes. Clark (1975) proposed a taxonomy of media attributes which would facilitate research. After reviewing research on media concerned with relevant attributes, he proposed a media taxonomy cube as an organizational rubric for research variables in instructional technology. The cube is a 3 x 3 x 3 matrix with sides for media attributes, subjects, and behaviors. The intersection of each cell thus represents the interaction of media, learner and task characteristics. Clark felt that such a taxonomy would make media research more generalizable and

would be appropriate for a field that emphasized aptitude-treatment interaction research. His Media Taxonomy Cube is shown in Figure 5.

Insert Figure 5 about here

In his article Clark reviewed a number of other attempts at taxonomic classification in instructional technology. His approach was a good idea for a taxonomic structure but needed more definitional development to be useful.

Fleming and Levie's Principles of Message Design. Fleming and Levie (1978; 1993) authored two books about message design principles organized by types of learning. In the books, principles related to areas such as motivation, perception, memory, concept formation, problem solving and attitudes were presented. These books could be considered a start on a taxonomy of message design. Nevertheless, a practical taxonomy of message design principles would require schemata for the organization of principles in relation to each other, which Fleming and Levie do not provide except by inference from learning classification.

In 1967 Fleming designed a taxonomy of instructional illustrations that would include "physical types (size, color, etc.), verbal modifier types (captions, etc.), educational objective types, and subject matter types (p. 246). He operationally defined illustration as consisting of elements common to textbook pages: pictorial elements, verbal elements, and design elements (combinations that did not meet the definition of pictorial or verbal such as a picture plus captions, titles and arrows). Fleming designed a study to test and refine this taxonomy with a sample of textbook illustrations and to tabulate frequencies of occurrence of each type in sample textbooks. He concluded that the physical attributes could be classified easily and reliably by naive judges. Types of educational objectives addressed by the illustrations could be classified by experienced teachers. For example, he would ask teachers "With particular reference to the information obtainable from the illustration, which is the most appropriate type of behavior to expect from this student"? (Fleming, 1967. p. 249).

Instructional Strategies. Theories about instructional strategies, such as those developed by David Merrill and by John Keller (Reigeluth, 1983), vary

in the type of classification system they represent. Merrill's Component Display Theory (CDT) is taxonomic and approaches a theoretical system through propositions which can be tested empirically. The conceptual framework is vague, but this may be due to its relatively narrow domain. Nevertheless, it is one of the few examples of an IT theoretical system in the process of development in that it has a taxonomic components and a conceptual framework in addition to offering propositions that can be empirically tested. For CDT to reach the level of theoretical system, there needs to be more complete development of the taxonomy associated with it and its conceptual framework. If at some point it has these elements and a system of propositions that can be deduced from each other, then it will be a theoretical system.

Keller's Motivation Theory is also a theoretical system in process. Although it combines taxonomic classification with a conceptual framework, the linkages between constructs and propositions are often too general to be deducible or empirically testable. The interdependence of this area with other areas such as learner characteristics makes the development of empirically testable propositions difficult at this time. More conceptual theory is needed in IT and education for this conceptual framework to progress to a theoretical system.

Richey's Conceptual Model. Richey (1986) developed a conceptual model or schema for classifying variables in instructional design decision making. The model presented four variables, the learner, content, environment and delivery, and associated theory with each. It was intended to provide a method for consistent reporting of research on instructional design that would aid generalization, just as Clark's proposed classification of media attributes would. Richey's model can be used for research design and theory construction in that you can use it to identify gaps in the research and generate new theory based on research. In 1965 Meridith had presented a similar proposal for taxonomic classification using physical stimulus variables, subject variables, environmental variables, and behavior variables. Richey's model is a taxonomic classification because it provided categories and links between categories, but not propositions.

It is clear from this review of representative approaches that most classification efforts in IT are at a early level of development. Although many fine classification structures have been proposed, much more information needs to be conceptualized for taxonomic, conceptual framework and theoretical systems levels to be achieved. One should not, however, assume that every theory in a field is best in theoretical system form. Many types and levels of theory are needed to sustain a field. Conceptual frameworks are just as valuable for understanding of relationships in a developing area. Taxonomic classifications offer essential communication tools. Nevertheless, the domain structure of the 1994 definition and other classification efforts need to progress further towards taxonomies, conceptual frameworks and theoretical systems.

