

Survey of
Instructional
Design Models

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2015

Editing and Design by
Donovan R. Walling

The first four editions of this book were published under the
title, *Survey of Instructional Development Models*.

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Foreword to the Fifth Edition

Since *Survey of Instructional Development Models* was initially published in 1981, successive editions have provided practitioners and students of instructional design with up-to-date information every few years. This fifth edition, with the title slightly altered to *Survey of Instructional Design Models*, attests to the high quality and enduring utility of this volume.

The principles on which many of the models described in this new edition build tend to change little over time, whether since the first edition in 1981 or since the more recent fourth edition, which was published in 2002. However, technological advances have occurred—and continue to occur—rapidly, and the effects on teaching and learning of such advances can be dramatic. Consider just a few of the technological advances that have occurred between publication of the fourth edition in 2002 and this new, 2015 fifth edition.

- Wikipedia was launched in 2001, as the fourth edition of this book was being prepared for publication. This online encyclopedia often is now students' go-to first choice for basic information.
- Apple launched iTunes Music Store in 2003, selling one million songs in its first week and revolutionizing the music sales industry. That year Skype also was launched, as was LinkedIn, the professional networking site.
- Mark Zuckerberg took Facebook online in 2004, marking the true beginning of social media. Educators increasingly find educational value in this platform.
- YouTube launched in 2005—on Valentine's Day. While entertainment predominates on YouTube, instructional videos have a growing presence. This also

is the year that broadband connections surpassed dial-up.

- Twitter came into being in 2006. It rapidly became a platform for sharing ideas about education topics among professionals and students.
- Apple released its first iPhone in 2007 and created the App Store the next year, 2008. Education apps have rapidly become a major category, tapped by users—students, parents, and teachers—at all levels.
- Facebook reached 400 million active users in 2010, only six years after its launch. Pinterest and Instagram were both launched this year. Apple also brought out the first iPad this year, inaugurating the age of tablet computing. Other manufacturers followed Apple's lead.
- In 2011 Twitter and Facebook played a large role in pro-democracy revolts in the Middle East, demonstrating the communicative power of social media.
- By 2012 Facebook had reached one billion monthly active users.
- By 2013 a majority of Americans (56%) owned a smartphone, and many would say it was the primary way they accessed the Internet.

This timeline is important because much of the classroom technology that is now available simply did not exist or was still in an early stage of development at the time the previous edition of this book was published. Today, more than even as little as five years ago, instruction is likely to be technology mediated, whether the learners are kindergarteners or grad students. Consequently, important instructional design decisions often are affected by the availability of various forms of technology.

Moreover, such decisions may change from year to year—or even semester to semester—as technology continues to advance.

As was the case with previous editions, this new fifth edition of *Survey of Instructional Design Models* provides a succinct, readable overview of the field, including new developments and models developed in other countries. Practitioners and students of instructional design will discover, as earlier readers have, that this book is a vital resource and a welcome addition to the professional literature.

—Phillip Harris, Executive Director
Association for Educational Communications and Technology

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Introduction

The purpose of this book is to offer a framework for adopting or adapting instructional design (ID) models for use in curriculum, courses, and training development. The framework features a taxonomy that takes into account the prevailing paradigms associated with teaching and learning and technology-based instructional delivery formats. The basic idea is that an instructional design process works best when it is matched to a corresponding context. However, educational contexts can be complex and feature complicated issues related to teaching and learning that are often unaccounted for during the development process. Therefore, effective instructional design models need to be sensitive to different educational contexts and responsive to complex teaching and learning issues as well. This edition of the *Survey of Instructional Design Models* updates and expands earlier editions by Gustafson (1981, 1991) and Gustafson and Branch (1997, 2002). Since the first appearance of instructional design models in the 1960s there has been an ever-increasing number of ID models published in instructional technology journals and other education literature. This edition presents a brief history of ID models, a taxonomy for classifying those models, examples from each of the categories in the taxonomy, and trends in their content and focus. A list of references and a short annotated bibliography of selected ID models are also provided.

Only a small proportion of the available ID models were selected for this edition to describe in detail so as to illustrate the different classification categories of the taxonomy. This was a difficult task because there are more than a hundred in the literature. Selection criteria included: the historical significance of the model, its unique structure or perspective, and its general distribution and citation in the literature. Due to the increasing presence of instructional design models in literature from around the world, a deliberate decision was made to make this review more international and interdisciplinary than will be found in previous editions of this book. Also, it was necessary to select

models to match each of the categories in the classification taxonomy. As a result, many excellent models are not included in this survey. The decision also was made to exclude models that omitted any of the five conceptual phases of the ADDIE paradigm: Analyze, Design, Develop, Implement, and Evaluate). Cennamo and Kalk (2005) suggest that “full-scale, systematic instructional design and development efforts are in order in at least four situations:

- When the content is stable enough to warrant the time and costs.
- When the potential audience is large enough to warrant the time and costs.
- When communication among a team of designers and developers is required.
- When it is important to make sure that the instruction works before it’s used.” (p. 12).

Therefore, those models that were selected are believed to be generally representative of the literature and among them contain all of the main concepts found in other models.

Instructional Design Defined

Identifying a single definition of instructional design was difficult. Although several attempts have been made to define the field and derive a standard set of meanings for various terms (Ely 1973, AECT 1977, Ely 1983, Seels and Richey 1994, Januszewski and Molenda 2008), the results have not been widely adopted or consistently used in the literature. Seels and Richey (1994) use the term *instructional systems design* (ISD) instead of *instructional development* and define it as “an organized procedure that includes the steps of analyzing, designing, developing, implementing, and evaluating instruction” (p. 31). The Seels and Richey definition is similar to how an AECT (1977) committee, chaired by Kenneth Silber, defined instructional development almost two decades earlier as:

A systematic approach to the design, production, evaluation, and utilization of complete systems of instruction, including all appropriate components and a management pattern for using them; instructional development is larger than instructional product development, which is concerned with only isolated products, and is larger than instructional design, which is only one phase of instructional development. (AECT 1977, p. 172)

Consistent with both definitions is that the overall process is far more inclusive than those activities associated with preparing lesson specifications and determining moment-to-moment instructional strategies, sequencing, motivational elements, and students actions.

Some educational researchers and instructional practitioners use the terms *instructional development* and *instructional design* interchangeably and consider them synonymous. A complete treatise on this debate is beyond the scope of this edition and deserves a discussion about possible differences and other nuances of each term in another forum. However, it is appropriate to mention that “instructional design (ID) is a systematic process that is employed to develop education and training programs in a consistent and reliable fashion” (Gustafson and Branch 2007, p. 11). Instructional design is a complex process that promotes creativity during development and results in instruction that is both effective and appealing to students. Instructional design models convey guiding principles for analyzing, producing, and revising intentional learning contexts. Instructional design models visually communicate their associated processes to stakeholders by illustrating the procedures that make it possible to develop effective designs. Figure 1 displays the conceptual relationships among the core elements of instructional design. The five core elements—analyze, design, develop, implement, and evaluate (ADDIE)—inform each other as development progresses and revision continues through implementation.

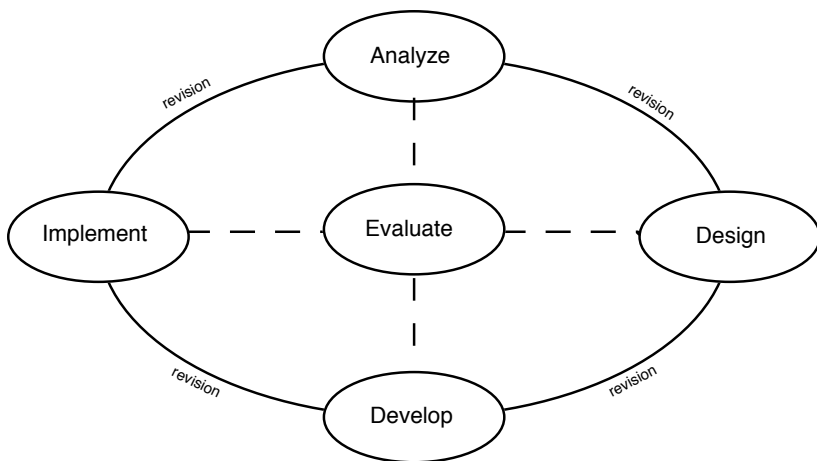


Figure 1. Core elements of instructional design.

Instructional design seems to be gaining some dominance in the literature, so it seems prudent to use *instructional design* rather than *instructional development*, and we have updated this book's title accordingly. However, the fact remains that we are dealing with the comprehensive process, not one or merely a few of its components. *Instructional design*—acronym ID—will be used when we refer to the overall process in any general narrative, and the actual terms used by the authors will be used when describing their specific models.

Another term within the realm of instructional design that is used inconsistently and further adds to the confusion of communication is *system*. The term *system* is used in at least three different ways, one of which is equivalent to how we have chosen to define instructional design. However, some authors describe the outcomes or products of the development effort using the term *system*. Based on the second perspective the actual learner environment and its related management and support components together comprise an instructional system. A third, less common use of the term *system* is in the context of general systems theory (GST). Numerous general systems theory concepts, such as open and closed systems, entropy, and interdependence, are applied during discussions of the instructional development process. Reiser (2001), in providing a history of instructional design, noted:

Over the past four decades, a variety of sets of systematic instructional design procedures (or models) have been developed, and have been referred to by such terms as the systems approach, instructional systems design (ISD), instructional development, and instructional design. Although the specific combination of procedures often varies from one instructional design model to the next, most of the models include design, development, implementation and evaluation of instructional procedures and materials intended to solve those problems. (p. 58)

Analysis also is a major activity that typically initiates any instructional design process. There are many different and inconsistent uses of terminology to describe the comprehensive process we call instructional systems design. Thus, the definition of instructional design used in this edition is characterized by at least five major activities:

- analysis of the contexts and the needs of the learner;
- design of a set of specifications for an effective, efficient, and relevant learning environment;
- development of all student and course management materials;
- implementation of the planned instruction; and
- evaluation of the results of the design processes, both formative and summative.

The five activities above have often been referred to as ADDIE and labeled as a generic instructional design paradigm. The ADDIE paradigm provides a useful set of criteria for determining whether a model is inclusive of the entire ID process or only one or more of its elements. A sixth activity may be added involving distribution or dissemination and monitoring of that learning environment across varied contexts and perhaps over an extended period of time. However, several assumptions

are associated with adopting the ADDIE approach to instructional design.

Assumptions

Because an emphasis is placed on identifying the assumptions made by the creators of the instructional design models included in this edition and that are used in their classification, it seems appropriate to make visible the assumptions about the ID process and ID model building and application used in this edition. The motivation for this edition is to promote better understanding and appropriate use of ID models. A greater awareness about the variety of models used to portray the process will be of benefit to both longtime practitioners and those new to the field. Further, the contention is that there is enough room within the fundamental concept of instructional design to incorporate many emerging theories and philosophies of learning and advances in the technology available for design, development, and delivery of instruction. Thus, our definition of the process, explanation of the role of models, and the taxonomy presented for classifying them are based on three assumptions.

Assumption 1: Instruction is interpreted as both teaching and learning. Teaching and learning are inextricably connected to instruction: you can't have one without the other. Teaching is the action performed by the person or technology that facilitates the presentation of content and the exchange of knowledge and skills. Teaching is an attempt to organize external events for the purpose of constructing knowledge and skills. Learning is done by an individual to construct knowledge and skills. Learning is a personal and covert cognitive activity that is idiosyncratic to an individual. Instruction is concerned with the activities between the teacher and the students on a daily basis, where the focus is on achieving a defined outcome. Instructional strategies are the overt means by which knowledge, skills, and procedures are constructed during an episode of intentional learning. Effective instructional episodes should have a definite beginning, middle and end. Instructional strategies organize the external events that occur during the episode of intentional learning. There are many

effective application frameworks that implement the beginning, middle and end theory of instructional strategy development. However, this edition promotes an adaptation of Gagné's Nine Events of Instruction (Gagné et al. 2005), illustrated in Figure 2.

1. Gain Attention
2. Clarify Expectations
3. Review
4. Present the Content
5. Guided Practice
6. Independent Practice
7. Share New Knowledge
8. Implementation
9. Authentic Practice

Figure 2. Gagné's Nine Events of Instruction.

Assumption 2: Educational contexts are influenced by activities that occur outside of the classroom. Education refers to the activities that affect the classroom but, more importantly, the activities outside the classroom that directly influence the context in which intentional learning occurs. Educational contexts include things such as human resources, technology resources, financial support, infrastructure, and curriculum planning that support formal and informal learning opportunities.

Assumption 3: Instructional design models work best when they are matched to a corresponding context. "Instructional design is a process used to generate curriculum, courses, teaching units and single episodes of guided learning" (Branch 1999, p. 145). Instructional design models help us to conceptualize the complex processes associated with a learning context. Instructional design possesses the attributes of being able to respond to constant changes to the scope of the teaching and learning situation, being able to generate strategies for constructing effective student-centered educa-

tional materials, and being able to validate instructional artifacts relative to a shared expectation. Such parallel processes require instructional designers and similar educational professionals to be able to multitask within complex environments. According to You (1993), learning is complex because knowledge is a dynamic system and an active construction of dynamic reality comprised of an interconnected web of patterns. Thus, instructional design models work best when they are matched to a corresponding context.

Chapter One

The Role of Models in Instructional Design

Of necessity one must pick an arbitrary date from which to begin to trace the origins of the ID model building process. Otherwise one can make the case that the creators of the earliest recorded cave drawings and the scribes that produced papyrus scrolls represent the pioneers of systematic instruction. Similarly many ideas and procedures commonly found in instructional design models, such as job analysis, measurable objectives, and performance testing, predate the period generally accepted as representing the beginnings of ID model building.

The specific term *instructional development*, defined as a systematic process for improving instruction, appears to have its origins in a project conducted at Michigan State University from 1961 to 1965. The final report, titled *Instructional Systems Development: A Demonstration and Evaluation Project* (Barson 1967) is available as ERIC document (ED 020673). The setting for this ID model and related project was higher education with the goal of improving college courses. The Barson model is notable in that it is one of the few models ever subjected to evaluation in a variety of projects at a variety of institutions. The Barson project also produced a set of heuristics (e.g., take faculty members out of their own disciplines when showing them examples of instructional strategies) for instructional developers. These heuristics provided the basis for much of the early research on the ID process and also served as a general guide for developers in higher education.

Other early work by a number of authors also produced ID models, although they did not use the term *instructional development*. For example, the developers of programmed instruction (c.f., Markle, 1964, 1978) often applied a systematic process but generally did not recognize the major contribution of the tryout and revision process to the successes they recorded. In the 1950s and 1960s one of the most influential model builders

was L.C. Silvern (1965). His work with the military and aerospace industry resulted in an extremely complex and detailed model (with multiple variations) that drew heavily on general systems theory. The model is not widely circulated today but remains an excellent original source for those willing to wade through Silvern's sometimes obscure writing. Students of the ID process will readily see his influence on the content of contemporary models.

A model developed by Hamreus (1968) while at the Teaching Research Division of the Oregon State System of Higher Education is another classic. One of his significant contributions was to present "maxi" and a "mini" versions of his model. This "two-size" approach was based on the belief that there is a need for a simple model to communicate with clients and a more detailed operational version for those working on the project. Hamreus' model provided the basic structure for the Instructional Development Institute (IDI) model (National Special Media Institutes 1971). The latter model received extremely wide distribution and was among the best known in the United States in the 1970s and 1980s. A five-day workshop was created for teachers and administrators and by the late Seventies had been offered to more than 20,000 public school personnel. The materials from that workshop were extensively used by graduate programs of that era to introduce the basic concepts of the ID process. The IDI model was reproduced and described by Seels and Glasgow (1998) in their book on the ID process. Hamreus' model was extensively reviewed by Twelker and colleagues (1972) to which readers are referred for details.

Other Reviews of Instructional Design Models

Four other major reviews of ID models have been done that are worthy of mention in addition to the Twelker and colleagues (1972) review. In 1972 Stamas reviewed twenty-three models to determine whether each included a list of components that he felt were part of the ID process. This study, originally part of a doctoral dissertation at Michigan State University (Stamas 1972), also was reproduced as an occasional paper by the Division of Instructional Development of the Association for Edu-

cational Communications and Technology. In 1980 Andrews and Goodson reviewed forty models in the *Journal of Instructional Development*. Like Stamas, they developed a matrix of ID elements and analyzed the models for their inclusion of those elements. They also attempted to trace a logical progression or evolution of later models from earlier ones but were unable to detect any pattern.

Sailsbury (1990) reviewed a number of ID models from major textbooks in the field to determine the degree to which they contained specific references to a range of general systems theory concepts. He concluded that most models contained few specific references to those general systems concepts contained in his matrix. Edmonds, Branch, and Mukherjee (1994) presented the results of an extensive review of ID models as a way to address their proliferation over the previous decade. Edmonds and colleagues concluded that an ID model is understood better when it is classified by its context and by the level of application for a specific context.

Taken together, these reviews provide an excellent sampling of the array of existing ID models and present alternative perspectives on how they might be examined. It is interesting to note that until about the time of the Edmonds, Branch, and Mukherjee review, reviewers of ID models concluded that the overall ID process as originally conceived had not changed significantly, even though additional theories and design and delivery tools and procedures had emerged.

However, the last few years have seen a rather dramatic shift in thinking about how ID can be practiced. The shift represents an extension of researchers' and practitioners' thinking about ID rather than a replacement of past models and practice. Despite the exaggerated claims of some recent authors that classic ID is dead, or at least seriously ill (Gordan and Zemke 2000), there remains considerable interest in and enthusiasm for its application (Beckschi and Doty 2000). Instructional design models serve as conceptual, management, and communication tools for analyzing, designing, creating, and evaluating guided learning, ranging from broad educational environments to narrow training applications.

Why Models?

Models help us conceptualize representations of reality. A model is a simple representation of more complex forms, processes, and functions of physical phenomena or ideas. Models of necessity simplify reality because often it is too complex to portray and because much of that complexity is unique to specific situations. Thus, models typically seek to identify what is generic and applicable across multiple contexts. Norbert Seel (1997) identifies three different types of ID models (theoretical/conceptual, organization, and planning-and-prognosis) and would label those we review here as organization models that can be used as general prescriptions for instructional planning.

We believe that these models provide conceptual and communication tools that can be used to visualize, direct, and manage processes for creating high-quality instruction. Models also assist us in selecting or developing appropriate operational tools and techniques as we apply the models. Finally, models serve as a source of research questions as we seek to develop a comprehensive theory of instructional development.

Rarely are these models tested in the sense of rigorous assessment of their application and the resulting instruction against either predetermined criteria or competitive means of developing instruction using some other defined process. Rather, those ID models with wide distribution and acceptance gain their credibility by being found useful by practitioners, who frequently adapt and modify them to match specific conditions.

Conceptual and Communication Tools

Conceptual tools assist in identifying the contexts within which an ID model might be utilized. In fact, the quantity and quality of tools accompanying a model become significant criteria for selecting one for a specific setting.

Conceptual Instructional Design Process. Instructional design is a complex process that, when appropriately applied, promotes creativity during development and results in instruction that is both effective and appealing to learners. Instructional design

models convey the guiding principles for analyzing, producing, and revising learning environments. Both established and newer ID models accommodate emerging theories about planned learning and the broad array of contexts in which ID is being applied. Philosophical orientation and theoretical perspective frame the concepts upon which ID models are constructed. The more compatible the theory and philosophy are to the context in which a model is to be applied, the greater the potential that the original intent of the model will be achieved.

