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Transition to Cognitive Learning Theories

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ABSTRACT

The roots of instructional theory can be traced to early efforts by educational psychologists to develop a connection between the science of psychology and the practical application of learning theory in educational settings. Two theorists of particular importance at the turn of the century were John Dewey (1910), who envisioned a special linking science between learning theory and educational practice, and Edward Thorndike (1913), who investigated principles of learning that could be directly applied to the teaching process (i.e., the laws of effect and exercise). Thorndike developed a body of instructional design principles that included task analysis and teaching methods based on his research findings and student evaluation methods.

Keywords: Instructional technology; Learning theory; Instructional design; Technology; Theoretical foundations

Technology and Instruction

In the 1950s, two developments outside the fields of education and psychology played an important role in establishing momentum for increased instructional theory research. First, the post World War II baby boom presented a challenge to the existing educational system. Within a very short period in the early 1950s, schools were forced to absorb a significant increase in students, necessitating rapid changes in instructional methods. Second, in 1957, the Russians launched Sputnik, shattering the comfortable image of American educational and technological superiority and calling into question the adequacy of contemporary methods of instruction. In response to the perceived challenge, the United States government increased its interest in and funding of research and development of new curricular and teaching methods.

Early Developments

In the early stages, instructional theory was defined primarily in behaviorist terms as follows:

Small, incremental steps sequenced to link information in a logical order; active learner participation in responding to instructional stimuli with immediate feedback as a positive reinforcer. Learner progress is based on successful attainment of defined behavioral objectives.

The instructional design field was seen as an attempt to develop a single, ideal instructional theory based in systems theory that would specify teacher characteristics, classification and evaluation procedures, and means to modify the design systems being tested. The goal from this perspective was the development of instructional programs that would enable the majority of students to achieve levels of performance that were pre-determined in terms of behaviorally defined objectives.

Transition to Cognitive Learning Theory

Instructional design researchers in the 1970s tried to establish a more complete picture of the conditions of learning. Theories sought to incorporate individual differences into the instructional design process, leading to the extensive use of pretests and formative evaluation procedures. Research was centered on identifying those aspects of cognitive psychology that were central to the design of instruction.

Information Analysis

Cognitive researchers used information analysis to identify the levels of learning that distinguish a novice from an expert in a subject-matter domain. Much of the research work was on describing the complex structure and sequencing of cognitive processes such as attention, memory, and recognized the importance of perception in the performance of individuals who are highly skilled in specific domains.

Content/Task analyses

This trend toward methods of information analysis continued with advancements coming first from cognitive psychology and more recently from constructivist theory. Thus, an important component of instructional design theory is the analysis of the information-to-be-learned. Two basic types of information analyses included: (a) a content analysis, which focuses on defining the critical attributes of the given subject matter and the relationship of those attributes according to superordinate and subordinate organizations; and, (b) a task analysis, which focuses on a hierarchical organization of human performances. Both of these analyses identify the external structure of the information but do so independent of how it might actually be stored in human memory.

Content analysis focuses on components, not integrated wholes. The components that result from a content analysis are individual items, such as facts, concepts, principles and procedures. Instruction derived from this form of content analysis may allow students to pass

tests, but is not effective in helping students integrate information into meaningful wholes. These integrated wholes are essential for understanding complex and dynamic phenomena and for using knowledge in complex problem solving situations. That is, a well-developed cognitive structure (schema) is necessary for new information to be learned meaningfully and for accurate recall later.

Transition to Cognitive Instructional Theory

Gagné and Briggs (1979) early on incorporated cognitive theory into their instructional theory for conceptualizing instructional design. They defined a set of requirements for instructional systems design, "The system must be designed for the individual, It should include immediate and long-range phases, It should substantially affect individual development, and It must be based on knowledge of how people learn."

Their instructional theory was based on a set of capabilities, or learning outcomes, that students would acquire through instruction. These outcomes were classified into five categories: verbal information, intellectual skills, cognitive strategies, motor skills, and attitude. Instead of emphasizing generalized factors such as practice and reinforcement in the learning process, their theory required that the conditions of external events and internal processes must be specified separately for each learning outcome. Also important to their instructional design theory was the interaction of instruction with the student's previously acquired learning.

Another concept developed in the field of cognitive psychology that was relevant to instructional theory was learner production of knowledge. Investigations in cognitive strategies that guide internal learning and thinking processes resulted in specific strategies for such processes as problem solving, organizing information, reducing anxiety, developing self-monitoring skills, and enhancing positive attitudes.

