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ABSTRACT

This examination of 40 models of instructional design from a variety of sources discusses the purposes and uses of these models, and then offers an explanation as to why there are so many different models. The 40 models are divided into categories based on their most pertinent characteristics. It is concluded that because of the varying levels of quality of the models, educators must be careful in choosing the model to be followed when designing instruction. A 72-item bibliography is attached. (Author/JEG)

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MODELS OF INSTRUCTIONAL DESIGN:
ORIGINS, PURPOSES, AND USES

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ABSTRACT

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

Models of Instructional Design: Origins, Purposes, and Uses

Instructional materials can be designed and created in two ways:

> 1. Take one master teacher, expert in a subject, place him (her) in isolation for a period of cogitation and incubation and, voilà, a work of art--- a compendium of instructional materials---an inspired product....
>
> 2. Apply a 'scientific' method according to a system of logic in order to get the learner from where (s)he is to where you want him (her) to be. This is the method used by those who call themselves instructional programmers and instructional technologists (Friesan, 1973, p. 1).

The first way admittedly has a long history. Although some educators consider this a 'tried-and-true method', it often is not accomplished by empirical verification. By contrast, the second way, by definition, requires the acquisition of learning data to provide feedback for the revision process. That is, a systematic or systems approach is characterized by an input-process-output-feedback-revision cycle.

This paper shall address the systematic approach to designing instruction, a process which focuses on the design problem of finding a way to ensure the goodness of fit among the objectives, the form of instruction, and the context of learning. Educators in general and instructional designers specifically, usually solve this problem by using a particular model or pattern when they design and develop instruction. They tend to do this in the same way that an architect satisfies customer

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preferences or needs in the creation of a specified blueprint. Together, the architect and contractor work with compatible building requirements for the customer. The instructional designer also must look to different models depending upon the instructional requirements of a particular project.

Part of the appeal of the systems approach to educational design is that it yields detailed plans. These plans assure the educator that every piece of instruction that is used, regardless of content, will have recognizable 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, instead of merely format or quantity.

Past experience has shown that models of instructional design are important in education and that the systems approach is both logical and useful. However, educators often are confused about which model to use. One reason for this confusion is the bewildering array of models which may contribute to the limited use of the systems approach in education. Another reason, however, probably results from the way in which the models are reported. That is, often the diagram or outline of a reported model omits some basic components that nonetheless may be delineated in a narrative about the model. Another phenomenon that frequently seems to occur is that a component may be omitted in the narrative, but nonetheless, included in the application of the model.

There seem to be at least two other reasons for the less than satisfactory acceptance of the systems approach. One reason is the apparent absence of empirical validation and/or theory base for many models. The other reason may be the visible cost of design when many educators fail to balance the cost of applying a model against the quality or utility of its outcomes.

Instructional design models come from the military, industry, education, and a variety of other sources. They are often viewed, therefore, as valid only for vocational education. In order to make an effective choice the educator may want to know where the model comes from, why it was developed, how it might work for the goals to be accomplished in the educator's specific setting, and the kind of documentation, application, or validation, the model has undergone. This study proposes to explore these questions and thus, perhaps make the concept of instructional design models somewhat easier to understand and use. Specifically, it will accomplish the following:

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 schemas for 40 existing models according to origin, theoretical underpinnings, purpose and use, and degree of documentation.

4. Offer an explanation as to why there are so many models of instructional design.

5. Suggest guidelines for use by instructional designers (educators) that will facilitate their choice of a model that will meet their needs.

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 referent system. Logan (1976) refers to the manner in which models vary with specific referent systems. "The term 'models' can take many different forms and vary considerably from one field to another. For example, a model in economics may be in fact a computer program while in instructional psychology a model may be simply a drawing on paper" (p. 4).

If a model is documented and the educator knows that it will work in a particular setting, then we might say that a model of instructional design is a pattern for quality instruction that should be followed as closely as possible. Often, however, the model is appealing to an educator for reasons that have little to do with effectivenesss. The educator may like the model because it contains a component that fits nicely into a particular setting or a component that is intuitively appealing. In these cases models of design present a series of goals that the educator uses to shape the instruction toward. The educator does not wish to follow the model exactly because the entire model does not seem to fit the educator's needs. More generally, educators should be cautioned to carefully analyze the relevant system "so that the complex network of interactions can be understood" (Hayman, 1974, p. 494) when using a model based on general system theory.

How does the concept of theory relate to the concept of model? Adair and Foster (1972) consider theories and models in the social sciences. They include descriptions of the physical, the semantic, the formal, and the interpretive types of models before describing pedagogical models for the curriculum developer. Regardless of which type of model they consider they link the concept of a model with the concept of a theory in the following way.

