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Using Instructional Design Theories in Library and Information Science Education

Dian Walster

This article examines five instructional design theories valuable to library and information science education and describes the basic components of the theories and their application to instruction, particularly in library and information science education and practice. A concluding section forecasts the impact of two emerging theoretical trends, critical theory and constructivism, upon library and information science education in instructional communication and design.

In considering instructional design theory it is useful to identify the audiences within library and information science that are affected by the theories. There are knowledge users, such as instructional designers, library media specialists, library educators, and bibliographic instruction specialists. Whereas knowledge producers, such as researchers and theorists, are interested in coherence, replicability, understanding, and research implications, knowledge users are interested in applicability to real-life situations and the improvement of instruction.¹ Therefore this article is directed to library and information science educators as knowledge users. It identifies elements of instructional design theory helpful in acquiring new methods of instruction and applicable to library environments such as bibliographic instruction. It is usually considered the responsibility of the knowledge user to translate theories and models into

appropriate practice. This article is aimed at bridging the gap between the producers of instructional design theory and the potential users in the library and information science community.

The reason for knowing about a range of instructional design theories and models is to be able to match audience needs, subject-area requirements, and instructional preferences. Is there an effective method for deciding which instructional theory to use? Should library and information science educators or practitioners use only one theory or a combination of theories? Initially it is easier and more efficient to focus on a theory or model that meets immediate needs or matches a curricular problem. However, as experience and expertise with different theories is gained, it is advantageous to use different theories and to combine useful elements from different models.

This article examines five instruc-

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tional design theories and their associated models of instructional design:

- Gagné-Briggs' prescriptive model
- Landa's algo-heuristic theory
- Collins and Stevens' cognitive theory of inquiry teaching
- Reigeluth's elaboration theory
- Keller's motivational model

The salient points of each theory are reviewed. Examples are given for use in library and information science environments. There is a discussion of the relationships among the theories. Finally, two emerging theories in educational communications, critical theory and constructivism, are described, and their potential for use in library and information science education discussed.

Theories of Instructional Design

Five instructional design theories that have endured are discussed in the following sections. The theories can be identified in two ways. The first way equates the theory with its originator or most well-known proponent in that the theories are known as the Gagné-Briggs, the Landa, the Collins-Stevens, the Reigeluth, and the Keller theories. The second way of identifying the theories is by the content represented.

Provided below are overviews of the principles of each of the five theories. This is intended to aid library and information science educators in discovering a wider range of possible instructional design strategies for creating

and delivering instruction. In addition, library and information science practitioners can apply these theories in school library media settings, bibliographic instruction, and training environments.

Gagné-Briggs' Prescriptive Model

The Gagné-Briggs' prescriptive model closely resembles the generic instructional design model used by educators across most curricular areas.² It is also the most broadly defined model available. Five psychological domains form this instructional model: verbal information, attitudes, intellectual skills, motor skills, and cognitive strategies. It is believed each of these domains requires a different type of instruction. The unique contributions of the Gagné-Briggs model are

- comprehensiveness in prescribing instruction for all three of Bloom's domains (cognitive, affective, and psychomotor),
- breadth of instructional strategies, and
- prescriptions for selecting and sequencing content.

The Nine Events of Instruction are the most well known and applied components of the Gagné-Briggs model. They prescribe a series of activities for creating effective instruction: (1) gain attention, (2) inform the learner of the lesson objective, (3) stimulate recall of prior learning, (4) present stimulus material, (5) provide learning guidance, (6) elicit performance, (7) provide feed-

back, (8) assess performance, and (9) enhance retention and transfer.³

Because of its breadth, the Gagné-Briggs model is applicable to most instructional situations encountered in library and information science environments. This includes teaching information skills, training for technology use, and most bibliographic instruction situations. The major limitation of the Gagné-Briggs model is the lack of emphasis on creativity and higher cognitive processes. Gagné-Briggs might be unsuccessful for learning associated with activities such as developing reading and literature appreciation, increasing motivation for library usage, creative projects, and judging the value of information.

