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AN EXAMINATION OF PROPOSED PROCEDURES FOR THE SYSTEMATIC DEVELOPMENT OF INSTRUCTION

by

James Robert Bigsby

B.A., University of Victoria, 1967

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AN EXAMINATION OF PROPOSED PROCEDURES

FOR THE SYSTEMATIC DEVELOPMENT OF INSTRUCTION

by James Robert Bigsby

ABSTRACT

A wide range of procedures for the systematic development of instruction are examined to determine whether there is an empirical or conceptual basis for a general procedure, to state any such basis in useful form, and to consider how a general procedure might be applied to specific situations.

An organizing outline of twelve categories of activities is developed. Fifty-one procedures from the literature and from projects are analysed and classified using the outline, and the types of activities suggested within each category are summarized.

The twelve categories, listed in declining frequency of occurrence in the fifty-one procedures examined, are Methods Selection, Learning Objectives Analysis, Prototype Production, Evaluation and Revision, Task Analysis, Student Analysis, Implementation, Problem Analysis, Maintenance and Monitoring, Situation Analysis, Preparation for Evaluation, and Project Management.

Procedures are found to vary considerably in terminology, format and content. Terminology and format variations reflect the audience being addressed and do not in themselves suggest differences in activities recommended. Variations in content appear to be ones of omission rather than the result of conflicting opinions, suggesting that there is a basis for a general procedure including all the activities which might be applicable in a particular situation.

The twelve categories developed appear to provide a usable basis for analysing and synthesizing procedures from various sources so that a comprehensive and detailed general procedure for the systematic development of instruction can be compiled through further study. The general procedure can serve as the source for specific procedures adapted to particular needs, and further investigation of which formats and terminologies are best suited to common types of applications is recommended.

There is nothing more difficult to take
in hand, more perilous to conduct, or more
uncertain in its success, than to take the lead
in the introduction of a new order of things.

Machiavelli, The Prince

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Chapter I

INTRODUCTION

Statement of Objectives

As an educational consultant heavily involved in the development of instruction (a term used here to include the whole or any part of a structured learning situation), the investigator had noticed that the literature available to him did not describe a procedure which was both comprehensive and detailed enough to adequately describe the systematic development of instruction. Availability of such general procedure would, it seemed, have been useful in development projects in which he was involved or of which he was aware.

To both develop and validate such a general procedure would have been an undertaking far too ambitious for this study. However it seemed practical to take the first step and conduct a preliminary task analysis of the development process through examining many procedures from the literature and from projects. This required the development of a method for analysing, comparing and presenting the procedures examined. It also permitted a summary of the many activities which were involved in the procedure and allowed some insight into the relationship between a general procedure and the specific procedures under examination.

Therefore the study was directed towards three objectives:

(a) to determine whether there is an empirical or conceptual basis for compiling a general procedure for the systematic development of instruction;

(b) if a basis exists, to analyze and present it in a manner which might facilitate its use and further study;

(c) if a basis exists, to consider how a general procedure might contribute towards a specific procedure designed for and adequate for a particular situation.

The study was primarily concerned with the content of the various procedures examined, rather than with their terminology or format. "Content" refers to the activities which make up the development procedure. "Terminology" refers to the particular labels which different authors use for describing activities, and "format" refers to the method of presenting a procedure such as the use of flow diagrams, lists or textual descriptions.

It was impossible to examine all the procedures in the literature or in use, and the study restricted itself to examination of those procedures encountered by the investigator over a period of six years work in the field. As described later, the study was limited to fairly comprehensive articles and books dealing with specific activities.

Introduction to Systematic Development of Instruction

The process examined in this study is still in its formative stage and as yet does not have a widely-accepted name. For purposes of clarity and consistency, the investigator follows Mager and Beach (1967) and Twelker (1972) who use the term "systematic development of instruction".

It should be noted that the process is elsewhere sometimes described as "instructional design" (Gagné and Briggs, 1974; Kemp, 1971), as "curriculum development" (Robinson, 1971; Taba, 1962) and as "educational technology" (Ely and AECT members, 1972). These three terms and others were not used by the investigator because they already have accepted meanings too narrow to fully describe the total process under consideration. There seems to be a tendency for authors to label the process with terms extended from their own disciplines.

In the expression "systematic development of instruction" the term "instruction" is used in a general sense representing all elements of a structured learning situation. This includes the learners, staff, materials and facilities as well as the nature of their interrelationships. Change in any element or relationship affects all the other elements and relationships and thereby changes the whole of the instruction (Davis, 1975). The development process may focus on the creation or modification of a concrete product, such as a book or filmstrip, or a less tangible product, such as a questioning technique or selection criteria, but the total product is eventually instruction in its braodest sense.

The term "development" encompasses all activities in the process of creating or modifying instruction. It ranges from initial problem analysis through to introducing and monitoring the product.

"Systematic" describes a conceptual approach towards development and instruction in which phenomena are interpreted in terms of the "complex interaction of the individual elements of the system" (Silvern, 1973, p.3). Application of this concept to the elements of instruction is briefly described above. When applied to the development process, the concept has two aspects. First, development takes into account the various elements and interactions of instruction as well as considering the larger systems of which instruction is a part. Second, the development process itself is viewed as a system; the procedures examined in this study analyse the process in terms of its elements and their interrelationships.

A common application of the systems concept to education is to describe the development or instructional processes in terms of an industrial production process. Some form of raw material or "input" is processed and emerges as a product or "output" (Banathy, 1968; Stowe, 1973; Thompson, 1971). One type of interrelationship is the predictive function or "feed forward loop". The process is designed on the basis of a preliminary gathering and analysis of information which has been fed into a simulation model to determine, in advance, the likely results of alternative processes. In the social sciences such as education, the simulation model is not necessarily mathematical but is usually some other form of developed technology (Heinich, 1970, p. 108). Once it is designed and in operation, the process can be modified on the basis of another interrelationship - the evaluation and revision cycle or "feedback loop". The emerging product is compared to the desired standards and any shortcoming is used to modify the process until standards are met (Baker and Popham, 1970; Banathy, 1968). Although the feedback function is the one most universally mentioned in articles about systematic instruction or development, it is the predictive function that makes the initial contribution to quality; without it the feedback function would be reduced to mere trail and error.

The systems concept is not new; planning on the basis of all necessary information and revising of the basis of results are time-honoured techniques. The recent emphasis on systematic development is really a "formalization and procedural expression" of the approach which has always been taken by wise men trying to solve their problems (Carter, 1969, p. 31).

Instructional materials lend themselves to systematic development because they are replicable, an essential characteristic for both prediction and revision. An examination of curriculum reforms during the 1960's revealed that projects providing fully developed materials were the projects most likely to improve instruction (Popham, 1969, p. 319). The relatively high learning obtained from many instructional films and much programmed learning is probably due to the fact that such materials generally receive concise and careful planning; it is the quality of the development rather than the characteristics of the media which determine their success (Twyford, 1971, p. 371).

This factor was also suggested by Ellson who studied twenty outstandingly successful reading programs. They were found to have only one distinguishing feature in common:

> ...They were all carefully engineered and rigid in their application. They had clearly-spelled-out plans for administering them, and they required the teachers and tutors to follow those plans to the letter.
>
> (reported by Raspberry, 1974)

After conducting the study, Ellson reflected on the possible reasons for this pattern. He concluded that it was the result of those advantages accruing from division of labour. There are relatively few highly capable teachers who can succeed without direction. The problem is "how to help ordinary teachers succeed in situations that regularly produce failure" (Raspberry, 1974). Designing successful instruction is best done by the small number of people who are highly capable in the necessary activities; their product can then be replicated by the multitude of ordinary teachers. Ellson uses the analogy of music where there are few composers and many performers. The composer has the time and talent to create, and the performers have the numbers and talent to reproduce the creation in a multitude of settings. Ellson suggests that attempts to further distinguish between the design role and the operating role in education would be resisted by teachers and their unions because it would threaten their professional image (Raspberry, 1974).

Centralizing development in the U.S. Navy training program is described by Scanland who cautions that

> ...perhaps the military is the only setting in which such a decision could be made and have expectations of being carried out.
>
> (1974, p. 6)

The current reliance on localized development is described by DuMolin as a "cottage industry" which has become a "Major deterrent" to improved program quality(Armsey and Dahl, 1973, p. 14).

Lack of systematic development can cause the failure of an otherwise meritorious innovation.

> ...the great bulk of research studies of nongrading, team teaching, and flexible scheduling undertaken thus far have yielded no significant results favoring these plans. This is not to say that an excellent rationale cannot be formulated for them....
>
> Too often the assumption seems to be that the adoption of new content, new organizational plans, new instructional media, or new designs for facilities and buildings is, in itself, sufficient for instructional improvement.
>
> To date, implementation of new organizational plans has been hasty and superficial, with inadequate provisions for the total instructional system in terms of procedures, materials, media and required staff.
>
> (Saettler, 1967, p. 136)

Inadequate development of a product not only directly affects instruction, but can also affect it indirectly. Much research is based on the result of some development process. If the development is inadequate, the research findings may in fact be invalid resulting in the unwarranted rejection or adoption of an idea. Subsequent research or practice based on the results compounds the initial weakness (Borg, 1969, p. 7).

A distinction should be made between the application of the systems concept in the industrial and military fields and its application in education. Although the latter may be inspired by the former, it does not lend itself to the standardization and consequent precision which characterizes the former.

Of all the procedures examined in this study, only the one proposed by Brooks (1973) attempts to include a mathematically-based predictive model. Effective design and modification of a system requires elements which are "stable and reliable to the extent that the effect of a given modification can be predicted" (Hodge, 1969, p. 187). Human beings do not meet these criteria very well.

> Our success in dealing with things has led us to apply these approaches to people. Accordingly, we are currently enamored of the industrial model for running our public schools. We have assumed that the production of a student is the same basic problem as producing an automobile. We have sought the answers to effective learning in a study of inputs, systems, controls and organization and treated people as things to be molded, made, convinced, coerced, directed. We have overlooked the fact that automobiles don't think, love, hate, read, write, paint or solve problems.
>
> (Combs, 1969, p.65)

It would be a mistake to become infatuated with the systems concept and assume one were analyzing "a nice clean closed system" (Kraft and Latta, 1973, p.122). Merely following the style of systematic development would in itself be inadequate. There must be sufficient flexibility and resources to do the job properly (Carter, 1969, p. 31). Trained specialists capable of skillfully applying the technique are essential (Kraft and Latta, 1973, p. 122). They will have to consider a vast area of knowledge and anticipate the effect on and effect of major systems other than the instruction which is their immediate concern (Heinich, 1970, p. 106). This is particularly difficult because in the social sciences there is often insufficient knowledge to guide judgement with the degree of precision available to the physical science technologies (Carter, 1969, p. 31).

> ...the designer of an instructional system has only very limited reliable research data available to him and must therefore make pragmatic and intuitive design decisions.
>
> (Banathy, 1968, p. 17)

In summary, systematic development of instruction is a method of creating or modifying instruction which can optimize the result through prediction based on essential information and through improvement based on evaluation and revision. It is not an exact technology since it deals with a multitude of complex variables, many of which cannot yet be quantified or predicted, but it has a better chance of dealing with this problem than any other development procedures (Carter, 1969, p. 30).