Taxonomic Development of the Domains

Currently, theory building around the domains is at an early stage, the stage of general conceptual structure and taxonomic development. Concepts and constructs have been defined for each domain, but few principles of ordering have been identified, nor have links between concepts been specified adequately. The literature from this field and other fields suggests some approaches to doing this. For example, schools of psychology appear to have some validity for classification in this field as do learning hierarchies, and media attributes. Another approach to taxonomy development might be to approach layers of specificity, for example, message design concepts in the design domain might be refined and related to principles and procedures in the development domain. Then, these relationships could be specified through tools for practice such as templates, job aids, diagrams and work sheets. The issue of how to integrate across domains and classifications continues to be important and unresolved (Seels, 1994).

Taxonomic development will be require a long term effort involving many experts from the field and many theorists. Because the definition can lose currency while this effort is underway, the 1994 definition and other classification systems should be treated as dynamic structures, open to change as any taxonomic effort progresses.

Discussion

A need for theory building using taxonomic classification is clear because without a taxonomic structure it will be impossible to progress towards conceptual frameworks or theoretical systems. The development of the domains is a long term goal that will require the efforts of many to achieve.

Initial actions that can be taken are suggested by Krathwohl's (1994) history of the process by which the cognitive domain taxonomy was developed. After soliciting support from the American Psychological Association (APA), Bloom, who conceived the need and the approach to develop the taxonomy, initially organized work on drafts for a writing meeting. A two and a half day writing meeting was held. Further work was delegated, and a preliminary edition prepared for distribution. A symposium was organized for the APA convention. Then, 1000 draft copies were widely circulated for reactions. They proved more useful in generating interest than in obtaining feedback. Revisions were made, and the final copy printed. This process is similar to that used in preparing the 1994 definition of the field (Richey and Seels, 1994).

For the 1994 definitional theory to meet the criteria of significance and usefulness, further development needs to be fostered. Ways in which this could be done include:

1. AECT can sponsor an invitational symposium on to address reactions to the domains, relationships between the domains and taxonomic issues. The symposium can be based on invited papers.
2. The relationship with the Professors in Instructional Design organization that was so fruitful in generation of the 1994 definition can be continued. Means to do this in relation to taxonomic issues can be explored.
3. Divisions can arrange discussions around the domain or domains of relevance to them, especially around process for taxonomic development.
4. Researchers can identify an area of taxonomic need and pursue it through integrative research reviews, cognitive mapping or descriptive research.

5. Practitioners with expertise in a domain can pursue taxonomic issues individually or in groups.

The significance of the 1994 domain structure of the field will depend on the effort expended in further theory building related to the domains, especially through taxonomic classification.

References

AECT Task Force on Definition and Terminology. (1977). *The definition of educational technology.* Washington, DC: Association for Educational Communications and Technology.

Barker, D. (1974, September). *Groping through grouping: A comparison of hierarchic and non-hierarchic strategies.* In Occasional Paper No. 26 of the Department of Geography. London: University College.

Blake, R. H. & Haroldsen, E. O. (1975). *A taxonomy of concepts in communication.* NY: Hastings House, Publishers.

Bloom, B. S. (Ed.). (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain.* NY: David McKay Company.

Bretz, R. (1971). *A taxonomy of communication media.* Englewood Cliffs, NJ: Educational Technology Publications, 1971.

Bruner, J. S. (1967). *Towards a theory of instruction.* Cambridge, MA: The Belknap Press of Harvard University Press.

Butler, L. and Liske, R. L. (1972). Classification and coding systems for media resources. *AV Communication Review, 20*(3), 296-306.

Clark, R. E. (1975). Constructing a taxonomy of media attributes for research purposes. *AV Communication Review, 23*(2), 197-216.

Dale, E. (1946). *Audio-Visual methods in teaching.* NY: Dryden Press.

Diesing, P. (1991). *How does social science work? Reflections on practice.* Pittsburgh, PA: University of Pittsburgh Press.

Douglas, J. and Douglas, H. (1972, February). Balancing the taxonomies. *Audiovisual Instruction.*

Dubin, R. (1978). *Theory Building*. NY: Free Press.

Easton, D. (1966). Alternative strategies in theoretical research. In D. Easton (Ed.),*Varieties of Political Theory* (pp. 1-13). Englewood Cliffs, NJ: Prentice-Hall,Inc.

Eboch, S. C. (1962). *A process and systems structure for the field of audiovisual communications*. Doctoral Dissertation, University of Southern California, 1962. Abstract: Dissertation Abstracts 23: 2444-45; January 1963.

Ely, D. P. (1972). The field of educational technology: A statement of definition. *Audiovisual Instruction, 17*(8), 36-42.