While the conceptual display of the core elements of the ID process in Figure 1 is helpful, there remains a need to indicate how to practice particular elements of the ID process in specific contexts. It is the addition of this detail that has led to the creation of the many different models that appear in the literature. Conceptual and operational tools assist in identifying the contexts within which an ID model might be used. In fact, the quantity and quality of tools accompanying a model become significant criteria for selecting a model for a specific setting. However, specific procedures for planning, conducting, and managing the ID process can be implemented with operational tools that may or may not be identified as part of the ID model.

A common influence on the ID process is the Input → Process → Output paradigm. An instructional design model should contain enough detail about the process to establish guidelines for managing the people, places, and things that will interact with each other and to estimate the resources required to complete a project. Instructional design models can directly or indirectly specify products, such as time lines, samples of work, deliverables, and periodic endorsements by appropriate supervisory personnel.

While models provide the conceptual reference, they also provide the framework for selecting or constructing the operational tools needed to apply the model. Operational tools, such as PERT charts, nominal group techniques, task analysis diagrams, lesson plan templates, worksheets for generating objectives, and production schedule templates contextualize the ID process. Some ID models include highly prescriptive information about how to develop the companion tools or provide most of the tools necessary to apply the process. Other

models provide only a conceptual diagram without any operational tools or directions for constructing companion tools necessary for their application. The Interservices Procedures for Instructional Systems Development model (Branson 1975) is an example of a highly prescriptive ID model with a comprehensive set of companion operational tools. The Dick, Carey, and Carey model (2009) is moderately prescriptive and contains an array of companion operational tools. For those models having few or no accompanying tools Zemke and Kramlinger (1984) and Gentry (1994) describe tools that can be used with different models when appropriate. Generic operational tools for managing ID (e.g., Greer 1992) also are available.

Linear and Concurrent Aspects of Instructional Design. The instructional design process can be approached as a single linear process or as a set of concurrent or recursive procedures. Instructional development should be portrayed in ways that communicate the true richness and reality associated with planning instruction. Critics of ID models sometimes interpret them as stifling, passive, lockstep, and simple because of the visual elements used to compose the model (Branch 1997). This is partially because ID models have traditionally been portrayed as rectilinear rows of boxes connected by straight lines with one-way arrows and one or more feedback (revision) lines that are parallel to other straight lines (Figure 3). Rectilinear portrayals of ID models often do not acknowledge the actual complexities associated with the instructional development process. Curvilinear compositions of ovals connected by curved lines with two-way arrows better acknowledge the complex reality upon which the ID process is modeled (see Figure 4). However, even here there remains an implied sequence, at least among the core elements.

Need for an Organizing Framework

Instructional design is practiced in a variety of settings, leading to the creation of many different ID models. An organizing framework can help clarify each model's underlying as-

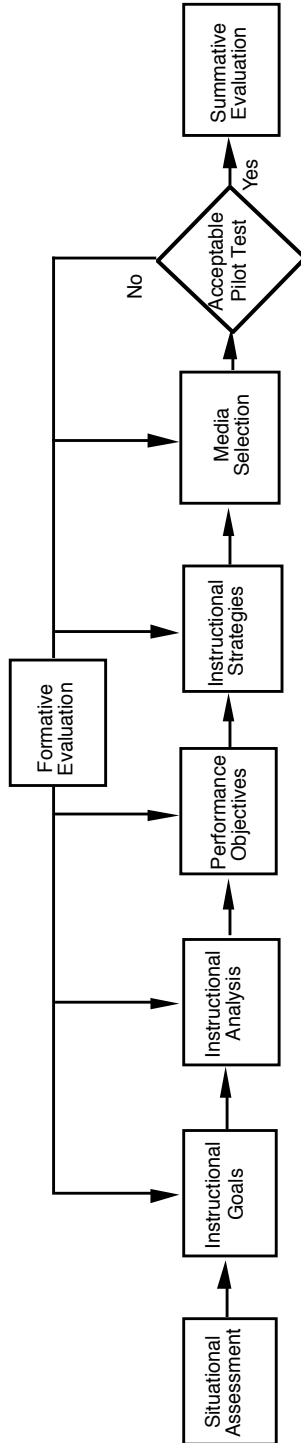


Figure 3. Rectilinear portrayal of instructional development process.

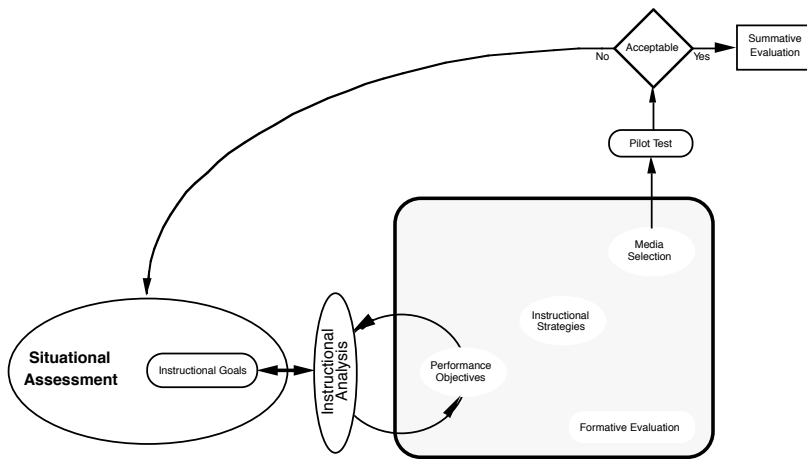


Figure 4. Curvilinear portrayal of instructional development process.

sumptions and identify the conditions under which each ID model might be most appropriately applied. Although the number of models published far exceeds the number of unique environments in which they are applied, there are several substantive differences among instructional development models. Thus, there is some value in creating a taxonomy for classifying ID models.

Instructional design models vary widely in their purposes, amount of detail provided, degree of linearity with which they are applied, and quantity, quality, and utility of the accompanying operational tools. While no single model is useful for all settings and all purposes, it is important to identify the intended focus of an ID model and the context for which it was intended. A taxonomy of ID models can help guide the way in which we adopt or adapt instructional development models.

A Response to the Complexity of Intentional Learning

Student-centered spaces, wherever they are located, represent an epistemological shift from regarding students as the occupants of learning spaces to regarding the actions of students

during guided learning as the motivation for the design of instruction. Thus, a clear understanding about the complexities of intentional learning is worthy of attention.

Complexity is a common phenomenon existing in biological organisms, geological formations, and social constructions, such as education. Education researchers and practitioners routinely encounter complex situations as a function of study and practice. Managing complex situations has become a common necessity for instructional designers and developers in order to make sense of complicated situations, such as those that occur in the classroom. Indeed, emerging philosophies about instruction and theories of learning have refocused the “classroom” concept to include a broader array of contexts. While a classroom is defined as “a place where classes meet,” classrooms are typically shaped by the prevailing societal paradigm, and until recently classrooms replicated our desire to compartmentalize, consistent with the Industrial Age. The desire to regiment and control was reflected in classrooms patterned after military models, but classrooms are beginning to reflect a societal shift to an Information Age.

Classrooms of the Information Age can be situated at remote sites, accessed at convenient times, and personalized to match the capability of individual learners. While students may still “meet” to study the same subject, the location, time, and pace are now dynamic. Educators and trainers should regard a classroom as any learning space. While each episode of intentional learning is distinctive and separate, each remains part of a larger curricular scheme. Episodes of guided learning are characterized by several participating entities that are themselves complex: the learner, the content, the media, the teacher, peers, and the context—all interacting within a discrete period of time while moving toward a common goal (see Figure 5).

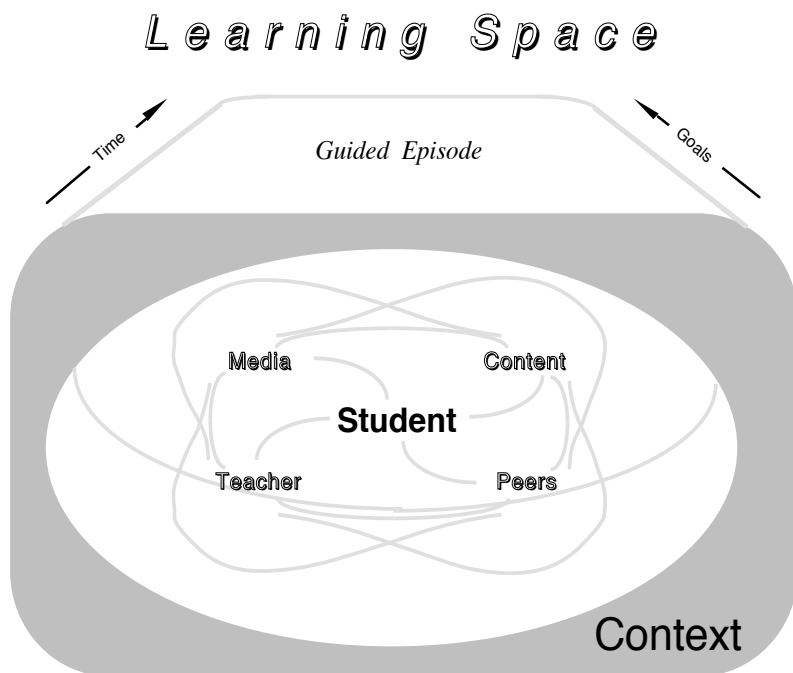


Figure 5. Intentional learning space.

Learning refers to the process of acquiring knowledge and skill. Intentional learning refers to learning that happens through purposefully arranged information, human resources, and environments to achieve a certain purpose. Intentional learning is complex because of the nature of knowledge and nonlinear interactions among multiple entities. According to You (1993), learning is complex because knowledge is a dynamic system and an active construction of dynamic reality composed of an interconnected web of patterns. Branch (1999) called such a dynamic system as intentional learning space. Branch identified eight entities that are always present within intentional learning space: student, content, media, teacher, peers, time, goal, and context. Branch purported that each of these eight entities is inherently complex. The student is complex because of the physical, emotional, social, and mental development of human beings and the effect of intelligence, cognitive styles, motivation, cultural norms, creativity, and socio-economic status on behavior patterns. Content is complex because it is a collection of con-

cepts, rules, propositions, procedures, and socially constructed information. Moreover, the information types may be attribute, categorical, classification, component parts, dimension, elaboration, goal, hierarchical, kinds, matrix, prerequisite, procedural, rule, skills and type. Peers are complex entity because of all of the social negotiations that occur among persons of the same age, status, or ability. Media are channels of communication that come in a multitude of forms. The teacher, or teacher function, assumes the executive decision-making role, such as identifying appropriate goals and expectations, analyzing learning needs, arranging content information, choosing media, selecting instructional methods, and conducting assessments of instruction and students. Time is a complex entity because it is omnipresent and can be measured by assigning discrete increments and intervals but not controlled. Context is the complex entity that refers to those conditions that directly and indirectly influence situations, environments, and communities. Contextual conditions are formed by physical, political, economical, and cultural settings: human ecology. Instructional development models provide conceptual tools for responding to the complexity of intentional learning.

Instructional Design Models as Conceptual Tools

The instructional design process is both descriptive and prescriptive. The instructional design process is descriptive because it shows relationships, illustrates what happens during a process, is interactive, explains, and provides if-then relationships; models can be conceived from displays of the processes. The instructional design process is prescriptive because it guides, assigns methods and procedures, generates strategies, is goal oriented, is active, and applies a variety of models.

Analyze, design, develop, implement, and evaluate (ADDIE) describe a generic instructional design paradigm (see Figure 6).

Analyze	Design	Develop	Implement	Evaluate
Identify the probable causes for a performance gap.	Verify the desired performances, and appropriate testing methods.	Generate and validate the learning resources.	Prepare the learning environment and engage the students.	Assess the quality of the instructional products and processes, both before and after implementation.
<ol style="list-style-type: none"> 1. Assess performance 2. Determine instructional goals 3. Analyze learners 4. Audit available resources 5. Determine delivery systems (including cost estimate) 6. Compose a project management plan 	<ol style="list-style-type: none"> 7. Conduct a task inventory 8. Compose performance objectives 9. Generate testing strategies 10. Calculate return on investment 	<ol style="list-style-type: none"> 11. Generate instructional strategies 12. Select or develop media 13. Develop guides for the student 14. Develop guides for the teacher 15. Conduct formative revisions 16. Conduct a Pilot Test 	<ol style="list-style-type: none"> 17. Prepare the teacher 18. Prepare the student 	<ol style="list-style-type: none"> 19. Determine evaluation criteria 20. Select evaluation tools 21. Conduct evaluations
<i>Analysis Summary</i>	<i>Design Brief</i>	<i>Learning Resources</i>	<i>Implementation Strategy</i>	<i>Evaluation Plan</i>

Figure 6. Generic version of ADDIE.

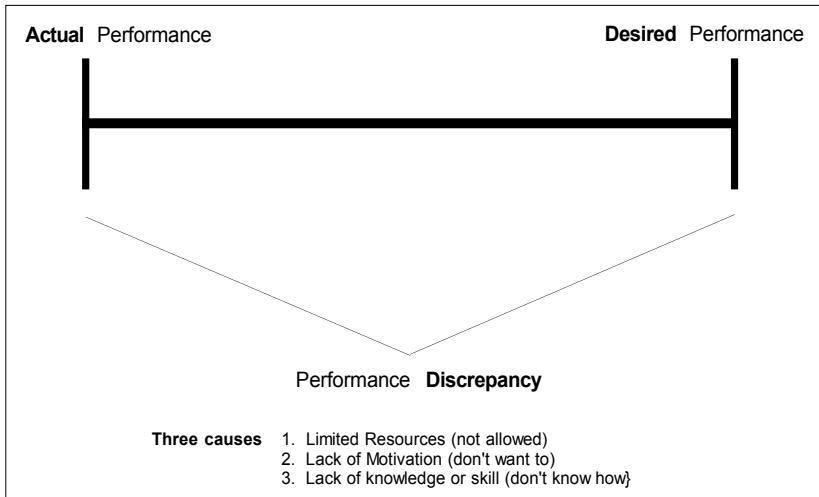


Figure 7. Gap analysis.

Design is typically the phase where you verify the desired performances, the learning tasks, and the appropriate testing strategies. A common result of the Design Phase is a “task analysis” (Figure 8).

Develop refers to generating the learning resources and validating the learning resources. Implement refers to preparing the environment and other preparation required to facilitate guided learning.

Evaluate refers to assessing the quality of the instruction before, during, and after implementation.

Purpose Statement

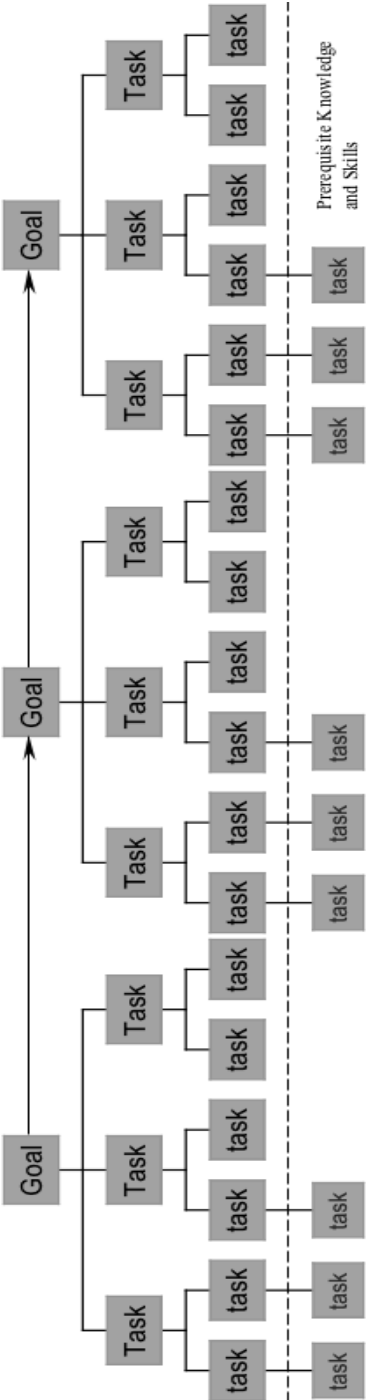


Figure 8. Task analysis.

Chapter Two

A Taxonomy for Instructional Design Models

Instructional design is being practiced in a variety of settings and therefore various models have been created reflecting these variations. A taxonomy of instructional design models can help clarify the model's underlying assumptions and identify the conditions under which it might be most appropriately applied.

While there is much similarity between systems-based instructional design models that subscribe to the ADDIE paradigm, there also are substantive differences. Consequently, there is value in creating a taxonomy for classifying models of instructional design. A taxonomy also helps to organize the extensive literature on this topic and can assist instructional designers in selecting one that is best matched to a given set of circumstances.

Gustafson (1981) created one such taxonomy. Gustafson's schema contained three categories into which models can be placed: classroom, product, and system. Placement of any model in one of the categories is based on the set of assumptions that its creator has made, often implicitly, about the conditions under which both the development and delivery of instruction will occur. For example, models by Gerlach and Ely (1980) and Heinich, Molenda, Russell, and Smaldino (1999) are clearly intended for use by classroom teachers, probably working alone as both designers and deliverers of instruction. In contrast, Bergman and Moore (1990) describe how a team including instructional developers, production staff, and computer programmers can use their model, plus a project manager, to develop multimedia-based instructional products, usually for wide distribution. Bergman and Moore's model implicitly assumes that no members of the development team will have a role in the product's implementation or use. Likewise, the model by de Hoog, de Jon, and de Vries (1994) describes the process they

used to develop simulations and expert system products. The models by Dick, Carey, and Carey (2005) and Smith and Ragan (1999) represent still a third category of ID models that appear intended for use in a variety of organizational settings. For each of these models it seems most likely it will be used by a skilled design team to develop a complex “system” of instruction such as one or more courses or an entire curriculum to meet specified education or training needs or goals. The Branson (1975) model designed specifically for military training also assumes there will be a large-scale, team-oriented design and development effort and wide distribution of the resulting system.

The taxonomy presented in Figure 9 can be used to categorize ID models based on a number of factors.

The text in each cell of the figure indicate how each characteristic is typically viewed by those using that class of model. Examples of how the characteristics relate to each class of model are described below:

- typical output in terms of amount of instruction prepared,
- resources committed to the development effort,
- whether it is a team or individual effort,
- expected ID skill and experience of the individual or team,
- whether most instructional materials will be selected from existing sources or represent original design and production,
- amount of preliminary (front-end) analysis conducted,
- anticipated technological complexity of the development and delivery environments,
- amount of tryout and revision conducted, and
- amount of dissemination and follow-up occurring after development.

As noted earlier, most authors of instructional design models do not explicitly discuss any of the above assumptions (characteristics). Rather, they simply describe their model’s major elements and how they are to be implemented. Thus, we derived

Taxonomy		
Delivery Format	Online	Asynchronous = any place and any time Synchronous = any place, but same time
	Face-to-Face	Same physical space and same time
	Flexible	Any combination of Online & Face-to-Face
Selected Characteristics	Factor	
	Scale	
	1. Opportunity for analysis	None, Limited, Unlimited
	2. Opportunity for formative evaluation	None, Limited, Unlimited
	3. Level of designer expertise required	Novice, Intermediate, Expert
	4. Planned length of the course	Hours, Days, Weeks, Months, Years
	5. Amount of human resources required	Individual, Small Group, Large Team
	6. Amount of digital resources required	Less than average, Average, More than average
	7. Anticipated area of distribution	Local, Regional, National, International

Figure 9. Taxonomy for comparing instructional design models.

the assumptions used for classifying each model discussed in subsequent chapters based solely on our review of the descriptive material accompanying each model.