Purpose of a Comprehensive General Procedure

If systematic development of instruction is in fact a "formalization and procedural expression" of a problem-solving approach (Carter, 1969, p. 31), it would appear both possible and desirable to have the procedure formally expressed. Many such descriptions have appeared in the educational literature in recent years. The main elements and relationships are usually represented by a graphic model or list which is usually explained further in accompanying text.

Unfortunately the format, terminology and content often differ considerably. Although some have undergone field evaluation and have been revised accordingly, and although most would appear to have been based in part on the author's own development experience, there is no authoritative guide to their usefulness in a general sense. Faced with such a wide choice, a person inexperienced in the field would have difficulty deciding which, if any, would be adequate for his purposes.

These purposes would likely be of two types. The first would be to use the procedure as a guide for planning and conducting the development process. This is particularly crucial to the person responsible for project management since it assists him to anticipate possible problems, locate information gaps, predict the time and resources needed, assign responsibilities, schedule activities and review progress (Alexander and Yelon, 1973, p. 35; Blanchard and Cook, 1973, p. 83; Carter, 1969, p. 30; Kraft and Latta, 1973, p. 123). The second purpose would be facilitating communication among those directly involved in development as well as between the developers and those with whom they must discuss the process. With the variety of terminology in the field, it is obviously essential that members of the development team have a consistent and properly-understood language and conceptual model.

> Anyone who has been a member of a design team can recall the difficulty in getting started. This is because each individual brings to the meeting a different conception, a different mental model, of the nature of the task, its objectives, the way the members are to work together, and what each shall contribute...if the team members have different backgrounds, they are also likely to bring different languages.
>
> (Alexander and Yelon, 1973, p. 37)

Use of a diagram or list as a "visual work plan" (Blanchard and Cook, 1973, p. 83) becomes a common framework and focus for discussion. A simple, clear overview of the process is particularly essential for liaison with those outside the team such as administrators, teachers, school boards and parents.

Whether or not a particular procedure is useful for either of these purposes will depend on its external and internal validity. As described in more detail later in this paper, external validity refers to the accuracy with which reality is represented. In this case it is a function of content: does the procedure include all the necessary elements and relationships? Internal validity refers to the effectiveness of communication. In this case it is a function of format and terminology: is the procedure quickly and uniformly understood?

A preliminary examination of many of the procedures reported indicates that the differences in format (flowcharts, lists, timelines, text, etc.) and terminology, although perhaps deserving study, are not as critical to the usefulness of a procedure as the content would be. The primary importance of determining external validity before focussing on internal validity has been stressed by Tuckman and Edwards (1973, p.70).

Oliver reviewed a number of procedures for curriculum design, a term he applied to the broad field herein referred to as systematic development of instruction, and concluded that they appeared to be "over-simplistic and fragmented in the range of critical events" which must logically come under the control of the developer, a situation which would not permit improvement of the current "crude technology" of development.

> It seems abundantly evident that if the general rigor and forecasting power of curriculum designs are to be improved, the theorist must start with a study of the necessary and sufficient events that must be controlled by the designer before he can proceed to develop techniques for assuring their semantic meaning. In short, the key question at this stage in the development of the curriculum field is <u>not</u> "How ought curricular events to be identified, described, analyzed and ordered?" <u>but</u> "What curricular events ought to be identified, described, analyzed and ordered?"
>
> (Oliver, 1970, p. 21)

He suggests that some type of conseptual structure is needed to identify the "critical dependent and independent events" with which the designer must deal, thereby describing what the designer should do, and proposes three general categories. The first is the demand for education, the second is the capability needed to meet that demand (such as the people, materials and organization comprising an instructional system), and the third is the method for implementing the capability so as to meet the demand (Oliver, 1970, p. 21 and p. 23).

A preliminary examination of many proposed procedures indicates that there is a considerable consensus among authors on the content described. Although differences are at times very pronounced, they appear to be matters of emphasis, scope or detail. An activity included by many authors may be omitted by a particular author, but not because of a dispute. There appear to be no conflicting opinions about content, no criticism by an author of the procedures suggested by others. There seems to be a tendency for many authors to concentrate on a particular activity or group of activities and to ignore or lump under a general heading all other activities. Those working in the field of psychology often tend to concentrate on the type of learning and the stimulus-response-reinforcement patterns. Trainers emphasize job analysis and alternatives to training. Those addressing classroom teachers deal with day-to-day practices. Media specialists elaborate on the selection, design or use of instructional materials. Managers emphasize project planning and control.

Content differences therefore appear to be matters of omission, not conflict, and this suggests that the content proposed could be organized into categories for eventual synthesis and validation. The mere existence of such a diversity of proposed content appears to be prima facie evidence that many, if not all, of the procedures would be inadequate as a general description of the process and could not provide useful guidance to a novice, nor supply a basis for validation or an accepted terminology.

Method of the Study

Since the study was largely of an exploratory nature, it was necessary to begin with only a general method in mind and then to refine it as events progressed.

Procedures were selected for examination on the basis of two criteria: being sufficiently comprehensive to include most of the development process, and being specific enough to permit analysis and to be a useable guide in practical applications. These criteria were at first applied very loosely in order to assemble a large universe of procedures for further consideration. This led to initial acceptance of procedures which later came to be regarded as too theoretical and abstract for the intended use. For example, Tyler's principles proved to be too general and were not included in the second classification, even though they are important ideas and can be used as the basis for sufficiently specific procedures. Similarly the initial selection included specialized procedures which later proved too limited in scope, such as the procedure for designing instructional media suggested by Briggs and others (1966).

As the study progressed, the above criteria were interpreted more restrictively, and procedures appearing too vague or too limited were rejected. A wide range remained, however, on the grounds that diversity was desirable in a study of this type. Selection was largely a subjective decision, without screening such as examining the author's credentials or the procedure's history. Procedures based on particular projects were included as well as generalized ones. The procedure might be explicitly set out in a graphic model or embedded in text or both; it might emphasize one type of product rather than a broad approach; it might be derived from a particular setting such as military or industrial training or public schools; it might, in effect, be almost anything as long as it contained a clear description of (and, generally, rationale for) a major part of the development process.

The search for these procedures was extensive, but it cannot be described as exhaustive; the investigator made maximum use of the resources available including books, articles and workshops, as well as obtaining working documents from some projects and visiting some research and development laboratories. On this basis the procedures selected are probably representative of the field.

The classification system was inspired by Twelker (1972). This was the only similar study found, although it is likely that most of the procedures were derived from others, and two are specifically described as syntheses (Carter, 1969; Scanland, 1974) which suggests that informal analysis has occured.

After examining a number of graphic models depicting the development process, Twelker created a classification system of nine categories. Five models were analyzed using this method. The investigator concluded that Twelker's results indicated some of his categories were too broad and from them developed an enlarged classification system of fifteen categories.

Sixty-one procedures were analyzed using the fifteen categories and the results recorded and totalled on tally sheets. Results of this first classification suggested that some procedures were either too vague for analysis or too limited in scope (not represented in at least half the categories). Twenty procedures were rejected.

It was decided to consolidate some of the categories to provide a better fit between the classification system and the procedures. Ten additional procedures had been selected following the first classification making a total of fifty-one to be analyzed using the revised categories. Results were recorded and totalled on tally sheets. It was decided that a clear and consistent pattern had emerged and no further modification of the categories was done.

During the analysis and tallying, it bacame apparent that the type of examples or details would often vary widely within a particular category. For example, using the categories "student analysis" might appear in three procedures, but a closer examination would reveal that one was referring to pre-design assessment of motivation or reading level, the second was referring to pre-testing for advanced or remedial placement, and the third was referring to recruitment and screening. There appeared to be a widespread pattern of agreement at a general level but diversity (not disagreement) at a specific level. As with the general procedures, differences appeared solely due to omission rather than conflicting opinions.

This suggested that a further analysis and description of details would be useful to anyone who wanted to fully understand the categories' breadth or who was intending to use the assembled information in any way. A summary of the details within each category, synthesized but with an indication of source, was prepared as a logical extension of the study.

There was a problem in determining how much detail could be dealt with in a study of this kind. It must be stressed that the study's intent is an overview of the development process in terms of its major elements. Many professional specialties contribute their expertise to the development of instruction, and it is not the purpose of this study to investigate or describe the details of any particular field. The study does not try to go beyond the needs or abilities of a generalist who is responsible for planning and conducting the development process or who is attempting to describe the basic elements of the process. Details are included only for the purpose of drawing attention to necessary information and expertise.

The study is limited to an examination of the procedures selected. Although the study entailed a search of the literature which included many descriptions of specific elements of the total process, there have not been examined or reported.

The study is not an attempt to establish the validity of any particular procedure or element of a procedure.

Chapter II

CLASSIFICATION

Preliminary Classification Attempts

In the early stages of the study, several ways of analysing the procedures were explored during small-scale trials. Initial attempts focussed on the use of a procedure which appeared somehow "typical" and attempting to fit into it the other procedures. It appeared that none of the procedures available was sufficiently comprehensive yet detailed enough to accommodate all the others.

It was also observed that translating a procedure from one format or terminology into another posed little difficulty, with one exception. Detailed flow diagrams proved to be unsatisfactory as organizing outlines due to two characteristics: Their use of boxes to rigidly define and separate activities, and their use of arrows to show dynamic interrelationships. Grouping activities within boxes made it impossible to allow for variations without the use of complex overlay techniques, and did not provide a workable way of comparing and totalling results. There was also reason to anticipate some user resistance, as described with an uncomfortable degree of tongue-in-cheek truth in one of Professor Finglemeyer's Irrefutable Laws of Media:

> An instructional model increases in accuracy relative to the ratio of arrows to boxes and, conversely, will be more ignored because of its apparent complexity.
>
> (Ananymous, Audiovisual Instruction, January, 1973)

Flow diagram arrows depicted the flow of information and the sequence of events. Examinations of procedures in all formats indicated some manner of depicting sequence, either by diagram arrows or by numbering or both. Authors were apparently in general agreement on the overall sequence which could be briefly described as problem analysis, information gathering and analysis, design of prototype, evaluation and revision, and implementation. They were also in general agreement that there were no watertight compartments between activities, that many occurred concurrently, and that developers would find it necessary to move back and forth as the project progressed due to initial information gaps. Events do not occur in isolation, as might be suggested by the precise boxes around each activity, and the multitude of arrows were intended to stress this.

Because of the need to work at a fairly general level, it was decided that the classification system must be a list (thereby permitting flexibility and simple tallying) which is based on the type of activity rather than its sequence; the placement of an activity in the list would indicate general sequence to the extent possible in such a simplification.

Twelker's Classification Method

An extensive search of the literature turned up only one study specifically intended to suggest a classification system and to analyse and report several procedures using that system (Twelker, 1972). Three categories of models were developed by O'Hanlon (1973) to describe the curriculum development process, but they are general summaries of conceptual approaches--management, systematic and open-access--rather than an examination in specific terms. The procedures used for two different projects are grouped under a general procedure by Carter (1969). The procedure reported by Scanland (1974) is based on an analysis and synthesis of the four procedures used in the branches of the U.S. military, but the process of analysis and synthesis is not described, only its outcome.

