DEVELOPMENT AND PILOT TESTING OF A SELF INSTRUCTIONAL MANUAL FOR THE DESIGN OF LEARNING MODULES: A RESEARCH AND DEVELOPMENT STUDY

By

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ABSTRACT

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In spite of widespread use of self instructional materials and a plethora of books and manuals on how to develop such materials, it was not known whether a self instructional manual could be used to enable college level instructors with very little background in instructional design to produce self instructional modules which involved higher level cognitive skills. To answer this question the author designed and tested a self instructional manual. Six college level instructors were asked to design modules using the cognitive skills and step by step guidance provided by the Manual. These instructors received no additional formal instruction regarding module design.

The completed modules were evaluated on a criterion-referenced evaluation form by six evaluators. All six modules reached the criterion level suggesting that the Manual was effective as a learning experience. The designers were positive about their experience. However, all designers indicated that they required additional outside information to fully complete their modules.

DEDICATION

This dissertation is dedicated

to my Mother and late Father.

ACKNOWLEDGEMENTS

I wish to acknowledge my indebtedness to Dr. A. Abedor, Chairman of my Committee for the support, advice and guidance which he so readily and competently provided. Other members of my Committee, Dr. R. Farace, Dr. C. Gentry and Professor B. Wenberg all provided excellent assistance in their own particular ways and to each I am grateful. The help and steadfast support provided by Professor Wenberg goes much further than her involvement on my Committee, and includes continuous support and, through a graduate assistantship, an inspired introduction to what was to me a whole new field of Dietetics.

A number of people have made important contributions in one way or another: the designers who produced modules in Australia and Hawaii, Mary Jo Morrissey for her module, Dr. Walter Dick of Florida State University for permission to use various materials, the Dietetic Faculty at Michigan State University for formatively evaluating the Manual and suggesting improvements.

To my wife Elizabeth for her love and help over the last three years I owe much of this work.

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CHAPTER 1

GENERAL INTRODUCTION

A. Subject Area

The subject area for this dissertation is instructional design, educational systems and educational technology. The major focus is the design of self instructional programs in higher education, particularly where higher level cognitive skills[1] are required.

B. Statement of Problem

In the area of Dietetic Education (as in a number of other professions[2]) the national controlling body has called for an improvement in the educational preparation of its pre-service students (Study Commission, American Dietetic Association, 1972).

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1 The term "higher level cognitive skills" refers to those skills which on Gagne's learning hierarchies (1977) are designated as "rule" or "problem solving".

2 Medical Education is another example, see A Handbook for Change, Recommendations of the Joint Committee on Medical Education. Wm. F. Fell Co. Philadelphia, Pennsylvania, 1972.

Part of the concern is the level at which subject matter is currently being taught. Cox (1970) found that the cognitive level at which the average college level instructor teaches is at the comprehension level on Bloom's (1956) taxonomy, a low level with reliance mainly on memory. Instructors claim (Cox, 1965, 1970) that they expect their college students to operate at a much higher level such as problem solving, where a number of concepts and principles are combined to reach a solution to a complex problem. This problem is fully discussed in the Manual (Appendix D).

In response to the challenge to improve the quality of education various innovative programs are being established throughout the country. At Michigan State University, on advice from the University's Learning and Evaluation Service, and funded by a Kellogg grant, a Competency Based Education (CBE) Program [1] has been initiated in the Department of Food Science and Human Nutrition.

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[1] The implied characteristics of CBE are:

1. Instruction is individualized and personalized.
2. The learning experience of the individual is guided by feedback.
3. The program as a whole is systematic.
4. The emphasis is on exit, not entrance, requirements.
5. Instruction is modularized.

W. Robert Houston, "Competency Based Education" in Houston, W.R., Exploring Competency Based Education, McCutchan Publishing Corp., Berkeley, 1974.

