A Comparative Analysis of Models of Instructional Design

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Abstract. Models of instructional design help educators to design instructional patterns that presumably have proven successful in past instructional endeavors. The writers examined 40 models of instructional design from a variety of sources. The 40 models were divided into categories based on the models' most pertinent characteristics. The purposes and uses of these models are discussed and an explanation is offered of why so many different models exist. The writers concluded that because of the varying levels of quality of models, educators must be especially careful in choosing which model to follow when designing instruction.

Introduction

According to Friesen (1973, p. 1), instructional materials can be designed and created in two ways. The first way requires a master teacher, working alone to create an inspired work of art. The second requires the application of a system of logic in order to accomplish specified learning objectives. Although the "tried and true" master teacher method has a long history, it often is unaccompanied by empirical verification of effectiveness. By contrast, the scientific method requires the acquisition of learning data to provide feedback for the revision process. That is, a systemic or systematic approach is characterized by an input-output-feedback-revision cycle similar to the cybernetic model shown in Figure 1.

The purpose of this paper is to list and describe a representative sample of the instructional design models that have evolved from this basic systematic approch.

Instructional design models come from industry, education, the military branches, and a variety of other sources. They are often viewed, therefore, as valid only for vocational education. To make an effective choice the educator may want to know where the model comes from; why it was developed; how it relates to the educator's specific goals and setting; and what kind of documentation, application, and/or validation the model has undergone.

Past experience has shown that models of instructional design are important in education and that the systematic approach is both logical and useful. However, educators are often confused about which model to use because of the bewildering array reported and because of the omission of some basic component from the literature that describes the model or reports on how the model has been used. Another reason for the less than satisfactory acceptance of the systematic approach is the apparent absence of validation for many models. (In this paper, validation refers to confirmation of the degree of fit among objectives, form of instruction, and context of learning.) Other reasons seem to be the weak or nonexistent theory base for many models and the visible cost of design—a cost which may seem high because many educators fail to balance the cost of applying the model against the quality or utility of its outcome. Finally, there is the problem of how to interpret the concept *systematic*. For some, the components of the model are *systemic*, each affecting the others so that a change in one requires a change in other components. But for others, the components of the model are only *procedural*, a plan of separate steps, each proceeding in a sequence that is more linear than systemic.

To provide a more comprehensive idea of what constitutes a model of instructional design, this study will accomplish the following objectives:

1. Examine several possible definitions of models of instructional design.
2. Present the purposes for having and using models of instructional design.
3. Propose two categorical schemata for 40 existing models according to origin, theoretical underpinnings, purpose and use, and degree of documentation.
4. Offer an explanation for the existence of the large number of models of instructional design.
5. Suggest guidelines for use by instructional designers and educators to facilitate their choice of an appropriate model.

Definitions of Models of Systematic Instructional Design

A model is usually considered to be an abstraction and simplification of a defined referent system, presumably having some noticeable fidelity to the

Authors' Note. The authors acknowledge the critical review of an earlier draft of this paper provided by Leslie J. Briggs, Walter Dick, Ronald C. Laugen, and Robert J. Stakenas, and the editorial review provided by Melissa Wheeler, all faculty members of Florida State University. In addition, they appreciate the inspiration and thoughts on model construction provided by the late Robert J. Kibler of Florida State University and by Robert C. Roberts, Florida Developmental Services Program, Department of Health and Rehabilitative Services. This paper was presented at the 1979 AERA Convention, San Francisco, CA.

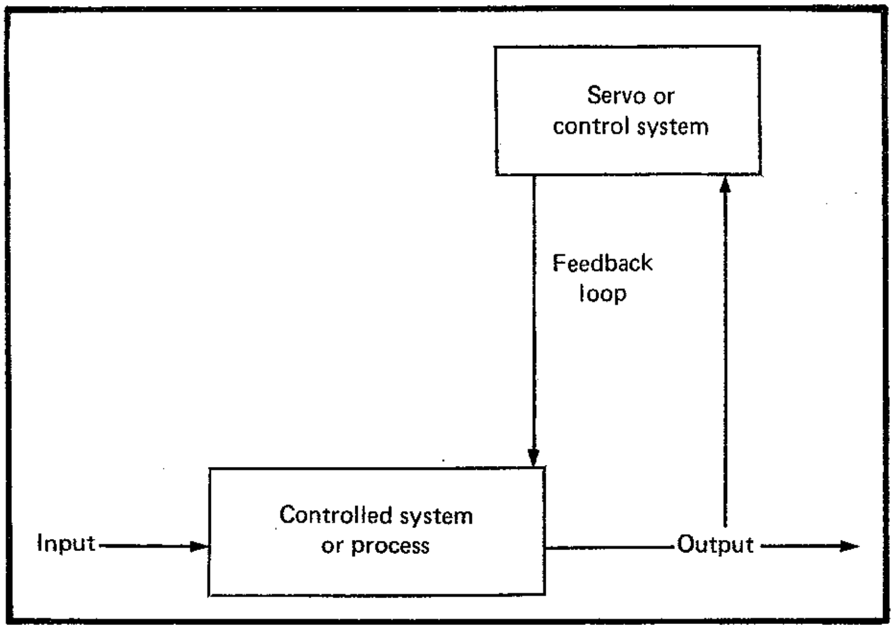

FIGURE 1. Basic cybernetic model (Pratt, 1978, p. 5).

referent system (Hayman, 1974, p. 4; Logan, 1976, p. 3). This fidelity is expected whether the model is intended to describe, prescribe, predict, or explain elements of the referent system, and whether the model is based on a set of implemented procedures or theoretical constructs. One of the problems in the literature on models of instructional design is associated with the basic definition of any model. That is, the fidelity of the model to the actual processes it represents will diminish as the specificity of the model diminishes.

Silvern defines a model (cited in AECT, 1977) as a "graphic analog representing a real-life situation either as it is or as it should be" (p. 168). The person who defines what "should be" in an instructional design model may be the model's developer. Some models, however, expect the client to determine the needs to be met by the use of the model. The educator who ultimately uses an instructional design model should know how and why the developer arrived at the model so the designer can determine the suitability of the model for the desired goals. Although a developer may initially intend only to describe what is being used on an individual project, the procedures described may become a prescriptive model if they are selected for use in another project or setting.