Twelker reviews five models, each a systems approach, which graphically describe the development process. Each has been successfully used to develop instruction in regular operational settings.

1. Teaching Research Systems Approach
2. Michigan State University Instructional Systems Development Model
3. Systems Approach for Education Model
4. Project MINERVA Instructional Systems Design Model
5. Banathy Instructional Development System Model

(Twelker, 1972, p. 2)

Of these five models, four were developed for college or school use, and the fifth--Project MINERVA--was designed for military training. Twelker analyses them using an organising outline which he describes as a sixth model, and which has itself been used for projects (Twelker, 1972, p. 11). Nine categories are used, each illustrated by some appropriate details.

Table I

Twelers's Organising Outline

Stages	Categories	Details
I: Define	Identify Problem	Assess Needs Establish Priorities State Problems
	Analyze Setting	Audience Conditions Relevant Resources
	Organize Management	Tasks Responsibilities Time Lines
II: Develop	Identify Objectives	Terminal Enabling
	Specify Methods	Learning Instruction Media
	Construct Prototypes	Instructional Materials Evaluation Materials
III: Evaluate	Test Prototype	Conduct Tryouts Collect Evaluation Data
	Analyze Results	Objectives Methods Evaluation Techniques
	Implement/Recycle	Review Decide Act

Having set out his categories, Twelker briefly describes each in his own terms (in effect a description of his own model) and then lists for each category the individual steps taken from each of the five models or, where appropriate, notes the absence of the step in a particular model. His conclusion is not an attempt at synthesis or evaluation:

> Which model best fits the reader's needs may well depend on the particular emphasis desired.... However, it should be clear from the brief comparison given above that all five of the models are addressing the same task (developing instruction) in similar ways, but with different descriptions and language.
>
> (1974, p. 11)

A critical examination of the results of Twelker's classification reveals that the "particular emphasis" is very marked in places. Some models do not include any activities in certain categories, while other categories appear to be so broad that they include as many as eight steps from a particular model. Even when different models each have a step within a particular category, the steps may be somewhat different.

Twelker organizes the categories in a general sequence which fits that described earlier. Each category will be briefly reviewed here in the sequence outlined.

In the category "Identification of the Problem", SAFE has eight separate steps while the other four only list one each and those differ from general to specific activities.

"Analyze Setting" illustrates the diversity of specific activities which can be suggested under the same category. Teaching Research specifies three steps: identifying the learner population, collecting relevant course material, and analysing instructional content. SAFE only suggests that constraints be determined. Michigan State offers a vague "gather input data". Twelker mentions the need to determine characteristics of school and community resources which may relate to the problem.

"Organize Management" is a forceful illustration of how some models may assume certain steps to be understood. Although Twelker, outlining three broad "crucial things which must be examined here", adds that "without formal organization development efforts typically fail", it is noteworthy that three of the five models do not specify any activity of this kind. Of the other two, Teaching Research includes the selection of support staff and determination of management controls and SAFE is represented by a step which, in the investigator's interpretation, is misplaced and should refer to management of the instruction.

"Identify Objectives" is equally represented in fairly uniform terms. Teaching Research differentiates between terminal and enabling objectives, and only Michigan State specifies entry objectives.

"Specify Methods" appears to be a very broad category including from two to five major activities from each model. A difference in the manner of perception is noted here. Teaching Research and Banathy both approach the matter from a psychology-oriented viewpoint with considerable emphasis on analysing the type of learning required and choosing appropriate activities and sequences. By contrast, SAFE concentrates on "management/operations plans" and cost-benefit analysis. Although a broad category which suggests the possibility for subdividing it, the differences appear to be based on the conceptual approach used and therefore, while not functionally mutually exclusive, make distinction into separate elements extremely difficult.

"Construct Prototypes" varies from four distinct steps for Teaching Research to none at all for SAFE. The primary reason for this disparity is that Teaching Research's steps include the first level of evaluation/revision--a technical and communication review of its materials to ensure accuracy and clarity prior to field testing. Performance tests are developed at this point by four of the five, but only Michigan State actually states the need to prepare for formative evaluation activities.

"Test Prototypes" groups together some activities which do not belong exclusively in this category, in that Banathy is described as performing "system training" and "install" steps. These are actually shown on Banathy's model to precede a field test (or any other implementation) and seem related to Michigan State's preparation for evaluation. In general all five models and Twelker describe the same type of formative evaluation to the stage where data are obtained. MINERVA is unique in including a follow-up of graduates on the job.

"Analyze Results" suggests an activity distinctly separate from the prototype testing, as if the data were gathered previously and is only now analysed and interpreted. Twelker's placement of some steps in this category is open to question. For example, Michigan State's "administer and analyze tests" is placed here, whereas MINERVA's "administer (and analyze) tests" is placed in the previous category. SAFE's activity here is "implied in previous step".

The final category, "Implement/Recycle", has uniform steps from each model but only ones involved in recycling--that is, revising the prototype to improve its performance. Twelker points out that at some point the decision must be made to stop recycling and to implement, but the models do not specify this. Other than Banathy's steps for "system training" and "install" and SAFE's general references to operations planning, none of which are included here by Twelker, the models make no mention of any steps to facilitate implementation.

Twelker does not suggest any subsequent activities once the prototype has been sufficiently recycled to the point where it is ready for implementation. The steps for installation mentioned above and MINERVA's step for following up graduates are the only activities described and they are placed within other categories. One must question Twelker's judgement on this matter. An examination of Banathy's model clearly indicates that he includes an "implementation and quality control" function which can be quite separate from field testing.

In summary, Twelker's model appears to provide a reasonably useful classification system with a few reservations. It demonstrates that procedures which appear different are in fact very similar in sequence and content and can be analysed and compared under a general classification system of broad categories. The differences noted were essentially omissions by any one model of activities proposed by the others, which indicates that none of the models studied is an adequate general procedure, although each may be satisfactory for a particular situation. The question is then whether Twelker's own model--his organizing outline, as he calls it--is sufficient.

The investigator concluded that although it was the best classification system found so far, it could be improved based on the difficulties found in the preceding analysis and on the preliminary attempts at classification which had revealed a considerable range of proposed activities.

First Classification: Categories

Results of the preliminary classification attempts combined with the review of Twelker's work indicated that the categories chosen should be fairly comprehensive yet also quite distinct. The following outline was adopted for the first classification:

Table II

Categories Used in First Classification

Stage	Category
Administration	Identify Problem; Plan Solution
	Obtain and Organize Resources
	Supervise Progress
Analysis/Design	Analyse Setting
	Analyse Task
	Define and Organise Learning Objectives
	Select Learning Methods
	Prepare for Evaluation
	Prepare for Implementation
	Construct Prototype
Evaluation/Revision	Field Test
	Analysis and Revision
Implementation	Start-up and Dissemination
	Operational Support
	Monitor Program

Fifteen categories are designed compared to the nine used by Twelker. One of the categories, "Analysis and Revision", combines two of Twelker's. Seven are entirely new. The rationale for adopting a more detailed system is the belief that a general procedure must interpret the development process in the broadest terms so as to comfortably include all procedures. It is also necessary to mention all key activities for the benefit of those unfamiliar with the process. Scanland describes this approach during the development of a joint services development model.

> The important thing is...the thoroughness with which the process is described by the model, and it is the concensus of the committee that nothing should be left to the assumption that it is too obvious to be addressed.
>
> (1974, p. 3)

A brief description of each category will provide an illustration of the investigator's interpretation of each category.

"Identify Problem; Plan Solution" is taken directly from Twelker with an additional range of meaning. Some stimulus starts the development process in motion. It could be detection of a possible performance deficiency, it could be the need to reduce costs or adapt to new circumstances, or it could take the form of an administrator's desire to enhance career potential or a publisher's search for profitable products or many other types of impetus. Before the development process can proceed further, its objectives must be clarified and confirmed and its choice justified. At this stage the activities are centered on administrative functions; instruction is seen as being only one possible solution to a problem. (Geis, 1970; Mager &Pipe, 1970)

"Obtain and Organize Resources" is the planning stage of project management. The resources needed to conduct the development process must be estimated and a budget prepared for those which are not already available under existing budgets. Those available already must be obtained through receiving authorization for their use; this would include facilities, equipment and staff. At this stage it is also necessary to obtain the authority required to perform the job; sanction from senior levels of power is often essential when dealing with other organizations. After obtaining the resources, it is necessary to assemble them (purchase, hire, etc.) and assign responsibilities and functions. Scheduling of activities should be performed at this stage.

"Supervise Progress" is not specifically stated by Twelker, but can be inferred from the fact that he plans for control procedures. By applying the systems concept to the development project itself, it is apparent that performance of project elements must be monitored and any difficulties identified and corrected. When staff are hired, for example, it is a predictive activity; by monitoring their output and taking corrective action, feedback/revision is conducted.

"Analyse Setting" is essentially the same category as Twelker's. It includes pre-design assessment of potential learners, pre-instruction assessment of learners, and pre-design analysis of the resources and constraints likely to affect the instruction and, to the extent not already determined, the development itself.

"Analyse Task" is a new category split off from Twelker's "Identify Objectives". This includes an investigation of the type of performance for which the learner is being instructed. This may be a job, a subsequent level of learning, or general life activities. The intent is to determine this information from source data to ensure its validity. This is most easily done when the performance can be clearly identified such as a particular job or subsequent instruction. This also includes an assessment of alternative methods of achieving performance details (to the extent not already done in "Identify Problem; Plan Solution"), of the conditions under which the task is or should be done, of the standards required, and of the priority to be placed on each type of performance. In effect, the general problem examined in the first category is now being studied in extreme detail and similar types of decisions are being made on each item as have already been made on a general level.

In the category "Define and Organize Learning Objectives" the information obtained through task analysis is stated in a form suitable for instructional design decisions, then organized to plan the sequence of learning. This category follows closely the writings of Mager (1962), Gagné (1970) and Briggs (1970).

"Select Learning Methods" involves such activities as choosing subject content to illustrate a concept, specifying stimulus-response-reinforcement patterns, choosing the communication channels to be used (teachers, tutors, media, observation, etc.), describing the facilities and equipment, planning the management of the instruction (time use, individual versus group activity, methods and frequency of student evaluation) and the like. It is a wide category and is at the heart of the entire development process. It was very tempting to split it into a number of categories such as those suggested by the activities listed above, but since the activities are so closely interrelated it seemed adequate to group them and to rely on a description of the category to point out these main activities.

"Prepare for Evaluation" was created as a distinct category because it is a responsibility of the developer to arrange for formative evaluation in some form (if it is to be done at all). The developer is the one who requires the information about the product's performance and must prepare in advance for a collection of data. In Twelker's study only Michigan State University included a step of this kind. The other responsibility of the developer is to facilitate the implementation of the product in a field test situation; Banathy included a "systems training" step in relation to "systems training". If the developer has designed the product on the assumption that certain facilities, equipment and staff behavior were required, he must ensure that they are met to make the evaluation valid.