One feature of CBE is that it requires instruction to be individualized and presented through modules. Individualized instruction through modules has become the fastest growing movement in education (Novak, 1973; Cross, 1976; Vermilye, 1976). The use of modules is also central in all other methods of improving education through individualization (Goldschmid, 1974).

For instructors to fully participate in CBE or any plan of individualized instruction, it will be necessary for them to be able to design modules as only rarely will they find suitable modules available for purchase.

The task of designing modules should be recognized as requiring a great deal of knowledge on learning, teaching, educational materials, the specification of learning outcomes, analysis of content, an understanding of the interrelatedness of parts of a learning system, and the cybernetic[1] nature of an instructional system. Most of this knowledge is new to university instructors without an education background (Chase, 1968; Clark and Hopkins, 1969; Gideons, 1970).

There are texts available on the design of modules but they usually require a workshop, prior experience, or an intensive period of training, e.g., System Approach for Education, (Corrigan

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[1] Cybernetic is taken to mean control through feedback. Von Bertalanffy's (1966) explanation of the cybernetic system is presented on p.

et al, 1969). Self instructional manuals on modular instruction are available, e.g. Criterion Referenced Instruction (Mager, 1961). Unfortunately there is no research study that provides evidence that useful modules actually result from working through a manual without additional intervention. As Branson (1978) points out, it may even be impossible to find a generic, all purpose manual or model to suit the specific needs and target population of a particular program.

Given the realities of constraints on instructors' time, and an understandable reluctance to "go back to school", one alternative would be a self instructional manual on the design of modules developed for a particular population and with its needs in mind.

Up to now the identification of need has been on a macro level. The target population at such a level is diverse, and according to Branson (1978) it would be unlikely that a model could be devised that adequately meets the needs of such a heterogeneous group. Consequently, it is necessary to look at the micro level in order to determine the needs of a more homogeneous group. Such a focus would be more specific in identifying needs, and it would be more likely that these specific needs could be met.

The population at the micro level for this dissertation is the Co-ordinated Undergraduate Program in Dietetics at MSU. In 1974, MSU was awarded a grant by the Kellogg Foundation to develop a co-ordinated undergraduate program in Dietetics. In its proposal for the grant, MSU stated that it would develop the program along the lines of a competency based education system. Subsequently a committee, designated as DURC[1], began to work to bring about a CBE program.

So as not to interupt the flow of this General Introduction, the proceedings of the Committee's work are stated in Appendix F. The pertinent aspect of DURC was a difficulty the committee experienced in accepting highly conceptual new ideas concerning Competency Based Education. It was stated by the Committee that actual examples of CBE concepts were necessary if progress was to be made.

Given the articulated need for knowledge on CBE concepts and a need for actual examples of modules, the author decided that there was a need for a manual which would attempt to meet these two needs. To the author the major problems appeared to be:

a. On the part of some key faculty members there was a rejection of rigid CBE methodology which they equated with behavioralism. These faculty looked for a less rigid program

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1 Dietetic Undergraduate Resource Committee.

which would accomodate their concerns. For example, they refused to participate in an early step of the CBE program (that of sequencing competencies) by stating that it was not possible to sequence competencies when competencies had not and could not be adequately determined through the use of a Magerian formula. Their concern is often expressed in literature (Eisner, 1975; Elam, 1972; Neff, 1975; Ainsworth, 1977)

b. For a number of faculty, particularly those heavily engaged in research, the concepts of CBE were quite novel. They held an open mind to a program which would improve learning, but did not have sufficient information on CBE to become committed to the program.

c. Lack of concrete examples of what the innovation (CBE) was all about led to a great deal of uncertainty. The commonly used term "module", which was chosen by DURC as the unit of instruction in CBE and therefore a key concept, was perceived by many as threatening.

C. Statement of Need

Given the above problems, the author, after consulting with a number of people from DURC, decided that the major needs in which he could have some impact were:

1. To modify the CBE concepts so that they responded to the needs and aspirations of the target population; thereby being perceived as rewarding and consequently accepted.