Landa's Algo-Heuristic Theory

Landa describes two basic methods for teaching about how to make decisions and solve problems: algorithmic and heuristic.⁴ Algorithms are step-by-step processes that must be followed to solve a problem. Heuristics are less clear and involve uncertainty in problem solutions. Landa also emphasizes the use of the snowball technique for internalizing thought processes. The snowball technique involves teaching the first operation in a process and then practicing. The second operation is taught alone and then practiced with the first. This continues for each succeeding operation until all operations have been taught separately but practiced together. The uniqueness of the Landa theory comes in selecting content. It clearly describes how to go about choosing what to teach as well as focusing on how to teach it.

Algo-heuristic theory is a broad-based approach to solving problems that focuses on teaching thought processes used by experts to solve problems. By using an algorithmic, a heuristic, or

an algo-heuristic approach, one can solve problems that require some structure. Cataloging, classification, and indexing are three areas where algo-heuristic theory would be applicable. In addition, individualized instruction for developing psychomotor skills necessary to use technologies is well suited to this theory. The development of skills for creating administrative and management procedures would also be appropriate uses of the algo-heuristic theory. A significant limitation of the theory is its failure to address affective issues. Motivation and attitudes are important factors in maintaining interest in academic subjects and information searching. This theory assumes that the mechanics of problem solving will be sufficient. One way of increasing the usefulness of algo-heuristic theory is to combine it with the suggestions in Keller's motivation model below.

Collins and Stevens' Cognitive Theory of Inquiry Teaching

The cognitive theory of inquiry teaching focuses on how the instructor can elicit learning in students through questioning strategies.⁵ It has three parts: the goals of the teacher, the strategies teachers use, and the control structures governing their teaching.

The strength of inquiry teaching theory comes from the extensive descriptions of strategies teachers use to direct discovery learning. It provides systematic and detailed examples of ten strategies from the simple to the complex. The strategies build on each other and include the following:

- Selecting positive and negative exemplars
- Varying cases systematically
- Selecting counterexamples
- Generating hypothetical cases
- Forming hypotheses
- Testing hypotheses

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- Considering alternative predictions
- Entrapping students (questioning students until they identify the fallacies and inconsistencies in their own thinking)
- Tracing consequences to a contradiction
- Questioning authority

Each type of strategy consists of a method for questioning students that allows the student to discover the concepts within that particular strategy. The student then learns to relate the questions and the answers to the issue or problem under consideration.

The theory of inquiry teaching develops depth of processing, higher-order cognitive skills, and independence of thought. The discovery approach directs the learner to focus on greater depth of processing of new knowledge. For this reason it would be particularly useful for teaching complex skills in library and information science, such as reference transactions, search strategies, and policy development. It also helps to develop higher-order cognitive skills rather than content-specific knowledge. This aspect of the theory might be applied to ethical and values issues in library and information science, such as intellectual freedom and copyright. Finally, it provides a method for teaching independence of thought. Developing research agendas and applying research to practice would be two excellent applications for this part of the theory.

The inquiry teaching theory is limited in three significant ways. It is primarily appropriate for discovering rules and principles; it does not stand alone; and it may not be cost- and time-efficient.

Inquiry theory is particularly useful for identifying principles and rules of the “how to” variety, such as how to develop a search strategy or how to conduct a reference interview. It is less ap-

propriate for teaching direct facts and concepts that may be presented more efficiently by expository methods. With a combination of inquiry teaching theory and Gagné-Briggs or algo-heuristic theory, a more complete repertoire of strategies may be developed. Topics more difficult to teach with an inquiry approach might include psychomotor skills, such as equipment usage, hardware maintenance, and use of specific software packages. In addition, factual content, such as historical information, statistical procedures, and cataloging procedures, might be more efficiently addressed through expository methods first. Inquiry theory could be used at a second stage to examine differences and similarities and to make comparisons.