"Prepare for Implementation" allows for the developer who wants to facilitate the successful introduction of his product. Of the models reviewed by Twelker, only Banathy includes a "systems training" and "install" activity, but a reading of other procedures indicated that this category was needed to include many activities designed to encourage or assist implementation.

"Construct Prototype" includes all production activities which are based on the types of learning activities and methods, as well as the materials needed for evaluation and implementation, earlier prescribed. This category also includes selection of prototype components when they are already available.

"Field Test" includes any type of formative evaluation, from critical reviews through small scale testing to an actual field test in an operational setting. The type of activity described here would encompass various levels of evaluation such as those just mentioned as well as observations about factors to observe and methods of gathering data.

After noting how Twelker's category "Analysis" tended to blur into the preceding "Test Prototype" and the following "Implement/ Recycle", it was decided to combine the analysis and revision functions since they were so closely related. In this category of "Analysis and Revision", the information gathered previously is examined to detect flaws in the prototype and suggest which of the previously-performed activities needed to be repeated in order to improve the product. If further changes are not justified, the product is either abandoned or implemented depending on how satisfactory it now is.

"Start-up and Dissemination" puts into practice the plans prepared earlier to encourage and/or facilitate implementation. The reason for including the developer's possible role in this function is described earlier.

"Operational Support" assumes that some developers will be in a position where from time to time they must provide maintenance services to their product's users. This could include continued in-service training, replacement of consumed materials, and a modest degree of customizing services when needed.

Finally, the developer may wish to "Monitor Program" to ensure that it is being used as planned, that it is producing the results it should (particularly important when students do not proceed immediately to the task they are being prepared for), and that there have been no changes in the task, situation, students, or problem and no new developments which make the product sufficiently obsolete to warrant cancellation or revision. Although these activities may not be performed by the same person or group who did the development, they are nonetheless part of the development process. Any indication that performance could be substantially improved or that it has become unneccessary is the stimulus which completes the cycle and leads again to the first category of problem identification.

First Classification: Comment on Methods

Worksheets with sixteen columns were made up. Fifteen columns were for the categories, and one was for the procedure's author or name. Sixty-one procedures selected from the literature and other sources were analysed and classified by making an entry in the appropriate column next to the procedure's name. Where possible, brief notations were used instead of checks or other tally marks in order to permit review of each category for patterns of consistency or differences. Wherever possible, all available information from the author's complete text was used to determine more precise meanings. Some procedures included activities which were only vaguely defined and it was necessary to enter a notation such as "general only". This proved very common in the categories "Identify Problem", "Analyse Task" and "Define and Organize Learning Objectives".

It was found that the activity "Construct Prototype" was omitted as such in many procedures, but was clearly inferred by the activities under "Select Learning Methods". When a procedure leapt from prescribing materials to be designed through to the testing of those materials, it seemed obvious that a construction activity was implied.

The activities in "Field Test" and "Analysis and Revision" were always treated as a linked pair and often described under a single heading. Another frequent treatment of the revision activity was depicting it as a feedback arrow in flow diagrams.

As noted in the review of Twelker's study, a procedure might include only one of several possible activities which could fit into a category. This happened throughout the first classification, particularly in the category "Analyse Setting" where a very definite pattern could be seen by reviewing the notations. Some procedures referred only to pre-design assessment of students, others to pre-instruction selection or advanced placement, and others to resources and/or constraints. It became apparent that a sufficient difference existed, both functionally and quantitatively, to warrant two categories.

As noted earlier, this first classification indicated a need to abandon some of the procedures which were too vague or too specialized as well as a need to modify the categories.

First Classification: Results

Table III

First Classification: Frequency of Activities, by Category, of Sixty-one Procedures for the Systematic Development of Instruction

Stage	Category	No.	%
Administration	Identify Problem; Plan Solution	37	61
	Obtain and Organize Resources	16	26
	Supervise Progress	7	11
Analysis/Design	Analyse Setting	48	79
	Analyse Task	45	74
	Define and Organize Learning Objectives	49	80
	Select Learning Methods	58	95
	Prepare for Evaluation	24	39
	Prepare for Implementation	29	48
	Construct Prototype	50	82
Evaluation/Revision	Field Test	53	87
	Analysis and Revision	53	87
Implementation	Start-up & Dissemination	22	36
	Operational Support	4	7
	Monitor Program	20	33

In general the categories appeared to provide a fairly good "fit" with the procedures selected. However it seemed that a few categories with very low totals had not appeared significantly different to enough authors to warrant their continued use in the study. It also appeared desirable to re-examine the procedures being analysed since some had proven difficult to classify due to their vagueness, or had proven so limited in scope that they occurred only in a few categories and thus tended to distort the results. As described elsewhere, twenty procedures were rejected following this review. Appendix "C" lists them and their sources.

In addition, four categories were merged with others and one was split into two new categories for a revised total of twelve categories which, it was hoped, woud provide a better "fit" with the procedures in the second classification.

The first two to be merged were "Obtain and Organize Resources" and "Supervise Progress" which were jointly renamed "Project Management". The "Analyse Setting" category was split into two new categories, "Analyse Students" and "Analyse Situation", after a supplementary tally of specific details indicated that 27 procedures dealt with student assessment of various kinds, 30 focussed on analysis of resources or constraints or both, and 4 were general comments. This seemed a sufficiently strong basis for creating two separate categories.

The category "Analyse Task" also had a distinct pattern, but the two types of activities specified were not different in function, only in degree. Only 16 procedures specified use of source data or other reliable indicators of relevance, while 29 made general statements such as "determine goals". There seemed to be no need for separate categories.

It became apparent during classification that the two categories "Prepare for Implementation" and "Start-up and Dissemination" duplicated each other. Although one referred to planning and the other to action, procedures would describe either plan or action and thereby imply what they omitted. It seemed advisable to consolidate these two into one category, "Implementation".

For similar reasons it was decided to merge "Field Test" with "Analysis and Revision" to form a new category "Evaluation and Revision". There was no difference whatsoever between the frequency of the two categories; if a procedure mentioned one it also mentioned the other. This now grouped into one category a potentially wide range of activities which could readily occur at different places, different times and through different people. However the activities appeared to be so unified, so logical in their interrelationship, that it would be unnecessary to state them separately at the level of a category; this could be done when stating details.

Finally, it was obvious that "Operational Support" did not enjoy sufficient mention to justify a separate category. It was merged with "Monitor Program" to form a combined new category of "Maintenance and Monitoring" which would include all activities of the development process which occurred after the product had been implemented in its final form. It should be noted that in some of the procedures, the authors did not expect the user to have the chance for a field test prior to full-scale implementation. In these circumstances (usually a one-shot workshop or a year-long class) the first implementation served as a form of field test; it was a difficult distinction to make.

In summary, what emerged from the first classification was a reduced list of procedures and a revised set of categories which would be used for the second classification.

Second Classification: Categories

Following the first classification results, a new set of categories with slightly modified titles was developed. For the purpose of reference each category was numbered; this was not intended to necessarily suggest a sequence, since there are no watertight compartments and design activities flow from one category to another and back as circumstances dictate.

Table IV

Categories Used in Second Classification

Stage	Category
Administration	1. Problem Analysis
	2. Project Management
Analysis	3. Task Analysis
	4. Student Analysis
	5. Situation Analysis
Design	6. Learning Objectives Analysis
	7. Methods Selection
	8. Prototype Production
Validation	9. Preparation for Evaluation
	10. Evaluation and Revision
Operation	11. Implementation
	12. Maintenance and Monitoring

Additional searches of the literature between the end of the first classification and beginning of the second resulted in the selection of an additional ten procedures. These were combined with the forty-one retained from the first for a total of fifty-one procedures analysed and classified using the modified categories.

The methods used were the same as those reported for the first classification.

Second Classification: Results

Table V

Second Classification: Frequency of Activities, by Category, of Fifty-one Procedures for the Systematic Development of Instruction

Stage	Category	No.	%
Administration:	1. Problem Analysis	24	47
	2. Project Management	18	35
Analysis:	3. Task Analysis	37	73
	4. Student Analysis	32	63
	5. Situation Analysis	21	41
Design:	6. Learning Objectives Analysis	48	94
	7. Methods Selection	59	98
	8. Prototype Production	46	90
Validation:	9. Preparation for Evaluation	20	39
	10. Evaluation and Revision	45	88
Operation:	11. Implementation	26	51
	12. Maintenance & Monitoring	24	47

The revised categories provided a better fit with the procedures under examination. A comparison of the forty-one originals and the ten new procedures did not indicate any differences which might affect the result, so the improvement appears due in part to more stringent selection of procedures and in part due to the categories.

The pattern of results is very striking but not surprising, as discussed later in the Conclusions. The most frequently-mentioned categories are the three in the Design stage and the "Evaluation and Revision". Although "Task Analysis" is also commonly mentioned, it should be observed that this category continued to combine two types of statements: specific analysis of a task in terms of using the performance learned, and general analysis of such abstract phrases as "broad educational goals" or "learning needs". There appeared to be a definite distinction between procedures which were job-oriented, such as those derived from military or industrial settings, and those which followed traditional curriculum design techniques.

As for the other categories, it is difficult to explain an author's reason for omitting activities in certain categories, although some possibilities are mentioned in the Conclusions. In none of the procedures studied did an author suggest that a particular activity was being deliberately omitted. No author criticized the inclusion of a particular activity by another. Some activities could be inferred by the presence of others, but the investigator was loathe to do this; for example, a procedure which includes evaluation would logically appear to presuppose a preparatory activity. Surely no procedure is envisioned as not requiring some type of management, but this could not be safely inferred by the investigator.

There appeared to be no grounds for further revision of the categories or reconsideration of the procedures selected. The study's stated purpose was to perform a preliminary task analysis of the developer's role by analysing a wide range of procedures, classifying them, and reporting on any conflicting opinions or areas of unanimity. This had been done to the investigator's satisfaction.

However the study had clearly revealed that within each category there might be a wide variety of specific activities suggested. A review of each category indicated that differences once again appeared to be matters of omission rather than opinion.

It was decided to examine the details in each category and to provide a summary of the various activities suggested. This would provide a clear illustration of the nature of each category, the details of each procedure and the potential scope for further refinement and elaboration of a general procedure. This was done through initial reference to the notations on the tally sheets and subsequent re-examination of the procedures.

Chapter III

SUMMARY OF THE ACTIVITIES MENTIONED WITHIN EACH CATEGORY

In this section frequent references to individual procedures are made. To avoid cluttering the text with a heavy concentration of formal citations, the procedures are referred to by a single reference name; in the case of a procedure with several authors, the name of the first is used. The procedures are listed alphabetically in Appendix A with full details of their sources.

Category 1: Problem Analysis

Twenty-one (47%) of the procedures included this activity in one form or another. A composite of the ideas suggested would indicate five main activities:

1. A stimulus initiates action.
2. The situation is analyzed, the problem identified.
3. Alternative solutions are considered; instruction is only one of several types of solutions.
4. Feasibility and priorities are considered.
5. Problem, proposed solution strategy, objectives and rationale are stated.