> Models have the characteristic of 'testing' the theory from which they are constructed. If the theory is, 'ill-defined, vague, and uncertain', the matter cannot be easily missed by those who would use it in the laboratory or classroom.
>
> The model and its referent theory, must be complementary in that each possess the same outer limits and factors within those boundaries. (p. 2.31)

Whether or not a model is intended to explain or predict, Adair and Foster find that the scope and factors are not clearly delineated for many models in general. They restate the warning given by Kaplan (1964) that propositions may receive attention because of the terminology used to describe them mixed with continual repetition so that the propositions may be "mistaken for genuine theory, and a program is accepted for its own fulfillment" (p. 273). This is one of the problems encountered in attempting to define models of instructional design as researchers encounter the "not-invented-here syndrome."

Models of instructional design are constructed from several sources: empiricism, theory, and other models. Some models are based on procedures that have been used in operational settings. Others are created to reflect theoretical constructs or an assimilation of other model components. It is generally understood that a model is a "symbolic representation of the structural components and interrelationships of some complex event or circumstance," (Roberts, 1978, p. 51). In this case the event is instructional design. The activities defining the event are those outlined in the different models.

While it is relatively easy to outline the array of instructional design models found in the literature, the capacity to construct a schema for classifying these models is limited by the same problem encountered in constructing the model itself. That is, as observed by Roberts (1978) when the construction of a model is "built on weak theory or no theory, the task can be a trial and error process. It can, in fact, be a theory building process rather than a theory or component testing process... Accordingly, models and theories may differ only in the degree to which they can predict occurances in their referent systems" (p. 52). Thus, a logical inference from the work of Adair and Foster (1972), Kaplan (1964), and Roberts (1978) is that the first step toward building a model of instructional design is the identification of the components and their relationships. This first step seems to be represented in Silvern's definition of a model (cited in Heinich, 1977) as a "conceptualization in the form of...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 descriptive procedures become a prescriptive model in practice when the procedures are selected for use in another project or setting without carefully analyzing the relevant system.

Models of instructional design have elements of explanation and prediction. They may be defined by considering the requirements for an instructional design theory as stated by La Gow (1977),

> 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).

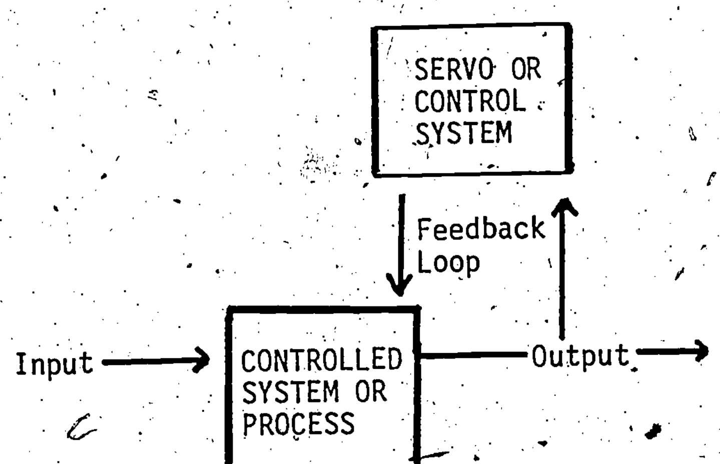
The requirement for the model follows from the requirement for the theory: to explain the sequence of events and functions for the tasks included in the model that lead to effective instruction. But this is only a necessary condition. If we are not also informed of the processes, and use the appropriate theory base in interpreting the model, the skills needed to apply the systems approach may remain undeveloped, a fear expressed well by Hayman (1974). The system approach in the design of instruction is more than "a problem solving process or set of processes applicable at various levels in education" (Hayman, 1974, p. 501); it is a particular problem solving process. Waldron (1973) identifies the problem solving process as instructional development. He contends that this problem solving process requires the identification of instructional problems or needs and corresponding solutions by means of effective and efficient teaching-learning activities based on relevant objectives. (p. 2)

It should be clear, however, that a model is not the same as a theory. Rather a model might encompass and overarch a number of theories. For instance, Joyce and Weil (1972) list a number of different models of teaching (eg., inductive teaching, jurisprudential teaching, non-directive teaching, operant conditioning and others). These models represent theories about motivation, reinforcement, personality, and creativity. Many models of instructional design also represent a variety of constructs related to effective instruction and learning. In this context, it is useful to consider Pye's (1972) commentary on design:

> The thing which sharply distinguishes useful design from such arts as painting and sculpture is that the practitioner of design has limits set upon his (her) freedom of choice. A painter can choose any imaginable shape. A designer cannot. If the designer is designing a bread knife it must have a cutting edge and a handle; if (s)he is designing a car it must have wheels and a floor. These are the sort of limitations which arise, as anyone can tell from the 'function' of the thing being designed. (p. 7)

Likewise, an instructional designer cannot choose any imaginable shape for instruction. The limitations that arise stem from the function of instruction and, therefore, the context of learning.

Thus, a basic cybernetic model such as the one presented in its simplest form by Pratt (1978, p. 5) below, will be adequate to the extent that users of this basic model also account for the context of learning.