Ely, D. P. (Ed.). (1963, January-February). The changing role of the audiovisual process in education: A definition and glossary of related terms. Technological Development Project Mongraph No. 1. *AV Communication Review, 11*(1), Supplement No. 6.

Fawcett, J. & Downs, F. S. (1986). *The relationship of research and theory*. Norwalk, CN: Appleton-Century-Crofts.

Finn, J. D. (1953) Professionalizing the audio-visual field. *AV Communications Review, 1*(1), 6-17.

Fleming, M. (1967). Classification and analysis of instructional illustrations. *AV Communication Review, 15*(3), 246-258.

Fleming, M. and Levie, H. (Eds.). (1993). *Instructional message design: Principles from behavioral and cognitive sciences* (2cd ed.). Englewood Cliffs, NJ: Educational Technology Publications.

Fleming, M. and Levie, H. (1978). *Instructional message design: Principles from the behavioral sciences* (1st ed.). Englewood Cliffs, NJ: Educational Technology Publications.

Frankfort-Nachmias, C. & Nachmias, D. (1992). *Research methods in the social sciences* (4th ed.). NY: St. Martin's Press.

Furst, E. J. (1994). Bloom's taxonomy: Philosophical and educational issues. In Anderson, L. W. Anderson & L. A. Sosniak (Eds.), *Bloom's taxonomy: A forty year retrospective* (pp. 28-40). Chicago: University of Chicago Press.

Gagne, E. D. (1985a). *The cognitive psychology of school learning.* Boston: Little, Brown, and Company.

Gagne, R. M. (1985b). *The conditions of learning and theory of instruction.* NY: Holt, Rinehart and Winston.

Gunter, B. (1987). *Poor reception: Misunderstanding and forgetting broadcast news.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Harrow, A. J. (1972). *A taxonomy of the psychomotor domain.* NY: David McKay Company.

Harvey, O. J., Hunt, D. E., & Schroder, H. M. (1961). *Conceptual systems and personality organization.* NY: John Wiley and Sons.

Heller, J. L. (1986). *Studies in Linnaen method and nomenclature.* NY: Verlag Peter Lang.

Heuck, D. (1994, November 27). Salk at 80. *PittsburghPost-Gazette* , pp. A-1, A-10.

Hoover, K. R. (1992). *The elements of social scientific thinking* (5th Ed.). NY: St. Martin's Press.

Januszewski, A. (1994, December). *The definition of instructional technology: An intellectual and historical account.* Unpublished doctoral dissertation, Syracuse University, Syracuse, New York.

Kaplan, A. (1994). *The conduct of inquiry: Methodology for behavioral science.* Scranton, PA: Chandler Publishing Company.

Krathwohl, D. R., Bloom, B. S. and Masia, B. B. (1964). *Taxonomy of educational objectives: The classification of educational goals. Handbook II. Affective domain.* NY: David McKay Co.

Krathwohl, D. R. (1994). Reflections on the taxonomy: Its past, present and future. In In Anderson, L. W. Anderson & L. A. Sosniak (Eds.), *Bloom's taxonomy: A forty year retrospective* (pp. 181-202). Chicago: University of Chicago Press.

Lewin, K. (1944). Constructs in psychology and psychological ecology. In *University of Iowa Studies in Child Welfare* , *20*, 1-29. Iowa Child Welfare

Research Station. Reprinted in Cartright, D. (Ed.). (1951). *Field Theory in Social Science.* NY: Harper and Row, Publishers.

Lurie, E. (Ed.) (1962). Editor's introduction. In Louis Agassiz, *Essay on Classification* (pp. ix-xxxii). Cambridge, MA: The Belknap Press of Harvard University Press.

Martin, B. & Briggs, L. J. (1986). *The affective and cognitive domains: Integration for instruction and research.* Englewood Cliffs, NJ: Educational Technology Publications.

Marx, M. (Ed.). (1963). *Theories in contemporary psychology.* NY: Macmillan Publishing Co.

Meredith, P. (1965). Toward a taxonomy of educational media. *AV Communication Review, 13*(4), 374-384.

Nachmias, D. & Nachmias, C. (1981). *Research methods in the social sciences* (2cd Ed.). NY: St. Martin's Press.

Neuman, B. (1982). *The Neuman systems model: Application and nursing education and practice..* NY: Appleton-Century-Crofts.

Okey, J. R. (1973). Developing and validating learning hierarchies. *AV Communication Review, 21*(1), 87-108.

