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ABSTRACT

Sound practice requires sound theory, and if instructional technology is to mature either as a field or a profession, theory that not only speaks to those problems unique to the field, but is also conceptually sound is required. Instructional technology, though having a practical focus, must build conceptual theory bases rather than relying primarily upon the use of procedural models. This position implies: (1) expanding our knowledge base by addressing processes, variables, and outcomes previously not studied in a systematic fashion; (2) constructing theory in many formats in addition to that of a procedural model; and (3) establishing an empirical foundation for and validation of those procedural models that currently serve as theory. The discussion includes an introduction to the nature of conceptual theory; techniques for the expansion of conceptual theory base in information technology; and validation of the field's existing procedural models. (Contains 25 references.) (MAS)

Expanding Instructional Technology's Foundation of Conceptual Theory

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Expanding Instructional Technology's Foundation
of Conceptual Theory

Once a year I teach a course for the Wayne State Instructional Technology doctoral students who are beginning to plan their dissertation research projects. I typically start this class by recounting a parable once printed in a 1963 issue of *Science* magazine in a letter written by Bernard K. Forscher (National Council of Teachers of Mathematics, 1967). It is a story of builders who constructed edifices (called explanations or laws) by assembling bricks (called facts). The builders were guided by special documents (called theory). In time, however, the production of bricks became paramount and began to take precedence over the construction of buildings. Soon, the ground became cluttered with bricks, especially those which were easy to make. Worse yet, it became difficult to build a useful edifice because as soon as the foundation was made, it was buried under an avalanche of random bricks, and alas, sometimes it was even impossible to tell the difference between a pile of bricks and a true edifice. The point of this paper is basically the same as was made in the parable -- an argument supporting buildings rather than a pile of bricks.

While Instructional Technology's initial foundation had more stability than that provided by only a pile of bricks, the foundation consisted of theory from *other* disciplines. Today, we are in the process of establishing our own disciplinary identity, and this process is substantially a task of developing theory which is unique to our own problems and concerns. Hence, there is a need to be mindful of the distinctions between a building and a pile of bricks.

Even though research has always influenced the work of this field (Knowlton & Tilton, 1929; Hoban, Hoban & Zisman, 1937; Dale, 1946), there has traditionally been less emphasis on formal theory. In 1981, Dick indicated that the instructional systems design models *were* the theory of the field, at least the theory of the design domain. This was an typical perception of the time, and is not uncommon today. However, more recently, there have been those in the field who are arguing for an expansion of our theory base, not simply to develop theory unique to Instructional Technology, but also to expand the form and scope of our theory. For example, Winn (1988, 1989) has advocated emphasizing predictive and descriptive theory as a basis for practice, and Clark (1989) has called for prescriptive theory with more front-end conceptualization in our research.

The intent here is not to argue for a particular theory, but rather to further discuss the thesis that our field -- even though we have a practical focus -- must build *conceptual* theory bases, rather than relying primarily upon the use of procedural models as theory. This position implies:

- expanding our knowledge base by addressing processes, variables, and outcomes previously not studied in a systematic fashion;
- constructing theory in many formats in addition to that of a procedural model; and also
- establishing an empirical foundation for and validation of those procedural models that currently serve as theory.

Each of these goals involves increasing the research of the field, but more importantly each demands using theory to guide this research and systematically synthesizing the findings into new theoretical positions instead of only constructing new procedures. These goals pertain to the need to build edifices rather than bricks, and when we do make bricks to make them with a purpose in mind.

The Nature or Conceptual Theory

Theory has been defined as "a set of related propositions that attempts to explain, and sometimes predict, a set of events" (Hoover, 1992, p.66). Hoover further notes that the term has a tentative nature. Theory demands that its validity be tested and credibly established. An alternative, but not totally unrelated, definition suggests a theory is constituted in terms of "two or more variables linked by rule and a set of limiting conditions" (Meehan, 1994, p. 115). Others have identified various types and levels of theory which vary in terms of format and formality. (See Richey, 1986, for a more detailed discussion.)

The purposes of theories are to describe, explain, predict, and (in some schemes) to control human events. Their value is a function of not only accuracy, but also of utility (Meehan, 1994). As such, theory is not the antithesis of practice, but instead is intimately related to practical pursuits. They are also judged in terms of their levels of generality and parsimony, as well as the extent of causality which they describe (Przeworski & Teune, 1970). However, theories can also predict the states of a model as well as predict values of variables (Dubin, as discussed in Schwen, 1977). Theories come in many forms, and have varying degrees of robustness. They can be formal systems of laws and propositions. They can be narrative explanations and predictions. They can be models which are either verbal, visual, or mathematical.