Although such a diagram may be adequate to outline a systems model, it does not constitute a model of instructional design. Hopefully, the review provided in this paper will more comprehensively display what it is that constitutes a model of instructional design.

PURPOSES OF MODELS OF SYSTEMATIC INSTRUCTIONAL DESIGN

As suggested in the review by Smith and Murray (1975), an array of procedures in the array of 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) noted that most instructional development is depicted "as 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) presented a similar purpose statement. Davis and McCallon (1974) presented a modification of this statement purpose with 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) did not refer to theory, but retained the purpose statement presented by Lowe and Schwen (1975) focusing directly on classroom activities as a specific environmental context.

Gagne and Briggs (1974, pp. 123-228) observe that the systems approach is useful for designing lessons and modules as well as instructional systems. They note "identical elements and similarities" (p. 227) in the procedures followed for either general purpose. But the purpose of the systems approach in particular may be " that it encourages the setting of a design objective, and it provides a way to know when that objective has been met" (p. 228). As a major advantage of the systems approach, other developers and reviewers have referred to the value of the systems approach as a planning, organizational, and/or managerial tool for effective design and development (Branson, 1978; Kelley, 1976; Smith and Murray 1975; Shoemaker and Parks, 1976; and Teague and Faulkner, 1978).

Educators in general and instructional designers specifically usually use a model of instructional design as a kind of "game plan" for their development efforts. The educator wishes to outline, before the instructional effort is begun, what components will be used in the design. Often they want a model that has been proven effective in previous instruction. The model will allow them to avoid mistakes that are inherent in each design endeavor. If a model has been based on theory or empirical viability, then many of the instructional problems will have been solved by the model's developer, thus improving the efficiency and effectiveness of the educator who uses the model.

Another advantage of using a particular model is the standardization of a project's design efforts so that design becomes task specific. The members of a development project of any kind, whether in the military, in a school system, in a private instructional design firm, or in an industrial or other institutional setting will be able to communicate more clearly and have more coordination with each others' efforts if they all are using the same model. For instance, the term "assessing learner needs" should be understood by all project members who use the same model. Major misunderstandings usually can be resolved by consulting the definitions and explanations provided with the model. The particular sequencing of events in a model also provide a management framework. In this context, PERT techniques and other management tools can be used by the manager to ensure the availability of human and material resources at required times. In this way the project events can be scheduled to minimize waste of time, materials, and other resources (cf. Briggs, 1977).

By employing a systematic model of instructional design, formative evaluation can be conducted so that the causes of process and product problems can be analyzed and referenced to particular components such as test development, instructional strategy, delivery system, or other design and development components. The alternative to this type of evaluation is to assess the outcomes of a finished product without any knowledge of the procedures use to create the product. Yet, to improve the effectiveness of the model, diagnostic information about sources of the product's ineffectiveness is required. Needs assessment information, criterion referenced tests and intended learning outcomes as well as delivery system requirements are just a few of the diagnostic references provided when a systematic model of instructional design has been used in the design and development effort.

The process of summative evaluation also may be facilitated, although the basic function at the summative stage is to compare and pass judgement on finished products. The model of instructional design can indicate key criteria for evaluation of the instructional product. By examining the model used, the summative evaluator can determine the major components contributing to the development of the product and possibly to the soundness of the product, especially when considering the feedback and revision loop provided in the system models.

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

In summary, there appear to be four general purposes associated with the system approach to instructional design;

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

2. Improving management of instructional design and development by means of the monitoring and control functions of the system approach.

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

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

This fourth purpose derives from the discussion of definitions of models with particular reference to the review of Adair and Foster (1972). This is a legitimate purpose with potential for serious contribution to design science. However, Smith and Murray (1975), who also considered the purposes of models, concluded that most of the development and evaluation models seem to be "exemplars of desirable or commendable operating procedures" (p. 13) instead of theory-based models.

The use of a model will not ensure that any or all of these purposes are accomplished. Apart from human variations in interpreting and implementing available models, Lowe and Schwen (1975) also have found that the documentation of instructional design models is missing the necessary detailed accounts of how the development process works in various setting. (An exception to this generalization is the detailed explication provided by Teague and Faulkner.) 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 a couple of categorization schemas for fulfilling this purpose.

CATEGORIZATION AND ANALYSIS

Two specific categorization schemas for reviewing models of instructional design are presented here. The resulting matrix for the first schema which matches Gropper's (1977) list of ten design tasks is displayed in Table I. The second schema for categorization is displayed in Table II.

Models Reviewed

The authors identified books, journal articles, ERIC documents and procedural manuals as sources for this study. An ERIC computer search was conducted and bibliographies of educational technology were consulted. As a result of this effort, over sixty possible target models were identified. To provide comprehensive sampling, albeit nonrandom, the authors deliberately selected models applied in nonformal as well as formal settings, models applied for modular or course development as well as for large scale curriculum or program development. Some of the models cited often in the literature are not reported here due to unavailability of the necessary references. The authors intend to provide representativeness in this study for the purpose of analytical organization and review and in no way intend to suggest any inadequacy in those models not contained in this review; nor is this review intended to represent the "best" of the models available.