Parsons, T. & Shils, E. (1962). *Towards a general theory of action.* NY: Harper & Row.

Postlethwaite, T. N. (1994). Validity vs. utilitiy: personal experiences with the taxonomy. In In Anderson, L. W. Anderson & L. A. Sosniak (Eds.), *Bloom's taxonomy: A forty year retrospective* (pp. 174-180). Chicago: University of Chicago Press.

Reigeluth, C. M. (1983). *Instructional -design theories and models: An overview of their current status.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Richey, R. C. (1986). *The theoretical and conceptual bases of instructional design.* London: Kogan Page.

Richey, R. C. & Seels, B. (1994). Defining a field: A case study of the development of the 1994 definition of instructional technology. *Educational*

Media and Technology Yearbook Vol. 20 (pp. 2-17). Englewood, CO: Libraries Unlimited, Inc.

Ridley, M. *Evolution and classification: The reformation of cladism.* NY: Longman Group Limited.

Rogers, E. M. (1983). *Diffusion of innovations* (3rd Ed.). NY: The Free Press.

Rogers, E. M. (1962). *Diffusion of innovations.* NY: The Free Press.

Rogers, E. M., & Shoemaker, F. F. (1971). *Communication of innovation: A cross-cultural approach* (2cd Ed.). NY: The Free Press.

Rohwer, W. D. Jr. & Sloane, K. (1994). Psychological perspectives. In Anderson, L. W. Anderson & L. A. Sosniak (Eds.), *Bloom's taxonomy: A forty year retrospective* (pp. 41-63). Chicago: University of Chicago Press.

Salomon, G. & Snow, R. E. (1968). The specification of film attributes for psychological and educational research purposes. *AV Communication Review, 16*(3), 225-244.

Schuller, C. F. (1962, September). AV theory is essential: How do we build it? *Audiovisual Instruction,,* 436-437.

Seels, B. (Ed.). (1995). Instructional design fundamentals: Issues of integration. In B. Seels, *Instructional design fundamentals: A reconsideration* (pp. 243-249). Englewood Cliffs, NJ: Educational Technology Publications.

Seels, B. (1994). Visual literacy: The definition problem. In D. M. Moore and F. M. Dwyer, *Visual Literacy: A Spectrum of Visual Learning* (pp. 95-112). Englewood Cliffs, NJ: Educational Technology Publications.

Seels, B. B. & Richey, R. C. (1994). *Instructional technology: The definition and domains of the field.* Washington, DC: Association for Educational Communications and Technology.

Wallington, C. J., Hyer, A. L., Bernotavicz, F. D., Hale, P & Silber, K. H. (1970). *Jobs in instructional media.* Washington, DC: Department of Audiovisual Instruction.

Watson, G. & Johnson, D. (1972). *Social psychology: Issues and insights.* Philadelphia: J.B. Lippincott Company.

Wilkinson, G. L. (1973, Spring). Cost evaluation of instructional strategies. *AV Communication Review, 21*(1), 11-30.

Winn, W. (1989). Toward a rationale and theoretical basis for educational technology. *Educational Technology Research and Development, 37*(1).

Wrightsman, L. S. (1977). *Social psychology.* Monterey, CA: Brooks/Cole Publishing Company.

Young, B. M. (1990). *Television advertising and children.* Oxford: Clarendon Press.

Zetterberg, H. L. (1965). *On theory and verification in sociology* (3rd ed.). Towowa, NJ: Bedminster Press.

Figure Captions

Figure 1. AV relationships to the educational-communication process. From "The Changing Role of the Audiovisual Process in Education: A Definition and Glossary of Related Terms." edited by D. P. Ely, 1963, *AV Communication Review, 11*(1), p. .

Figure 2. The domains of the 1972 definition. From "The Field of Educational Technology: A Statement of Definition." by D. P. Ely, 1972, *Audiovisual Instruction, 17*(8), p. 40.