Models of instructional design have descriptive, prescriptive, predictive, and/or explanatory elements in varying degrees. That is, some models *describe* the components or activities of instructional design, but they are used as if they *prescribe* the necessary activities, and sometimes are presented as prescriptions. Implicit in the presentation of many models of instructional design (and explicit in some) is the prediction of effective instruction, that is, that intended learning will occur when the activities outlined in the model are followed. Finally, some models have such a strong basis in learning theory that they tend to *explain* instructional design in terms of the events of learning.

The systematic approach in the design of instruction is a problem-solving process known as instructional development, which requires the identification of instructional problems or needs and corresponding solutions by means of effective and efficient teaching-learning activities based on relevant objectives (Waldron, 1973, p. 2). But if the educator is not also informed of the processes and use of the appropriate theory base interpreting the model, the skills required to apply the systematic (systemic) approach may remain undeveloped, a problem expressed well by Hayman (1974).

It should be clear, however, that a model is not the same as a theory. Rather, a model might incorporate a number of theories. For instance, Joyce and Weil (1972) list a number of different models of teaching (including inductive teaching, jurisprudential teaching, nondirective teaching, operant conditioning, and others). These models incorporate theories about motivation, reinforcement, personality, and creativity.

While models may help to form an initial investigation into factors of instructional design, theories may allow for a better understanding and control of the learning environment. As we increase our understanding of the processes required for effective instructional design and development, we should explicitly state the constructs and propositions that evolve and, therefore, change the assumptions upon which a model rests.

LaGow (1977) contends that a theory, like a model of instructional design, should express the interrelationships (sequence and criteria) among the components.

> An instructional design theory should be able to explain the sequence used in the design of instruction and provide a basis for criteria to judge the usefulness of tasks that are included in this activity. (p. 3)

The requirement for the model follows from the requirement for the theory: to prescribe the sequence of events and functions for the tasks that lead to effective instruction.

Some models of instructional design explicitly incorporate specific constructs related to effective instruction and learning, a characteristic that lends credibility to the use of the term *design*. Pye (1964) notes that while a painter or sculptor can choose any imaginable shape, a designer is limited by the function of the thing being designed (p. 7). Likewise, Simon (1969) notes that a complete design can be broken down into functional components (p. 73). Like other designers, an instructional designer cannot choose any imaginable shape for instruction. The limitations that arise stem from the function of instruction and, therefore, from the context of learning—a context that includes external as well as internal environments.

Purposes of Models of Systematic Instructional Design

Instructional design models serve four purposes:

1. Improving learning and instruction by means of the problem-solving and feedback characteristics of the systematic approach.

2. Improving management of instructional design and development by

means of the monitoring and control functions of the systematic approach.

3. Improving evaluation processes by means of the designated components and sequence of events, including the feedback and revision events, inherent in models of systematic instructional design.

4. Testing or building learning or instructional theory by means of theory-based design within a model of systematic instructional design.

managerial tool for effective design and development (Branson, 1978; Kelly, 1976; Shoemaker & Parks, 1976; Smith & Murray, 1975; Teague & Faulkner, 1978).

Educators generally and instructional designers specifically often use a model of instructional design as a kind of game plan for their development efforts. This plan assures the educator that every piece of instruction that is used will, regardless of content, have recognizable

"The educator who ultimately uses an instructional design model should know how and why the developer arrived at the model so the designer can determine the suitability of the model for the desired goals."

As suggested in the review by Smith and Murray (1975), the procedures in models may be based more on the monitoring and control functions associated with general systems than with any clearly stated instructional purpose. Lowe and Schwen (1975) note that most instructional development is "a systematic process focused on improving the effectiveness and efficiency of learning and instruction in various educational environments" (p. 43). Vance (1976) and Waldron (1973) present a similar purpose statement, while Davis and McCallon (1974) modify this purpose in stating their intent to "translate *social science learning theory* for practical use in a variety of instructional settings" (p. xi) to serve as a guide "to the theory and practice of adult education" (p. 6). Even (1977) does not refer to theory, but retains the purpose statement presented by Lowe and Schwen (1975), focusing on classroom activities as the specific environmental context.

According to Gagné and Briggs (1974), the purpose of the systematic approach (or a statement of its usefulness) is that "it encourages the setting of a design objective, and it provides a way to know when that objective has been met" (p. 228). In view of this purpose, Gagné and Briggs observe that the systematic approach is useful in designing lessons and modules as well as instructional systems (p. 227). Other developers and reviewers have referred to the value of the systematic approach as a planning, organizational, and/or

elements. This sameness aids educators in a variety of ways: Formative evaluations and revisions are more systematic and congruent; the sequence of developmental and evaluation events is planned in a procedural context; media development is more efficient; and evaluation systems can be developed with quality as a key criterion. This sameness also allows standardization of a project's design efforts so that design becomes task specific. This enables increased communication and coordination among the members of a development project. For instance, the phrase "assessing learner needs" should be defined similarly by all project members. Major misunderstandings usually can be resolved by consulting the definitions and explanations provided with a model. The sequencing of events in a model also provides a management framework conducive to use of PERT techniques and other management strategies for ensuring the availability of human and material resources at required times. In this way project events can be scheduled to make efficient use of time, materials, and other resources (cf. Briggs, 1977).

Another useful purpose of a model of instructional design is to allow testing of the theory from which the model was constructed. Adair and Foster (1972, p. 2.31) suggest this purpose for pedagogical models when the specific theoretical constructs can be identified. However, a model of instructional design may also be the result of a component-testing or theory-building process, in which case the construction of the model is built on weak theory or no theory at all, as suggested by Roberts (1978, p. 7) in his review of program planning models. The difficulty in deciding which theory-related purpose is being used is expressed by Kaplan (1964), who warns that propositions may be tautologically presented so that they become "mistaken for genuine theory, and a program is accepted for its own fulfillment" (p. 273). Most models, however, as noted by Smith and Murray (1975), seem to be "exemplars of desirable or commendable operating procedures" (p. 13) instead of theory-based models. (cf. Barson, 1965) That is, the assumptions and the interrelationship of factors are not revealed by the model. Instead, the model may be a frame of reference for only one setting in which it has been used.