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 represents the initiation of an analytical review that may provide a guide for selecting from the types of models available and lead to more theory testing through models of instructional design.

The reader is advised to note a distinction between design and development procedures based on learning theory and those based on systems theory. The former addresses the conditions and events of learning for intended learner capabilities, while the latter addresses a total design and development process including design based on learning theory as a subset of a larger set of procedures.

Description of the First Schema

All of the models reviewed are compared to Gropper's list of ten common tasks. 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. It also is a more recent source than others presenting "generally agreed upon" steps. For example, Merrill and Boutwell (1973) offer five basic components; Atkins (1975) offers twelve; Gagne and Briggs (1974, p. 213) offer another twelve. (If the biases of the authors of this paper were followed, the referent might have been Gagne and Briggs, instead of Gropper, but Gagne and Briggs do not indicate that their twelve steps are representative of other models. Future review efforts however, could benefit from a referent such as Gagne and Briggs, as the reader will see by analyzing the outcomes of the matrix of the first schema.)

During the review of the models, the authors found four additional components addressed separately by a number of models. These additional components also are shown in Table 1, which is coded to the following list, with tasks one to ten representing Gropper's (1977) list and eleven to fourteen representing the tasks often cited separately by other references.

1. Formulation of broad goals and detailed subgoals stated in observable terms.

2. Development of pre- 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" (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, revision of courseware

based on diagnosis.

10. Development of materials and procedures for installing, maintaining, and periodic repair of the instructional program.

11. Assessment of need, problem identification, occupational analysis, competence, or training requirements.

12. Consideration of alternatives.

13. System and environmental descriptions; identification of constraints.

14. Costing instructional programs.

Although Gropper alludes to some of these steps, it is worth listing them separately if for no other reason than to emphasize the importance of considering these particular issues. Kaufman (1972) describes in detail the requirements for systematic needs assessment processes (task 11) and provides a springboard for the work of Roberts (1978) and Stakenas and Knight (1979) as well as many others in the business of instructional problem solving. 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 system approach in terms of general system theory specify the requirements for (a) thorough system analysis to identify complex interactions and environmental constraints, (b) determination of alternative solutions to the identified problem, and (c) thorough system synthesis to maximize efficiency and minimize cost---all following the identification of desired outcomes. Any model which does not account for these last four tasks is probably doomed to lost efficiency, negligible impact, or total failure.

Many of the references shown in Table 1 do give separate consideration to these issues. When designing instruction, it is critical, however, to consider these issues in two perspectives: (a) the internal conditions of learning (cf. Gagne, 1977; Gagne & Briggs, 1974; and Briggs, 1975) and (b) the environment in which the learning will occur or the external conditions. This second perspective is embellished partly by reference to formal vs. nonformal settings, but also by particular constraints. In fact, 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). This consideration also appears in several of the models in this review.

To do justice to the issue of needs assessment, it is important to realize that the analysis of the learner population (task 5) is the type of needs assessment which 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 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, that 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.

Although Table 1 shows that the tasks outlined by Gropper are indeed included in the models in this review, the reader is hereby advised that the inferences made to create the classification matrix were sometimes generous in light of the amount of information or outline of model components cited 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. (The reader should note that an "X" is used to denote the presence of a task in the particular model reviewed.)