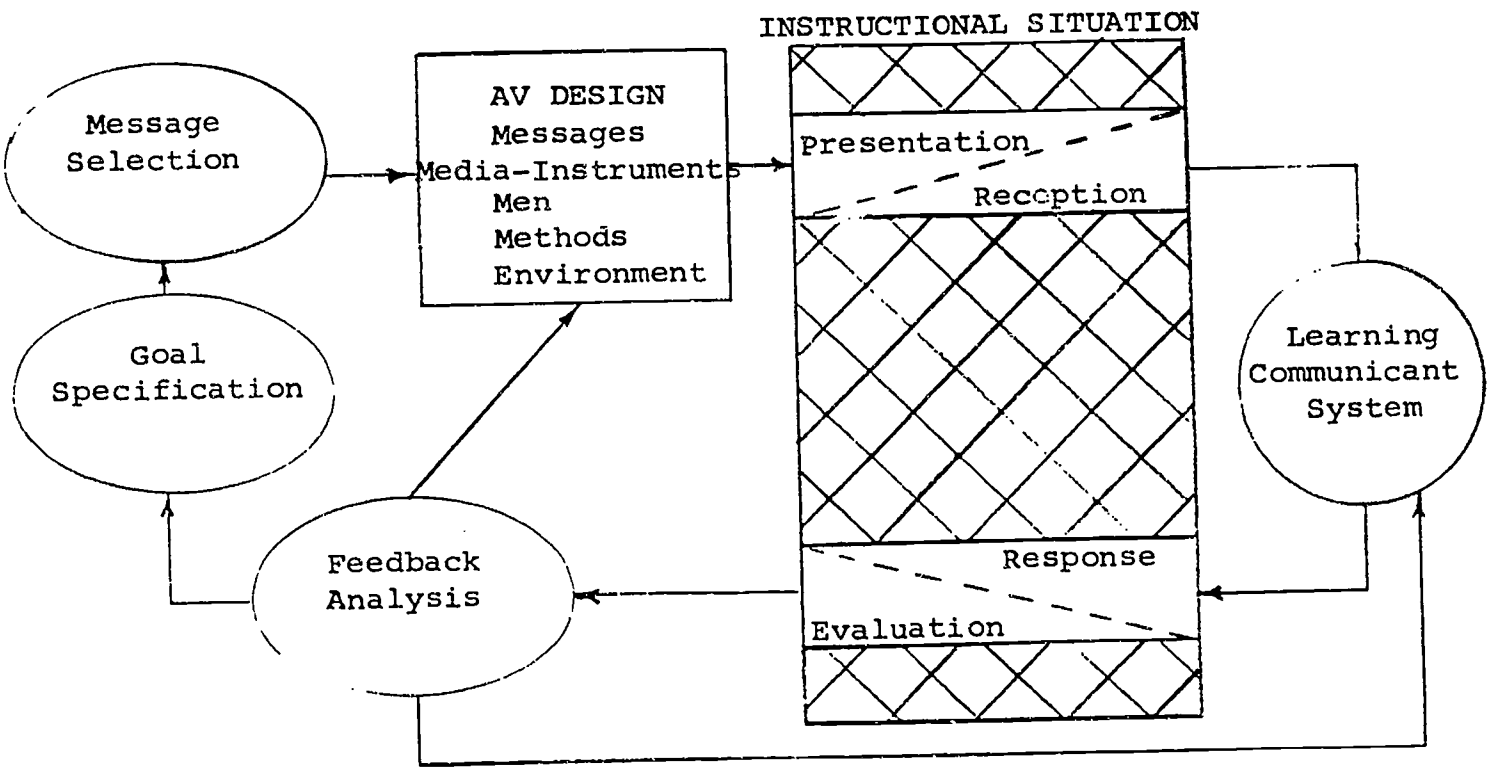
Figure 3. Domain of Instructional Technology. From*The Definition of Educational Technology.* by the AECT Task Force on Definition and Terminology, 1977, p. 3. Washington, DC: Association for Educational Communications and Technology.

Figure 4. Classification system for costing terminology. From "Cost Evaluation of Instructional Strategies." by G. L. Wilkinson, 1973, *AV Communication Review, 21*(1), p. 12.

Figure 5. Media taxonomy cube. From "Constructing a Taxonomy of Media Attributes for Research Purposes." by R. E. Clark, 1975, *AV Communication Review*, 23(2), p. 209.

Figures.

Figure 1. AV relationships to the education-communication process.