The various purposes and advantages cited here are consistent with Banathy's (1968) preface statement about a major advantage of the systematic (systems) approach, which is that it enables us "to develop and manage complex entities" (p. iii). Throughout his book, Banathy also stresses that the defined outcomes determine the particular system purpose.

The use of a model will not ensure that any or all of the four suggested purposes are accomplished. There is, for example, the effect of human variation in interpreting and implementing available models. Also, Lowe and Schwen (1975) found that the documentation of instructional design models often omits detailed accounts of how the development process works in various settings. (An exception to this generalization is the detailed explication provided by Teague and Faulkner, 1978.) Nonetheless, the documentation serving as the basis for this report has provided a means by which the origins, purposes, and uses of instructional design models can be described and analyzed. The next section presents two categorization schemas for fulfilling this purpose.

Categorization and Analysis

The categorization of components of models is a difficult task. Some references explicate theoretical considerations directly; others require inferences of theory. This study is not intended as a definitive statement about the status of any model. Instead, it is an analytical review of models as they are represented in available literature.

Models Reviewed

As the result of an extensive examination of books, journal articles, bibliographies, ERIC documents, and procedural manuals, over 60 possible target models were identified. To provide comprehensive (although nonrandom) sampling, the authors deliberately selected models applied in nonformal as well as formal settings and models applied for modular or course development as well as for large-scale curriculum or program development. To appropriately represent nonformal settings and large-scale development in this review, it was necessary to include program development as well as instructional development models, some of which represent the application of a prior model to a particular setting and purpose rather than a new model. Some of the models often cited in the literature are not reported here due to unavailability of the necessary references. A few models are reported because they are familiar to the authors through local use. However, the authors intend to provide representativeness in this study for the purpose of analytical organization, review, and synthesis, and in no way intend to suggest any inadequacy in those models not contained in this review. In fact, the models cited in this review represent an unevenness in amount and quality of information reported in the references.

Description of the First Schema

All of the models reviewed are compared to Gropper's (1977) list of 10 common tasks (Table 1). This list is used as a referent in this paper because, although Gropper does not state which models provide the basis for his list, he does indicate that the list represents a synthesis of the best models. Also, it is a more recent source than others presenting "generally agreed upon" steps. For example, Merrill and Boutwell (1973) offer 5 basic components; Atkins (1975) offers 12; Gagné and Briggs (1974, p. 213) offer another 12.

During the review of the models, the authors found four additional components addressed separately by a number of models. These additional components are also shown in Table 2, which is coded according to the list in Table 1, with Tasks 1 to 10 representing Gropper's (1977) list and Tasks 11 to 14 representing the tasks often cited separately by other references.

TABLE 1. Fourteen common tasks in model development.

Task Number	Definition
1	Formulation of broad goals and detailed subgoals stated in observable terms
2	Development of pretest and posttest matching goals and subgoals
3	Analysis of goals and subgoals for types of skills/learning required
4	Sequencing of goals and subgoals to facilitate learning
5	Characterization of learner population "as to age, grade level, past learning history, special aptitudes or disabilities, and, not least, estimated attainment of current and prerequisite goals" (Gropper, 1977, p. 8)
6	Formulation of instructional strategy to match subject-matter and learner requirements
7	Selection of media to implement strategies
8	Development of courseware based on strategies
9	Empirical tryout of courseware with learner population, diagnosis of learning and courseware failures, and revision of courseware based on diagnosis
10	Development of materials and procedures for installing, maintaining, and periodically repairing the instructional program
11	Assessment of need, problem identification, occupational analysis, competence, or training requirements
12	Consideration of alternative solutions to instruction
13	Formulation of system and environmental descriptions and identification of constraints
14	Costing instructional programs

Although Gropper only alludes to some of these last four tasks (11 to 14), they are listed separately to emphasize the importance of their consideration. Kaufman (1972) describes in detail the requirements for systematic needs assessment processes (Task 11) and provides a springboard for the work of Roberts (1978) among others. Tasks 12, 13, and 14 are inherent in the process of needs assessment but are listed separately because many people consider them separately. Banathy (1968), Churchman (1968), Hayman (1974), and von Bertalanffy (1968), who describe the systematic approach in terms of general systems theory, specify the requirements for thorough system analysis to identify complex interactions and environmental constraints, determination of alternative solutions to the identified problem, and thorough system synthesis to maximize efficiency and minimize cost—all following the identification of desired outcomes. Any model that does not account for these last four tasks is probably doomed to inefficiency, negligible impact, or total failure.

Many of the references shown in Table 2 do give separate consideration to these issues. When designing instruc-

TABLE 2. Tasks included in instructional design models.

Reference for Model	Outcomes	Tests	Analysis	Sequencing	Learner attributes	Strategy	Media	Development	Tryout/revision	Install/maintain	Need	Alternatives	Constraints	Cost	Total
1. Army Security Agency, Legere, et al. (1966)	•	•	•	•	•	•	•	•	•		•				10
2. Atkins (1975)	•	•		•		•		•	•	•	•		•		9
3. Banathy (1968)	•	•	•	•	•	•	•		•	•		•	•	•	12
4. Bishop (1976)	•	•	•	•	•	•	•	•	•	•	•		•	•	13
5. Briggs & Wager (1979)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	14
6. Brooks, et al. (1973)	•		•		•	•	•	•	•	•	•				9
7. Burkman (1976-1978); Laugen (1979)	•	•	•	•	•	•	•	•	•	•	•		•	•	13
8. Crittendon & Massey (1978)	•	•	•		•	•		•	•	•			•	•	10
9. Davis (1977)	•		•	•	•				•	•			•		7
10. Davis & McCallon (1974)	•		•		•	•	•	•	•	•	•		•	•	11
11. Dederick & Sturge (1975)	•	•	•	•		•		•	•	•	•				9
12. Dick & Carey (1978)	•	•	•		•	•	•	•	•		•	•			10
13. Even (1977)	•		•	•	•	•			•		•		•	•	9
14. Friesen (1973)	•	•	•	•	•	•	•	•	•	•	•	•		•	13
15. Gagné & Briggs (1974); Briggs (1975)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	14
16. Glaser (1966)	•	•	•		•	•		•	•						7
17. Gropper (1973)	•	•	•	•	•	•	•	•	•	•					10
18. Hayman (1974)	•				•			•	•	•	•	•	•	•	9
19. Interservice Procedures (1975); Branson (1978)	•	•	•	•		•	•	•	•	•	•	•	•	•	12
20. Kaufman (1972)	•	•			•	•		•	•	•	•	•	•	•	11