2. The dissemination process of the acceptable CBE concepts through a product. Concrete evidence should be produced to make CBE concepts visible.

3. The product referred to in (2) should be a module as modules are central to CBE (Houston, 1974).

4. The acceptable CBE concepts, and how to translate these concepts into a module, should be presented through a manual so as to be convenient and fit within faculty assumed method of information assimilation.

5. The manual should address the needs expressed (on pp.1–6) under Statement of Problem. For example, it should deal with higher order cognitive learning rather than lower level information skills.

Given this background the author decided to develop a manual to address these needs. That such a manual would be effective became the focus of interest in the present pilot study.

D. Research Questions

There are two major research questions to be addressed in this pilot study.

First, can a self instructional manual on designing modules be developed where those who complete the manual reach mastery level on its contents?

Second, will attainment of mastery of the self instructional manual result in a module which meets some minimum acceptable standards?

There is also a third question: will the module so developed obtain results at least as good as those obtained through traditional methods of instruction? Because of the time required it is unlikely that such data can be obtained. Furthermore, a number of uncontrollable factors could bias such data. Therefore, data related to this third question will be considered as additional supporting evidence rather than the primary focus of this dissertation.

The following are stipulations to the research question:

a. The designer of the module will be a faculty member in higher education in a field other than education and will have had very little formal training in education.

b. The learning outcomes of the modules must include higher order cognitive skills; on Gagne's (1975) classification they need to reach at least defined concept level or higher.

c. The designers of modules will need to be in geographic locations different from that of the author so as to control for possible author input.

E. Limitations of the Study

The following limitations reduce the generalizability of this pilot study. The major limitation is the relatively small number of modules available for evaluation. One reason for the small number is the tremendous amount of work involved in developing a module. A conservative estimate is that the design takes something like 100 hours. On top of this is time taken for developing materials (e.g., if the module is on PLATO, it may take another 100 hours to develop the PLATO program). For the self instructional manual to be mastered and a module produced may take six months. The estimates stated in this paragraph are based on the author's own experience in developing and testing the module RENAL which is on Control Data Corporation's PLATO systems. House (1974) gives an account of his experiences in developing modules on PLATO; his experiences parallel those of the author[1].

Another limitation is the lack of controls because the modules will be developed independently of the author, without his involvement. Thus factors which cannot be controlled in this study include: a) the variability of the learner/designer entry skills, b) the input from the designer's environment in addition to the Manual, and c) ensuring that the designer proceed through the Manual correcting his/her own embedded tests which dictate progress or remediation. There are no effective controls or way of monitoring this process; if the designer does not reach mastery on a test, will he/she in fact go through the materials again as required, or continue with the next

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1 Rosinski (1977) gives an account of the difficulties in recruiting faculty to develop modules even when an honorarium was offered--the anticipated number of modules went down from from twenty five to just one.

step in the manual? In other words, there are no effective controls which allow only those who have mastered the manual to proceed on to the design stage.

While these limitations are significant, it is felt that for purposes of the present pilot study they must be tolerated since further studies will lead to refinement.

CHAPTER II

REVIEW OF LITERATURE

Organization

The review of literature is divided into two sections. The first deals with some critical observations on literature on the design of instruction. The second addresses research findings pertinent to the choices made in designing the Manual, with a concluding review on the diffusion of educational innovations.

A. Critical Observations on Literature Review

The review of literature on self instructional manuals is a complex task. Part of the complexity is the abundance of idiosyncratic, loosely defined terminology. For example, self instructional manuals are referred to by a variety of alternative appelations including: Systems Engineering and Training (SET), Learning Systems Design (LSD), the Systematic Design of Instruction (SDI), Systems Approach to Training (SAT), Personalized Instruction (PI), Instructional Systems Development (ISD), just to mention a few.

In this dissertation the acronymn SAT (for Systems Approach to Training) will be used to represent self-instructional manuals.