The taxonomy is intended to help designers consider the characteristics of a design context and select a model or aspects of specific models. For example, design context where opportunity for formative evaluation is low or where user feedback is needed on a frequent basis may benefit from employing elements of concurrent or recursive models to acquire important user feedback throughout the design process. Similarly, designers may benefit from incorporating the evaluative elements of rectilinear models in situations where the content is relatively stable or the intended audience is comparatively large in size. By considering the characteristics noted in the taxonomy, designers might make more informed decisions about the models they use and the reasons for doing so. Gustafson and Branch (2002) examined the following nine characteristics of each model of instructional design based on the original Gustafson (1981) taxonomy of instructional development models: 1) typical output in terms of amount of instruction prepared, 2) resources committed to the development effort, 3) whether it is a team or individual effort, 4) expected instructional design skill and experience of the individual or team, 5) whether most instructional materials will be selected from existing sources or represent original design and production, 6) amount of preliminary (front-end) analysis conducted, 7) anticipated technological complexity of the development and delivery environments, 8) amount of tryout and revision conducted, and 9) amount of dissemination and follow-up occurring after development. The taxonomy presented in this edition of the *Survey of Instructional Design Models* is a revision of the characteristics identified in the Gustafson (1981) taxonomy. The current taxonomy presented here also includes contemporary instructional delivery formats. The revised taxonomy identifies common facilitators and constraints commensurate with instructional design industry standards.

Figure 9 presents a revision to the “Selected Characteristics” section of Gustafson’s taxonomy, and intended to represent contemporary instructional delivery formats. The revised taxonomy will retain the original three categories: 1) individual classroom instruction, 2) products for implementation by

users other than the developers, and 3) larger and more complex instructional systems directed at an organization's problems or goals.

Chapter Three

Classroom-Oriented Models

Classroom ID models are primarily of interest to professional teachers who accept as a given that their role is to teach and that students require some form of instruction. Users include elementary and secondary schoolteachers, community college and vocational school instructors, and university faculty. Some training programs in business and industry also assume this classroom orientation. Thus, there is a wide variety of classroom settings to consider when selecting an appropriate ID model to apply.

Most teachers assume (with justification) that students will be assigned to or will enroll in their classes and that there will be a specified number of class meetings, each of a pre-determined length. The teacher's role is to decide on appropriate content, plan instructional strategies, identify appropriate media, deliver instruction, and evaluate learning. The on-the-go nature of classroom instruction, often accompanied by a heavy teaching load, offers little time for the comprehensive development of instructional materials. Also, resources for development usually are limited. Consequently, teachers need to identify existing resources for adaptation to conditions, rather than engaging in original development. Furthermore, many elementary and secondary teachers teach most topics only once a year and so have less concern for the rigorous formative evaluation and revision associated with courses and workshops that are offered on a repetitive basis.

Classroom teachers usually view any ID model as a general road map. Typically only a few functions are outlined in this type of model, and such a model simply provides a guide for teachers. It should be noted that although there are a number of classroom-oriented ID models, they are not widely known or adopted by teachers. The developer who works with teachers within the given conditions and assumptions we have described would do well to employ any ID model with caution because teachers are unlikely to be familiar with the concepts or processes

of systematic instructional design. Teachers also may view the process depicted by many ID models as mechanistic and likely to result in dehumanized instruction.

However, the models discussed on the following pages have been found to be acceptable to and readily understandable by at least some teachers and represent a class of models with which all developers should be familiar. Four models have been selected to represent the variety of ID models most applicable in the classroom environment: Gerlach and Ely (1980); Heinich, Molenda, Russell and Smaldino (1999); Newby, Stepich, Lehman, and Russell (2000); and Morrison, Ross, and Kemp (2001).

The Gerlach and Ely Model

The Gerlach and Ely (1980) model is a mix of linear and concurrent development activities (Figure 10). Several steps are seen as simultaneous, but the model is generally linear in its orientation. The entry point of the model calls for identifying content and specifying objectives as simultaneous, interactive activities. While Gerlach and Ely clearly prefer the approach of specifying objectives as a “first task,” they recognize that many teachers first think about content. Their model is one of only a few that recognizes this content orientation of many teachers. Learning objectives are to be written and classified before making several design decisions. Their classification scheme is based on Gerlach’s other scholarly work and presents a five-part cognitive taxonomy with single categories for affective and motor skill objectives.

The next step in Gerlach and Ely’s model is assessing the entry behavior of learners, a step common to many classroom-oriented models. The next step is really five activities to be performed simultaneously. These activities are viewed as interactive, with any decision in one area influencing the range of decisions available in the others. The five activities are: 1) determine strategy, 2) organize groups, 3) allocate time, 4) allocate space, and 5) select resources.

Under strategies they posit a continuum from exposition (all cues) to discovery (no cues). The teacher/designer’s role is to

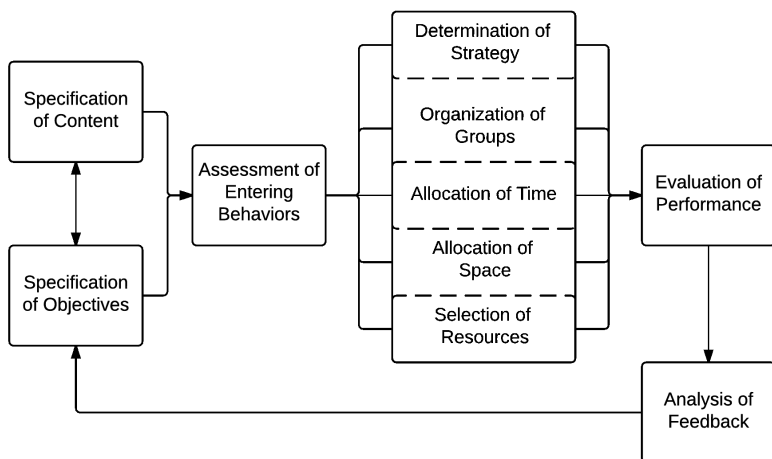


Figure 10. Gerlach and Ely model.*

select one or more strategies along this continuum. Students can be organized into configurations ranging from self-study to whole-class activities based on strategies, space, time, and resources. Time is viewed as a constant to be divided among various strategies. Space is not a constant because teachers can and should extend learning experiences beyond the classroom, which itself can be rearranged for different grouping patterns.

Selection of resources focuses on the teacher's need to locate, obtain, and adapt or supplement existing instructional materials. Emphasis is placed on where and how to find such resources and the importance of previewing and planning for their use as part of the overall instructional strategy. This emphasis on selecting rather than developing instructional materials is another common feature of classroom-oriented ID models.

Following these five simultaneous decisions is evaluation of student performance. This step directs the teacher/designer's attention to measuring student achievement and their attitude toward the content and instruction. Evaluation is closely linked to the learner objectives with particular attention directed to

*Gerlach, V.S., and Ely, D.P. (1980). *Teaching and media: A systematic approach* (2nd ed.). Englewood Cliffs, N.J.: Prentice-Hall. Reprinted with permission of Prentice-Hall.

evaluating the overall effectiveness and efficiency of the instruction. The last step in their model is feedback to the teacher regarding the effectiveness of the instruction with the possibility of making revisions the next time this topic is taught. Feedback focuses on reviewing all of the earlier steps in the model with special emphasis on reexamining decisions regarding the objectives and the chosen strategies.

The Smaldino, Lowther, Russell, and Mims Model

The ASSURE instructional development model was originally created by Heinich, Molenda, and Russell (1981). In the fifth edition of their book Smaldino joined the team to continue advancing the work. Now in its eleventh revision the model's sustainability and continued relevance can be attributed to Smaldino, Lowther, Russell, and Mims (2015). Their book continues to be a widely adopted college text on instructional media and technology for current and future teachers. While some might argue it is not a complete or formal instructional development model, teachers can readily identify with the systematic planning process it describes and its match to the realities of K-12 classrooms. Like many ID models, ASSURE is linear in nature, relying on specific decisions or inputs and outputs for each sequential stage. However, ASSURE is not portrayed in graphic or pictorial form. ASSURE is an acronym for

Analyze learners
State objectives
Select media and materials
Utilize media and materials
Require learner participation
Evaluate and revise

The *A* for “analyze learners” acknowledges the importance of determining the entry characteristics of learners. Smaldino, Lowther, and Russell (2011) have continued to caution teachers that it is not feasible to analyze all learner attributes. They suggest only selected “general characteristics” (e.g., grade level, job or position, and cultural and economic factor) and

selected specific entry competencies (e.g., knowledge, technical vocabulary, attitudes, and misconceptions) be examined. They also suggest that “learn-ing style” (anxiety, aptitude, visual, and auditory preference, etc.) be considered but acknowledge problems of defining and measuring these characteristics.

Their second step, *S* for “state objectives,” emphasizes the need to state the desired outcomes of instruction in specific and measurable terms. A rationale for stating measurable objectives is presented including their role in strategy and media selection, assessment of learning, and communicating the intent of the instruction to learners. The ABCD (Audience, Behaviors, Conditions, and Degree) format for writing complete objectives is easy to remember and apply.

The second *S* in the model, “select media and materials,” recognizes that most teachers have little time for designing and developing their own materials through the option of modifying existing materials. The procedures and criteria presented for selecting media and materials provide useful guidelines to teachers and to those assisting teachers in that task.

The *U*, or “utilize materials” step, describes how teachers need to plan for using the chosen media and materials in the classroom. The practical advice offered recognizes the realities of most American classrooms and the fact that teachers play a central role in delivering most instruction.

The *R*, “require learner participation” step, emphasizes the importance of keeping learners actively involved. The role of feedback and practice also are described. One might question why learner participation is singled out over and above other design considerations as a step in ASSURE model, but the original authors considered it to be of primary importance.

The last step in their model, *E* for “evaluate and revise,” is in reality two steps: evaluate *and* revise. They discuss the importance of evaluating the “total picture” to ensure both learner achievement of the objectives and the feasibility of the instructional process itself. Revision is then planned based on discrepancies between intended and actual outcomes and any noted deficiencies of the media, methods, or materials.

Although the ASSURE model focuses on media and materials selection and utilization in contrast to a wider view of the ID process, it has much to offer classroom teachers. The

relationship of its steps to an authentic environment and its practical guidance and structure make it easy to understand and apply. Through the years the supporting materials for the model have continued to evolve and to address the changing needs of teachers. For example, an “Innovation on the Horizon” feature helps introduce practitioners to advancing technologies and resources that will soon influence classroom learning. The well-written text and an available online supplement, MyEducation Lab, are excellent resources for teaching teachers the rudiments of the ID process.

The Newby, Stepich, Lehman, and Russell Model

Newby, Stepich, Lehman, Russell, and Ottenbreit-Leftwich (2011) present the PIE model (Figure 11) in a book written primarily for in- and pre-service teachers. Planning, implementing, and evaluating (i.e., P-I-E) are the three “phases” of the model. Clearly the focus is on classroom instruction created and delivered by the same individual or small group with an emphasis on using media and technology to assist them. The authors describe PIE as emphasizing what learners and teachers can do to affect learning. Their view is that media and particularly emerging technologies can play a central role, provided their use is carefully planned, implemented, and evaluated. In the latest edition of their book, the authors have added a PIE Checklist to use in conjunction with lesson planning as well as a simplified model for applying computers in education that focuses on computer as teacher and computer as assistant.

Planning includes gathering information on what, when, why, and how students will learn. Particular emphasis is given to how technology can assist in creating effective and motivational instruction in this phase. The artifact created during planning is an outline, lesson plan, or blueprint that will address a desired goal. Implementation addresses how to enact the plan using various forms of media and methods with a particular focus on how the computer can be incorporated into lessons. Evaluation includes both learner performance and how the data can be used to continuously improve teacher and student performance.

Newby, Stepich, Lehman, Russell, and Ottenbreit-Leftwich frame the PIE model with a set of questions related to

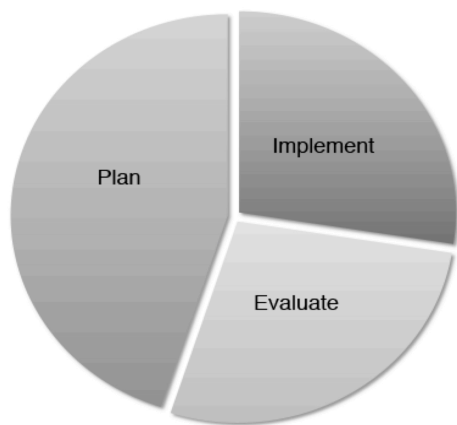


Figure 11. Newby, Stepich, Lehman, and Russell model.*

the categories of teacher, learner, and educational technology. These three categories are placed on the horizontal axis of a matrix with planning, implementing, and evaluating on the vertical axis. The questions are then placed in the resulting nine cells, thereby providing the overall structure for a

systematic design model. For example, questions in the cell related to the learner's role in planning to address the goals of instruction, designing learning outcomes, deciding ways to incorporate previous knowledge, identifying obstacles, and addressing motivation. In the learner implementation cell of the matrix, some of the questions include: How do I assemble or create what is needed to carry out the plan, how do I begin and follow the planned learning strategies, is this going the way I planned, and what outside materials or resources should be added? Typical questions in the evaluation row of the matrix are: Was the quality and quantity of learning at the needed level, what did I do when the selected tactics and learning strategies didn't work, what obstacles were encountered and what strategies were or were not effective in overcoming those problems, and what improvements could I make for future learning tasks?

Newby, Stepich, Lehman, Russell, and Ottenbreit-Leftwich frame the PIE model with a set of questions related to the categories of teacher, learner, and educational technology.

*Newby, T.; Stepich, D.; Lehman, J.; Russell, J.; and Ottenbreit-Leftwich, A. (2011). *Educational technology for teaching and learning* (4th ed.). Boston: Pearson. Reprinted with permission of Pearson.

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The Morrison, Ross, Kalman, and Kemp Model

This popular ID model initially was created by Kemp and adapted by Kemp, Morrison, and Ross in 1994. In the sixth edition of their book Kalman joined the group of authors, but the important influence of Kemp remains obvious. The most significant change to this model includes design considerations for technology-based instruction. Computer-based, web-based, and distance instruction are classified into five groups: drill-and-practice, tutorials, simulations, games, and hypermedia. The benefits of each type of instruction are summarized and design considerations are detailed for both individualized and group-based instruction. Morrison, Ross, Kalman, and Kemp (2011) present an instructional development model (Figure 12) with a focus on curriculum planning. They approach instruction from the perspective of the learner rather than content and contrast ID with traditional design practice by asking the following questions:

1. What level of readiness do individual students need for accomplishing the objectives?
2. What instructional strategies are most appropriate in terms of objectives and student characteristics?
3. What technology or other resources are most suitable?
4. What support is needed for successful learning?
5. How is achievement of objectives measured?
6. What revisions are necessary if a tryout of the program does not match expectations? (p. 6)

Based on how various individuals might approach designing a course, Morrison, Ross, Kalman, and Kemp (2011) identify four fundamental planning elements for systematic instructional planning that are represented by answers to the following questions:

1. For whom is the program developed? (learners)
2. What do you want the learners or trainees to learn or demonstrate? (objectives)
3. How is the subject content or skill best learned? (methods)
4. How do you determine the extent to which learning is achieved? (evaluation)

The entirety of the Morrison, Ross, Kalman, and Kemp model includes the four interrelated elements of the framework as they relate to additional components and ongoing processes that continue throughout the life of an instructional design project, as illustrated by the outer ovals in the figure.

Morrison, Ross, Kalman, and Kemp's model communicates their belief that ID is a continuous cycle with revision as an on-going activity associated with all of the other elements. They feel the teacher/designer can start anywhere and proceed in any order. This is essentially a general system view of development wherein all elements are interdependent and may be performed independently or simultaneously as appropriate. Although the Morrison, Ross, Kalman, and Kemp model indicates that the developer can start anywhere, in their narrative it is presented in a conventional framework starting with topics,

tasks, and purposes. The classroom orientation of the model is apparent through their choice of the words, *topics* and *subject content* for determining what will be taught. Both K-12 and business and industry instructors can readily identify with these words. From a teacher’s perspective the strength of this model is the concept of starting “where you are.” Also, the emphasis on subject matter content, goals and purposes, and selection of resources makes it attractive to teachers. The inclusion of design considerations for technology-based instruction and project management gives the model a modern appeal that is not found elsewhere. This model is one of the few that continues to be modified over time.

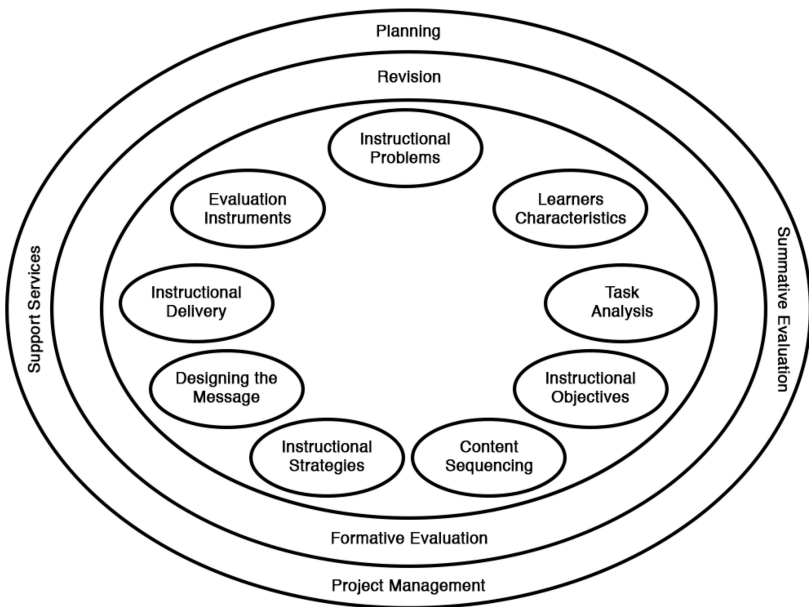


Figure 12. Morrison, Ross, Kalman, and Kemp model.*

The Wiggins and McTighe Model

Wiggins and McTighe (2005) originally developed the

*Morrison, Ross, Kalman, and Kemp (2011). *Designing effective instruction* (6th ed.). Hoboken, N.J.: John Wiley and Sons. Reprinted with permission of John Wiley and Sons.

Understanding by Design (UbD) framework, also known as “backwards design” or “backwards planning,” as way for educators to plan while focused on teaching for understanding. The UbD model is based on eight key tenets:

1. UbD is a way to think about curricular planning, not a rigid program.
2. The primary goal of UbD is to develop and deepen student understanding.
3. UbD breaks down and translates content standards and goals into Stage 1 elements and appropriate Stage 2 assessments.
4. Understanding is revealed when students transfer learning into authentic performance.
5. Effective curriculum is planned backwards from long-term desired results through a three-stage process.
6. Teachers are coaches of understanding whose focus is to ensure learning.
7. Units and curriculum must be regularly reviewed against design standards to enhance quality and effectiveness.
8. UbD is a continuous improvement approach to achievement.