In one sense all theories are conceptual. They all pertain to ideas. The term "conceptual", however, is being used here to distinguish those theories which address generalized and/or abstracted variables from the procedures advocated for the practice of Instructional Technology. Systems of law are conceptual theory. They are statements of generalized relationships among variables. Narrative explanations of a particular set of events are conceptual. They typically have much the same function as systems of laws, describing, explaining, and predicting. There are conceptual models which are general, verbal descriptions of a view of reality. They, too, identify and describe the predictive relationships among variables.

Procedural models, even though not classified as conceptual theory, can have a theoretical foundation. There is an *implication* of cause-effect relationships among variables. For example, design procedures imply that learning will take place with instruction designed in such as fashion. Hence, they are viewed by some as theory.

There are two concerns in this paper -- theory in general (and its related research) and conceptual theory in particular (as opposed to procedural models). The following sections will discuss the ways in which the field of Instructional Technology can expand its conceptual theory.

Techniques for Expanding Conceptual Theory

Expanding the Scope of the Instructional Technology Knowledge Base

An obvious way of expanding the field's conceptual theory is to expand the topics which our theory typically address. The current conceptual scope of the field has been described in the new AECT endorsed definition of the field (Seels & Richey, 1994). This orientation encompasses five domains of activity in Instructional Technology -- design, development, utilization, management, and evaluation. To date research and theory in the field has been primarily concentrated in the design domain, and less theoretical activity has addressed problems of development, management, utilization, or evaluation. A more detailed taxonomy of each of the domains could provide guidelines for future theorizing.

However, even when responding to such a framework, there are conceptualization tasks to be completed, including the:

- identification of critical outcomes and processes of the field; and
- identification, definition, naming, and measurement of values of constructs pertinent to these outcomes and processes.

Winn (1989) has argued that the field's theory should be cognitive in nature and directed toward learning outcomes. This is surely an appropriate tactic for design theory, but there are other orientations possible. For example, we have even less non-procedural evaluation theory than we have design theory. Some new evaluation topics, such as confirmative evaluation, have been recently introduced (Hellebrandt & Russell, 1993). This topic, for example, could be the target of theory development by highlighting the *process* rather than the procedures. Related conceptual theory could be directed towards problems such as: What are the events which contribute to and explain institutionalization of an innovation? What are the events which contribute to and explain knowledge utilization in new settings? We also have little theory which explains effective dissemination, or technology utilization, or policy formation. Even when addressing design concerns, the field has not developed *conceptual theory* around design processes such as reducing cycle time, for example. The initial conceptualization in each of these cases involves identifying critical outcomes and processes of the field.

The development of new theory also involves defining and explaining those constructs fundamental to the theory. This is often an area conducive to creative thinking and innovation. Past example of this activity can be found in Carroll's early work in which he initiated the study of time (including time available and time-on-task) as an important predictor of learning (Carroll, 1963). The identification and emphasis of this construct was one of the most important steps in Carroll's theory building. Today, new construct identification is also occurring in our field. Notable examples are in the introduction of the notions of "cycle time", of "designer decision-making", and certainly the conception of "multi-media" has substantially been redefined. These constructs become the conceptual building blocks of new theory.

Expanding the Forms of the Instructional Technology Theory Base

Formal Systems of Law and Proposition. Theories formally constructed as systems of law are the most traditional theory format, and at the same time the rarest theory form in Instructional Technology. However, the term "theory", used in this sense, can take many forms short of being a full-fledged system of laws. It can take the form of a hypothesis (even an initial and unsubstantiated hypothesis), or the form of a set of related propositions. These "theories" are built around suggested relationships among variables. Constructing theory of this type is typically a quantitative process, whether the task is approached inductively or deductively.

We have few examples of conceptual theory of this type in Instructional Technology. Some would applaud this situation. Heinich (1984) stressed that since Instructional Technology is an applied field, its scholarly orientation should *not* be in the direction of theory which is primarily concerned with cause and effect, but rather should be concerned with means-ends relationships. He asserted that the field was in need of scholars who concentrated on field-based investigations, especially studies of development. There are those today who would continue to support this position and would tend to reject conceptual theory of this first type.

Even though there is a historical precedent for formal theoretical systems to arise only from basic research, this is not essential. Traditional theory development can be rooted in research in applied, real-life settings as well as from experimental environments. I have developed a preliminary set of propositions related to the design of instruction for adult learners (Richey, 1992). The theory is directed toward identifying those factors that predict various learning outcomes in a training environment. It is based upon replicated empirical studies which were conducted in naturally occurring employee training programs. The research uses traditional, quantitative methodologies.