Several authors point out that any development activity begins with a stimulus of some kind. Gibbons refers to this as "dissonance" which can arise from evaluation of a current program, from awareness of a new alternative, or from development of new expectations. Eriksson stresses the need for continuous evaluation and revision to avoid the need for major adjustments; it should be a part of the community's social, technical and economic planning process. (Other comments of this kind are included in category 12, "Maintenance and Monitoring", which illustrates the "closed loop" systems use of feedback.) The monitoring activity may be done by other socio-economic systems, not only the instructional system. Training requests from employers are the stimulii for the Nova Scotia procedure.

The second activity is analysis of the situation in order to clearly define the problem. The stimulus may not be properly founded or interpreted. Cavert mentions the possibilibty that someone may request a particular treatment (in his case educational television) in spite of the existence of satisfactory alternatives; this is a common event as new instructional technologies emerge. Many authors who were included in this category were specific enough to be useful. The Instructional Development Institute says "assess needs"; Taba says "diagnose needs"; Thornton says "discover needs"; Carter says identify "real need to be satisfied".

After the problem is clearly confirmed and identified, other solutions besides instruction may be considered. Eriksson, Hunter and Holden point out that training or education is not always the best solution. Rather that train employees, for example, the job might be simplified through closer analysis or by job aids (Hunter), or the need for training might be reduced or eliminated by hiring better-qualified employees (Eriksson). A similar application of this approach in a school setting, says Eriksson, would be redesigning traffic signs rather than attempting to teach children to understand ones which are not clear; it might be more economical and it would probably be more reliable. There is a difference between knowing how to do something and wanting to do it, points out Hunter; performance after training will depend on supervision and performance rewards as well as the quality of training.

Identification of a problem or potential solution might also lead to the question of mandate. Ullery points out that a desirable action may not be the right or responsibility of the investigating agency.

The need to conduct a feasibility study, based on costs of the solution compared to benefits obtained, is mentioned by

Twelker, Holden and Ullery. Brooks suggests a sophisticated mathematical model for pre-design prediction of costs and benefits.

Finally, a number of authors mention the need to provide the design team with a clear statement of the problem and the solution strategy chosen, together with some indication of the rationale, criteria and frame of reference for the project. TRAND differentiates between the instructional objectives and the project objectives; for example, instructional objectives may describe the type of performance desired after instruction, whereas project objectives may describe financial, time, logistical or "spin-off" benefits being sought.

Category 2: Project Management

Only eighteen (35%) of the procedures mentioned this, making it the lowest of any category. This corresponds with Twelker's study where only one of the models specified this activity, although Twelker himself described three management activities as "crucial" and added that "without formal organization, development efforts typically fail"(p. 8). Kemp (1971) provides an extensive list of administrative activities which are essential for successful project management.

Time is a critical factor, needed both to develop and to implement the product. The need to schedule ahead is stressed by Brieve, Eriksson, CERI, Kemp, Thornton and others. Supplies and resources must be ordered sufficiently ahead of delivery dates (Eriksson, Hauenstein).

Finances are a second critical factor. A budget must be planned and approved (Eriksson, Kemp, Hauenstein, CERI, North West). Continued financial controls are suggested in general terms by Twelker, Teaching Resources and TRAND, and spelled out in considerable cost-accounting detail by North West.

Staffing the project is the third critical factor and easily receives the most attention in procedures. Tasks and responsibilities must be clearly defined at the beginning (Brieve, IDI, North West, Thornton, Twelker). A development should assemble a team drawing from a range of professional specialties and background experience (CERI, Childs, Kemp, Scanland). Clerical and other support staff should not be overlooked (Kemp, Scanland).

After selecting the staff (or having been assigned a group of personnel as might occur when an entire school is chosen) the developer must make sure they are fully oriented to the project purpose and methods. A model of the development process would illustrate key elements and relationships (Nova Scotia). Workshops may be useful to provide training and develop a common approach as the staff enters new stages of the process (TRAND). If the work is liable to move from specialist to specialist, rather than being carried through from beginning to end by a single person or team, it is essential that all members of the staff be familiar with the thought processes of all elements of design (Cavert). This is particularly important when the instructional design is turned over to "creative people" such as audiovisual specialists, artists and others with no instructional background. Kemp deals at length with the problems of classroom teachers involved in the development process; they are not accustomed to being questioned by outsiders, to having their instruction subjected to evaluation or to dealing with non-traditional methods.

The fourth critical factor is that of communication. There must be a good working relationship with the school board or equivalent authorities (Brieve). The developer should be sure he has full and unequivocal authority to proceed (Hauenstein, Thornton). Kemp advises a careful and thorough program of communication with administrators, colleagues, parents, pupils and any others who may be affected. He adds that communication will work both ways and the developers whould expect questions and criticisms. In vocational training where employer assistance and acceptance is critical, cooperation and committments should be sought from industry (Nova Scotia). Liaison with the funding agency is often necessary, and this may entail both financial records and work documentation (North West). Internal lines of communication must also be established and maintained to collect and distribute information among the design team (Twelker). Regular design conferences at key points in the process will assist co-ordination (TRAND).

Legal factors should be anticipated. If the project team wishes to use copyrighted material, or if it intends to retain copyright of its own product, this should be anticipated (CERI). There is also the element of risk in the project (Brieve). The use of students as guinea pigs must be carefully handled.

As indicated in the first classification where there were separate categories for planning and for conducting projects, very few (11%) mentioned the conducting once planning was done.

The need to control the operations of the development team is mentioned by Twelker and Teaching Research, but not described. North West places considerable emphasis on continual financial management. Kemp (1971) refers to the use of Program Evaluation and Review Techniques (PERT) and Planning-Programming-Budgeting-System (PPBS) as useful tools for project management. Brieve points out that a procedure by itself does not guarantee a good product; success will depend on the good judgement of the people involved.

Category 3: Task Analysis

Thirty-seven (73%) of the procedures included one or more activities which fit this category. Statements ranged from the very vague like "input data" (Michigan State), "system direction" (Robinson) and "general goals" (Tosti and Ball) through to very specific and usually job-oriented ones such as "collect job data" (MINERVA), "inventory of learning tasks" (Banathy) and "describe role/task" (Eriksson). In general the academics/educators tended towards the broad statements and the trainers towards the specific ones, perhaps a natural result of their scale of responsibility, but this was not an absolute dichotomy.

For example, Tuckman pointed out that the decision about what to teach must be made on some basis, and even though some types of learning would require complex analysis and would be open to debate, that is no reason for not making the attempt.

> ...while task analysis has been traditionally associated with occupations, there is no reason that it cannot be used as a point of departure for instructional material development in any learning area.
>
> (p. 65)

> The external validity of the system will depend on its relevance in the society. Instruction with high internal validity but not external validity, while resulting in efficient learning, is superfluous.
>
> (p. 70)

The need for general education to be based on real life situations is also mentioned by Briggs, Eriksson, Fraenkel, Hauenstein, Kemp (1971) and Wong. The fact that the learning may not be used until some future date makes it difficult to forecast specific needs for general education compared to job training, although one immediate goal of general education is often the next stage of that education (Briggs, Fraenkel, and Robinson).

The need to fully analyse a job or vocation before prescribing what should be learned is widely reported (Borg, Brooks, Eriksson, Hunter, Holden, Mager, MINERVA, Scanland, Thornton, Whitley, Ullery). Methods include observation, interviews and referral to regulations and job manuals. The activity can be compressed by assembling a group of workers, supervisors and trainers for an intensive workshop/brainstorming session known as the Dacum technique (for Designing a Curriculum). Any task analysis should be validated before design as well as through long-term followup (Borg).

Factors to determine are the type of performance, the level of achievement or standards, the conditions under which the performance is usually done, and the frequency with which it is done (Eriksson, Scanland, Thornton, Ullery). Stewart suggests an additional dimension--the length of time during which the learning will be needed. It is essential to distinguish between "need to know" and "nice to Know" learning. A review of Bell Telephone courses revealed that many provided the students with theory and design information which they never used and soon forgot (Holden). A "no frills" training approach in the U.S. military increased media proficiency and lowered costs through reduced training time (Hunter).

Category 4: Student Analysis

Thirty-two (63%) of the procedures advocated some form of analysis to determine student characteristics prior to design and/or prior to instruction. Information obtained prior to design helps to determine entry requirements and select suitable types of learning activities. Information obtained after design is used to select students and to identify those who can be given advanced placement. Both pre- and post-tests provide information during the evaluation cycle.

The type of information which might prove useful is very diverse. The most common characteristic sought was the type and level of entry skills (Banathy, CERI, Fraenkel, Kilber, Wilson). This might include any skill or knowledge necessary for successful completion but not included in the program. This would include reading skills in the subject area (Kemp, Markle) as well as general study skills (CERI). A test for pre-knowledge of the program content is an aid to design and, following design, a means of providing advanced placement when possible (Bjersted, Cavert, CERI, Kemp (1971), Kilber).

Other characteristics include place and time. Adult students are sometimes available only during certain seasons or hours and may be concentrated in certain geographical areas because of employment patterns (Tippett). Physical qualities such as strength, dexterity, endurance or handicaps may be relevant (Brooks, Mager). Attention span, age and general maturity are an interrelated and often important group of characteristics (Kemp, 1971). Aptitude and intelligence tests would provide a predictive device for counselling or selection (Brooks, Kemp (1971), Wilson). Socio-economic and ethnic factors, plus the study facilities available at home, should be known (Cavert, Eriksson, Kemp, Mager). Relevant experience is an important factor (Carpenter, CERI, Eriksson). Different students learn best in different ways; it is possible to perform a "cognitive mapping" to determine which might be best (Wilson). The broad field of motivation, plans, interest, prejudices and other attitudinal factors is widely mentioned (Eriksson, Kemp (1971), Kilber, Mager, Stewart, Wilson). Legal norms such as bondability, citizenship and licenses may be relevant (Brooks).

Sources for this information not only include testing, but also available records (Gerlach, Wong) and interviews with teachers and the students themselves (Wong).

Once minimum entry-level performance criteria are set, there are three alternatives for dealing with students who do not have the prerequisites (Briggs). One is to provide remedial instruction prior to entry or to include it in a second track of the program. A second is to accept everyone regardless and be prepared for dropouts. A third is to screen students and only accept those who meet the minimum standards.

Brooks illustrates the need for a selection process in situations where demand may exceed program capacity. Selection criteria and method must be established in order to select only the most promising; some applicants who meet the minimum will nonetheless have to be rejected, so a method of establishing priority is essential. An advertising campaign may be needed to attract good potential students (Brooks). Of all the procedures studied, only one suggests a form of self-selection device: provision of full information and counselling service to interested students. The one is Nova Scotia, and it begins by circulating full information about the training opportunity, followed by counselling which exposes the applicant to information about the work which would follow the training. The object is to provide guidance and useful information and rely on the student making a wise choice about enrolling.

Category 5: Situation Analysis

This category, included in twenty-one (41%) of the procedures, provides the designer with an idea of what resources are available and what constraints must be accepted or overcome.