Reigeluth's Elaboration Theory

Elaboration theory is a complex macro theory providing an alternative to the traditional hierarchical organization of instruction.⁶ It is based on a “zoom lens” analogy, where each subsequent part provides closer detail of the original. When instructing with elaboration theory, an educator begins each course with an epitome, a special overview that identifies the critical components of a course. Content may then be organized by concept, procedure, or principle. Whichever approach is chosen, that framework is then followed through with further elaborations. Each level in elaboration theory builds on the previous level and provides greater detail and depth. Elaboration theory integrates sequencing strategies to provide consistent prescriptions for instruction.

Reigeluth provides a six-step design procedure for structuring instruction with elaboration theory:

1. Choose orientation structure
2. Make the structure
3. Analyze the structure

4. Identify and make supporting structures
5. Identify individual elaborations
6. Design the epitome and all elaborations

Design in elaboration theory is complex and interactive. Whether or not the time required to design instruction within an elaboration theory framework is ultimately cost and learning efficient has not yet been proven.

The most appropriate library media content areas for teaching with elaboration theory are those with inherently complex structures such as search strategies, research design, information analysis, and collection development. The least useful instructional areas would be those with simple or limited content, such as training for equipment usage, basic subject classification, and copyright guidelines.

Keller's Motivational Model

Keller draws on a broad range of positions to support the development of the motivational model.⁷ The model is directed toward immediate application to all instructional contexts and consists of four action stages:

1. Analyze the motivational problem
2. Design the motivational strategy
3. Implement the strategy
4. Evaluate the consequences

These four basic components are much like a generic instructional design model. However, it is important to note that the Keller model does not stand alone. To be most effective, it should be used with another more extensive instructional design model or theory. The Keller model is a method for expanding any content-oriented design model to include the affective as well as the cognitive needs of students.

The design component originally consisted of four specific strategies: in-

terest, relevance, expectancy, and satisfaction. The names of the categories were changed in a later version to create a convenient acronym—ARCS (attention, relevance, confidence, and satisfaction)—but the definitions remain the same.⁸ “Attention” is the need to arouse a learner’s curiosity and sustain it over time. “Relevance” is the perceived relation of instruction to individual needs. “Confidence” refers to how likely the student is to be successful and whether or not the learner retains control of success. “Satisfaction” is a combination of extrinsic rewards and intrinsic motivation. Keller indicates that intrinsic motivation is the more appropriate state for long-term learning to occur.

Keller’s motivational model can be used with any content or subject area. It is equally useful for students with high motivation and those who may wish to develop stronger motivation. Of particular importance in applying the model is looking at areas where intrinsic motivation exists or can be developed.

Relationships among the Instructional Design Theories

Gagné-Briggs can generically be called a theory. However, it is more accurately a model for prescribing the delivery of instruction, and it is therefore often called the prescriptive model. Landa’s theory is founded in algorithms and heuristic patterns. Many other educators have also tried these approaches, and this theory is most often identified as algo-heuristic theory. Collins and Stevens are only two proponents of a much broader field of inquiry- or discovery-based learning. The uniqueness of their theory is the focus on the instructor as questioner rather than student as questioner. This is why the theory is called the theory of inquiry teaching; the focus upon who is doing the inquiry is different from many

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other discovery-learning endeavors. Reigeluth's elaboration theory is an outgrowth of an earlier instructional design theory developed by M. David Merrill and called component display theory.⁹ Elaboration theory is the macro level, and component display theory is the micro level. For library and information science educators, elaboration theory holds the more promising applications at this point in both theories' developments.¹⁰ Focus on motivation is not unique to Keller, and like Gagné-Briggs his approach is more accurately identified as a model for integrating motivation with instructional design. However, the application of motivation to instructional situations and the development of specific methods for integrating motivation is a valuable contribution of the motivation model (also called ARCS).