tion, it is critical, however, to consider these issues from two perspectives: (a) the internal conditions of learning (cf. Gagné, 1977; Gagné & Briggs, 1974; and Briggs, 1975), and (b) the environment (or the external conditions) in which the learning will occur. This second perspective is embellished partly by reference to formal versus nonformal settings and partly by particular constraints. As implied by Roberts (1978), a model with a high degree of fidelity to the internal conditions of learning may be "overly costly, time consuming, and distracting to the task at hand" (p. 52).

In recognizing the nature of needs assessment, it is important to realize that the analysis of the learner population (Task 5) is the type of needs assessment that identifies gaps between "current and prerequisite goals" (Gropper, 1977, p. 8) for the learner (cf. Maher, 1978, p. 26) based on the analysis conducted in Task 3—a task sometimes omitted in the design process. The needs assessment represented by Task 11 is more global, focusing on such issues as problem identification or occupational analysis, which provide the basis for the goal statements in Task 1.

Some authors, instead of completing a needs assessment, proceed from the assumption that a broadly defined or stated learner need has been identified and therefore consider no other alternatives apart from the creation of an instructional solution. Others proceed as if the nature of the problem may require an alternative other than the acquisition of learning capabilities or the development of an instructional product. Some recognize that even when the problem pivots on learning capabilities of some sort, the solution may be another alternative such as management of a system or management of resources instead of creation of a new product or program. Briggs and Wager (1979) present a systems schematic of a model for the design of instruction (p. 10) which starts with stating the objectives and performance

TABLE 2. Tasks included in instructional design models (Continued)

Reference for Model	Outcomes	Tests	Analysis	Sequencing	Learner attributes	Strategy	Media	Development	Tryout/revision	Install/maintain	Need	Alternatives	Constraints	Cost	Total
21. Ledford (1973)	●		●		●	●	●	●	●	●					8
22. Lee (1975)	●	●	●	●		●	●	●	●	●	●	●	●	●	13
23. Mager & Pipe (1978)	●	●	●	●	●		●	●	●	●		●	●		11
24. Maher (1978)	●				●	●	●	●	●	●			●		8
25. Merrill (1973); Merrill & Boutwell (1973)	●	●	●	●		●	●	●	●						8
26. Michigan State University; Barson (1965)	●	●				●	●	●	●						6
27. Pennington & Green (1976)	●			●	●	●			●		●		●		7
28. Penta (1973)	●	●		●			●	●	●		●	●			8
29. Roberts (1978)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	14
30. Scanland (1974)	●	●	●	●	●	●	●	●	●	●	●	●	●		13
31. Sherman (1978)	●		●		●	●			●		●	●	●		8
32. Shoemaker & Parks (1976)	●	●	●	●		●			●		●		●		8
33. Teague & Faulkner (1978)	●	●	●	●	●	●	●	●	●	●	●				11
34. Tennyson & Boutwell (1971)	●	●	●	●		●		●	●						7
35. Tosti & Ball (1969)	●				●	●		●		●					5
36. Tuckman & Edwards (1973) (cf. Davis, 1977)	●	●				●		●	●	●	●		●		8
37. Vance (1976)	●		●	●	●	●	●	●	●	●	●		●		11
38. Waldron (1973)	●	●	●			●	●	●	●	●			●	●	10
39. Wallen (1973)	●	●	●					●	●	●	●				7
40. Waters, et al. (1978)	●	●	●			●	●	●			●		●		8
Frequency	40	28	29	23	27	34	24	34	38	28	27	14	25	14	
Percentage	100	70	73	58	68	85	60	85	95	70	68	35	63	35	

Note: The models are listed alphabetically, because a chronological sequence reveals no definite evolutionary patterns for those models contained in this review. When examining the models chronologically, it appears only that tasks 3 to 4 and 10 to 14 are reported somewhat more frequently after 1972, but not consistently. A bullet (●) is used to denote the presence of a task in the particular model reviewed, as indicated by the reference for the model.

standards. But their explication of the model starts with determining needs, goals, and priorities (pp. 19-40) and resources, constraints, and delivery systems (pp. 41-59).

Although Table 2 shows that the tasks outlined by Gropper are included in the models in this review, the inferences made in analyzing models according to the first matrix were sometimes generous in light of the amount of information or the outline of model components presented in the reference. The reader should refer to the results of the second categorization schema for information about the origin, theoretical basis, purposes and uses, and documentation associated with these models.

Description of the Second Schema

Table 3 defines the coding dimensions. Table 4 is coded according to the numbers and letters assigned to the set of dimensions in Table 3. For example,

TABLE 3. Dimensions used in model schemata.