While there is little formal *theory* which predicts variable relationships, the field does have many examples of *research* which fit into this category. Most issues of *Educational Technology Research and Development* describe studies of variables and their relationships to each other. These studies are, by and large, attempting to establish fact, but often are not designed as a step in systematic theory building. This body of literature can be synthesized to develop hypotheses, but there is a tendency to accept *hypothesized* theory (especially that of a somewhat formal nature) as *verified* theory. If we were to seriously begin expanding our formal theory base, we would need to not only systematically synthesize such research findings into statements of principle, but also empirically confirm and validate these principles.

Narrative Descriptions of the Field. Traditional theory tends to be based upon quantitative research, but more narrative explanations of the critical processes and outcomes of the field are often based upon qualitative research. This type of theory has been described as being the "mirrors of man" and is developed so that we can see ourselves better (Kluckhohn, as noted in Diesing, 1991).

Currently, there is a new body of research in designer decision-making and problem solving that has the potential of developing into conceptual theory of this type. Much of this research is qualitative (Nelson, 1990; Rowland, 1992), and its primary goal is to understand the process of instructional design and the nature of design thinking, rather than to construct another procedural model. This research describes and explains factors such as the instructional design task environment (Goel & Pirolli, 1988; Kerr, 1983), and the cognitive process of instructional design (Akin, Chen, Dave, & Pithavadian, 1986). This body of literature exemplifies the development of new theoretical constructs (e.g. designer thinking, design task environment), and the construction of narrative theory.

Models as a Theory Form. The third form of theory relates to models of dynamic processes. The procedural models of instructional systems design are still viewed by many as authoritative theory. The argument here is that even though procedural models can be appropriately viewed as a type of theory, they should not be the exclusive theoretical format in this field, and we should instead expand our models to include conceptual models as well.

Conceptual models are typically general, verbal descriptions, and in Instructional Technology these models tend to address processes. While not true *explanations* of such processes, they are, nonetheless, analytic since they identify the process components and the relationships between these elements. While such models can be narrative or taxonomic, most models in Instructional Technology are visual. Dale's Cone of Experience or Carroll's Model of School Learning are prime examples (Richey, 1986).

What tasks are involved in expanding the field's model-based conceptual theory? These question can be answered in two ways. The most basic way is to construct and validate new models pertinent to the field. This can be accomplished in either an inductive or a deductive fashion, or at times by using a combined approach. Model construction is not fundamentally different from constructing other theory. Hypothesized models are based upon an interpretation of both the research literature and current practice, and they are subsequently tested to validate its components and measure the strength of the relationships among these components.

Validation of the Field's Existing Procedural Models

The proliferation of procedural models in Instructional Technology has led to a call for the construction of new conceptual models for use as theory, but it does not mean that procedural models do not have a role as a type of theory. It does mean that they need to be validated to warrant continued use either as basis for theory construction or solely as a communication or planning tool. Too many of our models, be they general models describing the steps in instructional systems design or more specific models of lesson design, lack empirical support. In other words, they are generally accepted without being tested and confirmed. Testing can occur in a variety of ways, although it is most likely to occur through evaluation research or through developmental research.

Gustafson (1991) has outlined a way to scientifically validate instructional design and development models.

> Such validation would require precise descriptions of the elements of the model followed by systematic data collection concerning the application and impact of those elements. The investigator would also need to be alert to possible discrepant data not accounted for in the model. Repeated trials under such conditions would, if the model had any validity, result in a precise set of findings regarding the conditions under which the model was valid (p. 47).

This method would be appropriate for validating the vast majority of procedural models in the field. It would also provide a basis for using our existing procedural models as a stimulus to new theory construction. Once the factors that influence the effectiveness of the procedures have been identified and the relationships and dependencies among those factors have been explained, it would then be possible to construct a *conceptual* model describing those procedures in terms of their underlying processes. Such an endeavor may or may not result in changing the original procedural model, but it would contribute to the expansion of the conceptual theory base of the field.

Conclusions

As Gustafson (1991) so delicately noted, there are far more practitioners in this field than theorists. While most of these practitioners pay little attention to the musings of those who worry about theory, it still is worth noting that even in applied fields sound practice continues to require sound theory. Yet sound theory can not be equated to research, even large amounts of research which generates significant findings. If Instructional Technology is to mature either as a field or a profession, we must develop theory that not only speaks to those problems unique to us but also is conceptually sound.

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