The most apparent resource and, by its finite quality, constraint, is the budget available for development and the cost criteria set for operations (Brieve, Eriksson, Kemp (1971), Tippitt, Wilson). Facilities, equipment and materials must be considered (Brieve, CERI, Kemp (1968 & 1971), Robinson, Tippitt, Wilson). An example of this being overlooked is reported by CERI: one of the Nuffield Foundation science schemes specified an amount of equipment which far exceeded the standard school storage space. People can be viewed as either a resource or constraint (Brieve, Eriksson, Kemp (1971), Robinson) and are generally viewed as a constraint when they are the administrators or classroom teachers who will be implementing the project's product (Fraenkel, Wilson).

The values of the school, district and community must be taken into account (Fraenkel, Robinson) as well as the interests and values of other organizations and institutions affected (Brieve). Time is in one way or another a constraint (Brieve, Eriksson, Kemp (1971), Tippett) particularly when encountered in the form of a prescribed school year, holidays, day and period schedule (Robinson). The design criteria set for the project are themselves constraints (Carpenter). Laws and legal requirements (Brieve, Robinson) and selection factors outside the system (Eriksson) also limit the designer.

The analysis of resources and constraints provides background for the instructional design so that learning activities match the available learning situation, and it also should indicate possible problems which may be encountered in the implementation and permits preparation to overcome these.

Category 6: Learning Objectives Analysis

Forty-eight (94%) of the procedures specifically mentioned this activity. Three main activities were mentioned: statement of learning in terms of behavioral objectives, sequencing of the objectives for effective learning, and analysis of the learning to determine its type. There was remarkable terminology uniformity due to the common heritage evident in the text or bibliographies. Most authors relied on Mager (1962) for their ideas about behavioral objectives. Sequencing of objectives is based on Gagné (1970) or Briggs (1970). Types of learning are based on either Bloom (1956) or Gagné (1970).

The only procedures which omitted an activity in this category were Christiansen, SAFE and North West. It may be speculated that SAFE included the ideas but obscured them behind the unique military jargon it uses.

Behavioral objectives specify the behavior to be performed, the conditions under which it will occur, and the criteria to be met. Depending on their location in the program they are referred to as entry, enabling or terminal objectives. Kibler makes a distinction between planning objectives, such as those which are highly specific, and the more general informational objectives used to communicate the designer's intent to others including students. Objectives provided to students should include a rationale (Kemp, 1971).

The Instructional Objectives Exchange at the University of California, Los Angeles, is mentioned by Tuckman and Kemp (1971), but Tuckman stresses that objectives used for each situation must be based on a task analysis. Twelker (1973) warns that in any situation there are often unstated objectives which must be considered. As an illustration he describes simulation games.

> ...extreme competition in a simulation game may produce the desired stated objectives, but at the risk of promoting dishonesty, thus not fulfilling an unstated objective regarding proper inter-personal behavior.
>
> (Twelker, 1973, p. 31)

Appropriate sequencing of objectives for effective learning is mentioned by many and most thoroughly dealth with by Briggs. Whitley points out that a sequence which appears best from a theoretical viewpoint may not be best in situations where the learner can apply his learning as the program proceeds; it may require grouping certain objectives to allow completion of functional segments which the learner can then practise. (This is a difficult point to understand without an illustration. A typical situation might be an industrial training situation where a combination of hands-on and theoretical learning is desirable. It might be absolutely essential to provide some unexplained safe-practice rules prior to on-the-job learning; the concepts for the rules can be explained later.

Once learning objectives are stated and sequenced, the type of learning involved should be determined as the basis for the next category--selecting methods. Behavioral objectives have some limitations and Kemp (1971) discusses them and suggests methods to overcome difficulties.

Category 7: Select Methods

Fifty (98%) of the procedures included one or more activities in this category. The sole exception was Brooks, although the activity can readily be inferred from his other activities. Two main concerns were dealt with, each widely represented among the various authors. The first was the type of learning activity and was stated either in general terms such as "instructional strategy" or in specific psychology-based terms such as "stimulus-response format". The second concern was the media selection. Some related the two and both Briggs and Tosti provided detailed outlines for media selection based on the stimulus-response characteristics of the learning. This is perhaps an imprecise technique as yet:

> Unfortunately, there is no formula for matching activities to objectives. What may work for one teacher or with one group of students can be unsatisfactory in another situation. You need to know the strengths and weaknesses of alternate methods and of various materials. Then, with that background, you can make your selections in terms of student characteristics and needs that will best serve the objectives that you have established.
>
> (Kemp, 1971, p. 52)

Childs suggests a procedure which first considers whether an objective can be adequately taught through media. If it cannot, he recommends reviewing the objective to see if it can be adapted for mediated instruction. Only after this alternative is rejected is the objective assigned to live instructions. His rationale for this approach is that the teacher is the most valuable instructional resource, being both effective and costly, and should be reserved for use only where less valuable resources cannot suffice.

Choice of instructional strategy and media is most commonly done by comparing effectiveness and costs of each alternative. Other specific factors to be considered include the time required for development and implementation (Brieve, Carter), equipment and supervision requirements (Kemp, 1968), and staff utilization and organization (Robinson). Interpersonal relationships and student motivation (Stewart) and the effects of noise, light and space limitations (Wilson) must be anticipated. A major factor which is often not stated is the choice's acceptability in terms of policies, political factors and the risk of failure (Brieve, Carter).

In addition to the two main concerns outlined above, several related activities are included in this category. At this point the bare bones of behavioral objectives will be fleshed out with suitable content material (Cavert, CERI, Fraenkel, Mager, Taba). The administrative routines required to operate the instruction must be planned (Eriksson, SAFE, Scanland, Thornton).

This category is particularly prone to design based on intuition; a considerable body of research knowledge exists and design should be based on it (Kemp (1968), Kemp (1971), Kibler, Robinson).

Category 8: Produce Prototype

Forty-six (90%) of the procedures studied specifically mentioned activities in this category and all said virtually the same thing. Of the five not including this activity, one is primarily concerned with cost-benefit analysis based on activities prior to this (Parker), two are more traditional curriculum planning procedures (Fraenkel, Taba) and two appear to imply it although not specifying it (SAFE, Thornton).

The decisions made in "Select Methods" should be a prescription for the selection or design of materials. Selection is an option when adequate materials exist elsewhere (Childs, Scanland). The prototype would include such materials as instructional media, guides for teachers, administrators and students, and evaluation instruments to measure student performance and characteristics before, during and after instruction. Assuming the prototype is to undergo some form of revision, it should be considered a "first working draft" and should not receive unnecessary production polish (Borg, Twelker).

It is useful to design, produce and evaluate instruction in small segments rather than all at once (Briggs, Kemp (1971), Ullery). This permits the developers to pay equal attention to each segment and to design later segments based on findings from the earlier ones. When all have been developed and tested, the segments can be assembled into an entire prototype. This approach is also a way to combine the activities of research and development (Borg).

Category 9: Prepare for Evaluation

Only twenty (39%) of the procedures made specific reference to the need for a distinct preparatory activity prior to evaluation. It is possible to infer that all procedures which included some type of formative evaluation would entail this activity too. The types of activity in this category were of two kinds: the design and production of evaluation procedures and instruments to be used in the reviews, tryouts and field tests, and the actual preparation for implementing the instruction on these occasions.

A general plan is needed to ensure that formative evaluation is adequately prepared for (Eriksson, Johnson, Newstart, Twelker, TRAND). Instruments unique to the formative evaluation process such as forms for observers and participants may be needed (SWRL). Among the decisions to be made are those of specifying the information needed, how it will be collected, stored, organized, analyzed and reported, who will be involved in each step and what resources are needed to perform the function. The type of information to be collected should include not only student performance results but also cost (Thornton) and an appraisal of the student characteristics, teacher characteristics and other external factors which may have affected performance (Fraenkel). The information-gathering function should be built into the instructional system if possible (Taba, Tuckman).

Preparing to implement instruction for formative evaluation purposes may involve the same type of activities as are needed to facilitate introduction of the final product (Banathy, Borg). Equipment and supplies must be ordered (Hauenstein), the program packaged and distributed (TRAND), sites and students selected (Brooks, North West), the learning environment prepared (Gibbons, Nova Scotia), and, perhaps most important for both instructional and evaluative validity, the instructors and testing personnel must be trained (Banathy, Borg, Cavert, TRAND). The activities which are planned to facilitate implementation are themselves undergoing formative evaluation at this stage (Twelker, Ullery).

Category 10: Evaluation and Revision

Forty-five (88%) of the procedures included a specific activity of formative evaluation and revision prior to general product use. Of the six which did not, two envisioned no opportunity for a pilot study as such but included a more long-range type of evaluation/revision cycle described in the "Maintenance and Monitoring" category (Hunter, Hauenstein), two did not set out to include any activities beyond the design stage (Nova Scotia, Tippett), one appeared confident that available knowledge would allow them to predict effective design, although subsequent evaluation and revision was not specifically ruled out (Tosti), and one report based on actual projects reported the intent but not the opportunity due to project constraints (Carter).

Three types of activity are included in this category and reflect the original three categories of Twelker that were combined into this one: gathering the evaluative information during the review, tryout or field test, then analyzing the information to detect problems in the prototype (and to note success as a basis for future work), and finally arranging for the necessary revision.

It should be noted that revision might involve further work in any of the other categories. Details of revision are not specified by any author; usually one word sums up the entire activity ("revise", "refine", "modify", "adjust" or "iterate") and often it is indicated only by a feedback arrow.

Although procedures tend to show evaluation as occuring after production of all or part of the prototype, some form of evaluation is going on throughout the entire process (Scanland, Taba). Several procedures recommend that at certain points during the procedure either the project staff, management or outside experts (or all of them) should review the accomplishments to date. To avoid work based on faulty foundations, this should be done early after the initial problem analysis and task analysis as well as during more advanced stages (ILP, SWRL). Review can be focussed on the technical accuracy (Teaching Resources, Twelker, TRAND, Stewart) as well as on the instructional format, clarity and correctness of usage (Teaching Research, TRAND, Stewart). The objectives derived from task analysis should be validated prior to design (Brooks, SWRL, Ullery) and the test instruments themselves must be validated to ensure proper formative evaluation (Brooks, Stewart, Ullery).

The early development of "exploratory" segments is a useful way to gather pre-design information of all kinds and to supplement existing research knowledge (Newstart, North West, SWRL). When available knowledge is not adequate, development often includes a research dimension (Borg). Working through a few units first is also necessary as a training experience for a novice design team (Kemp, 1971).

Many procedures include several levels of formative evaluation beginning with small segments of instruction and small student samples in controlled conditions, and then progress through successively larger segments and samples until finally the entire product is tested in a fully operational setting. Small segments should be evaluated at first to allow careful concentration on each (Briggs, CERI, Markle, SWRL). Often only one student at a time is advisable (Markle, SWRL).

After review and individual tryouts, the prototype then is tested in situations which become less experimental and more operational with reduction of the project staff's involvement to the level planned for ongoing implementation. The final field test, often referred to as the operational test, is as close to a post-development situation as possible (Borg, Briggs, North West) and at this point no revision in the instructional material is usually expected (Bjerstedt). The primary purpose is to test the implementation procedure to ensure that innovation will be transferrable (Twelker, Ullery, SWRL) and to assemble summative data for consideration by potential users (Briggs). At this stage the development process itself should be reviewed in light of successes and difficulties and the conclusions used for future development procedures (SWRL).