Code	Dimension
1.0	Origin
1.1	Theoretical
1.1a	Total model (includes general systems theory or other total approach)
1.1b	One or some of the components (includes adult learning theory and other learning theories)
1.2	Empirical (includes reports of experience or research of viable processes)
2.0	Theoretical underpinnings
2.1	Emphasis on learning or instructional theory (includes constructs about adult learning requirements)
2.2	Emphasis on control/management/monitoring functions of systems theory
2.3	Emphasis on analysis function (includes content, task, and learning analysis of systems theory)
3.0	Purposes and uses
3.1	Teach instructional design
3.2	Produce viable instructional product(s) or activity(ies)
3.2a	Nonformal (includes military, industrial, governmental, vocational, nonformal adult education)
3.2b	Formal (includes public, higher, and professional education)
3.2c	Small-scale lesson/course/module development
3.2d	Large-scale curriculum/system/program development
3.3	Reduce costs of training/education
4.0	Documentation
4.1	Documentation, application, or validation data relating to use of the total model
4.2	Documentation, application, or validation data relating to part of the model (the mere outline and description of a model being insufficient to qualify as documentation)

1.1a means that there appears to be a theoretical basis for the total model, while 1.1b means that there appears to be a theoretical basis for only part of the model. Each of these dimensions is explained later in more detail. Figure 2 summarizes the results of Table 4.

Origin. Knowledge of the origin of a model can help the educator use a particular model in the most appropriate manner. There are two main discernible sources of origin: theoretical and empirical. Of course, logical inference and combinations of theory and experience also are used to create or modify models of instructional design.

Theoretical models have as their origin a particular theory-based rationale, such as Banathy's (1968) approach based on general systems theory or Gagné's (1977) approach to the conditions of learning. As this paper is based on a sampling of systematic approaches to instructional design, it is not surprising that most models reflect this source.

In order to qualify as having an origin in general systems theory, the description of a model should contain specific reference to general systems theory or describe the systemic approach with emphasis on interaction of the components of the model as they relate to accomplishment of the intended outcomes in the intended environment. For example, Bishop (1976), Kaufman (1972), and Roberts (1978) reference in detail the ways of identifying and describing the total system objectives, the performance measures for the whole system, the effect of constraints and resources of the target system, and the management of the system, as well as specific interactive processes for accomplishing the defined outcomes through checking and rechecking in the feedback and revision processes.

Merrill and Boutwell (1973), however, refer to some of the same components as found in Bishop and Roberts, but stress learning theory and give no explanation of the system components that they briefly list. Similarly, Even's (1977) and Vance's (1976) approach to instructional design strongly emphasizes learning theory, as does the approach of Davis and McCallon (1974), who stress adult learning theory in particular. Thus, when learning theory, such as that constructed by Bruner (1966), Gagné (1977), or Houle (1972) provides the main basis for a model, with little or no reference to general systems theory, the model is judged to have a theoretical basis for only some of the components. This is the nature of the systematic approach, which logically makes use of learning theories in the direct design of instruction after outcomes are specified and before evaluation occurs. An exception to this generalization is Glaser's (1966) model, which is wholly grounded in learning theory. Although Glaser mentions feedback and revision along with psychological activities, the origin of the total model is clearly learning theory rather than general systems theory.

TABLE 4. Categorization by origins, theoretical underpinnings, purposes and uses, and documentation.

Reference for Model	Origins			Underpinnings			Purposes and Uses						Documentation	
	1.1		1.2	2.1	2.2	2.3	3.1	3.2				3.3	4.1	4.2
	a	b						a	b	c	d			
1. Army Security Agency, Legere, et al. (1966)			●			●		●			●			●
2. Atkins (1975)									●		●			
3. Banathy (1968)	●		●	●	●	●	●		●	●			●	
4. Bishop (1976)	●		●	●	●	●	●	●		●	●			●
5. Briggs & Wager (1979)	●		●	●	●	●	●	●	●	●	●		●	
6. Brooks (1974)	●							●		●			●	
7. Burkman (1976-1978); Laugen (1979)			●						●	●	●		●	
8. Crittendon & Massey (1978)	●				●				●	●	●	●	●	
9. Davis (1977)	●							●	●		●			
10. Davis & McCallon (1974)		●	●	●			●	●	●		●			●
11. Dederick & Sturge (1975)			●					●			●	●	●	
12. Dick & Carey (1978)		●	●			●	●	●	●	●			●	
13. Even (1977)		●		●					●	●				●
14. Friesen (1973)	●			●	●	●	●	●	●	●				●
15. Gagné & Briggs (1974); Briggs (1975)	●		●	●	●	●	●	●	●	●	●			●
16. Glaser (1966)	●			●				●	●	●	●			
17. Gropper (1973)			●		●		●							
18. Hayman (1974)	●				●	●	●							●
19. Interservice Procedures (1975); Branson (1978)		●		●	●	●		●			●	●		●
20. Kaufman (1972)	●		●	●	●	●	●	●	●	●	●		●	
21. Ledford (1976)	●			●			●						●	
22. Lee (1975)			●					●		●	●			
23. Mager & Pipe (1974)	●			●			●	●	●	●	●			●
24. Maher (1978)						●			●				●	
25. Merrill & Boutwell (1973)				●	●	●	●		●	●				
26. Michigan State University; Barson (1965)			●	●					●	●			●	
27. Pennington & Green (1976)			●		●			●		●				●
28. Penta (1973)			●		●				●	●				●

TABLE 4. Categorization by origins, theoretical underpinnings, purposes and uses, and documentation. (Continued)

Reference for Model	Origins			Underpinnings			Purposes and Uses						Documentation	
	1.1		1.2	2.1	2.2	2.3	3.1	3.2				3.3	4.1	4.2
	a	b						a	b	c	d			
29. Roberts (1978)	•		•		•	•		•			•		•	
30. Scanland (1974)									•		•			
31. Sherman (1978)		•				•	•						•	
32. Shoemaker & Parks (1976)	•		•		•	•	•	•	•		•		•	
33. Teague & Faulkner (1978)			•		•	•		•		•	•		•	
34. Tennyson & Boutwell (1971)	•				•	•			•	•			•	
35. Tosti & Ball (1969)	•			•	•			•	•		•		•	
36. Tuckman & Edwards (1973); (cf. Davis, 1977)		•		•		•			•		•		•	
37. Vance (1976)	•			•		•			•	•			•	
38. Waldron (1973)					•			•			•			•
39. Wallen (1973)	•				•	•		•			•			•
40. Waters (1978)		•	•	•				•		•			•	

It would seem that theories related to organizational development might have a place in the classification of some models. That is, the strategies, targets, tactics, and management activities required to effectively implement an instructional project based on any model selected would also have impact on the workability of some models in different settings. Such concepts are not included in this particular review, though it would probably benefit the user to consider theories of organizational development when selecting a model to use. (Some models have no discernible theory base.)