Table 1

Tasks Included in Instructional Design Models

Reference for Model	Outcomes	Tests	Analysis	Sequencing	Learner Attributes	Strategy	Media	Development	Tryout and Revision	Install and Maintain	Need	Alternatives	Constraints	Cost	Number of Tasks
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1. Army Security Agency, Legere, et al (1966)	X	X	X	X	X	X	X	X	X	O	X	O	O	O	10
2. Atkins (1975)	X	X	O	X	O	X	O	X	X	X	X	O	X	O	9
3. Banathy (1968)	X	X	X	X	X	X	X	O	X	X	O	X	X	X	12
4. Bishop (1976)	X	X	X	X	X	X	X	X	X	X	X	O	X	X	13
5. Brooks, et al (1973)	X	O	X	O	X	X	X	X	X	X	X	O	O	O	9
6. Burkman (1976, 1979); Laugen (1979)	X	X	X	X	X	X	X	X	X	X	X	O	X	X	13
7. Crittendon & Massey (1978)	X	X	X	O	X	X	O	X	X	X	O	O	X	X	10
8. Davis (1977)	X	O	X	X	X	O	O	O	X	X	O	O	X	O	7
9. Davis & McCallon (1974)	X	O	X	O	X	X	X	X	X	X	X	O	X	X	11
10. Dederick & Sturge (1975)	X	X	X	X	O	X	O	X	X	X	X	O	O	O	9
11. Dick & Carey (1978)	X	X	X	O	X	X	X	X	X	O	X	X	O	O	10
12. Even (1977)	X	O	X	X	X	X	O	O	X	O	X	O	X	X	9
13. Friesan (1973)	X	X	X	X	X	X	X	X	X	X	X	X	O	X	13
14. Gagne & Briggs (1974); Briggs (1975)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
15. Glaser (1966)	X	X	X	O	X	X	O	X	X	O	O	O	O	O	7
16. Gropper (1973)	X	X	X	X	X	X	X	X	X	X	O	O	O	O	10
17. Hayman (1974)	X	O	O	O	X	O	O	X	X	X	X	X	X	X	9
18. Interservice Procedures for Instructional Systems Development (1975); Branson (1978)	X	X	X	X	O	O	X	X	X	X	X	X	X	O	11
19. Kaufman (1972)	X	X	O	O	X	X	O	X	X	X	X	X	X	X	11
20. Ledford (1973)	X	O	X	O	X	X	X	X	X	X	O	O	O	O	8
21. Lee (1975)	X	X	X	X	O	X	X	X	X	X	X	X	X	X	13
22. Mager & Pipe (1978)	X	X	X	X	X	O	X	X	X	X	O	X	X	O	11
23. Maher (1978)	X	O	O	O	X	X	X	X	X	X	O	O	X	O	8
24. Merrill (1973); Merrill & Boutwell (1973)	X	X	X	X	O	X	X	X	X	O	O	O	O	O	8
25. Michigan State University Model; Barson (1965)	X	X	O	O	O	X	X	X	X	O	O	O	O	O	6
26. Pennington & Green (1976)	X	O	O	X	X	X	O	O	X	O	X	O	X	O	7
27. Penta (1973)	X	X	O	X	O	O	X	X	X	O	X	X	O	O	8
28. Roberts (1978)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
29. Scanland (1974)	X	X	X	X	X	X	X	X	X	X	X	X	X	O	13
30. Sherman (1978)	X	O	X	O	X	X	O	O	X	O	X	X	X	O	8
31. Shoemaker & Parks (1976)	X	X	X	X	O	X	O	O	X	O	X	O	X	O	8
32. Stakenas & Knight (1979)	X	O	O	O	X	X	O	X	X	X	X	X	X	X	10
33. Teague & Faulkner (1978)	X	X	X	X	X	X	X	X	X	X	X	O	O	O	11
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	

Reference for Model	Outcomes	Tests	Analysis	Sequencing	Learner Attributes	Strategy	Media	Development	Tryout and Revision	Install and Maintain	Need	Alternatives	Constraints	Cost	Number of Tasks
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
34. Tennyson & Boutwell (1971)	X	X	X	X	O	X	O	X	X	O	O	O	O	O	7
35. Tosti & Ball (1969)	X	O	O	O	X	X	O	X	O	X	O	O	O	O	5
36. Tuckman & Edwards (1970)	X	X	O	O	O	X	O	X	X	X	X	O	X	O	8
37. Vance (1976)	X	O	X	X	X	X	X	X	X	X	X	O	X	O	11
38. Waldron (1973)	X	X	X	O	O	X	X	X	X	X	O	O	X	X	10
39. Wallen (1973)	X	X	X	O	O	O	O	X	X	X	X	O	O	O	7
40. Waters, et al (1978)	X	X	X	O	O	X	X	X	O	O	X	O	X	O	8
TOTALS Frequency	40	28	29	23	27	34	24	34	38	28	27	14	25	14	
TOTALS Percentage	100	70	73	58	68	85	60	85	95	70	68	35	63	35	

Description of the Second Schema

Table 2 is coded to the numbers and letters corresponding to the dimensions listed below. For example, 1.1a means that there is a theoretical basis for the total model, while 1.1b means that there is a theoretical basis for only part of the model. Each of these dimensions is explained in more detail following this list.

1.0 Origin

1.1 Theoretical

1.1a Total model (specific reference to general systems theory or other total approach)

1.1b One or some of the components (including adult learning theory)

1.2 Empirical (based on experience or reported research of viable processes)

2.0 Theoretical Underpinnings

2.1 Emphasis on learning or instructional theory (including constructs about adult learning requirements)

2.2 Emphasis on control/management/monitoring function of systems theory

2.3 Emphasis on analysis function (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 (military, industrial, governmental, vocational, nonformal adult education)

3.2b Formal (public, higher, and professional)

3.2c Instructional development (lessons, modules)

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 on use of the total model

4.2 Some documentation, application, or validation data

<u>Origin</u>. Knowledge of the origin of a model can help the educator to use a particular model in the most appropriate manner. There are two main discernable 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. It is useful for the purpose of classification, however, to focus separately on what we mean by theory and empiricism as sources of origin.