UbD is divided in to three stages. Stage 1 includes identifying desired results. In this stage, educators ask questions such as: What long-term transfer goals are targeted, what meanings should students make, what essential questions will students consider, what knowledge and skill will students acquire, and what established goals are targeted?

In Stage 2 acceptable evidence is determined by asking: What performances and products will reveal evidence of meaningful transfer, what criteria will be used to assess Stage 1 results, and are all assessments aligned to all Stage 1 elements?

The actual planning of learning experiences and instruction occurs in Stage 3. In this stage educators identify activities, experiences, and lessons to lead to achievement of Stage 1 results and Stage 2 assessments. Other questions asked during Stage 3 include: How will the learning plan help students achieve transfer with increasing independence, how will progress be monitored,

how will the unit be sequenced and differentiated to optimize achievement for all learners, and are the learning events aligned with Stage 1 goals and Stage 2 assessments?

Wiggins and McTighe prescribe sketching out unit ideas in a table. The table is divided into three columns (one for each of the three stages). In the first column the educator should write the desired learning results. Necessary evidence required to prove the learned knowledge or skills is recorded in the second column. All learning events that would produce the necessary evidence are then recorded in the third column. This practice ensures alignment among the three stages for each of the identified outcomes.

As a cautionary note the authors also detail what they have termed the “twin sins of typical unit planning” (pp. 8-9). The first sin, more common at the elementary and middle school levels, is labeled as “activity-oriented teaching.” That is, activities are planned to be more engaging and kid-friendly without considering how to create coherent, focused, and generative learning. The second sin, more common at the secondary and post-secondary level, involves working through a specific resource without consideration for engaging activities. In the latter case, resources become the focus of instruction as opposed to learning outcomes that use the resource.

The Van Merriënboer Model

The Four-Component Instructional Design (4C/ID) model was originally developed by Jeroen van Merriënboer and proposed as a holistic design approach in contrast to the traditional fragmented approaches prescribed by the majority of instructional design models (Van Merriënboer and Kirschner 2007). The 4C/ID model aims for integration of declarative, procedural, and affective learning in a coalesced knowledge base rather than focusing on compartmentalization of each of the domains. To carry out this purpose the 4C/ID model is simplified into ten steps that are distributed among the four components:

Learning Tasks

1. Design learning tasks
2. Sequence task classes
3. Set performance objectives

Supportive Information

4. Design supportive information
5. Analyze cognitive strategies
6. Analyze mental models

Procedural Information

7. Design procedural information
8. Analyze cognitive rules
9. Analyze prerequisite knowledge

Part-task Practice

10. Design part-task practice

The assumption that forms the basis of the 4C/ID model is that these components and steps are blueprints for complex learning. To better understand the components of the model, it is important to define what occurs within each area. First, learning tasks are authentic, whole-task experiences based on real-life tasks that focus on integrating skills, knowledge, and attitudes. In Figure 13 the learning tasks are represented by the circles on the blueprint. Second, supportive information is anything helpful for learning and performing problem-solving and reasoning aspects of the learning tasks. In the blueprint supportive information is depicted as the wide bars beneath and between learning tasks. The third component is composed of procedural information, details that are prerequisite for learning and performing the learning tasks. The thin bars between learning tasks and supportive information represent procedural information. Fourth, part-task practice includes practice items provided to help learners reach a high level of automaticity for routine aspects of a task. This last element is represented by smaller circles within bars directly above learning tasks in the blueprint.

Overall, the 4C/ID model provides a unique approach to designing instructional experiences. However, the focus is on designing and developing instruction with no discussion of activating or evaluating and revising instruction.

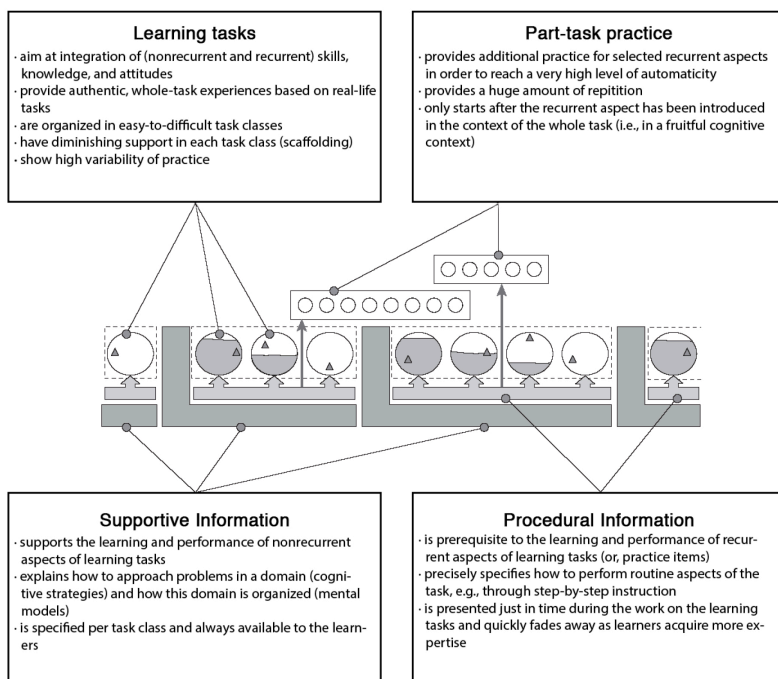


Figure 13. Van Merriënboer model.*

The Sims and Jones Model

Sims and Jones proposed the Three-Phase Development (3PD) model for instructional design in 2002 as a way to focus on end-to-end learning content and evaluation development specifically for web-based online learning. The authors feel that traditional models of instructional design are not valid for dynamic learning environments typical of online instruction or the diversity of skills required to implement effective online learning (Sims and Jones 2002). The interesting emphasis on scaffolding is what sets the 3PD model apart from others, and therefore is the basis for inclusion in this survey. Integral to the 3PD model also is the concept of iterative development or

*Van Merriënboer, J., and Kirschner, P. (2007). *Ten steps to complex learning: A systematic approach to four-component instructional design*. Mahwah, N.J.: Lawrence Erlbaum Associates. Reprinted with permission of Lawrence Earlbaum Associates.

successive approximations. The authors note that initial development is done to provide functional delivery. Later iterations are then enhanced with resources or activities based upon peer review, evaluation, and feedback. As a result, there are three phases that make up the 3PD model (see Figure 14).

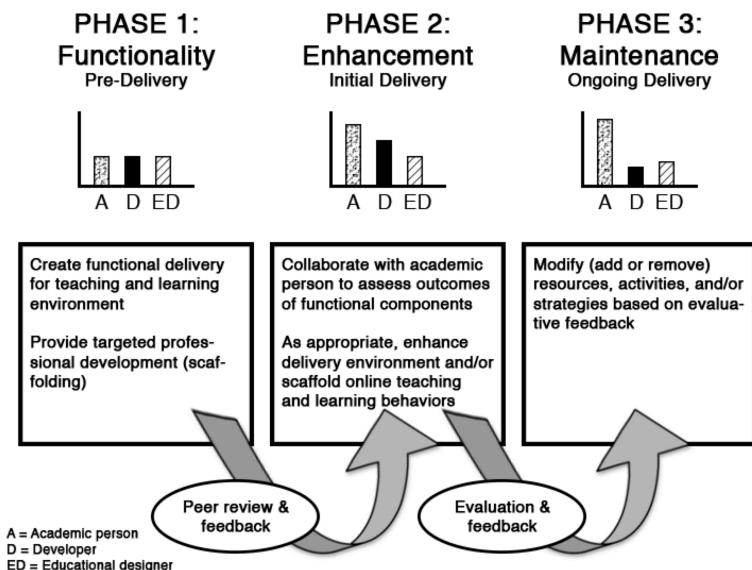


Figure 14. Sims and Jones model.*

The focus in the first phase of the 3PD Model is to design and create a functional teaching and learning environment. The baseline expectation is that this product meets all learning outcomes and learning strategies. The authors feel that this simple depiction sets their model apart from others and makes it easier to bring a course design to implementation as quickly as possible.

*Sims, R., and Jones, D. (2002). Continuous improvement through shared understanding: Reconceptualizing instructional design for online, pp. 1-10. In *Winds of change in the sea of learning: Proceedings of the 19th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)*, Auckland, New Zealand, 8-11 December 2002, UNITEC Institute of Technology, Auckland, N.Z. Reprinted with permission of Sims and Jones.

The second phase then occurs simultaneously during delivery of the instruction. Modifications and enhancements to the learning environment are based on feedback from both teachers and learners.

The third phase of the 3PD model begins at the completion of the course delivery and study. At this point additional changes are made or prescribed for future deliveries. The learning environment then moves in to maintenance mode until a more formal review occurs. Additionally, the authors admit that use of the 3PD model implies that the original environment is always subject to change and therefore require resources to support the course for the lifetime of the project. Also unique to the 3PD model is an explanation of specific personnel resources included in designing, creating, and maintaining the learning environment. These considerations may be considered limitations of the model for designers who do not have access to all of the identified resources. However, for the designer of learning in online environments 3PD provides an adaptable model for instructional designers and organizations beginning to enter the industry.

The Dabbagh and Bannan-Ritland Model

Dabbagh and Bannan-Ritland (2005) spent many years designing, developing, researching, and implementing technology in online and distributed learning contexts before creating the Integrative Learning Design Framework (ILDF), which “provides a systematic, iterative approach for designing online learning materials and activities” (p. 111) that incorporates what the authors believe to be the three key components necessary to foster meaningful learning and interaction. These components are pedagogical models or constructs, instructional and learning strategies, and online learning technologies. Dabbagh and Bannan-Ritland suggest that the three components form a continuous cycle in which pedagogical models are based on learning strategies that have been enabled through the use of learning technologies. Perhaps most unique to ILDF is an emphasis on usage-centered design, a concept not typically explored in other instructional design models. Usage-centered design generally

any or all of the phases. Interaction between the online learning developer and the key components of the framework must be ongoing. It is expected that the developer will bring his or her own assumptions and experiences to the process and that the resulting interaction will provide a means of enacting new strategies and continuous evaluation. Although the process is cyclical, the model does indicate a starting point, implying that design must begin with identifying pedagogical models or constructs.

The last element of the ILDF model is social and cultural context. This emphasis on context echoes many modern instructional models and situates design and development in a constructivist environment. While this designation does not necessarily make the model unique, the emphasis does allow for a certain amount of flexibility towards and expectation for designing collaborative and engaging online learning. As more educators look to develop online learning, ILDF provides an integrated approach to traditional instructional design.

Chapter Four

Product-Oriented Models

Product development models typically assume that the amount of product to be developed will be several hours, or perhaps a few days, in length. The amount of front-end analysis for product-oriented models may vary widely, but often it is assumed that a technically sophisticated product will be produced. Users may have no contact with the developers except during prototype tryout. However, in some rapid prototyping models, early and continuous interaction with users or clients is a central feature of the process. Product development models are characterized by four key assumptions: 1) the instructional product is needed, 2) something needs to be produced rather than selected or modified from existing materials, 3) there will be considerable emphasis on tryout and revision, and 4) the product must be usable by learners with access to only “managers” or facilitators, but not teachers. The assumption of need should not necessarily be considered a limitation of these models. In some settings a front-end analysis has already been conducted and needs determined for a variety of products. The task then becomes developing several related products efficiently and effectively. Also, in a number of situations the need is so obvious that it is unnecessary to ask “should” but only “what” needs to be done. An example would be the need to develop an operator-training package for a new machine that is about to be marketed.

Extensive tryout and revision often accompany product development because the end-user cannot, or will not, tolerate low performance. Also, the performance level may be externally established, such as the user being able to utilize all of the capabilities of word processing software. This is in contrast to classroom settings, where the performance level often is subject to considerable up or down adjustment based on the effectiveness of instruction. Cosmetic appearance of the product also may be important to clients, thus making subjective evaluation a substantial part of the tryout process. Use of the product by

learners, as opposed to teachers, often means that the product is required to stand on its own without a content expert available. An example would be computer-based training for telephone company line engineers, which is distributed to them for self-study on a CD-ROM, on how to install a specialized piece of equipment. The demand for freestanding products is another reason tryout and revision is emphasized in product development. As computer-based instruction has become more popular, the demand for effective instructional products has increased and is likely to expand even more rapidly in the future. The rapid growth in distance learning also has increased interest in product-oriented ID models. Consequently, the demand for highly prescriptive ID models, applicable to a variety of settings and instructional products, will continue and likely increase. This was a factor in our decision to review five product models, four of them new, in this review.

Product models, such as those reviewed in the next section, often contain elements that might qualify them as systems models. However, they seem to be best classed as product models based on our belief that they are primarily focused on creating instructional products rather than more comprehensive instruction systems. The five models reviewed are: Bergman and Moore (1990); De Hoog, de Jong, and de Vries (1994); Bates (1995); Nieveen (1997); and Seels and Glasgow (1998).

The Bergman and Moore Model

Bergman and Moore (1990) published a model (Figure 16) intended specifically to guide and manage producing interactive multimedia products. This focus on managing the process, which receives little attention in many ID models, is the basis for its selection for this review. Although their model includes specific reference to interactive video (IVD) and multimedia (MM) products, it is generally applicable for a variety of more recent "high-tech," interactive instructional products.

Bergman and Moore's model contains six major activities: Analysis, Design, Develop, Production, Author, and Validate. Each activity specifies input, deliverables (output), and evaluation

strategies. The output of each activity provides the input for the subsequent activity. They refer to each horizontal row of their model as a “phase” and remind the reader that, although not shown, it may be necessary to review a phase and reexamine selected activities. They also emphasize the importance of evaluating the output (deliverables) from each activity before proceeding. The checklists they provide for performing these evaluations are extensive and would be valuable even if one were using a different product development model for interactive multimedia development.

Bergman and Moore report that a request for proposal (RFP) initiates the development process. They suggest that even if an external RFP does not exist, preparing an internal RFP is desirable. The RFP drives analysis activities, including identification of the audience, tasks, user environments, and content. Design activities include sequencing the major segments and defining their treatment, labeled by Bergman and Moore “high-level design.” Detailed design then follows and includes specification of motivational elements, media, interaction strategies, and assessment methodology. Development includes preparing all of the documents necessary for later production. Examples of what Bergman and Moore call “producible documents” are storybooks, audio scripts, shot lists, art and graphic renditions, and a database for managing production. Production “transforms the producible documentation into its corresponding medium: video sequence, audio, graphic, or text” (p. 17).

Authoring activities integrate the individual media into the completed product. Its three sub-activities are coding, testing, and tuning. Validation consists of comparing the finished product with its original objectives. Revision, to reflect changing conditions or to increase effectiveness, also may occur at this time, as might assessing achievement of its sponsor’s goals.

Development of sophisticated interactive multimedia products almost always requires a team, a point made repeatedly by Bergman and Moore. Interactive video and multimedia also require a sound management system, the structure for which this model provides. This model was selected for review partially because of its focus on new technology and partially because of

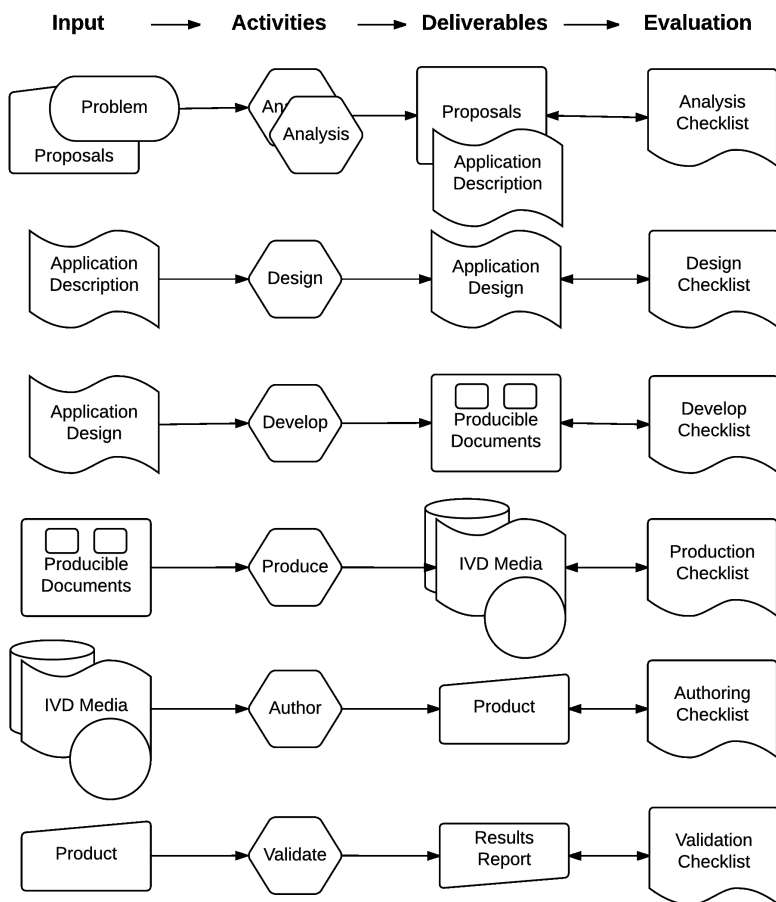


Figure 16. Bergman and Moore model.

the excellent and extensive checklists and other guides contained in the text. Even without the model, these support materials are well worth examining.

*Bergman, R.E., and Moore, T.V. (1990). *Managing interactive video/ multimedia projects*. Englewood Cliffs, N.J.: Educational Technology Publications. Reprinted with permission of Educational Technology Publications.

The de Hoog, de Jong, and de Vries Model

De Hoog, de Jon, and de Vries (1994) published a model (Figure 17) that they used to develop simulations and expert systems. The products produced are for distribution and use by individuals other than the developers. The authors describe the model as “product-driven,” thus its placement in our taxonomy as a product model.

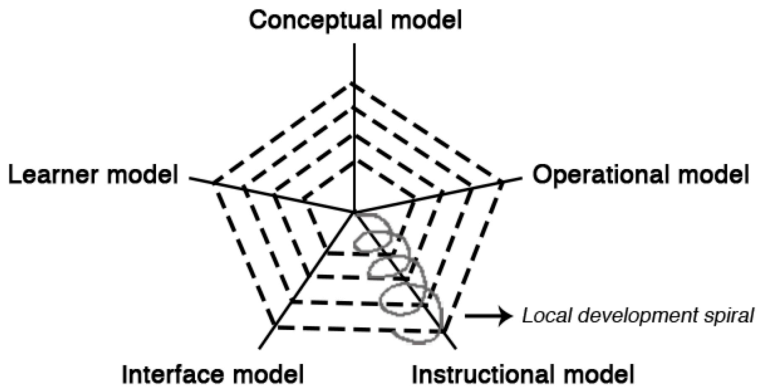


Figure 17. De Hoog, de Jong, and de Vries model.*

The underlying bases of the de Hoog, de Jon and de Vries model lie in rapid prototyping, availability of computer tools to facilitate prototype development and testing, and a “web structure” for elements needing to be considered when creating simulations. De Hoog and colleagues stress that “intertwining of methodology, product, and tools requires a comprehensive approach” that if not followed “will probably do more harm than good” (p. 60).