Many models have their origin in the developer's or user's particular experiences with instructional design, as in the case of the Individualized Science Instructional System (ISIS) model, described by Burkman (1976-1978) and Laugen (1979), and in the Center for Studies in Vocational Education (CSVE) model described by Crittendon and Massey (1978). The descriptive model of a certain set of procedures in these cases produced good results and is an example of a description that may become a prescription for other users.

Developers may also borrow heavily from a previously existing model and add their own special modifications. For example, J. Davis (1977) presents a model adapted from Tuckman and Edwards (1973) (cited in Davis, p. 36; cf. Tuckman, 1969). Sherman (1978) bases his model on Hayman (1974), but lays out the type of learning capabilities and conditions required to master each of the systems process components in order to teach the systems approach. Brien and Towle (1977) did not present their own model, but instead referred their readers to Boutwell and Tennyson, Tuckman and Edwards, and Briggs. In this instance a more recent model described by Gagné and Briggs (1974) and Briggs (1975) is listed in place of the 1970 reference to Briggs given by Brien and Towle. (Also see Briggs & Wager, 1979.) Of course, some models appear to be based on other models, but without specific reference to the particular source of origin.

Finally, a few models have either stated or implied origins that are both theoretical and empirical. This would seem to be the ideal set of origins, but few models fall into both categories.

Of the models reviewed, about 65% reported some source of theoretical origin, about 50% for the total model (such as general systems theory) and about 20% for only some of the components of the model. About 50% reported an empirical origin. (The reader is cautioned to remember that the categories are not mutually exclusive. Subsequently, the sums across dimensions of a category may equal more than 100%.)

Theoretical underpinnings. This portion of the categorization schema displays three main divisions to show which models emphasize learning or in-

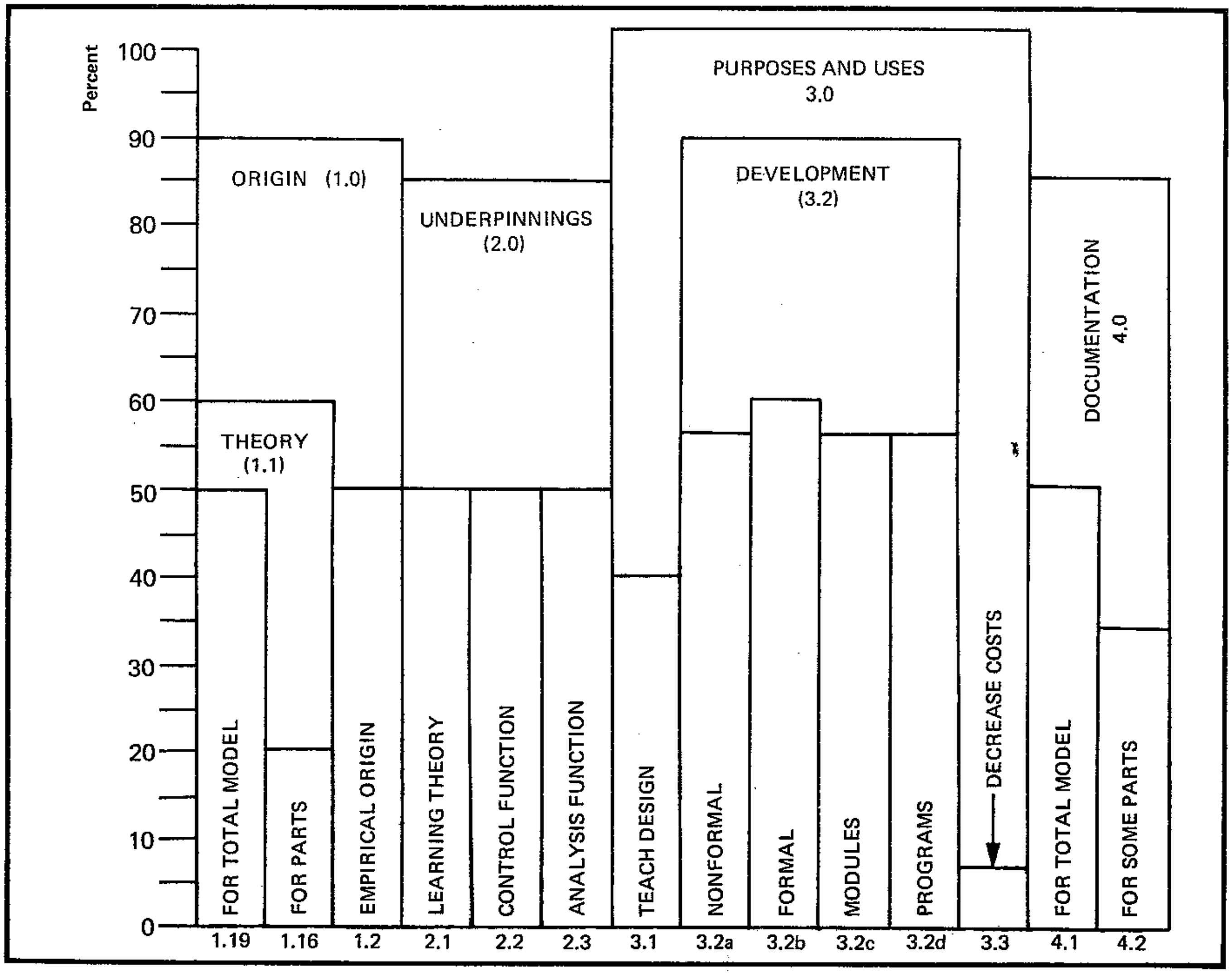

FIGURE 2. Summary of categorization of instructional design models by origins, theoretical underpinnings, purposes and uses, and documentation.

structional theory and which emphasize subdivisions (functions) of general systems theory.