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

In order to qualify as having an origin in general systems theory, the description of a model should contain reference to general system theory specifically or describe the system approach with emphasis on interaction of the components of the model in the process of accomplishing the intended outcomes in the intended environment. For example, Bishop (1976) 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, 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 emphasize learning theory as do Davis and McCallon (1974) who stress adult learning theory in particular. Thus, when learning theory, such as represented by Bruner (1966) or Gagne (1977) or Houle (1972), provides the main origin with little or no reference to general system theory the model is judged to have a theoretical basis for only some of the components. This is the nature of the system 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 as the basis for instructional design. Although he does mention feedback and revision along with psychological activities, the origin is clearly learning theory rather than general system theory for the total model.

It would seem that theories related to organizational development also would have a place in the classification of some models, but such theories were not in this particular review. (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, 1979) and Laugen (1979) and in the Career Education Center (CEC) model described by Crittendon and Massey (1978). The descriptive model of a certain set of procedures in these cases were tried and produced good results and are examples of descriptions that sometimes become prescriptions for other users.

Developers also may borrow heavily from a previously existing model and add their own special modifications. For example, Davis (1977) presents a model adapted from Tuckman and Edwards (1970). Sherman (1978) bases his model on Hayman (1974), but Sherman 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), furthermore, did not present their own model, but instead referred their readers to Boutwell and Tennyson, Tuckman and Edwards, and especially to Briggs. In this instance a more recent model described by Gagne and Briggs (1974) and Briggs (1975) is listed in place of the 1970 reference to Briggs given by Brien and Towle. 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 inferred origins that are both theoretical and empirical. This would seem to be the ideal set of origins, but few models fall into both categories.

Theroretical underpinnings. This portion of the categorization schema displays three main divisions to show which models emphasize learning or instructional theory and which emphasize subdivsions (functions) of general systems theory.

Those models based on learning theory usually indicate this status early in the model's description and research concerning the theory often enters into 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 determine the major foundation of the model.

The two subdivisions of the general systems approach are: (a) the control/management/monitoring function, and (b) the analysis function. In the first function, the educator wishes 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 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 seize on this analysis function in order to break down and 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 adding a new component or application than with building on the theoretical basis of the original model.

Purposes and uses. The purposes and uses of a model center around one of three main categories: the teaching of the instructional design process, the production of viable instructional products, and the reduction in cost of education. Although almost every model could be used to teach the instructional design process, decisions for this category are limited to those models which expressly state 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: formal and nonformal education. A distinction among these settings is offered by means of 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 non-formal adult education activities. The formal setting is primarily delimited to public, higher, and professional education activities. Except for activities unique to the specific settings, such as occupational analysis, many of the models could be used in either setting, although the reference may have named one type of organization or the other as the main area of interest.

The models reviewed have two main uses: the development of instruction on a small scale (lessons and modules) and on a large scale (courses, curricula, 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 vs. a program plan.

Few of the reviewed models mention any costs associated with the model. This seems unfortunate. Those who do, however, make the point that economy of scale would enable educators who use a particular model to reduce the total resource expenditure in their special setting. This concept is limited by Glasgow's (1976) observation that the cost effectiveness of systematic development has no empirical basis. Carey and Briggs in Briggs, (1977), however, discuss cost benefit approaches to the use of a system approach to instruction. Goodson and Roberts (1978) also present a two-by-two matrix of instructional quality vs. product impact (p. 25) as an evaluation schema that can be used for legitimate cost-benefit analysis of instructional products within the staff training program of a human services agency.

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 setting of interest. Few of the models reviewed supply any data conerning their effectiveness. Some assert that the particular model works well without supporting data or descriptions of applications. 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) have little excuse for not revealing this data. (A pertinent question might be raised concerning the publishing of a model without having its efficacy established beforehand by means of a firm theory base and/or empirical validation.)

An analysis of Table 2 shows that even at the grossest categorization level there was no 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. 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%.

Origin. About 65% reported some source of theoretical origin, about 50% for the total model (such as general system theory)and about 20% for only some of the components of the model. About 50% reported an empirical origin.

Theoretical Underpinnings. About 50% 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 system theory. About 65% of those who focused on learning theory (10 of 15) also cited the general system theory advantages. (About 35% did not do so.) Only about 40% of those who focused on the general system theory advantages (10 of 27) also cited a learning theory basis.

Purpose and Uses. About 35% reported the teaching of instructional design (or equivalent) as the primary purpose, 90% as the production of an instructional product, but less than 10% emphasized 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. 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% (18 of 26) cited some form of documentation; but of those citing documentation, only 55% (18 of 33) cited any theoretical origin.