As an example of a product developed using the model, they describe a web structure that included five partial products: conceptual model, operational model, instructional model, interface model, and learner model. These partial products are considered part of global development and represent important

*De Hoog, R.; de Jong, T.; and de Vries, F. (1994). Constraint driven software design. *Performance Improvement Quarterly* 7(3):48-63. Used with permission of *Performance Improvement Quarterly*.

underlying features of the simulation or expert system that can be developed by different team members. Although not specifically stated by the authors, we interpret their description to mean that these partial products may vary somewhat depending on the overall product being developed.

Emanating from the web that represents the entire product are axes for each of the partial products around which there is spiral development of four components: compliance, quality, integration, and specificity. These axes are referred to as “local development.” Thus, to understand the model it is necessary to think in three dimensions, with spiraling taking place concurrently around the axis and with the complete product gradually emerging as the partial products become more complete.

The dotted lines of their model represent the inter-dependent nature of the conceptual, operational, instructional, interface and learner models and the need to consider how decisions in one area will likely affect the others. These lines also indicate the emerging nature of the final product. The spirals around each axis (only one is shown in Figure 17) represent the prototyping that takes place related to compliance, quality, integration, and specificity. In an electronic communication (August 2001) with de Jong, the researcher indicated that these authors have continued to refine and apply their model and another article with additional details would be forthcoming.

The Bates Model

Bates (1995) originally presented a model (Figure 18) for developing open and distance learning based on his experience in Canada. While acknowledging the limitations of the model and the resulting instruction, he notes that for students at a distance, who often are working largely on their own schedules and perhaps independently, extensive pre-planning and design are necessary. In particular Bates raises a concern for the lack of interaction and flexibility in much distance learning and stresses the need to specifically focus on this issue during design of such courses.

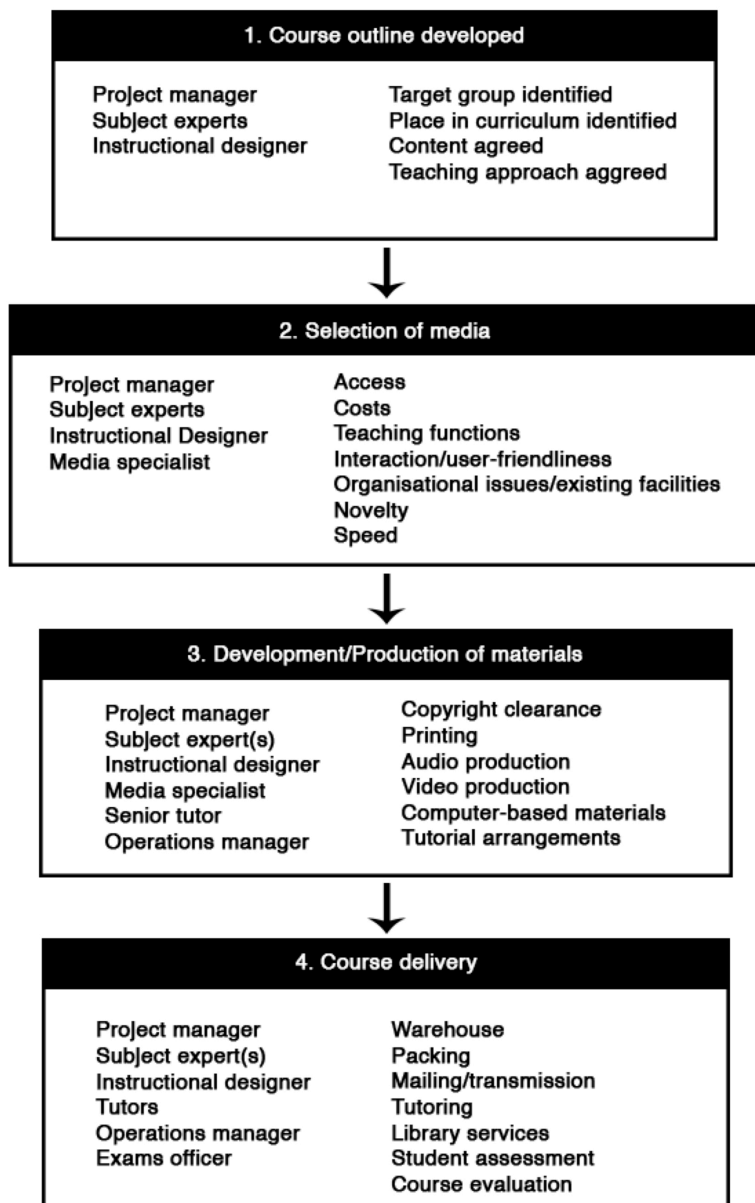


Figure 18. Bates model.*

*Bates, A.W. (1995). *Technology, open learning, and distance education*. London: Routledge. Reprinted with permission of Routledge.

Bates' model of what he calls "front-end system design" contains four phases: course outline development, selection of media, development/production of materials, and course delivery. Within each phase he identifies the team roles that are required and indicates actions or issues that need to be addressed. Although, according to Bates, this model is based on a systems approach, it implies rather than specifically addresses some of the ADDIE elements.

In the second edition of *Technology, E-learning, and Distance Education* Bates (2005) reorganized the structure of the model to account for new and emerging technologies, noting that "we need to understand the differences and the appropriate circumstances for applying various technologies for effective distance teaching and learning" (p. 3). The emphasis in Bates' model is therefore more related to decision making rather than technology-based curriculum design. As a means of accessing learning technologies, Bates presents the popular ACTIONS framework whereby curriculum developers must consider Access, Cost, Teaching/learning implications, Interaction/usability, Organizational issues, Novelty, and Speed of a specific technology. Using this framework when designing curriculum for distance delivery is meant to discourage developing instruction devoid of interaction and is most important when working with methods that have not yet been fully validated. The important takeaway message is that there are no bad technologies, but some are better within specific contexts.

Bates' approach to e-learning and distance education is unique based on the context philosophy and technology emphasis. Using the ACTIONS framework, various technologies can be evaluated within specific learning contexts, including the four types of e-learning (supplementing classroom teaching, supplementing print- or broadcast-based distance teaching, mixed mode, or fully online). There are twelve rules for using technology that can be of use to both seasoned and novice instructional designers:

1. Good teaching is important: It may overcome poor use of technology, but technology can never save bad teaching.

2. Designing effective learning experience requires instructional designers who understand the technology.
3. Each medium has its own idiom and grammar to follow for professional production.
4. Educational technologies are flexible and can be used in a variety of ways limited only to human imagination and creativity.
5. There is no “super-technology.”
6. Make all mediums (face-to-face, print, audio, video, interactive multimedia) available to the learners.
7. Interaction is essential.
8. Student numbers are critical for economies of scale.
9. New technologies are not necessarily better than old ones.
10. Teamwork is essential in educational use of technology.
11. Teachers and resource persons need training to use technologies effectively.
12. Technology is not the question—decide what the students need to learn through the use of technology.

Bates reminds readers that at the time of course delivery, the issues of warehousing, packaging and mailing of print materials, library services, and tutoring are critical to success. These are make-or-break issues too often neglected by novice designers of open and distance learning courses.

The Nieveen Model

Nieveen (1997) published an ID model (Figure 19) in Holland that was the outgrowth of several years of work by her and her colleagues at the University of Twente. The long-term goal of this effort is to produce multiple versions of a computer-based electronic performance support system for enhancing the quality and efficiency of curriculum materials development. To date, several versions of these EPSSs have been developed and tested in Holland, Botswana, South Africa, and the People’s Republic of China. Although Nieveen uses the term *curriculum*

development rather than *instructional development*, the underlying perspective is consistent with ADDIE. Her model has been use for educational materials in schools, rather than for training programs in business and industry. Nieveen’s model has been applied in creating lesson materials and courses in the Dutch context for creating materials to be distributed to schools across the country. These materials would typically include both learner materials with which students directly interact and support materials for teachers to ensure successful implementation.

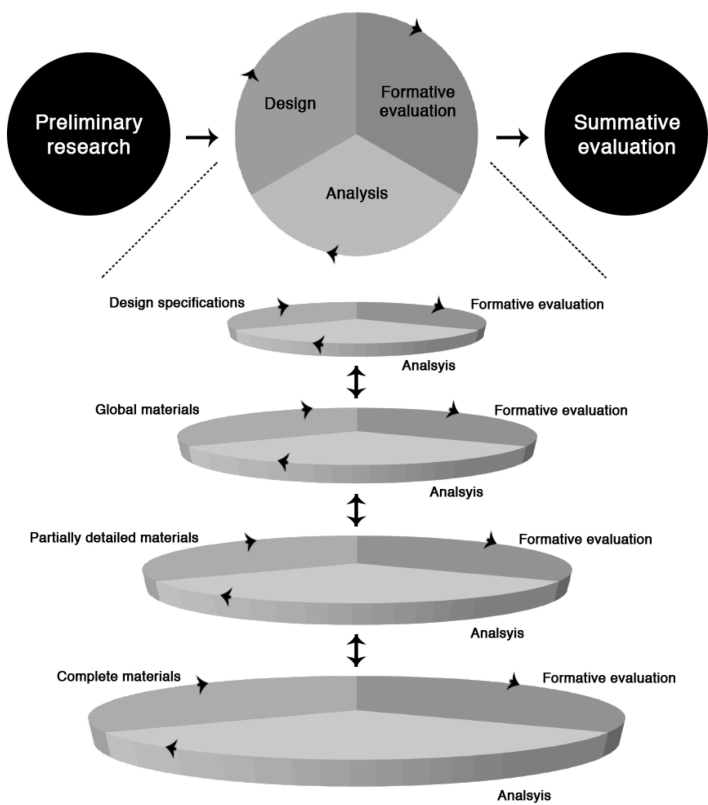


Figure 19. Nieveen model.*

*Nieveen, N. (1997). *Computer support for curriculum developers: A study of the potential of computer support in the domain of formative curriculum evaluation*. Doctoral dissertation. Enschede, The Netherlands: University of Twente. Reprinted with permission of Nienke Nieveen.

Nieveen's model is driven by extensive use of formative evaluation of successive versions of the design documents and then the actual curriculum materials until a satisfactory level of quality has been achieved. Quality is defined in terms of validity (materials are based on state-of-the-art knowledge and are internally consistent), practicality (users can and do use the materials as designed), and effectiveness (learners experience the materials as intended and achieve the intended objectives). These definitions of quality adhere to the distinctions made in the literature about different perspectives on what constitutes the curriculum.

The process begins with preliminary research about what is needed and concludes with summative evaluation. However, in between these anchoring activities the development process goes through several iterative cycles, each consisting of analysis, design, and formative evaluation activities. The model depicts this iterative process as having four levels, but in reality each cycle may have multiple iterations to achieve the necessary level of quality. Preliminary research may not be a part of every project because it may have been done earlier on a larger scale with the results being applied to a series of smaller development efforts. Assuming the preliminary research indicates development should take place, and funding is available, the first development cycle includes creating and formatively evaluating design specifications. This is done primarily by the design team. During the second cycle global materials are created with evaluation being largely done by expert appraisal. During the third cycle partially designed materials are prepared and both expert appraisal and small-scale tryout are employed. During the last cycle complete materials are prepared and subjected to expert appraisal, small group testing, and large group tryout. Summative evaluation occurs after the materials have been released for general use in a variety of settings.

The Seels and Glasgow Model

In the second edition of their book Seels and Glasgow (1998) present the "ISD Model 2: for Practitioners" (Figure 20). Seels and Glasgow compare their model to several others, including some reviewed by us, and to the generic ADDIE frame-

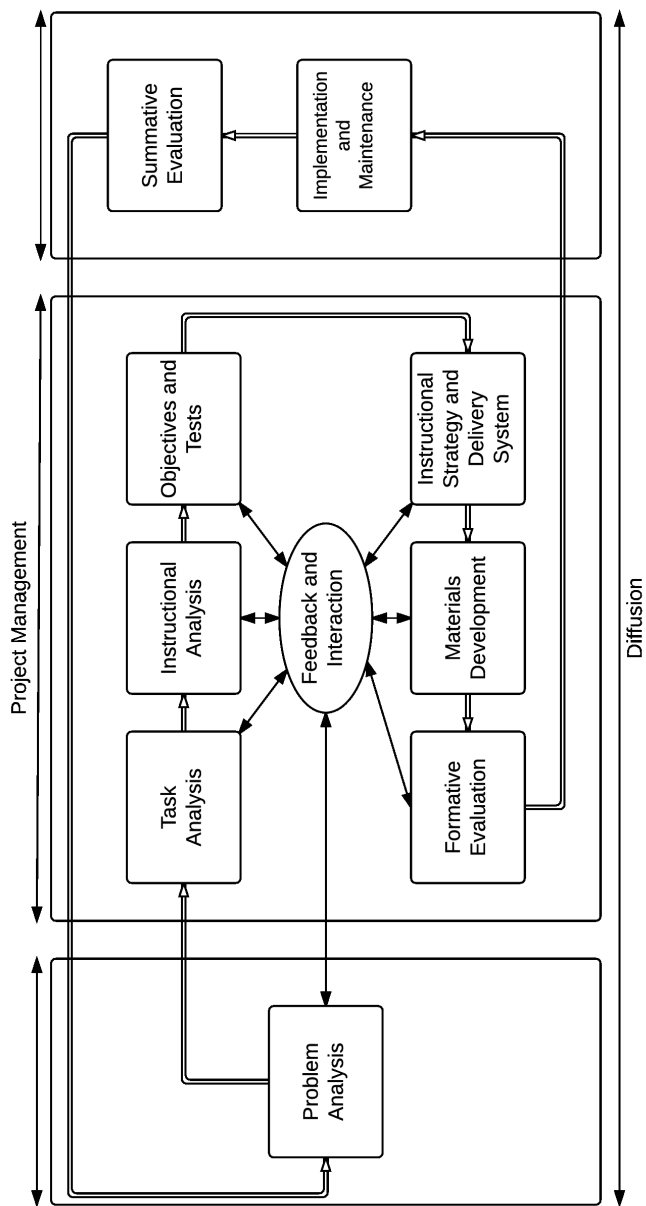


Figure 20. Seels and Glasgow model.*

framework. Seels and Glasgow conclude that their model is similar to many others but is based on the assumption that design and development take place in the context of project management. Thus, their model is organized into three management phases: needs analysis management; instructional design management; and implementation and evaluation management. Cutting across all three phases is paying attention to the ultimate diffusion of the “products” created and their adoption by clients and users. This is in recognition of the problem often encountered by developers who fail to consider how diffusion and adoption will occur until the product is ready for transfer to clients or users, only to find it unacceptable or only minimally adopted. Individual chapters in their book provide specifics on how each phase and each step are to be conducted and include related exercises. Seels and Glasgow emphasize that the steps within each phase may be conducted in a linear fashion but often are not, although the three phases are generally considered to be self-contained and linear. In particular they note that the steps in the instructional design phase are interdependent and concurrent and may involve iterative cycling.

Their first phase, problem analysis, includes all of the decisions associated with conducting needs analysis and formulating a management plan. These include “needs assessment (goals), performance analysis (instructional requirements), and context analysis (constraints, resources, and learner characteristics” (p. 177). The interactive and dynamic nature of their second phase, instructional design, is indicated by the double-ended arrows connecting each of the six steps with a central oval labeled “Feedback and Interaction.” Completion of phase two occurs after satisfactory results are obtained from formative evaluation. Phase three, implementation and evaluation, includes preparing training materials and offering training for users, creating support structures, summatively evaluating the instruction, and disseminating information about the project.

The Seels and Glasgow model appears to be intended for developers of products and lessons with the expectation that the

*Seels, B., and Glasgow, Z. (1998). *Making instructional design decisions* (2nd ed.). Upper Saddle River, N.J.: Merrill, Prentice-Hall. Reprinted with permission of Merrill.

results will be disseminated for use by others. Distinctive features of the model are its emphasis on management and early and continuing attention to diffusion of the results.

The Agile Development Model

The Agile Development Model is more commonly recognized and used by software developers. Originally created as a manifesto written by seventeen software developers (Beck et al. 2001), the Agile approach promotes:

- individuals and interactions over processes and tools
- working software over comprehensive documentation
- customer collaboration over contract negotiation
- responding to change over following a plan

Practitioners of Agile indicate that the major benefits of the methodology are:

- empirical (learn the process)
- iterative (small steps)
- participatory (frequent feedback)

Instructional designers in international business and industry are adapting the Agile process for instructional processes because of the focus on individuals and outcomes as opposed to following a prescribed, linear plan. The process itself places emphasis on self-organization and motivation and allows for a continuous collaboration between stakeholders and developers. This latter consideration is in response to the challenge of identifying all requirements during the opening phase of an instructional project. Instead, it becomes important to incorporate modes of communication that include all team members and a representative of the stakeholder. The Agile process refers to this communication specifically as a “daily scrum meeting,” which lasts no longer than fifteen minutes and allows all involved parties to report on the previous day’s development activities, to indicate the next course of action, and to identify any issues or problems

that are prohibiting progress. The primary measure of progress in the Agile process is a working product.

Instructional designers who use Agile developing benefit from the inherent flexibility. The focus on individuals and interactions allows for team members to draw on whatever tools or processes fit the needs of the specific project. Designers also are free to devote development time and resources to the end product(s) rather than to writing supplemental or completing documentation. The agility of the process is most apparent when designers and developers are free to adjust the development plan in progress when a significant issue or problem is encountered. Traditionally, design or development stops and stakeholders are brought in for a full report to address necessary changes. The daily reporting mechanism of the Agile process affords a clear, continuous understanding by all parties and expedites the overall process. However, it should be noted that the strength of the Agile process hinges on the team make up and relationship between the designers and stakeholders. The more external factors—stakeholder representative(s), developers, subject matter experts, etc.—the easier it is for the communication process to break down and progress to degrade.

The Agile model may work well for instructional designers who work on projects related to the software industry, where the process is familiar to stakeholders. Large-name software corporations are advocating for the use of the Agile methodology by their instructional designers.

Chapter Five

System-Oriented Models

System-oriented models typically assume that a large amount of instruction, such as an entire course or entire curriculum, will be developed with substantial resources being made available to a team of highly trained developers. Assumptions as to whether original production or selection of materials will occur vary, but in many cases original development is specified. Assumptions about the technological sophistication of the delivery system vary, with trainers often opting for much more technology than teachers are able to consider. The amount of front-end analysis is usually high as is the amount of tryout and revision. Dissemination is usually extensive and delivery does not typically involve the team that did the development.

System-oriented ID models usually begin with a data-collection phase to determine the feasibility and desirability of developing an instructional solution to a “problem.” Many system-oriented models require that a problem be specified in a given format before proceeding. Thomas Gilbert’s (1978) and Mager and Pipe’s (1984) work on front-end analysis is particularly relevant to the models discussed herein. Gilbert and Mager and Pipe take the position that, although a problem may have an instructional solution, one should first consider lack of motivation and environmental factors as alternative domains for action. Systems models, as a class, differ from product-development models in the amount of emphasis placed on analyzing the goals of the organization before committing to development. Systems models also typically assume a larger scope of effort than product-development models. However, in the design, development, and evaluation phases the primary difference between systems models and product models is one of magnitude rather than the types of specific tasks to be performed. Six models have been selected to represent the variety of ID models most applicable in the systems context: Interservices Procedures for Instructional Systems Development (Branson 1975); Gentry (1994);

Dorsey, Goodrum, and Schwen, (1997); Diamond (2008); Smith and Ragan (1999); and Dick, Carey, and Carey (2009).