The importance of ensuring transferrability is illustrated by Carter. When the project staff maintained major control over a field test, 96% of the students attained mastery. When the project staff remained in the background while regular teachers managed the instruction only 80% of the students achieved mastery. And when the project staff made no direct contact at all, working entirely through the normal school administrative channels, the results dropped still further. In the latter case, investigation showed that one class did relatively well because the teacher closely followed the instructions provided and used the resources fully ~~and~~ in the prescribed manner, whereas another teacher did not follow the prescribed procedures resulting in a considerable decline in student achievement.

Success of the product must be measured in terms of the original project objectives. These most commonly refer to the student performance desired, but also include objectives such as reduced time or cost. Most procedures include pre-tests and post-tests to measure change in student performance, but information should also be gathered about development and operating costs (Brieve, Kemp (1971), Thornton), the time required for instruction (Brieve, Kemp (1971), Kibler), the facilities and equipment available (Kemp, 1971), the behavior displayed throughout by instructors, students, administrators and other human elements (Brieve, Kemp (1971), Robinson, Ullery) and all other aspects of the situation, controlled or not, which might have affected instruction and/or evaluation.

Sources of difficulty to look for (other than weaknesses in the instructional process itself) include the prerequisites and selection procedures (Kibler), the pre- and post-tests and their administration and other facets of formative evaluation design (Brieve, Cavert, IDI, Kilber, MINERVA, SWRL, Thornton, Ullery), the implementation and operation (Brieve, Briggs, SAFE), the development procedure followed (SWRL), and initial unrealistic project objectives (Kibler). Student motivation is often stated as a cause of poor performance (Bjerstedt, Eriksson, Johnson, Kibler, Robinson) but it is not clearly indicated whether the authors are referring to poor motivation which existed prior to instruction or to poor motivation which occurred after the instruction began; the difference would appear to be important. Careful assessment of cause and effect is needed. Techniques such as discipline, entertainment, charisma and extrinsic rewards can be employed to "drive, lure or cajole students into behaving in desired ways when they are supervised" and a teacher making unusual use of these during formative evaluation would camouflage weaknesses and might also violate some unstated objectives about student initiative (Gibbons).

There are few time-controlled studies available which demonstrate the degree of performance improvement attainable through the evaluation/revision cycle, but less rigorous evidence is readily available (SWRL). However at some point in the evaluation/revision cycle, the decision to stop the activity must be made and the project either abandoned or implemented (Bjerstedt, Twelker). A commercial product may require "polish" to be marketable, but research evidence indicates that this is not otherwise needed.

> ...a product's overall technical quality has virtually nothing to do with its effectiveness as an educational tool and there seems little justification for the additional expenditure needed.
>
> (Borg, p. 9)

Category 11: Implementation

Twenty-six (51%) of the procedures include some activity to bridge the gap between validated design and actual use. Eriksson puts the point succinctly:

> Putting the system into action is an often neglected part of the development. ...one must face up to and work with the problem of resistance to change. In order to have the system perform at all, and bring with it the improvements that were hoped for, a complete plan for the introduction and acceptance of the system must be formulated.
>
> (p. 68)

In his procedural model, Eriksson includes an entire sub-system devoted to this purpose. Borg also stresses that problems of implementation must be anticipated and prepared for throughout the entire development process so that the final product will function effectively, and he indicates the reasons why:

> ...inadequately developed educational products have a great many blank spaces that must be filled in by local teachers or principals. The manner in which these blanks are filled in largely determines whether the product succeeds or fails. Experience suggests few school teachers or administrators have either the time or the training to fill in such voids effectively.
>
> (p. 7)

At the simplest level of development--that of a teacher preparing new materials or methods for his own class--only simple preparation for implementation is needed. Approval from the principal and completion of logistical steps may be adequate (Brieve, Hauenstein).

But large-scale innovations, particularly when developed by specialist teams rather than the future users, require three types of implementation activities: strategy planning, production and institutionalization.

During strategy planning the developers anticipate likely obstacles and devise ways of overcoming them, usually through either information or incentives, and it is imperative that this planning be done early enough for preparation to be complete (Eriksson, Gibbons, Kemp (1969), Kemp (1971), North West, Scanland, Tosti).

Information may be relatively neutral such as a documentation stating the product's objectives, target population and summative evaluation results which permits an enlightened choice by the consumer (Markle). Information may also be advocatory, taking the attitude that the product deserves adoption and that consumers need to be actively convinced through a demonstration or a description of its advantages (CERI, Eriksson, Kilber, Newstart, North West, TRAND); this approach assumes that Newton's law of inertia applies to human behavior too. Information should be provided to all who may influence adoption or success of the product, including the other staff, administrators, parents and the students themselves (Kemp (1971), Kibler).

Incentives are not exactly rewards for adopting a product, but rather special assistance which reduces barriers to adoption. In addition to the provision of institutionalization services as described below, they would take the form of subsidies, free equipment or materials, additional budget grants, or cost reductions through purchasing consortiums (CERI).

Production activities range from obtaining financing through to providing delivery on time; this is often assigned to a commercial publisher. However in the cases where the development team is directly involved they must consider all the problems. In addition to producing or purchasing instructional materials and other components in sufficient quantities, provision must also be made for packaging suitable for shipping and storage (TRAND). Facilities and staff may be required to warehouse and distribute the product; easy ordering routines and prompt assured delivery are essential if potential users are to make commitments (CERI, TRAND).

Institutionalization refers to the package of services which the developer might provide to the user. This would include guidance about the necessary facilities, equipment, staff, organizations, time and support services which the user will have to arrange (Brieve, Eriksson, Kemp (1971)). The most vital service provided by the developer is likely to be a training program for the instructional staff (Banathy, Bjerstedt, CERI, Eriksson, Gibbons, Holden, Kemp (1971), Newstart, North West, Nova Scotia, Robinson, Scanland, SWRL). Traditional teachers are very likely to be unfamiliar with the method, intent or terminology of a systematic development process and such concepts as criterion-referenced evaluation may be new and require major changes in their understanding (Nova Scotia). A manual describing the product, its rationale and its application is recommended (Bjerstedt).

In addition to training for abilities, the developer must also train for attitudes (Kemp, 1968). A teacher accustomed to the traditional classroom techniques sees himself as the course designer and subject expert. To accept the developed product, the teacher must redefine his role.

> He must...resist the temptation to duplicate the role of the instructional materials. Under this concept, the person who actually conducts the training is no

> longer the course designer; he is no longer the sole source of information for the student; he is no longer the sole medium.... What then is he?
>
> This is the question which causes great anxiety among instructors and teachers. It causes their own role-perception to become cloudy; it creates a threat to the self-image. It requires the substitution of a new image to replace the old.
>
> (Holden, p. 17)

The new image should be deliberately fostered as part of the implementation activity. It would include all the things the good teacher always wanted to do but never had time for until the product became available: more individual diagnosis, tutoring and guidance; more research in the subject matter and current developments in the field; more attention to the teacher as a source of challenge and reassurance.

There is an inherent conflict between rigidly-engineered programs and teacher motivation.

> Clearly, the more comprehensive and fully validated the package, the less is the scope for local adaptation. But the less the individual teacher can feel personally involved in the implementation process, the less enthusiastic a user he may prove--and there is ample research evidence to show how powerfully teacher attitudes can affect student performance.
>
> (CERI, p. 55)

The activities of facilitating implementation may be assigned in part or whole to other agencies such as the school system, thereby relieving the development team of the cost. It is even possible to gain revenue when this is done by assigning a product to a commercial publisher (CERI, North West, SWRL), but this could present some problems.

> If marketing is not itself tightly controlled by the sponsoring agency...there may arise serious problems of misuse. Where a school does not ensure that its teachers are suitably qualified...these teachers may possibly produce such poor results that the material concerned falls into disrepute.
>
> (CERI, p. 54)

This statement suggests the need for long-term monitoring.

Category 12: Maintenance and Monitoring

Twenty-four (47%) of the procedures included some development activity which occurred over a long-term period after the product had been put into general use. Only a few authors suggested that the developer be concerned with the provision of on-going support services (Eriksson, Kemp (1971), North West, Thornton) and these services were not specified. The common long-term developer involvement (or type of development activity, regardless of who performed it) is the long-term evaluation and revision cycle.

This is often represented as a feedback loop in flow diagrams. It should be noted that this "closed loop system" would actually provide the stimulus mentioned in Category 1. Evaluation and revision should occur as frequently as possible to avoid the major difficulties of massive revisions or grossly outdated products.

> Educational reforms are traditionally very burdensome enterprises to a nation. They are stretched out and occur at intervals.... The harmful consequence is that the educational system for long periods of time is quite out of synchronism with ongoing development and transformations which characterize a continuously and rapidly changing society. We are just beginning to understand that continual changes in a society as a whole should be paralleled--perhaps even to some extent directed--by a well-planned, systematized and continuous revision of the entire educational system.
>
> (Eriksson, p. 62)

Change might affect all of the original factors considered in the product's development--the problem, the task, the students, the situation and the available design knowledge and techniques. Both internal and external validity must be evaluated. Internal validity would include monitoring to maintain original effectiveness and efficiency as well as to detect new opportunities for improvement such as new instructional techniques (Gibbons, Kibler). External validity is usually monitored by a follow-up study of graduates (Briggs, Brooks, Holden, Mager, MINERVA, Scanland, Ullery).

Chapter IV

DISCUSSION

The objectives of the study appear to have been satisfactorily met. A wide range of proposed procedures for the systematic development of instruction have been found, analysed and compared. The result is a clear pattern of activities which can be of use to practitioners or researchers.

Conclusions

1. There appears to be widespread agreement and no disagreement about the major elements and relationships of the procedure for systematically developing instruction. There also seems to be some agreement and no disagreement about many specific activities comprising the procedure. This would suggest that a conceptual basis exists for compiling a general procedure, although there is no evidence of any empirical basis for a general procedure. The mere presence of agreement and absence of disagreement within the procedures studied cannot be considered as conclusive proof of validity. Exclusion of procedures found to be too abstract or too limited for this study does not reflect on value; there is, in fact, reason to believe that many of the procedures selected owed their basic similarity in part to a common heritage of principles found too general for this study (such as Tyler, to name but one).

2. The category system developed during the study appears capable of organising a wide variety of procedures for the purpose of analysis and comparison, and therefore seems suitable for use in further study of the topic. Differences in format and terminology, although at times considerable, do not in themselves represent differences of content and are not serious impediments to the analysis or comparison of procedures. They would, however, affect attempts to communicate in various situations.

3. Variations of content in the procedures examined appear to be matters of omission rather than of conflicting opinions, and generally reflect the author's particular purpose and background. This suggests that specific procedures (including their content, terminology and format) may have adequately served the specific situations in which they were used. It follows that one might find that a general procedure would at times be too comprehensive, too detailed or too obscured by a particular format or terminology for a given situation. Hence a general procedure's value might often lie in its use as a source of specific procedures designed for particular circumstances.