Inconsistency in Instructional Design Theory

One of the failings and strengths of instructional design theory is its inconsistency. It draws from no singular set of theoretical assumptions, nor does it rely exclusively on one curricular area or audience domain. Consequently, each of the theories has strengths and weaknesses. They also vary in their emphasis on different aspects of the instructional environment. Thus no one of them (or any other instructional design theory or model) is a perfect match for all instructional situations and all learner needs. When one chooses among them, it is important to look at their areas of similarity and difference. Three important dimensions can be considered to differentiate the five theories: expository versus discovery instruction; prescriptive versus descriptive focus¹¹; and the theory domain from which assumptions are drawn. Each of these dimensions has important implications for application of the theo-

ries to instructional situations in library and information science.

Expository and Discovery Instruction

Two of the early instructional theorists represent the basic positions on expository and discovery models of instruction. Bruner developed an instructional model based on discovery methods and stages of intellectual development.¹² Ausubel, on the other hand, developed a model based on expository methods and cognitive structures.¹³ Discovery methods require students to uncover rules and principles and guide their own learning. Expository approaches require that the instructor provides the framework and structure (e.g., Ausubel's advance organizers), which function like the abstract at the beginning of this article. Gagné-Briggs is an expository approach. Collins-Stevens is a discovery approach. The other three, Landa, Reigeluth, and Keller, while predominantly expository, have small discovery elements.

Inquiry teaching and discovery learning are time-intensive uses of scheduled class hours. They require intense participation on the part of the student. The suggested advantages are a greater depth of understanding by the student and more flexibility to apply knowledge to diverse problem situations. Expository teaching requires more direct preparation time for the instructor initially but is efficient at the delivery stage. Its advantages are consistent and similar exposure to information by all students in the class or learning situation.

Descriptive and Prescriptive Components

Instructional design is a prescriptive process. It involves choosing methods, materials, and means for providing in-

struction. It requires clearly stating what is to be done, how it is to be done, and the underlying principles of why it is to be done. Theories, however, may be descriptive or prescriptive. A descriptive theory will describe what the outcomes of using certain methods or procedures will be. Descriptive theory is considered to be goal free in that it does not advocate specific choices but merely catalogs the outcomes when given certain parameters. Prescriptive theory advocates specific choices that will achieve the goals of the theory. It differentiates among possible outcomes to provide for the best instruction. Descriptive theory is essentially passive and describes the state of things. Prescriptive theory is active and prescribes what should be done.

Among the theories presented, Gagné-Briggs' prescriptive model, Reigeluth's elaboration theory, and Keller's motivational model are primarily prescriptive. Landa's algo-heuristic theory and the Collins-Stevens' cognitive theory of inquiry teaching are primarily descriptive. Descriptive theories require greater cognitive flexibility on the part of the designer to create instruction. Since specific prescriptions are not presented, the designer must infer how instruction may be created from the descriptions.

Theoretical Foundations for the Instructional Design Theories

Gagné-Briggs, Reigeluth, and Keller attempt to integrate theory from a broad range of research findings. Their strength is in the synthesis of information from many sources, but their weakness stems from the same source. All three are continually refined to verify the validity of their prescriptions, and changes in structure, applications, and prescriptions appear each time a new study or series of studies is completed,

creating constantly growing and changing theories and models.

Landa and Collins-Stevens specifically draw their theory from cognitive psychology. Collins and Stevens rely predominantly on the problem-solving theory of Newell and Simon. Landa draws his conclusions from a broader range of cognitive theory and research. The narrowness of their theory base may limit generalizability. However, their strength is that consistent theory allows for the strong hypotheses needed for empirical research.