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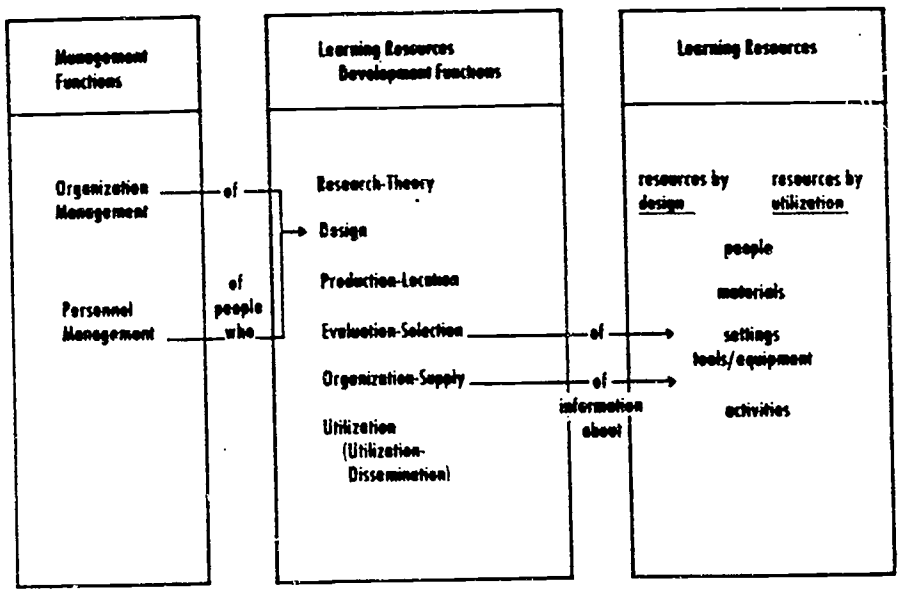

Figure 3. The Domain of Instructional Technology

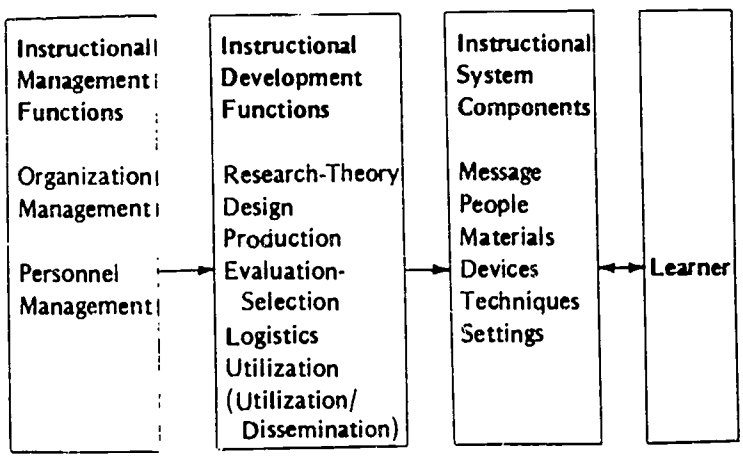

Figure 4. Classification system for costing terminology.

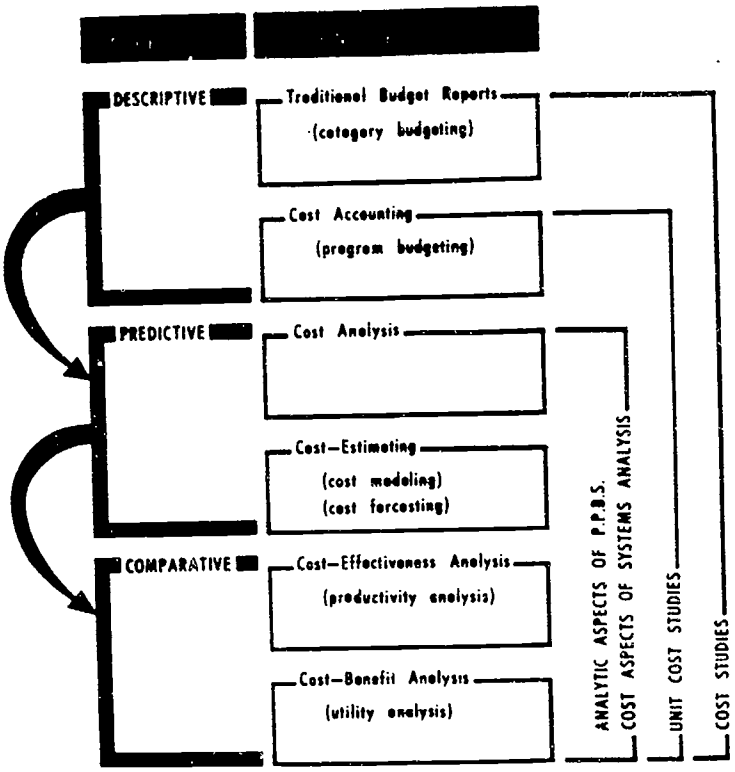

Figure 5. Taxonomy of media attributes.