Because the development procedure involves an overview of many situations and areas of knowledge, it must include sufficient detail to guide those who are unaware of the important aspects of these situations and areas of knowledge. At the same time, however, it cannot become so detailed as to be cumbersome. In the design of a specific procedure, decisions as to the degree of detail suitable for its purpose must remain a matter for the judgement of the user and his advisors; as yet there is no evidence to indicate what is necessary and adequate for particular applications. Similarly, decisions about suitable format and terminology remain matters of judgement.

Implications

1. Further study of appropriate content, format and terminology for common types of applications would be of value. For example, what would be most suitable when approaching school trustees?

2. Attempts to experimentally validate a comprehensive general procedure would be impractical, due to the difficulty and cost of dealing with the many potential variables. Results would be of limited value if controlled circumstances were used, since a procedure should work in a "real world" of infinite variation.

3. The most promising way to further develop a general procedure would be analysing the process in several ways. One method would be a review of the literature dealing with specific activities. Included in the bibliography are a number of works of this kind. Another useful method would be direct observation of development processes. A third method would be interviews with the people participating in or affected by a development project. A fourth method would be an examination of articles reporting on development projects.

4. Examination of actual processes, directly or through reports, should attempt to locate critical or frequent problems which arise. This is the "critical incident analysis" referred to by Mager (1972), and would direct attention to activities which require either greater stress or improved techniques.

5. Examination of development projects which have encountered difficulties should be approached using the problem identification techniques described in Category 1 of this paper. It is always possible that the existence of a valid procedure may not be the most promising solution, and that other solutions are more deserving of attention. Similarly, it may be that other solutions are essential to ensure the success of a valid procedure.

6. Successful completion of the entire process requires the successful completion of each essential activity. The value of a development procedure as a technology is directly dependent upon the quality of the technologies comprising its parts.

7. A development procedure describes the desired behavior, but does not set the criteria. It is up to the project manager to monitor the success of each activity and take corrective action when necessary. This requires a capable project manager with adequate authority and resources to do the job properly, which in turn requires a senior person or group prepared to grant the necessary authority and power and able to hire a competant manager.

8. If the procedures outlined in this study are indeed valid, it suggests that a considerable body of research which involved developed materials should perhaps be subject to review. An example would be the many studies attempting to compare one type of media or method with another; if the media or method were inadequately developed, the results of the research could be misleading.

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* Briggs	Briggs, Leslie J. *Handbook of Procedures for the Design of Instruction.* Pittsburg: American Institutes for Research, 1970.
* Brooks	Brooks, Carl N. "Training System Evaluation Using Mathematical Models." *Instructional Systems.* Englewood Cliffs: Educational Technology Publications, 1973, 131-138.
Carter	Carter, Launor F. "The Systems Approach to Education: Mystique and Reality." Educational Technology, April 1969, 22-31.
Cavert	Cavert, C. Edward. *An Approach to the Design of Mediated Instruction.* Washington: The Association for Educational Communications and Technology, 1974.
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* Procedures marked with an asterisk are those ten additional ones which were not included during the first classification.

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Eriksson	Eriksson, Bo. "A Systems Approach to Educational Technology (with special reference to Swedish conditions)." Educational Technology, June 1969, 62-69.
Fraenkel	Fraenkel, Jack R. "A Curriculum Model for the Social Studies." Social Education, January 1969, 41-47.
* Gerlach	Gerlach, Vernon S. and Donald P. Ely. Teaching and Media: A Systematic Approach. Englewood Cliffs: Prentice-Hall, 1971.
Gibbons	Gibbons, Maurice. "Systematic Development in Schooling." The Journal of Education, April 1970, 32-43.
Hauenstein	Hauenstein, A. Dean. Curriculum Planning for Behavioral Development. Worthington, Ohio: Charles A. Jones Publishing, 1972.
Holden	Holden, F. J. "A New Look at Instructional Technology." Canadian Training Methods, May-June, 1972, 15-18
Hunter	Hunter, Harold G. "The Process of Developing Course Content for Military Technical Training." Training Technology, Supplement to Educational Technology, June 1970, S10-S17.
IDI (Instructional Development Institute)	Hanna, Tom. "Around Washington." Resources for Teaching and Learning, Fall 1971, pp. 6 and 15.
ILP (Individualized Learning Program)	Research for Better Schools, Inc. ILP Development Model. Monograph. Philadelphia, n.d.

* Johnson	Johnson, Stuart R. and Rita B. Johnson. Developing Individualized Instructional Material. Palo Alto, California: Westinghouse Learning Press, 1970.
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* Kibler	Kibler, Robert J., Larry L. Barker and David T. Miles. Behavioral Objectives and Instruction. Boston: Allyn and Bacon, 1970.
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Markle	Markle, Susan M. "Programmed Instruction." Encyclopedia of Education. The MacMillan Co. and Free Press, 1971.
Michigan State (University Instructional Systems Development Model)	Twelker, Paul A. and others. The Systematic Development of Instruction: An Overview and Basic Guide to the Literature. Stanford University ERIC Clearinghouse on Educational Media and Technology. March 1972.
MINERVA (Project MINERVA Instructional Systems Design	Ibid.
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Northwest	Northwest Regional Educational Laboratory. "Long-Range Planning Policy, Revised Draft." Portland: December 10, 1973.
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* RAND	Carpenter, Polly. Developing a Methodology for Designing Systems of Instruction. Santa Monica, California: The Rand Corporation, 1971.
* Robinson	Robinson, Agnes. "Curriculum Building." Encyclopedia of Education. The MacMillan Co. and Free Press, 1971, 568-575.
Romiszowski	Romiszowski, A. J. The Selection and Use of Teaching Aids. London: Kogan Page, 1968.
SAFE (Systems Approach for Education)	Twelker, Paul A. and others. op. cit.
Scanland	Scanland, Worth. "The Instructional Systems Development Function--How to get it Done." Paper delivered before the annual convention of the National Society for Performance and Instruction, Miami Beach, 17 April, 1974.

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Stewart	Stewart, Donald K. "A Learning-Systems Concept as Applied to Courses in Education and Training." Educational Media: Theory into Practice. R. V. Wiman and W. C. Meierhenry (eds.). Columbus, Ohio: Charles E. Merrill Publishing Co., 1969.
Taba	Taba, Hilda. Curriculum Development: Theory and Practice. New York: Harcourt Brace and World, 1962.
Teaching Research (System)	Twelker, Paul A. and others. op. cit.
Thornton	Thornton, James E. "Instruction Design System for Continuing Education." Paper presented at the W.K. Kellogg Conference-Workshop (Program Planning) in Continuing Education in the Health Sciences, Vancouver, June 1974.
Tippett	Tippett, L. G. "Sequencing and Clustering Behavioral Objectives in Designing a Curriculum." Manuscript accompanying presentation to design workshop for coursewriters, Burnaby, British Columbia, December 12, 1974.
Tosti	Tosti, Donald T. and John R. Ball. "A Behavioral Approach to Instructional Design and Media Selection." Audio Visual Communication Review, 17:5-25, Spring, 1969.

TRAND (Training Research and Development Station)	Smith, A. D. and L. G. Tippett. Working plan for the VAST IV Project and personal interviews with the investigator, Burnaby, British Columbia, December 12-15, 1974.
* Tuckman	Tuckman, Bruce W. and Keith J. Edwards. "A Systems Model for Instructional Design and Management." Introduction to the Systems Approach. Englewood Cliffs: Educational Technology Publications, 1973.
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Appendix "B"

Table VI

Procedures Examined in the Second Classification

Analysis by Category

	Problem Analysis	Project Management	Task Analysis	Student Analysis	Situation Analysis	Learning Objectives Analysis	Methods Selection	Prototype Production	Preparation for Evaluation	Evaluation and Revision	Implementation	Maintenance and Monitoring
Banathy	*		*	*		*	*	*	*	*	*	*
Bjerstedt			*	*	*	*	*	*		*	*	*
Borg			*			*	*	*	*	*	*	
Brieve		*	*		*	*	*	*	*	*	*	*
Briggs			*	*		*	*	*		*		*
Brooks	*		*	*		*		*	*	*		*
Carter	*		*		*	*	*	*		*		
Cavert	*	*	*	*	*	*	*	*	*	*		
CERI	*	*		*	*	*	*	*		*	*	*
Childs			*		*	*	*	*		*		
Christiansen		*	*	*	*		*	*		*	*	*
Eriksson	*	*	*	*	*	*	*	*	*	*	*	*
Fraenkel			*	*	*	*	*		*	*		
Gerlach				*		*	*	*		*		
Gibbons	*		*	*	*	*	*	*	*	*	*	*

Table VI continued...

	Problem Analysis	Project Management	Task Analysis	Student Analysis	Situation Analysis	Learning Objectives Analysis	Methods Selection	Prototype Production	Preparation for Evaluation	Evaluation and Revision	Implementation	Maintenance and Monitoring
Hauenstein	*	*	*			*	*	*			*	*
Holden	*		*			*	*	*		*	*	*
Hunter	*		*			*	*	*				*
IDI	*	*		*	*	*	*	*		*		
ILP			*	*	*	*		*		*	*	
Johnson						*	*	*	*	*		
Kemp 1968			*		*	*	*	*		*	*	*
Kemp 1971		*	*	*		*	*	*	*	*	*	*
Kibler				*		*	*	*		*	*	*
Mager			*	*		*	*	*		*		*
Markle				*		*	*	*		*	*	
Michigan State			*	*	*	*	*	*	*	*		*
MINERVA	*		*			*	*	*		*		*
Newstart	*					*	*	*	*	*	*	
North West	*	*					*	*	*	*	*	*
Nova Scotia	*	*	*	*		*	*	*			*	
Parker		*		*		*	*			*	*	
RAND			*	*	*	*	*	*				
Robinson			*	*	*	*	*	*		*	*	
Romiszowski			*	*	*	*	*	*		*		
SAFE	*	*	*				*			*	*	
Scanland		*	*			*	*	*	*	*	*	*

Table VI continued...

	Problem Analysis	Project Management	Task Analysis	Student Analysis	Situation Analysis	Learning Objectives Analysis	Methods Selection	Prototype Production	Preparation for Evaluation	Evaluation and Revision	Implementation	Maintenance and Monitoring
SWRL	*	*		*		*	*	*	*	*	*	*
Stewart			*	*		*	*	*		*		
Taba	*		*			*	*			*		
Teaching Research	*	*		*	*	*	*	*		*		
Thornton	*	*	*	*		*	*		*	*	*	*
Tippett	*		*	*	*	*	*	*				
Tosti			*	*		*	*	*			*	
TRAND	*	*				*	*	*	*	*	*	
Tuckman			*			*	*	*	*	*		*
Twelker	*	*		*	*	*	*	*	*	*		
Ullery	*		*			*	*	*		*		*
Whitley			*			*	*	*		*		
Wilson				*	*	*	*	*	*	*		
Wong			*	*		*	*	*		*		
TOTALS	24	18	37	32	21	48	49	46	20	45	26	24

Appendix "C"

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