A View to the Future of Instructional Design Theory

Two divergent theoretical approaches are emerging within educational communications and technology. They draw on different foundations and provide widely variant descriptions and prescriptions for how instructional design should develop. Critical theory is founded in philosophy, literature, and sociopolitics.¹⁴ It focuses on human and social consequences of instructional and technological settings. Constructivism is based in cognitive psychology and looks at the role of the individual in building his or her own learning.¹⁵ The sections below provide a brief glimpse into these two theories and speculate on their possible consequences for library and information science education.

Critical Theory and Instructional Design

"Critical theory" is a broad term used to encompass a variety of philosophical and theoretical positions. It is often associated with terms such as "postmodern thinking," "deconstruction," "discursive practices," and sometimes "poststructuralism."¹⁶ Gibson

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describes critical theorists as generally concurring on three points:

- Reality is socially constructed.
- Positivistic labeling of people is not natural.
- Scientific explanations of human behavior lack objectivity.¹⁷

Within educational communications and technology, critical theory is being used to challenge traditional beliefs, to explore social responsibility, and to examine equity and ethics. Difficult questions are being posed about how instructional design is applied, such as, Should we label learners with test results? Is the social processing of students and trainees into those who may and those who may not do things appropriate? Does continuous monitoring of performance interfere with learners' rights? And are we producing obedient cyborgs?¹⁸

In counterpoint, prescriptions for ways to improve instructional design through application of critical theory and postmodern thinking are also being proposed:

- Be cautious: All media are metaphoric and never mean exactly what they seem to convey.
- Look for self-contradictions in both your messages and other people's messages.
- Expect diversity in the way people understand.
- Plan by considering needs and not just technologies.¹⁹

Critical theory provides provocative and challenging descriptions of learning and prescriptions for change. It focuses on the social, political, and cultural meanings of the systematic design of instruction. Library and information science educators can inform this conversation with their own experience. It is also an opportunity to add a ne-

glected dimension to the design and delivery of instruction.

Constructivism and Instructional Design

Constructivism is based in the field of cognitive psychology. It is not a new idea; Piaget and Vigotsky are considered to be constructivists. Part of the theory is based in the new approaches of cognitive psychology and part of it is based in experiential foundations, such as those of Piaget and Vigotsky. The core of this theory is described thus:

Constructivism is the belief that knowledge is personally constructed from internal representations by individuals using their experiences as a foundation. Knowledge is based upon individual constructions that are not tied to any external reality, but rather to the knowers' interactions with the external world. Reality is to a degree whatever the knower conceives it to be.²⁰

As an emerging instructional design theory, constructivism focuses on the learner. The purpose of instruction is to create contexts within which the learners can create their own sense. In this regard constructivism does not believe that it is the task of instruction to teach learners specific things but rather to allow them to use and create tools for solving problems. One underlying assumption within constructivism is that if instructors give up the control of the learning environment, then the learner must assume that control.²¹ Constructivism is currently a descriptive theory of instruction. It functions to explain conditions of how learners use experience to construct reality. Future research and application will begin to develop prescriptions. Library and information science educators are already exposed to the results of constructivist instructional design. Hypermedia and multimedia programs often use con-

structivist thinking in their creation. Online instruction, interactive environments, electronic access, and electronic training environments will be influenced by constructivist philosophy and psychology.

Conclusion

Theories and models of instructional design provide a range of possible choices for designing and implementing instruction in library and information science settings. The purpose of surveying different theories and models is to increase the available techniques for library and information science educators and practitioners. Differences in students' learning styles and instructors' teaching styles are widely recognized. For appropriate instruction that meets the needs of students, a variety of instructional strategies is necessary. The five traditional theories and the two emerging theories provide a foundation for building instruction in different ways. In themselves, they provide neither the necessary nor sufficient conditions for effective instruction. However, taken together they add to the repertoire of library and information science educators a wide choice of possible strategies, techniques, and methods for improving student learning. The two emerging theories also expand debate about the purpose and role of educators in designing and delivering instruction. Social, ethical, and cultural responsibilities must be addressed.

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