The Interservices Procedures for Instructional Systems Development (IPISD) Model

The Interservices Procedures for Instructional Systems Development (IPISD) model was, as the name suggests, a joint effort of the United States military services. The Army, Navy, Marines, and Air Force created this model (Figure 21) in the interest of utilizing a common approach to instructional development. The underlying concern of each service was to have a rigorous procedure for developing effective instruction. An additional impetus was to facilitate shared development efforts and improve communication with contractors doing instructional development across different branches of the military. A large number of personnel contributed to creating the IPISD model; however, the name most commonly associated with it is Robert Branson (1975).

The IPISD model has several levels of detail. The simplest level has five phases: analyze, design, develop, implement, and control. These phases subdivide into twenty steps, which can be further divided into hundreds of sub-steps. In fact, the IPISD model is one of the most highly detailed models of the ID process generally available. The IPISD model is published as a four volume set (Branson 1975) and can be ordered from the National Technical Information Service (NTIS).

Because a detailed review of all the steps in this model is beyond the scope of this survey, it will be reviewed only at the phase level. The reader should keep in mind that the IPISD approach is designed specifically for military training. Most other models have a much broader range of intended applications. The narrower focus of IPISD is both a blessing and a bane. Its virtue is the extremely detailed level of specification. However, the price of this specification is the lack of generalizability of many of its specific procedures to other contexts.

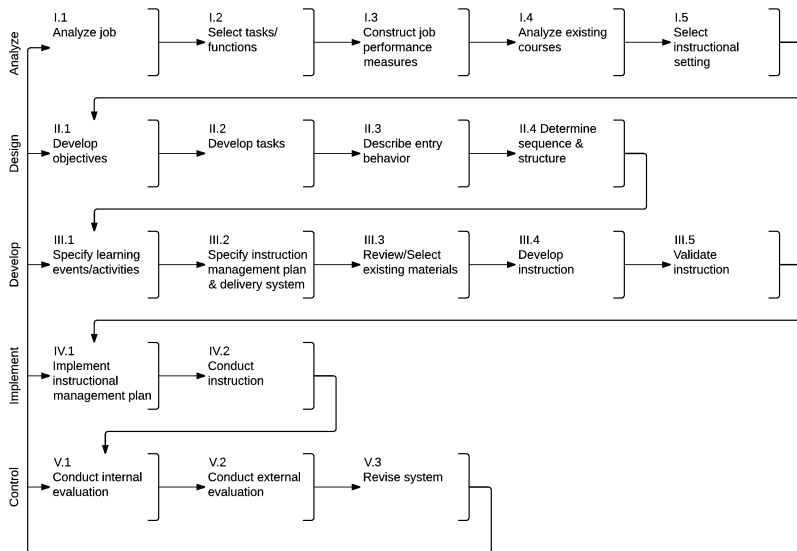


Figure 21. IPISD model.*

Phase one of IPISD (analyze) requires specification of the tasks military personnel perform on the job. Tasks that are already known or easy to acquire are subtracted and a list of tasks requiring instruction is generated. Performance levels and evaluation procedures are specified for the tasks, and existing courses are examined to determine if any of the identified tasks are included. A decision is then made either to modify the existing course to fulfill task requirements or to plan a new course. The final step in phase one is to determine the most appropriate site for instruction, such as school or non-resident instruction.

Phase two (design) begins with the arrangement of job tasks into instructional outcomes classified by the learning elements involved. Tests are generated and validated on a sample of the population and instructional objectives written in be-

*Branson, R. K. (1975). *Interservices procedures for instructional systems development: Executive summary and model*. Tallahassee, Fla.: Center for Educational Technology, Florida State University. (National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161. Document Nos. AD-A019 486 to AD-A019 490) Public domain document.

havioral form. Next, the entry behavior expected of typical students is determined, followed by the design of the sequence and structure for the course.

The development of prototype materials occurs in phase three (develop) of the model. Development begins with specifying a list of events and activities for inclusion in instruction. Media are then selected and a course management plan developed. Existing instructional materials are reviewed for their relevance and, if appropriate, adopted or adapted for the course. Necessary new materials are then produced and the entire package is field tested and revised until satisfactory learner and system performance are achieved.

Phase four (implement) includes training for course managers in the utilization of the package, training of subject matter personnel who will manage or deliver the training, and distribution of all materials to the selected sites. Instruction is then conducted and evaluation data collected on both learner and system performance.

During phase five (control) internal evaluation is performed by “on-line” staff who are expected to make small-scale changes to improve the system after each offering. In addition, they forward evaluation results to a central location. External evaluation is a team effort directed toward identifying major deficiencies requiring immediate correction. External evaluation also follows course graduates to the job site to assess real-world performance. Changes in practice in the field are also monitored to determine necessary revisions to the course. Thus, the emphasis in phase five is on quality control and continued relevance of the training over an extended period of time.

The major strength of the IPISD model is the extensive specification of procedures to follow during the ID process. Its major limitations are its narrow instructional focus and linear approach to ID. Berkowitz and O’Neil (1979) prepared an annotated bibliography of additional relevant resources for the IPISD model.

The Gentry Model

Gentry (1994) created an Instructional Project Development and Management (IPDM) model intended to introduce both the concepts and procedures of the ID process and the supporting processes (Figure 22). His model attends to what needs to be done and how something is done during an instructional development project. Gentry's model is accompanied by numerous techniques and job aids for completing the tasks associated with instructional development. According to Gentry, the IPDM model is intended for graduate students, practicing instructional developers, and teachers. However, the comprehensive description of the entire process and the accompanying tools for managing large projects make it suitable for developing large-scale systems.

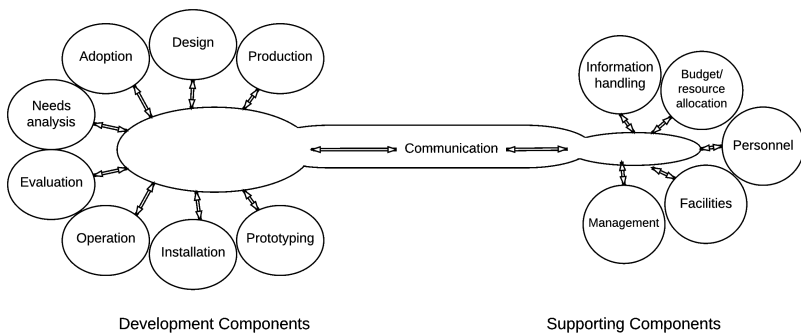


Figure 22. Gentry model.*

Gentry's model is divided into two groups of components: development components and supporting components with a communication component connecting the two clusters. There are eight development components: 1) Needs Analysis (establish needs and prioritize goals for existing or proposed instruction); 2) Adoption (establish acceptance by decision makers, and obtain commitment of resources); 3) Design (specify objectives, strategies, techniques, and media); 4) Pro-

*Gentry, C.G. (1994). *Introduction to instructional development: Process and technique*. Belmont, Cal.: Wadsworth. Reprinted with permission of Wadsworth Publishing Company.

duction (construct project elements specified by the design and revision data); 5) Prototyping (assemble, pilot test, validate, and finalize an instructional unit); 6) Installation (establish the necessary conditions for effective operation of a new instructional product); 7) Operation (maintaining the instructional product after its installation); and 8) Evaluation (collect, analyze, and summarize data to enable revision decisions).

There are five Supporting processes: 1) Management (process by which resources are controlled, coordinated, integrated, and allocated to accomplish project goals); 2) Information Handling (process of selecting, collecting, generating, organizing, storing, retrieving, distributing, and assessing information required by an ID project); 3) Resource Acquisition and Allocation (processes for determining resource needs, formalizing budgets, and acquiring and distributing resources); 4) Personnel (processes for determining staffing needs, hiring, training, assessing, motivating, counseling, censuring, and dismissing ID project members); and 5) Facilities (process for organizing and renovating spaces for design, implementation, and testing of elements of instruction).

The IPDM model emphasizes the importance of sharing information between the two clusters of components during the life of the instructional development project. The communication component is the “process by which essential information is distributed and circulated among those responsible for, or involved in, the activities of a project” (Gentry 1994, p. 5).

Fang and Strobel (2011) adapted the IPDM model for use in game design. Applying the Gentry model in this context provided a constructivist learning environment. Specifically, use of the model in a game design context served as process scaffolding and was well received by novice designers. As a result, it may be worthwhile to consider applying IPDM (and other instructional design models) to new applications, such as game design.

A unique quality of Gentry’s IPDM model is the way the instructional development process is related to specific techniques for its implementation. Some may view the IPDM model as a somewhat mechanistic approach to instructional development because of its reliance on jargon and its behavioristic orientation. However, Gentry warns against being overly dog-

matic and linear in applying his model. The model depicts procedures that contain enough descriptive and prescriptive information, and at varying levels of detail, to make it a comprehensive introduction to the processes and techniques of instructional development.

The Dorsey, Goodrum, and Schwen Model

Dorsey, Goodrum, and Schwen (1997) label the process they describe “Rapid Collaborative Prototyping” to emphasize the central role users play in the development process. They conceive of designers not as external experts who oversee development, but as collaborators on teams on which users play key design roles. They believe that this collaboration results in better products that are more likely to be implemented since users have played a central role in all phases of the process.

Based on the examples included in their description of the model (Figure 23) it seems most appropriately applied at the course development level, although it also might be employed to produce products for use within courses. Their model features a series of closely spaced iterative testing cycles of prototypes that initially are of low fidelity with an initial emphasis on clearly establishing what users want. Later “pilot” prototypes are of increasing fidelity. Related to the model, they have identified five levels, or cycles, of the prototyping process, but there can be a number of iterations within each cycle. The five cycles are: create a vision, explore conceptual prototypes, experiment with hands-on mock-ups, pilot test working prototypes, and fully implement the evolving vision.

Dorsey, Goodrum, and Schwen do not provide detailed prescriptive information on how development and testing should take place but do offer a number of rapid prototyping principles under four categories: process, interaction, fidelity, and feedback. The three process principles are: iteratively modify the prototype several times in each level of design, modify and return the prototype quickly (speed is critical), and seek alternatives not just modifications.

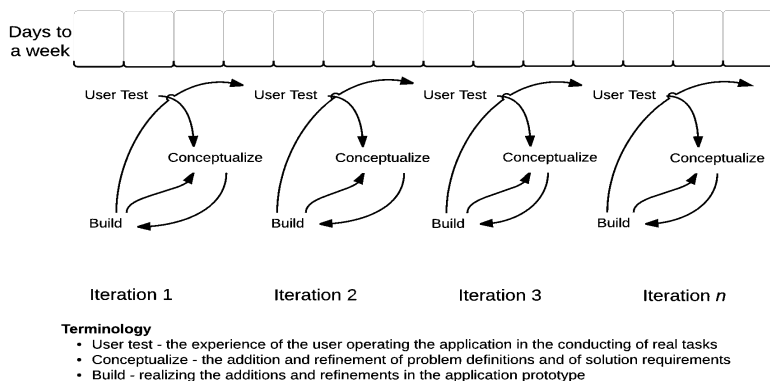


Figure 23. Dorsey, Goodrum, and Schwen model.*

Their three interaction principles are: regard the user as designer, avoid the use of technical language, and maintain consistent communication. Under fidelity the three principles are: employ low-fidelity prototypes to gain feedback during early levels of design and employ high-fidelity prototypes to gain quality feedback during final levels of design, consider the prototype to be effective if it allows the user to give pertinent and productive feedback, and exploit the available technology. The three feedback principles are: capture what the user likes but more importantly what he/she does not like, if the user doesn't want it fixed don't fix it, and gather data on three levels (micro, midi, and macro).

This highly iterative model stresses rapid prototyping across all five ADDIE elements, which makes it distinctive in the ID literature and is the basis for its selection for review. Unfortunately, it is more conceptual than operational and so details as to how to implement it are lacking. However, we anticipate seeing more such models in the future, hopefully with

* Dorsey, L.; Goodrum, D.; and Schwen, T. (1997). Rapid collaborative prototyping as an instructional development paradigm, pp. 445-465. In C. Dills and A. Romiszowski (eds.), *Instructional development paradigms*. Englewood Cliffs, N.J.: Educational Technology Publications. Reprinted with permission of Educational Technology Publications.

more operational detail, as developers seek to apply rapid prototyping to all phases of the ID process.

The Diamond Model

Over a number of years Diamond (2008) created and refined a development model that is specific to higher education institutions (Figure 24). Although Diamond's model might be considered classroom oriented, we have placed it in the systems category because of his belief that development is a team effort and often is directed at comprehensive curricular offerings in addition to individual courses. Diamond also emphasized the need to be sensitive to political and social issues existing on the campus and within academic departments. Ensuring that the proposed development effort is consistent with organizational priorities and missions is another critical concern that is distinctive about this model. Diamond believed ID is a team process with significant input from university personnel specifically assigned to assist faculty. For all these reasons his model seems most appropriate for classification as a systems model.

Diamond's model is divided into two sequences with two phases within the first sequence. During the basic design sequence, action begins with assessing need and creating a statement of goals before moving to designing, implementing, assessing, and revising the curriculum. The assessment sequence is included as a response to external mandates to assess the quality of academic programs. The phases of the first sequence are divided into project selection and design and production, implementation, and evaluation. During phase one the feasibility and desirability of launching the project are examined. Instructional issues, such as enrollment projections, level of effectiveness of existing courses, institutional priorities, and faculty enthusiasm, are all considered prior to beginning development. Diamond recommends commencing the ID process by thinking in terms of an "ideal" solution without regard to existing constraints. His argument is that by thinking in ideal terms, a team will be more creative and innovative in outlining powerful solutions. Once a

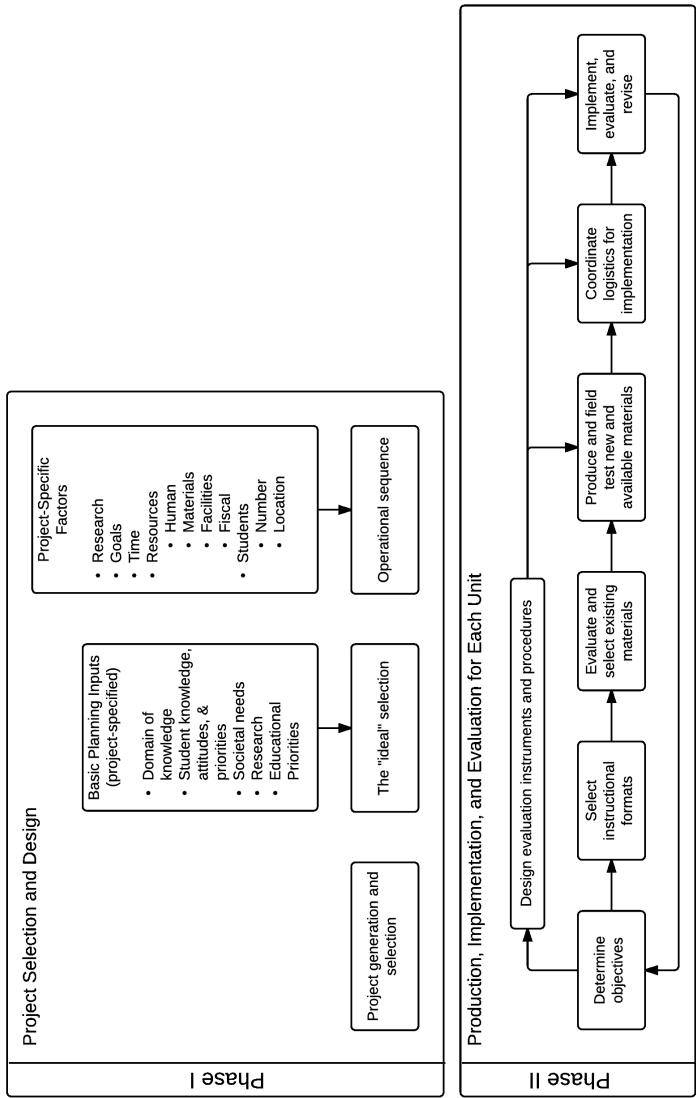


Figure 24. Diamond model.*

decision is made to begin a project, an operational plan is developed that accounts for the goals, timeline, human and other resources, and student needs.

During phase two each unit of the course or curriculum proceeds through a seven-step process. The first step is to state the goals and learning outcomes of the course or curriculum. This is followed by selecting instructional formats. The next step involves design of evaluation instruments and procedures, a step that proceeds concurrently with evaluating and selecting existing materials while also producing and field-testing new and evaluated materials. Interestingly, Diamond includes field-testing as part of the same step as materials production although most model developers make them separate steps. Also implicit in this step is revision of instruction based on field-test data, but Diamond includes revision later in the process. The next to the last step is coordinating logistics for implementation, followed by full-scale implementation, including evaluation and revision.

Diamond emphasizes matching the decision of whether to engage in development to institutional missions and strategic plans as well as to instructional issues. He also stresses the need to ensure faculty ownership of the results of the development effort and the need for a formal organization to support faculty development efforts.

The Smith and Ragan Model

Smith and Ragan (1999) created an instructional design process model (Figure 25) that is becoming increasingly popular for students and professionals in the field of instructional technology who are particularly interested in the cognitive psychology base of the ID process. Almost half of the procedures in their process address the design of instructional strategies.

Smith and Ragan's model has three phases: analyzing the learning context, generating instructional strategies, and formative and summative evaluation. These three phases provide the

*Diamond, R.M. (2008). *Designing and assessing courses and curricula: A Practical Guide*. San Francisco: Jossey-Bass. Reprinted with permission of author.

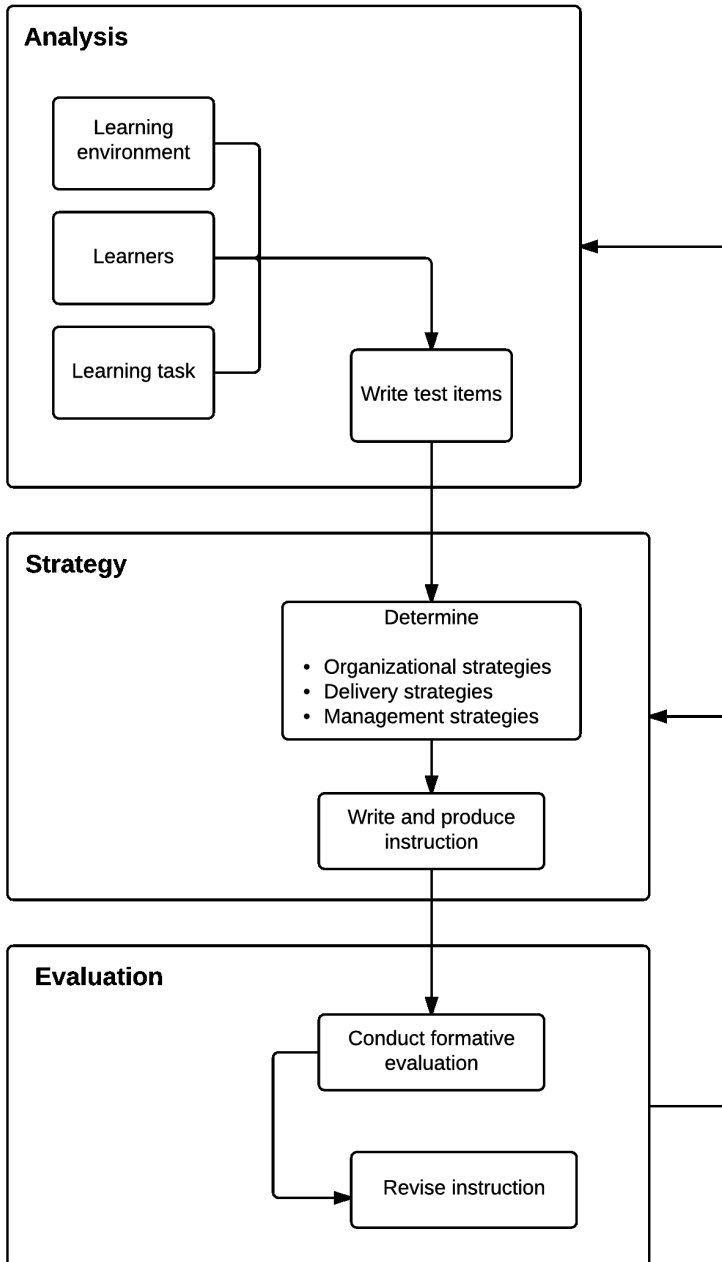


Figure 25. Smith and Ragan model.*

conceptual framework for the eight steps that comprise their ID process. Their eight-step approach includes: analyzing the learning context, analyzing the learners, analyzing the learning task, assessing learner performance, developing instructional strategies, producing instruction, conducting evaluation, and revising instruction.