Those models based on learning theory usually indicate this status early in the model's description and/or in the discussion about the model's purposes and uses. In a few instances, the authors of this paper made inferences about the probable theoretical basis for a given model. Sometimes this was done by analyzing the reference section of the source to identify the probable foundation of the model.

The two subdivisions of the general systems approach are: (a) the control/management/monitoring function, and (b) the analysis function. The first function allows the educator to make sure that all portions of the instructional system behave in the prescribed manner. This is sometimes very difficult to accomplish with a large curriculum project. Special steps are often added to the model to assure the developer that every component will flow smoothly.

The second function allows the systems user to have confidence that the analysis of a task will proceed in a logical, orderly manner. Most of the models use this analysis function in order to simplify the complex concepts involved in a learning process.

Finally, some models seem to have no discernible theoretical basis as reported in the reference citation. These models usually appear to be based on one or more previous models and are concerned more with the addition of a new component or application than with building on the theoretical basis of the original model.

About 50% of the models emphasized an underpinning in learning theory, 50% in the control/management/monitoring function of general systems theory (either explicitly or implicitly), and about 50% in the analysis function. Together about 70% emphasized either the control or analysis function of the general systems model. This means that about 30% of the references reported in Table 2 focused no discernible attention on two of the basic functional advantages of general systems theory. Of those who focused on learning theory, about 70% (11 of 15) also cited the general systems theory advantages. (About 30% did not do so.) Of those who focused on the general systems theory advantages, only about 40% (11 of 27) also cited a learning theory basis.

Purposes and Uses. The purposes and uses of a model center around one of three main categories: (a) teaching of the instructional design process, (b) production of viable instructional products, and (c) reduction in cost of education. Although almost every model could be used to teach the instructional design process, models placed in this category were limited to those expressly stating this as their purpose. The production of an effective product tends to take second place for models having this classification.

Many models are constructed to yield instructional products for the purpose of improving the training or education function of an organization. Two main settings are conceived within this category: (a) formal, and (b) nonformal education. A distinction between these settings is offered by Ingle (cited in Roberts, 1978, p. 4), who defines nonformal education as "any organized activity, outside of the established framework of the formal school and university system, which aims to communicate specific ideas, knowledge, skills, attitudes and practices in response to a predetermined need." Thus, the nonformal setting includes military, industrial, governmental, vocational, and other nonformal adult education activities. The formal setting is primarily limited to public, higher, and professional education activities. Except for activities unique to a specific setting, such as occupational analysis, many of the models could be used in either setting, although the reference may have named one type of organization as the focus of the model.

The models reviewed have two main uses: (a) the development of instruction on a small scale (lessons and modules), and (b) the development of instruction on a large scale (courses, curriculums, and programs). Generally, the source for the models cited herein indicates the intended use, although some inferences are made about uses based upon the particular products associated with the model, such as a module versus a program plan.

Few of the reviewed models mention any costs associated with the model. Those that do, however, make the point that economy of scale would enable educators using a particular model to reduce the per unit expenditure in their special setting. However, while Glasgow (1976) observes that the cost effectiveness of systematic development has no empirical basis, Carey and Briggs (1977) discuss cost-benefit approaches to the use of a system approach to instruction. Goodson and Roberts (1979) also present a two-by-two matrix of instructional quality versus product impact (p. 25) as an evaluation schema that can be used for cost-benefit analysis of instructional products within the staff training program of a human services agency.

> "The general tasks constituting a model of instructional design . . . are generic in that they may be applied across differing purposes, emphases, origins, uses, and settings."

Of the models reviewed in this study, about 40% reported the teaching of instructional design (or equivalent) as the primary purpose, 90% emphasized the production of an instructional product, and less than 10% reported cost reduction as a basic purpose. The setting category (nonformal and formal) was evenly split as was the scale of production (large and small).

Documentation. Unless an educator knows whether or not a particular model has been tried out in an actual instructional setting, it will be difficult to make a decision about that model's chance of success in the planned setting. Few of the models reviewed supply any data concerning their effectiveness. Some assert that the particular model works well, although no supporting data or descriptions of applications are provided. Since most of the models' sources are journal articles, it may be argued that too little space is available for the reporting of this type of data or information. However, the longer sources that were reviewed (books and ERIC documents) would seem to have little excuse for not revealing this data. (A pertinent question might be raised about the usefulness of publishing a model without having its efficacy established beforehand by means of a firm theory base and/or empirical base.)

An analysis of Table 4 shows that even at the grossest categorization level, there was not one model which addressed all of the categories. In addition, only the "purposes and uses" category was addressed by all of the models. As the categorization became more specific, the percentages of models matched to categories continued to decrease.

Of the models reviewed in this study, about 50% reported documentation of some sort on the application of the total model, and about 35% offered some limited documentation. Finally, of those reporting some theoretical origin, about 70% (19 of 27) cited some form of documentation; but of those citing documentation, only 55% (19 of 34) cited any theoretical origin.

Analysis of Models. The analysis of the 40 models selected for this study using the two schemata described above is presented in Tables 2 and 4. Table 2 shows the *tasks* included in Instructional design models according to the first schema. Table 4 shows the categorization of ID models by origin, theoretical underpinnings, purposes and uses, and documentation (second schema).

Possible Reasons for Model Proliferation

There are a number of possible reasons for the large variety of models of instructional design. One of the most obvious reasons seems to be that many educational endeavors are afflicted with the "not-invented-here" syndrome. Much effort seems to be duplicated because educators do not seek out existing models of instructional design or available materials before they endeavor to develop their own. The symptoms of this malady usually take the form of an attitude that says, in effect, "We have our own special circumstances and problems here and any innovation (design model) which comes from outside our organization boundaries will very likely fail in our unique situation." This attitude is certainly not restricted to the educational field; industry, military, government, and many other types of organizations seem to fall prey to it just as easily. Molnar (1971) points out the tremendous inefficiency resulting from such an attitude.