Table 2

Categorization by Origins, Purposes and Uses, Documentation, and Theoretical Underpinnings

Reference for Model	Categories													
	1.0			2.0			3.0						4.0	
	1.1		1.2	2.1	2.2	2.3	3.1	3.2				3.3	4.1	4.2
	Theoretical		Empirical	Learning Theory	Control Function	Analysis Function	Teach Design	Instructional Development				Reduce Costs	For Total Model	For Some Parts
	a	b						a	b	c	d			
	Total	Some Parts						Nonformal	Formal	Modules	Programs			
1. Army Security Agency Model; Legere, et al (1966)			X			X		X			X			X
2. Atkins (1975)									X		X			
3. Banathy (1968)	X		X	X	X	X	X		X	X			X	
4. Bishop (1976)	X		X	X	X	X	X	X		X	X			X
5. Brooks (1974)	X							X		X			X	
6. Burkman (1976, 1979); Laugen (1979)			X						X	X	X		X	
7. Crittendon & Massey (1978)	X				X				X	X	X	X	X	
8. Davis (1977)	X							X	X		X			
9. Davis & McCallon (1974)		X	X	X			X	X	X		X			X
10. Dederick & Sturge (1975)			X					X			X	X	X	
11. Dick & Carey (1978)		X	X			X	X	X	X	X			X	
12. Even (1977)		X		X					X	X				X
13. Friesen (1973)	X			X	X	X	X	X	X	X				X
14. Gagne & Briggs (1974); Briggs (1975)	X		X	X	X	X	X	X	X	X	X			X
15. Glaser (1966)	X			X				X	X	X	X			
16. Gropper (1973)			X		X		X							
17. Hayman (1974)	X				X	X	X							X
18. Interservice Procedures for Instructional Systems Development (1975); Branson (1978)		X		X	X	X		X			X	X		X
19. Kaufman (1972)	X		X		X	X	X	X	X	X	X		X	
20. Ledford (1976)	X			X			X						X	
21. Lee (1975)			X					X		X	X			
22. Mager & Pipe (1974)	X			X			X	X	X	X	X			X

Reference for Model	Categories													
	1.0			2.0			3.0						4.0	
	1.1		1.2	2.1	2.2	2.3	3.1	3.2				3.3	4.1	4.2
	Theretical		Empirical	Learning Theory	Control Function	Analysis Function	Teach Design	Instructional Development				Reduce Costs	For Total Model	For Some Parts
	a Total	b Some Parts						a Nonformal	b Formal	c Modules	d Programs			
23. Maher (1978)						X			X				X	
24. Merrill & Boutwell (1973)			X	X		X	X		X	X				
25. Michigan State University Model; Barson (1965)			X	X					X	X			X	
26. Pennington & Green (1976)			X		X			X		X				X
27. Penta (1973)			X		X				X	X				X
28. Roberts (1978)	X		X		X	X		X			X		X	
29. Scanland (1974)									X		X			
30. Sherman (1978)		X				X	X						X	
31. Shoemaker & Parks (1976)	X		X		X	X	X	X	X		X		X	
32. Stakenas & Knight (1979)	X				X	X		X			X			X
33. Teague & Faulkner (1978)			X		X	X		X		X	X		X	
34. Tennyson & Boutwell (1971)	X				X	X			X	X			X	
35. Tosti & Ball (1969)	X			X	X			X	X		X		X	
36. Tuckman & Edwards (1970)		X		X		X			X		X		X	
37. Vance (1976)	X			X		X			X	X			X	
38. Waldron (1973)					X			X			X			X
39. Wallen (1973)	X				X	X		X			X			X
40. Waters (1978)		X	X	X				X		X			X	