Integrated Instructional Strategies

By the 1990s, the trend in instructional design moved towards a synthesis of elements of the various instructional theories and advancements from cognitive science and educational technology. The emphasis was on instructional variables and conditions based on individual learner progress and need. That is, by assessing the learner's progress, the learning need could be established from which appropriate instructional strategies, sequences, and media could be determined. The role of the instructor continued to change to reflect more flexibility in the learning environment. The role of technology changed as well, as instructional design researchers worked with computer software specialists to develop interactive instructional systems.

Media and Learning

Interaction of learners with media and learning environments became important in the late 1990s and continues to be an area of increasing focus during the first decade of the 21st century. Interactive technologies that can adaptively and intelligently respond to at-the-moment learning needs and progress can activate that environment. Online interactivity is a vital area of research given the growth of the Internet. E-learning will expand as a delivery system and will be a major concern for educational technology researchers.

Domain-Specific Competency: Structured vs. Self-regulation

Researchers continue to investigate the processes and structures of competent performance in specific domains and to develop instructional programs to produce such competence. Two often-dichotomous stances toward instruction are reflected in such programs: structured approach and self-regulated approach.

Structured approach

One stance is that of a mastery approach, which emphasizes learning proceduralized knowledge through extensive practice with problem solving. In this paradigm, the teacher controls the direction of learning, with learners following a specific path of carefully structured sub-goals leading toward the efficient performance of a well-defined cognitive skill. Practice with successful performance is thought to lead to subsequent metacognitive abilities.

Self-regulated approach

A second stance toward instruction emphasizes self-regulated control of instructional strategies by the learner in accomplishing a complete, non-decomposed task. The teacher provides modeling of the metacognitive strategies necessary for beginning the task, and, when problems are encountered, assistance is provided by the teacher or group. One learning procedure reflecting this stance, Reciprocal Teaching, structures collaborative group works in sharing a complex problem-solving task. This approach is based on learning theories about the social genesis of learning in which the learner is characterized as being motivated to seek explanations through exploration.

Transition from Instructional Theory to Instructional Design Model

Two examples of instructional theories are presented to illustrate the transition from learning theory to instructional design models. The two theories are the elaboration theory and the linking theory. These two instructional theories offer direct transitions between learning theory, instructional theory, and instructional design process and methodology.

Elaboration Theory

Elaboration theory is a theory of instructional design aimed at telling people how to teach rather than focusing on why and how people learn. It is concerned with the structure and organization of instructional material (stimuli) rather than the material itself. Elaboration theory is based on cognitive psychology and seeks to be consistent with cognitive theories of learning.

Two primary components of elaboration theory are that instruction should proceed from the general to the specific and that each part should be related to the general context and to the other parts, referred to as synthesizing. The method for implementing the theory is to start with a general overview of the material then divide it into parts and elaborate on each part. Each part is then further subdivided into smaller parts, which are elaborated, and those parts divided again, until the desired level of detail has been reached.

Linking Theory

The second example of an instructional theory that illustrates the transition to instructional design models is the linking theory first proposed by Tennyson and Rasch. This theory directly links learning theory to educational goals, learning objectives, and instructional prescriptions.

The learning philosophy of the linking theory emphasizes the roles of the teacher, peer, and self in the learning process. Thus, it makes use of four basic concepts of a philosophy of learning: Nature, nurture, self, and society. Nurture is highlighted by the design of the learning environment by the instructional designer. On the other hand, the self is primarily responsible for a large part of the learning process and management. This also includes the concept of nature as having a major effect on self-regulation aspects of learning. Society is integral mode of instruction in those objections reflecting higher order cognitive activities in problem solving, decision making, and trouble shooting. Finally, learner assessment methods are directly linked to the other five instructional design components. Too often, learner assessment is reduced to only one or two forms, thereby, attempting to generalize to other educational goals. The assumption in the revised linking theory is that assessment methods should reflect the type of learning that is occurring.

Recommendations

Instructional theory should be usable. It should be stated with enough clarity to allow successful implementation; Instructional theory should be valid. It should have evidence of empirical testing and practical evaluation; Instructional theory should be theoretical. It needs to explain theoretically how a particular instructional procedure works; and, Instructional theory should be linked to learning theory. It must use the wealth of research in learning and cognition.

CONCLUSION

Although building on earlier theories of learning, researchers working toward interactive technologies perceived limitations in earlier methods. By developing instructional theories that emphasize synthesis and integration of sets of knowledge and skills, researchers hope to address such limitations as:

An emphasis on components instead of integrated wholes, A closed instructional system that makes incorporation of new knowledge difficult and which results in essentially passive instruction, and The labor-intensive practice in design and development of instruction.

Future Trends in Instructional Theory

Human relations and resources will likely be a center of much instructional design progress in the coming years. Learner variables, for example, have already begun to play an important role in instructional theory, and the area of motivation promises to be of particular significance in the near future. The role of the instructor has again emerged as a topic of interest.

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