The large amount of uncoordinated research activities and the lack of preplanned linkages between research and practice has led to the existence of an expensive cottage industry in educational technology which tends to retool every academic year. Researchers and educators frequently demonstrate a strong resistance to the use of someone else's innovation. It has been said that if there was a Nobel prize for educational research, we would nominate an entire generation of researchers for their co-discovery of the wheel. (p. 7)

Another reason for the great number of models seems to be related to the degree of documentation that the models have. As stated by Logan (1976):

> Instructional systems development assumes more or less the previous reputations of other innovations. This delays acceptance of ISD, for as with other innovations, promised performance could not be met and, if met, could not be maintained. Developers of innovations often left the customers with inadequate supporting documentation if they left any at all. (p. 17)

Since many models are never tried out, educators may be skeptical about the model being reviewed and thus decide to develop their own.

Merely examining a model tells one very little about its efficacy. Unless performance data are available from tryout situations, the educator interested in choosing a model will have few objective criteria on which to base a decision. Because few available models actually exhibit tryout data, it is little wonder that designers are reticent about adopting or adapting even a well-known model. The risk of sinking a project's resources into a model which is, in effect, an unknown quantity must be disconcerting to a project director.

Yet another reason is linked to Alexander's (1964) observation about the nature of design: "What does make design a problem in real world cases is that we are trying to make a diagram for forces whose field we do not understand" (p. 21). This effort appears to be a problem within the context of learning within a particular educational environment as well as within the context of learning in general.

The major learning theorists, including Ausubel (1968), Bruner (1966), Gagné (1977), Piaget (1954), Skinner (1954), and others, present different propositions regarding the conditions for learning. These differences may have the greatest impact on the development of materials, but they may also cause individual educators to reject certain steps in available system approach models. For example, a strong advocate of discovery learning might reject the specification of objectives and corresponding direct match of instructional events to these objectives.

More often, however, the major steps of models are adapted to particular differences in the learning environment, whether it be nonformal or formal education, education for academic settings or for other institutional, business, or community settings. This type of difference is fairly obvious when we compare and contrast various models. When, for instance, we contrast the Davis-McCallon (1974) or Bishop (1976) models to the Dick-Carey (1978) or Gagné-Briggs (1974) models, this distinction becomes apparent. The major differences in these kinds of models appear to stem from variations in carrying out these kinds of variations in carrying out the major steps by means of specific events and activities.

"A few of the models reported are not models at all in that they fail to describe, explain, or predict elements in their referent system . . . the buyer should beware."

At least three factors have forced educational researchers to develop and apply their own unique methods to such things as job analysis, test generation, construction of behavioral objectives, and implementation, evaluation, and revision of instruction.

1. Many educators feel very strongly that instruction should have a local, indigenous quality (Demerath & Daniels cited in Logan, 1976).

2. There is a lack of information on available authoring tools and procedures and a lack of clearinghouses for existing course materials (Logan, 1976).

3. Instructional development efforts are usually driven by a "raw empiricism" so that:

> Instructional materials are prepared on the basis of intuition, folklore, or experience and administered to members of the target population. If the students pass the test, the product is considered appropriate; if not, the materials are revised and tried again. This tryout revision cycle is repeated until the product works or the developers run out of resources or time (Merrill & Boutwell cited in Logan, 1976).

Conclusions

The review of models reported here provides an approximation of the state of the art regarding models of instructional design. Categorizing the models as shown in Tables 2 and 4 may do injustice to some models and give undue credit to others. Even with these possible inequities, however, several substantial generalizations can be made with some confidence.

1. The components of the general systems approach applied to instruction have proliferated in varied forms with varied origins, purposes, uses, and documentation.

2. Learning theory bases are not explicitly prescribed in many of the models using a systematic approach to instructional design.

3. Documentation of the systematic application of the models for specific purposes and uses is generally inadequate for assessing the effectiveness of particular models.

4. Although the *systemic* approach is "an inquiry and a discipline, complete with theoretical underpinnings and a developed methodology" (Hayman, 1974, p. 495), many of the *systematic* instructional design models, as described in the literature, represent a series of mechanical or linear steps rather than the complex and rigorous analytical and cybernetic process required for effective application of the general systems approach to instructional design.

5. The general tasks constituting a model of instructional design, though differing in sequence, are generic in that they may be applied across differing purposes, emphases, origins, uses, and settings. This attests to the robust qual-

ity of the systemic or systematic approach to instructional design.

6. Little concern or documentation is reported to demonstrate the cost-utility of using different models of instructional design.

7. Models such as those reported by Bishop (1976), Briggs (1975), Briggs and Wager (1979), Gagné and Briggs (1974), Roberts (1978), Scanland (1974), and Teague and Faulkner (1978), appear to provide enough explication to enable users to apply the reported models as intended. The reader is advised, however, to consider a model that matches the dimensions of the user's context and to make judgments about the adequacy of documentation and theory base before selecting a model to use. To begin patterning instruction after the first model encountered might very well be a mistake for two reasons: (a) the model may have been developed for a completely different setting for a completely different purpose, and (b) the model may not have been validated. A model may work well when finally used, but not many educators or project directors can afford the luxury of trying the model out with their own resources.

8. A few of the models reported are not models at all in that they fail to describe, explain, or predict elements in their referent system. Instead, they represent the use of jargon in a nearly tautological manner and possibly mechanical prescriptions inappropriate to the intended users. These models will be unnamed but the buyer should beware.

9. Instead of model proliferation, it would be more useful to engage in model evolution. That is, by examining the two schemata presented in this paper, it should be possible not only to select the most appropriate model for given purposes and uses but also to identify at least the general type of theory basis for a given model. The results of the categorization and analysis schemata presented here indicate gaps in documentation or validation of models as well as in the theoretical bases of some models. Based on these results, the educator should consider describing particular theoretical bases and providing thorough documentation of the implementation of a given model. In this way, there could be more theory development and testing by means of model implementation.

In view of these generalizations and the comparisons provided in this analytic review of models of instructional design, it would be ill advised to recommend that one, and only one, grand pattern be used for all design efforts. However, a strong argument can be made that the large number of extant models is not only confusing, but also often wasteful of the resources over which educators and project directors have command.

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