Analyzing the learning context involves a two-part procedure: 1) substantiation of a need for instruction in a certain content area, and 2) preparing a description of the learning environment in which the instructional product will be used. Analyzing the learners describes procedures for describing the stable and changing characteristics of the intended learner audience. Analyzing the learning task describes procedures for recognizing and writing appropriate instructional goals. Assessing learner performance describes procedures for identifying which of several possible assessment items are valid assessments of objectives for various types of learning. Developing instructional strategies is the step that presents strategies for organizing and managing instruction. Producing instruction is the step that provides strategies for translating the decisions and specifications made in previous steps into instructional materials and trainer guides. Production is followed by formative and summative evaluation. Smith and Ragan offer procedures for evaluating the effectiveness of the instructional materials both during development and after implementation. Lastly, revising instruction offers procedures for modifying the proposed instruction. Although this description suggests that the process is highly linear, Smith and Ragan caution that circumstances often require concurrent attention to several steps in their model.

The Smith and Ragan model reflects their philosophic belief that applying a systematic, problem-solving process can result in effective, learner-centered instruction. Their model is particularly strong in the area of developing specific instructional strategies, a common weakness of many other ID models.

*Smith, P.L., and Ragan, T.J. (1999). *Instructional design*. New York: Macmillan. Reprinted with permission of Macmillan.

The Dick, Carey, and Carey Model

Without a doubt the most widely cited ID model is one originally published by Walter Dick and Lou Carey, to which they have now added James Carey. Both advocates of ID and its most vocal critics invariably cite this model when expressing their opinions about the desirability of systematically designing instruction. The Dick, Carey, and Carey model has become the standard by which all other ID models (and alternative approaches to design and development of instruction) are compared. For this reason we have chosen to include this model in this survey.

In their widely used text, now in its seventh edition, Dick, Carey, and Carey (2009) include a model (Figure 26) that is largely unchanged from earlier editions. This model might be considered product oriented rather than system oriented depending on the size and scope of step one activities (identify instructional goals). Additionally, the first step has been updated to reflect that identifying goals may occur through a variety of actions, including established goals, learner experience, analysis, or some other requirement. The authors have also refreshed the narrative to include learning with portable devices. The serial case study is directed at a specific instructional product, but parts of the narrative suggest a more encompassing perspective. For our purpose we consider it to be a course or system level model that is also applicable to projects having a more limited focus. It should be noted that they use the term instructional design for the overall process that we define as instructional development.

Dick, Carey, and Carey's model begins with Identify Instructional Goal(s). The first component of their model immediately distinguishes it from many other instructional development models by promoting needs assessment procedures and the importance of identifying clear and measurable goals. They recommend criteria for establishing instructional goals as a way to decide what the designer is trying to achieve before beginning the ID process. Two steps are then done in parallel: Conduct Instructional Analysis and Analyze Learners and Contexts. The former is vintage hierarchical analysis as conceived by Gagné, with added procedures for constructing cluster-analysis diagrams for verbal information. The latter step specifies collecting information about prospective learners' knowledge, skills,

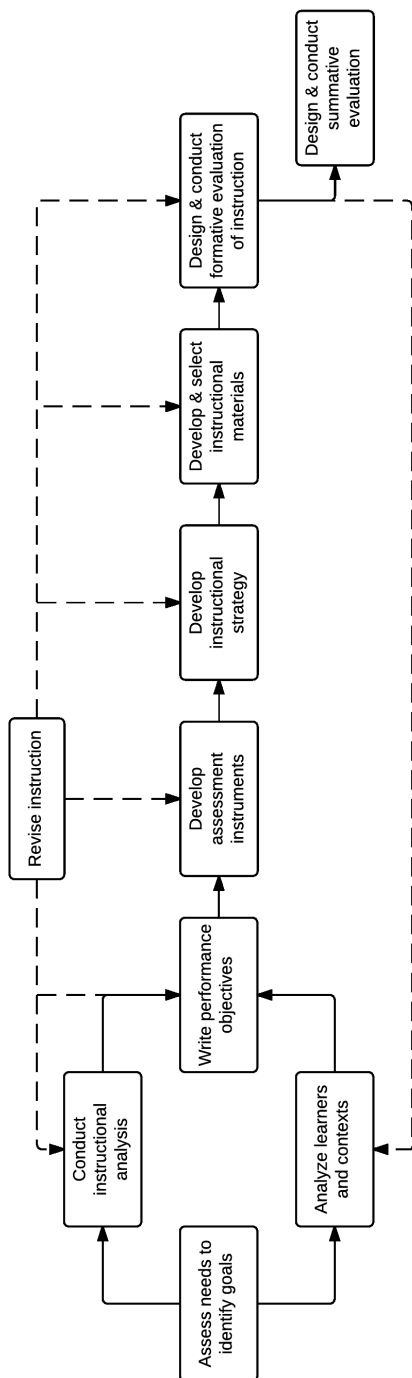


Figure 26. Dick, Carey, and Carey model.*

and attitudes and the environment in which they are situated. The next step is to Write Performance Objectives in measurable terms, followed by Developing Assessment Instruments. Criterion-referenced test items then are generated for each objective. In the Develop Instructional Strategy step they recommend ways to develop strategies for assisting particular groups of learners to achieve the stated objectives. The next step is to Develop and Select Instructional Materials. Dick, Cary, and Carey acknowledge the desirability of selecting as well as developing materials, but the degree of emphasis devoted to development suggests that they are far more interested in original development. The next step is to Design and Conduct Formative Evaluation, a process for which they give excellent guidance. The process of conducting a formative evaluation of instructional materials is iterative and consists of at least three cycles of data collection, analysis, and revision. The first cycle pinpoints errors in the materials. The second cycle occurs after these errors have been corrected and is designed to locate additional errors in the materials and procedures. The third cycle is a field trial that is conducted following the refinement of materials after the second cycle and is intended to identify errors when the materials are used in their intended setting. Design and Conduct Summative Evaluation also determines the degree to which the original instructional goals (and perhaps other unintended ones) have been achieved.

The Dick, Carey, and Carey model reflects the fundamental design process used in many business, industry, government, and military training settings, as well as the influence of performance technology and the application of computers to instruction. It is particularly detailed and useful during the analysis and evaluation phases of a project.

The Merrill Model

As a result of working to identify first principles of instruction, Merrill has contributed one of the most widely

*Dick, W.; Carey, L.; and Carey, J. (2009). *The systematic design of instruction* (7th ed.). Upper Saddle River, N.J.: Merrill. Reprinted with permission of the authors.

discussed and used models of instructional design in the past 10 years. Through a systematic review of instructional design theories, models, and research, Merrill (2009) concluded that well-designed instruction possesses five core principles that are indicative of its effectiveness, efficiency, and engagement. These five principles are: demonstration, application, task-centered, activation, and integration. Merrill asserts that learning is promoted when learners observe a demonstration, apply the new knowledge, engage in a task-centered instructional strategy, activate relevant prior knowledge, and integrate new knowledge into their everyday activities. Merrill's (2002) Pebble in the Pond development model is based on these first principles of instruction and considers each principle within a series of expanding activities. However, it should be noted that Merrill believes Pebble in the Pond to be a content-centered modification that should be used in conjunction with traditional instructional systems design. For this reason, Merrill's model is considered a product-oriented model, and we have not included it in this section for that reason.

With respect to the integrative nature of Merrill's (2002) first principles of instruction and Pebble in the Pond development, there is a series of decisions and actions that must be made by designers. As the problem is identified, or "casting a pebble" (p. 40), the designer must determine what the instruction should accomplish. Through analysis, the skill to be mastered is broken down into a series of tasks of varying complexity. Merrill (2009) cautions that first principles are most appropriate for generalizable skills, or those that "can be applied to two or more different specific situations" (p. 43). Generalizable skills also are categorized as concept classification (kinds of), procedural (how to), or predicting consequences (what happens). Identifying the skill allows the designer to determine which instructional strategies to use for consistent portrayal or demonstration. Merrill notes that failure to provide sufficient demonstration often plagues instruction, thus the need for categorizing and consistency when presenting information. By using consistent demonstration, designers also can provide activities that allow for consistent application of the skill(s) to be learned. At this point in the process, Merrill is careful to point out that designing task-centered strategies is not the same as designing problem-based instructional strategies. The primary difference is that task-centered in-

instructional strategies are a form of direct instruction placed within the context of authentic, real-world tasks. An efficiently structured, task-centered strategy provides a frame-work within which learners are able to activate prior knowledge and integrate newly acquired skills. Reflection, peer critiques, personal use, and public demonstration all contribute to integrating new knowledge and skills into everyday activities. Once fully planned, the content and instructional strategies are combined in the design process, which takes the designer through to the production “ripple” of the model.

The Pebble in the Pond development model is unique in that Merrill intends for the process to fit within other instructional design processes as opposed to standing alone. However, the integration of Merrill’s first principles of instruction within the model certainly allow for the possibility of independent use. As training and instructional needs become increasingly diverse, the model is well suited for use in a variety of settings from traditional classrooms to product demonstrations.

Conclusion

This review of representative instructional design models may leave readers unsure of how to react to such a wide variety of models. The literature is replete with models, many claiming to be unique and deserving of attention. However, while there are hundreds of models, until recently there have been only a few major distinctions among them. Many of the models are simply restatements of earlier models by other authors using somewhat different terminology. The typical journal article simply describes the major steps in the ID model and perhaps how they are to be performed. Books on the topic (e.g., Dick, Carey, and Carey 2001; Smith and Ragan 1999) do provide extensive guidance on how to apply the models, and some computer-based tools are beginning to appear. However, in almost all instances the authors assume that their models are worthwhile but present no evidence to substantiate their position. There is a disturbingly small volume of literature describing any testing of the models. While no one can be certain, it appears that many have never actually been applied, much less rigorously evaluated. In some instances, a case study of a development project is presented along with the model, but even this low level of validation is less common than we would prefer. (There is a useful compilation of short cases studies by Ertmer and Quinn (1999), but the cases are not systematically linked to specific ID models.)

We hope that in the future at least some ID models will be subjected to more rigorous validation. Such validation would require precise description of the elements of the model followed by systematic data collection concerning their application and the effects of the resulting instruction. The investigator also would need to be alert to possible discrepant or negative data. Repeated trials under such conditions would, if the model had validity, result in a set of specifications regarding the conditions under which the model was valid. It is safe to say that none of the models currently available in the literature has been subjected to such rigorous scrutiny. In fact, most authors completely ignore the is-

sue of what conditions should be present if one plans to use their models. For a more complete discussion of procedures for validating a model, we refer readers to an excellent chapter on models and modeling by Rubinstein (1975).

What then, should be the response of the responsible ID professional to the plethora of ID models? First, we would suggest that developers acquire a working knowledge of several models, being certain that all three of the categories in our taxonomy are represented. Then, as new and different models are encountered, they can be compared to those with which one is familiar. Also, if a client brings a model to a development project, it is probably better to use it (modified if required) rather than force the client to adopt the contractor's favorite model. Another suggestion is to have available examples of models that can be presented with varying levels of detail. This will provide an easy introduction that later can be expanded to provide more detail for uninformed clients as they become more experienced. Also, when facing a range of situations, developers should be in the position of selecting an appropriate model rather than forcing the situation to fit the model. Bass and Romiszowski (1997) probably state this position best, "instructional design is, and always will be, a practice based on multiple paradigms" (p. xii). Like Bass and Romiszowski, we believe that all competent professional developers should have a number of models in their tool bag and use the right one, perhaps with modification, for the job.

Looking back over the last few years, we see significant trends developing after many years of little change in the underlying structure of the ID process and its accompanying models. Although some would say that the newfound interest in constructivism (an old idea rediscovered) forms the basis for this trend, we believe new trends in instructional development lie more in advances in technology and the emergence of better design and delivery tools. For example, as was noted earlier, rapid prototyping models are now becoming more common. Their emergence closely parallels creation of tools that facilitate quick and inexpensive creation and modification of prototypes that simply were not previously possible. Instructional developers have always appreciated the power of prototypes to generate creative thinking and to test the feasibility of design ideas. However, until tools became available most developers were forced to

use the “design by analysis” approach common to most classic ID models.

This is not to suggest that constructivism (as well as social learning and other theories) has not contributed to the increased interest in learner-centered instruction. However, one of the fundamental early contributions of ID was to move from teacher-centered to learner-centered instruction. Recent developments continue to promote this view, and we believe it should be encouraged, but its origins should not be ignored. Advances in technology also increase our ability to create more interactive and engaging learning environments, a goal of developers designing from virtually all theoretical perspectives.

Other forces that are influencing how we are now beginning to think about the ID process include performance support systems, knowledge management, and concurrent engineering. To date most of the interest in performance support has been in occupational job support, but this idea can be extended to formal learning environments as well. There are at least two issues here. One issue is, how can ID contribute to the design of performance support systems? The second issue is, how does one design training to complement performance support because many will require at least some prior or concurrent knowledge and skill development? There are similar issues related to knowledge management. Effective knowledge-management systems will require much more than simply organizing and making available large quantities of data to users. Data are not information. Although to date interest in knowledge management has been limited to the commercial sector, we believe it also has implications for how we design classroom and independent learning environments. Similarly, as concurrent engineering becomes more common, instructional developers will need to find ways to become contributing members of development teams if they hope to be central to the primary business of corporations and large social services agencies. Being an initial member of a cross-disciplinary team creating a new product or process will require ID models and practices beyond what we now use.

Tool creation is increasingly becoming a major enterprise for some ID professionals, a trend we expect to continue. These tools range from the very simple to the very complex. Instruc-

tional development professionals are creating many tools for use by developers as well as tools to support teachers or subject matter experts in doing their own development work. Goodyear (1997) and Van den Akker, Branch, Gustafson, Nieveen, and Plomp (1999) provide excellent descriptions of some such tools and how they are being used. Tools to support automation of the ID process also are increasing in number, but progress has been slower than their proponents have hoped. However, they too will play an expanded role over the next decade.

In closing, it is fair to predict that the future will be both exciting and a little unsettling for ID professionals. After a relatively lengthy period of slow evolution of ID practice we are on the threshold of major shifts. As is the case in all such shifts, the key is determining how to incorporate what is valid and useful from past theory and practice into a new frameworks, while testing and revising the new ideas rather than uncritically accepting them. These are exciting times for ID professionals with many opportunities (some brilliantly disguised as headaches) available for making significant contributions. We are eager to see which of these trends will most affect the next edition of this review.

Instructional developers increase their potential for success when the applied model matches the educational context. However, instructional developers also should consider specific contextual issues that may require the application of additional considerations such as rapid prototyping and concurrent engineering. Further, people who intend to use instructional development models may be well served to investigate the instructional design competencies required to implement an instructional development model successfully, such as those promoted by the International Board of Standards for Training, Performance and Instruction (Richey, Fields, and Foxon 2000). Finally, a survey of instructional development models should assist readers in adopting an existing model that has been proven successful or adapting an existing model to increase the potential for fidelity between the educational context and the desired instructional outcomes or creating one's own model that addresses each of the selected characteristics of the taxonomy.

References

- Andrews, D.H., and Goodson, L.A. (1980). A comparative analysis of models of instructional design. *Journal of Instructional Development* 3(4):2-16. (ERIC Document Reproduction Service No. EJ 228 351).
- Association for Educational Communications and Technology (AECT). (1977). *Educational technology definition and glossary of terms*. Washington, D.C.: Association for Educational Communications and Technology.
- Barson, J. (1967). *Instructional systems development: A demonstration and evaluation project. Final report*. East Lansing, Mich.: Michigan State University. (ERIC Document Reproduction Service No. ED 020 673).
- Bass, C., and Romiszowski, A. (eds.). (1997). *Instructional development paradigms*. Englewood Cliffs, NJ: Educational Technology Publications.
- Bates, A.W. (2005). *Technology, e-learning and distance education* (2nd ed.). New York: Routledge.
- Bates, A.W. (1995). *Technology, open learning and distance education*. London: Routledge. (ERIC Document Reproduction Service No. ED 407 597)
- Beck, K., et al. (2001). *Manifesto for agile software development*. Agile Alliance. Retrieved from <http://agilemanifesto.org/>.
- Beckschi, P., and Doty, M. (2000). Instructional systems design: A little bit of ADDIEtude, please. In G. Piskurich P. Beckschi, and B. Hall (eds.), *The ASTD handbook of training design and delivery*. New York: McGraw-Hill.
- Bergman, R.E., and Moore, T.V. (1990). *Managing interactive video/multimedia projects*. Englewood Cliffs, N.J.: Educational Technology Publications.
- Branch, R. (1999). Instructional design: A parallel processor for navigating learning space, pp. 145-154. In J. van den Akker, R. Branch, K.L. Gustafson, N. Nieveen, and T. Plomp (eds.), *Design approaches and tools in education and*

- training*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Branch, R. (1997). Perceptions of instructional design process models. In R.E. Griffin, D.G. Beauchamp, J.M. Hunter, and C.B. Schiffman (eds.), *Selected readings of the 28th annual convention of the International Visual Literacy Association*, Cheyenne, Wyoming.
- Branson, R.K. (1975). *Interservice procedures for instructional systems development: Executive summary and model*. Tallahassee, Fla.: Center for Educational Technology, Florida State University. (National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161. Document Nos. AD-A019 486 to AD-A019 490). Public domain document.
- Cennamo, K., and Kalk, D. (2005). *Real world instructional design*. Belmont, Calif.: Thomson Wadsworth.
- Dabbagh, N., and Bannan-Ritland, B. (2005). *Online learning: Concepts, strategies, and application*. Boston: Pearson Education.
- De Hoog, R.; de Jong, T.; and de Vries, F. (1994). Constraint-driven software design: An escape from the waterfall model. *Performance Improvement Quarterly* 7(3):48-63.
- Diamond, R.M. (2008). *Designing and assessing courses and curricula: A practical guide*. San Francisco, Calif.: Jossey-Bass.
- Dick, W.; Carey, L.; and Carey, J. (2009). *The systematic design of instruction* (7th ed.). Upper Saddle River, N.J.: Merrill.
- Dorsey, L.; Goodrum, D.; and Schwen, T. (1997). Rapid collaborative prototyping as an instructional development paradigm, pp. 445-465. In C. Dills and A. Romiszowski (eds.), *Instructional development paradigms*. Englewood Cliffs, N.J.: Educational Technology Publications.
- Edmonds, G.; Branch, R.; and Mukherjee, P. (1994). A conceptual framework for comparing instructional design models. *Educational Technology Research and Development* 42(4):55-72.
- Ely, D. (1983). The definition of educational technology: An emerging stability. *Educational Considerations* 10(2):2-4.
- Ely, D. (1973). Defining the field of educational technology. *Audiovisual Instruction* 8(3):52-53.
- Ertmer, P., and Quinn, J. (1999). *The ID casebook: Case studies in instructional design*. Upper Saddle River, N.J.: Merrill.