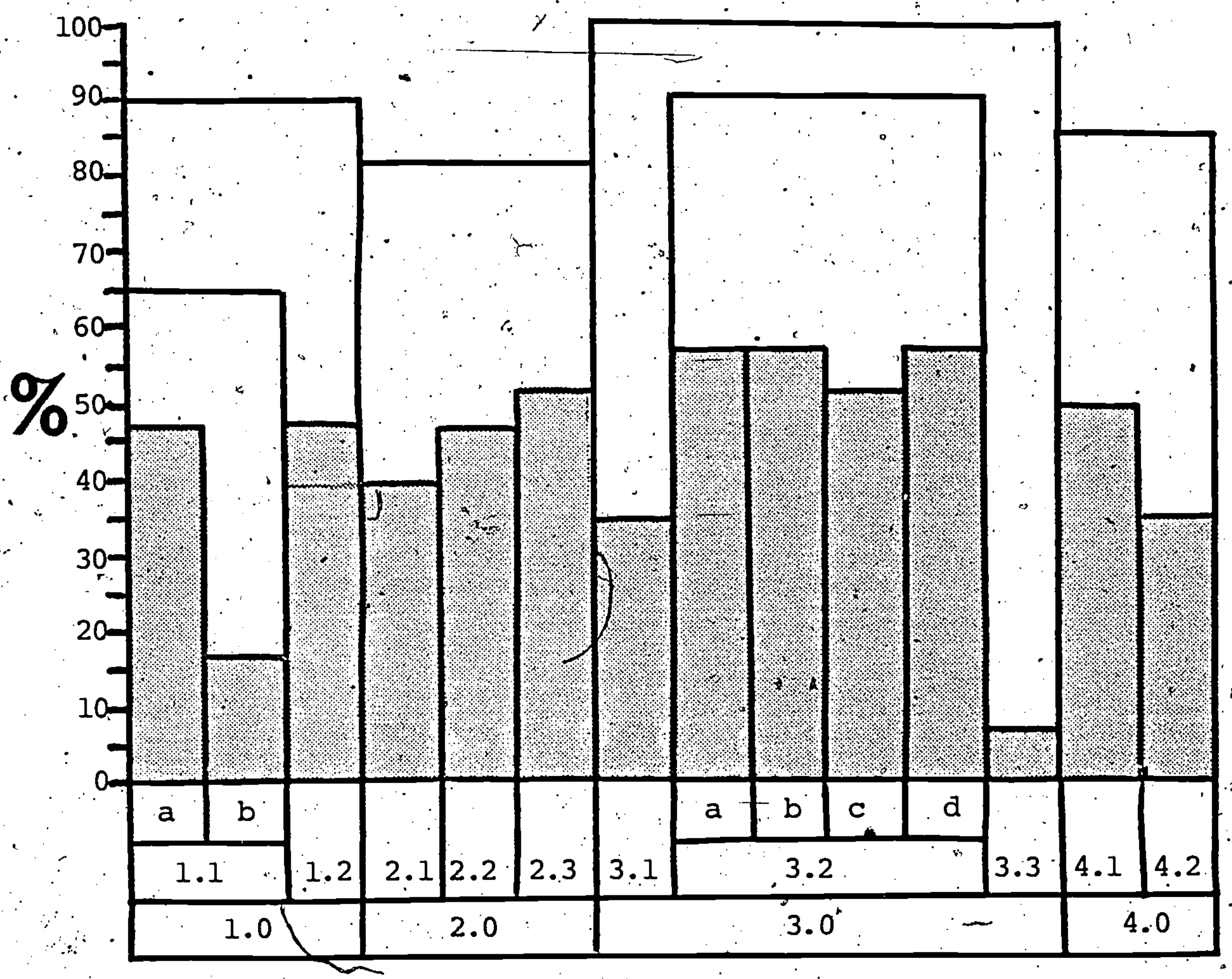


Figure 1. Summary of categorization of instructional design models by origins, purposes and uses, documentation, and theoretical underpinnings.

Summary of Categories			
1.0 <u>Origin</u> 1.1 Theoretical 1.1a Total 1.1b Some 1.2 Empirical	2.0 <u>Underpinnings</u> 2.1 Learning Theory 2.2 Control Function 2.3 Analysis Function	3.0 <u>Purposes/Uses</u> 3.1 Teach Design 3.2 Development 3.2a Nonformal 3.2b Formal 3.2c Modules 3.2d Programs 3.3 Reduce Costs	4.0 <u>Documentation</u> 4.1 Total 4.2 Some

POSSIBLE REASONS FOR MODEL PROLIFERATION

The reader may have gathered by now that there are a multitude and variety of models of instructional design. This study pointed out a number of possible reasons for this phenomenon. One of the most glaring 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 boundries 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 must constantly be on guard. In other words, as stated by Molnar (1971):

> The large amount of uncoordinated research activities and the lack of pre-planned 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. Reseachers 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.

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.

Since many models are never tried out educators are perhaps skeptical about the model that is 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 try-out situations the educator who is interested in choosing a model will have few objective criteria on which to base a decision. Since, as has been shown previously in this paper, few models that are available actually exhibit try-out data, it is little wonder that designers are reticent to adopt or adapt even a well known model. The risk of sinking a project's resources into a model which is, in effect, an unknown quantity can't help but 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 with the context of learning within a particular educational environment as well as with the context of learning in general.

The major learning theorists; Ausubel (1968), Bruner (1966), Piaget (1954), Skinner (1954), and others, present different propositions regarding the context or conditions for learning. These differences presumably have the greatest impact on the development of materials, but they also may cause individual educators to reject certain steps in available system approach models. For example, a "true believer" 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 non-formal 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 Gagne-Briggs (1974) models this distinction becomes apparent. The major differences in these kinds of models appear to stem from variations in operationalizing the major steps by means of specific events and activities.

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 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).

It would be ill advised to recommend that one, and only one, grand pattern be used for all design efforts. Even though this is true, a strong argument can be made that the large number of extant models are not only confusing but also often wasteful of the resources over which educators have command.

CONCLUSIONS

Categorizing the models as shown in Tables 1 and 2 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 system 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 steps which may be implemented mechanically rather than with the complex and rigorous analytical and cybernetic processes required for effective application of the general system approach to instructional design.

5. The general tasks constituting a model of instructional design, though differing in sequence, do have agreement across differing purposes, emphases, origins, uses, and settings. This attests to the robust quality of the 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), Gagne 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 which matches the dimensions of the user's context and to make judgements about the adequacy of documentation and theory base before selecting a model to use. To begin patterning instruction after the first model that one comes across might very well be a mistake for two reasons: (a) the model may have been developed in a completely different setting for a completely different purpose, and (b) many models have not been validated. They may work very well when finally used, but not many educators 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 the sense 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, "Buyer, beware".

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