- Fang, J., and Strobel, J. (2011). How ID models help with game-based learning: An examination of the gentry model in a participatory design project. *Educational Media International* 48(4):287-306.
- Gagné, R.M.; Wager, W.W.; Golas, K.C.; and Keller, J.M. (2005). *Principles of instructional design* (5th ed.). Belmont, Calif.: Wadsworth.
- Gentry, C.G. (1994). *Introduction to instructional development: Process and technique*. Belmont, Calif.: Wadsworth.
- Gerlach, V.S., and Ely, D.P. (1980). *Teaching and media: A systematic approach* (2nd ed.). Englewood Cliffs, N.J.: Prentice-Hall.
- Gilbert, T. (1978). *Human competence: Engineering worthy performance*. New York: McGraw-Hill.
- Goodyear, P. (1997). Instructional design environments: Methods and tools for the design of complex instructional systems. In S. Dijkstra, N. Seel, F. Schott, and R. Tennyson (eds.), *Instructional design: International perspectives, Vol. 2*. Mahwah, N.J.: Lawrence Erlbaum Associates.
- Gordon, J., and Zemke, R. (2000). The attack on ISD. *Training* 37(4):42-45.
- Greer, M. (1992). *ID project management: Tools and techniques for instructional designers and developers*. Englewood Cliffs, N.J.: Educational Technology Publications.
- Gustafson, K.L. (1991). *Survey of instructional development models* (2nd ed.). Syracuse, N.Y.: ERIC Clearinghouse on Information and Technology, Syracuse University.
- Gustafson, K.L. (1981). *Survey of instructional development models*. Syracuse, N.Y.: ERIC Clearinghouse on Information and Technology, Syracuse University.
- Gustafson, K.L., and Branch, R. (2007). What is instructional design? pp. 11-16. In R.A. Reiser and J.V. Dempsey (eds.), *Trends and issues in instructional design and technology* (2nd ed.). Upper Saddle River, N.J.: Merrill, Prentice Hall.
- Gustafson, K.L., and Branch, R. (2002). *Survey of instructional development models* (4th ed.). Syracuse, N.Y.: ERIC Clearinghouse on Information and Technology, Syracuse University.
- Gustafson, K.L., and Branch, R. (1997). *Survey of instructional development models* (3rd ed.). Syracuse, N.Y.: ERIC Clearing-

- house on Information and Technology, Syracuse University.
- Hamreus, D. (1968). The systems approach to instructional development. In *The contribution of behavioral science to instructional technology*. Monmouth, Ore.: Oregon State System of Higher Education, Teaching Research Division.
- Heinich, R.; Molenda, M.; and Russell, J. (1981). *Instructional media and the new technologies of instruction*. New York: John Wiley and Sons.
- Heinich, R.; Molenda, M.; Russell, J.D.; and Smaldino, S.E. (1999). *Instructional media and technologies for learning*. Upper Saddle River, N.J.: Prentice-Hall.
- Januszewski, A., and Molenda, M. (eds.). (2008). *Educational technology: A definition with commentary*. New York: Lawrence Erlbaum Associates.
- Mager, R., and Pipe, P. (1984). *Analyzing performance problems: Or you really oughta wanna* (2nd ed.). Belmont, Calif.: Lake.
- Markle, S. (1964). *Good frames and bad: A grammar of frame writing*. New York: Wiley. (ERIC Document Reproduction Service No. ED 019 867).
- Markle, S. (1978). *Designs for instructional designers*. Champaign, Ill.: Stipes.
- Merrill, M.D. (2009). First principles of instruction. In C. M. Reigeluth and A. Carr (eds.), *Instructional design theories and models: Building a common knowledge base* (Vol. III). New York: Routledge.
- Merrill, M.D. (2002). A pebble-in-the-pond model for instructional design. *Performance Improvement* 41(7):39-44.
- Morrison, G.; Ross, S.; and Kemp, J. (2001). *Designing effective instruction* (3rd ed.). New York: John Wiley and Sons.
- Morrison, G.; Ross, S.; Kalman, H.; and Kemp, J. (2011). *Designing effective instruction* (6th ed.). New York: John Wiley and Sons.
- National Special Media Institute. (1971). *What is an IDI?* East Lansing, Mich.: Michigan State University.
- Newby, T.; Stepich, D.; Lehman, J.; Russell, J.; and Ottenbreit-Leftwich, A. (2011). *Educational technology for teaching and learning* (4th ed.). Boston: Pearson.
- Nieveen, N. (1997). *Computer support for curriculum developers: A study of the potential of computer support in the domain of formative*

- curriculum evaluation*. Doctoral dissertation. Enschede, The Netherlands: University of Twente.
- Reiser, R.A. (2001). A history of instructional design and technology, part II: A history of instructional design. *Educational Technology Research and Development* 49(2):57-67. (ERIC Document Reproduction Service No. EJ 629 874).
- Richey, R.C.; Fields, D.C.; and Foxon, M. (2000). *Instructional design competencies: The standards* (3rd ed.). Syracuse, N.Y.: ERIC Clearinghouse on Information and Technology, Syracuse University.
- Rubinstein, M. (1975). *Patterns of problem solving*. Englewood Cliffs, N.J.: Prentice-Hall.
- Salisbury, D. (1990). General systems theory and instructional systems design. *Performance and Instruction* 29(2):1-11. (ERIC Document Reproduction Service No. EJ 408 935).
- Seel, N. (1997). Models of instructional design: Introduction and overview. In R. Tennyson, F. Schott, N. Seel, and S. Dijkstra (eds.) *Instructional design: International perspectives* (Vol. 1). Mahwah, N.J.: Lawrence Erlbaum Associates.
- Seels, B., and Glasgow, Z. (1998). *Making instructional design decisions* (2nd ed.). Upper Saddle River, N.J.: Merrill, Prentice-Hall.
- Seels, B., and Richey, R. (1994). *Instructional technology: The definitions and domains of the field*. Washington, D.C.: Association for Educational Communications and Technology.
- Silvern, L.C. (1965). *Basic analysis*. Los Angeles, Calif.: Education and Training Consultants Company.
- Sims, R., and Jones, D. (2002). Continuous improvement through shared understanding: Reconceptualizing instructional design for online, pp. 1-10. In *Winds of change in the sea of learning: Proceedings of the 19th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE)*, Auckland, New Zealand, 8-11 December 2002, UNITEC Institute of Technology, Auckland, N.Z.
- Smaldino, S.E.; Lowther, D.L.; and Russell, J.D. (2011). *Instructional technology and media for learning* (10th ed.). Upper Saddle River, N.J.: Pearson, Merrill, Prentice-Hall.

- Smaldino, S.E.; Lowther, D.L.; Russell, J.D.; and Mims, C. (2015). *Instructional technology and media for learning* (11th ed.). Boston: Pearson, Merrill, Prentice-Hall.
- Smith, P.L., and Ragan, T.J. (1999). *Instructional design*. New York: Macmillan.
- Stamas, S. (1972). A descriptive study of a synthesized model, reporting its effectiveness, efficiency, and cognitive and affective influence of the development process on a client. *Dissertation Abstracts International* 34. (University Microfilms No. 74-6139).
- Twelker, P.A., et al. (1972). *The systematic development of instruction: An overview and basic guide to the literature*. Stanford, Calif.: ERIC Clearinghouse on Educational Media and Technology, Stanford University.
- Van den Akker, J.; Branch, R.; Gustafson, K.; Nieveen, N.; and Plomp, T. (1999). *Design approaches and tools in education and training*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Van Merriënboer, J., and Kirschner, P. (2007). *Ten steps to complex learning: A systematic approach to four-component instructional design*. Mahwah, N.J.: Lawrence Erlbaum Associates.
- Wiggins, G., and McTighe, J. (2005). *Understanding by design*. Alexandria, Va.: ASCD.
- You, Y. (1993). What we can learn from chaos theory? An alternative approach to instructional systems design. *Educational Technology Research and Development* 41(3):17–32.
- Zemke, R., and Kramlinger, T. (1984). *Figuring things out: A trainer's guide to needs and task analysis*. Reading, Mass.: Addison-Wesley.

Annotated Bibliography

Altun, S., and Büyükduman, F. (2007). Teacher and student beliefs on constructivist instructional design: A case study. *Educational Sciences: Theory and Practice* 7(1):30-39.

This research analyses a constructivist instructional design experience at Istanbul Technical University. The study confirms the constructivist approach as beneficial to students and teachers, but concludes that it does not result attractive to some students due to school system traditions.

Angeli, C., and Valanides, N. (2005). Preservice elementary teachers as information and communication technology designers: an instructional systems design model based on an expanded view of pedagogical content knowledge. *Journal of Computer Assisted Learning* 21(4):292-302.

The authors discuss the evolution of an instructional systems design model that was based on Shulman's concept of pedagogical content knowledge (PCK). Based on experiences with preservice teachers, the model shows evidence of being effective in developing aspects of the PCK.

Cennamo, K. (2003). Design as knowledge construction: Constructing knowledge of design. *Computers in the Schools* 20(4):13-35.

Emerging from the analysis and reflection on the process of designing materials for constructivist learning environments, the author presents the Layers of Negotiation model of instructional design. The article offers insights about this model that evolved in spiral fashion in stages of analysis, design, development, and evaluation. Projects in which the model has been applied confirm its premises—design is collaborative, iterative, and involves questioning.

Cook, M. (2006). Visual representations in science education: The influence of prior knowledge and cognitive load

theory on instructional design principles. *Science Education* 90(6):1073-1091.

This article discusses the effects of visual representations on learners from the cognitive load perspective. According to the author, because learners have limited working memory, instructional representations should reduce unnecessary cognitive load. The article also discusses the role of previous knowledge on the effects of visual representations.

Denham, T. (2002). *Comparison of two curriculum/instructional design models: Ralph W. Tyler and Siena College accounting class, ACCT205*. Course paper, Programs for Higher Education, Nova Southeastern University. (ERIC 471 734).

This article makes a comparison between the curriculum design model developed by Ralph W. Tyler and the model used at Siena College in New York. Tyler's model consists of four parts: 1) defining objectives of the learning experience; 2) identifying learning activities for meeting the defined objectives; 3) organizing of learning activities for attaining the defined objectives; 4) evaluation and assessment of the learning experiences. Taking an accounting course at Siena College as an example, the article concludes that the models have similarities because both value the individual learner and use assessment to achieve the defined learning objective.

Dickey, M. D. (2006). *Girl gamers: The controversy of girl games and the relevance of female-oriented game design for instructional design*. *British Journal of Educational Technology* 37(5):785-793.

This article discusses the emergence of girl games and the design of constructivist learning environments from the perspective of female-oriented game design. The text presents an overview of digital games and gender, an outline of girl games and "pink" software, a discussion of the controversy of girl games, and a review and discussion of the research and implications of female-oriented game design for instructional design.

Fox, E. J. (2006). Constructing a pragmatic science of learning and instruction with functional contextualism. *Educational Technology Research and Development* 54(1):5-36.

The author presents functional contextualism as a new perspective to instructional design and technology (IDT) and as an alternative to constructivism, criticized by the author in its practical and theoretical aspects. The article introduces the main characteristics and philosophical principles of functional contextualism. Implications for instructional design also are discussed.

Hannafin, M.J. (2006). Functional contextualism in learning and instruction: Pragmatic science or objectivism revisited? *Educational Technology Research and Development* 54(1):37-41.

This text is a response to Eric Fox's 2006 article, "Constructing a Pragmatic Science of Learning and Instruction with Functional Contextualism," stating that functional contextualism is not an alternative to constructivism. It questions several assertions and definitions of the referred article, placing it in the objectivist-inspired domain.

Hoogveld, A.; Paas, F.; Jochems, W.; and Van Merriënboer, J. (2002). Exploring teachers' instructional design practices from a systems design perspective. *Instructional Science* 30(4):291.

This study is an exploratory analysis of design activities of ten teacher trainers after curriculum changes in higher education in the Netherlands. Their design practice is compared to an instructional systems design (ISD) approach. The article discusses the little attention paid to evaluation and implications for innovation in education.

Jonassen, D.H. (2006). On the Role of Concepts in Learning and Instructional Design. *Educational Technology Research and Development* 54(2):177-196.

This article defines concepts and describes their importance to learning and instruction. Concepts have been regarded, however, as discrete entities in instructional design. The

author discusses the importance of conceptual change and its implication for concept learning and assessment.

Kester, L.; Kirschner, P.; and Corbalan, G. (2007). Designing support to facilitate learning in powerful electronic learning environments. *Computers in Human Behavior* 23(3):1047-1054.

The article is the introduction to a compilation of contributions that discuss the design process for powerful (multi-media) electronic learning environments. It offers insights on how to design learning situations that support either individual or collaborative learning.

Koper, R.; Giesbers, B.; van Rosmalen, P.; Sloep, P.; van Bruggen, J.; Tattersall, C., et al. (2005). A design model for lifelong learning networks. *Interactive Learning Environments* 13(1-2):71-92.

This work discusses lifelong learning and its new conceptual demands—learner-centered and learner-controlled instructional design models. The authors present a model for structuring learning networks supported by software agents and open learning technology.

Magliaro, S., and Shambaugh, N. (2006). Student models of instructional design. *Educational Technology Research and Development* 54(1):83-106.

This article studies the instructional design models developed by students during an instructional design master's level course and discuss how they understand the ID process. Mental and ID models form the conceptual framework of this study, which employed content analysis and categorized the structural nature of student ID models into metaphoric, dynamic, and sequential.

Nadolski, R.J.; Kirschner, P.A.; van Merriënboer, J.J. G.; and Woretshofer, J. (2005). Development of an instrument for measuring the complexity of learning tasks. *Educational Research and Evaluation* 11(1):1-27.

In this article the authors present an instrument that measures the complexity of learning tasks, used in three experi-

ments carried out in competency-based learning environments. An instructional design model that takes into account learning task complexity also is described.

O'Neil, H.F.; Wainess, R.; and Baker, E.L. (2005). Classification of learning outcomes: Evidence from the computer games literature. *Curriculum Journal* 16(4):455-474.

This article focuses on the discussion of learning outcomes in the context of video games and draws implications for instructional design. The article offers suggestions for classification of learning outcomes and comments on evaluation issues in education and training settings.

Salter, D.; Richards, L.; and Carey, T. (2004). The "T5" design model: An instructional model and learning environment to support the integration of online and campus-based courses. *Educational Media International* 41(3):207-218.

This article describes the T5 instructional design model developed by the University of Waterloo in Canada as a collaborative-constructivist approach to online course design. This model emphasizes Tasks (learning tasks with deliverables and feedback), Tools (for students to produce the deliverables associated with the tasks), Tutorials (online support/feedback for the tasks, integrated with the tasks), Topics (content resources to support the activities), and Teamwork (role definitions and online supports for collaborative work). The article also discusses implications for faculty support, sharing of resources, and institutional systems.

Schwabe, G., and Goth, C. (2005). Mobile learning with a mobile game: Design and motivational effects. *Journal of Computer Assisted Learning* 21(3):204-216.

This article deals with mobile technologies and learning environments. It describes the design of a game prototype (MobileGame) applied in orientation days of a university. Issues pertaining to game learning design and evaluation are addressed. The discussion framework is based on Prensky's six structural elements.

Schwartzman, R. (2006). Virtual group problem solving in the basic communication course: Lessons for online learning. *Journal of Instructional Psychology* 33(1):3-14.

The author addresses issues related to performance expectations in online learning for group problem solving via threaded discussion boards. After four years of research in group problem solving in a higher education course, the author produces instructional guidelines to enrich the learning experience.

Song, H.-D.; Grabowski, B.L.; Koszalka, T.A.; and Harkness, W.L. (2006). Patterns of instructional-design factors prompting reflective thinking in middle-school and college level problem-based learning environments. *Instructional Science* 34(1):63-87.

The authors describe a study that compares the patterns of middle school and college level learners in relation reflexive thinking in problem-based learning (PBL) environments. Instructional design factors, such as environment, teaching methods, and scaffolding tools, are analyzed based on the learners' age and developmental stage. Suggestions for the development of PBL environments that prompt reflexive thinking are offered.

Stubbs, M.; Martin, I.; and Endlar, L. (2006). The structuration of blended learning: Putting holistic design principles into practice. *British Journal of Educational Technology* 37(2):163-175.

This paper discusses a two-year case study that reviewed blended learning in the context of higher education, using Anthony Gidden's structuration theory as a framework to implement holistic design. In the pursuit of intended outcomes through careful attention to the axes of structuration, four intended norms were conceptualized: tutor as expert of last resort, attention to detail, regular engagement, and demonstration of learning outcomes.

Van Berlo, M.; Lowyck, J.; and Schaafstal, A. (2007). Supporting the instructional design process for team training. *Computers in Human Behavior* 23(3):1145-1161.

This work discusses the development of instructional principles for team training in the military. It discusses 1) how instructional designers can be supported in analyzing team tasks and designing team training scenarios and 2) validating the quality of this support. The authors tested guidelines in three experiments and found evidence of improvements in the analysis and design phases.

Van Gerven, P.W.M.; Paas, F.; and Tabbers, H.K. (2006). Cognitive aging and computer-based instructional design: Where do we go from here? *Educational Psychology Review* 18(2):141-157.

This article analyzes the most relevant instructional design principles and cognitive aging theory that are present in the literature. The authors recommends ways to adapt the development of online learning environments that target specific characteristics of older adult learners according to general instructional design theories.

Van Merriënboer, J.J.G., and Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review* 17(2):147-177.

This article reviews the outcomes of experimental studies in the area of cognitive load theory (CLT) and instructional design that connect complex learning to real-life tasks. Various newly developed instructional methods that address changes from simple to complex learning, from short experiments to lengthy training programs, and from preplanned instruction to adaptive eLearning are discussed.

Verstegen, D.M.L.; Barnard, Y.F.; and Pilot, A. (2006). Which events can cause iteration in instructional design? An empirical study of the design process. *Instructional Science* 34(6):481-517.

This article discusses the role of iteration during the instructional design process. Iteration is described as going back to a design activity that the designer has already worked. During an empirical study five events were introduced as the sources of iteration (scheduled global and detailed design phases, peer

review, contact with domain expert, e-mail message from customer about resources, and discussion in chat session). The authors conclude that different types of iteration are caused by different kinds of actions and events.

Wang, H. (2007). Performing a course material enhancement process with asynchronous interactive online system. *Computers and Education* 48(4):567-581.

This article discusses the development of course materials for online learning systems. According to the author, improvement of course quality can be guaranteed with the contribution of students, once they participate in the instructional design process.