Differences between the manuals range from superficial variations in terminology to fundamental variations in philosophy. A basic issue on which disagreement exists is the degree to which the instructional design process can be reduced to a linear sequence of generally applicable, prescriptive procedures. The positions that have been espoused range from Eckstand's (1964) statement that the design of instruction is primarily an art, to the hypothesis that course design can be reduced to a series of well defined procedures which can be carried out by untrained personnel.[1]

Of the dozens of methods contained in the different manuals and in the related literature, none seem to have attained widespread acceptance. Campbell (1971) points out that a major problem with the available manuals is that they do not indicate how their particular methodology differs from other methodologies or from traditional ways of developing educational programs. At the present, the use of self-

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1 A number of manuals state in the preface that no prior training is required, e.g. Modular Instruction by James Russell states: "The only prerequisite is a desire to improve student learning." (preface).

instructional programs is growing faster than any other method of improving instruction (Novak, 1973; Cross, 1976) and the required ingredient in the title of the program seems to be "systems approach" even when there is little agreement as to what that term means. This confusion is primarily the result of three factors: lack of standardized terminology, problems associated with educational innovations, and the evolutionary nature of the systems approach to manual design. Each of these will be discussed in some detail in this section.

1. Lack of Standardized Terminology

Manuals seem to use similar terms: objectives, task analysis, methodology, media selection, sequencing, objective performance measure, criteria referenced testing, individualized instruction and evaluation.

The use of a common terminology creates the initial impression of high content similarity among the manuals. However, closer inspection of the operational definitions given to these terms shows this impression to be false as the following example will illustrate.

Virtually all of the manuals use the term "task analysis" but the operational definitions of task analysis provided by the manuals differ both in content and in degree of detail. While some manuals leave much to the discretion of the analysts, others are so specific as to provide a form broken down into hierarchical categories such as role, duty and activity, or job, task, and element; others provide little or no structure as to the number or the types of categories to be used. Some require each task to be classified as psychomotor, cognitive or affective; others rate each task on each of these categories; still others ignore this breakdown.

Manuals generally provide only one procedure for task analysis. When alternative procedures are not provided, the assumption is made that the method given is universally applicable. This assumption is not warranted by the literature on task analysis. The Gilbreths (reported in Swain, 1962) in their pioneering work on improving industrial efficiency, developed the first formalized task analytic methodology. Their procedures were useful in time and motion studies on production line tasks. However, in the 1950's, R.B. Miller found that the Gilbreth's procedures did not allow for the identification of human attributes used in complex tasks (Swain, 1962). Miller developed a methodology entitled "task-demands analysis" because he believed that existing methods did not provide adequate data concerning the demands which tasks make on the operator. Since 1960, the number of available task analytic methodologies has risen dramatically. A number of theorists, after reviewing this state of affairs, have concluded that no single method of task analysis can be generated which is valid in all circumstances (Gustafson, Honsberger, and Michelson, 1960; Folley, 1964; DeGreen, 1970; Rankin, 1974).

The degree to which task analysis can or should be proceduralized is controversial. The trade-off is that although higher degrees of proceduralization result in narrower ranges of application, they may permit the use of less qualified, less costly analysts. DeGreen's (1970) analysis of this problem led him to conclude that: (a) reduction of task analysis to a routine checklist procedure results in "a deluge of useless data"; (b) task analysis must always be viewed as a means and not as an end; and (c) the usefulness of task analytic data is a function of the degree of expertise of the analyst.

Although the example used here is "task analysis", a similar presentation could be made concerning each of the terms shared by the majority of manuals: behavioral objectives, media selection, methodology selection, criterion referenced testing, objective performance measurement, sequencing, evaluation. Research and analysis are needed to determine for each of these concepts, the degree to which procedurealization can be achieved, the generality of those procedures, and the skills necessary to apply them.

2. Problems of Educational Innovations

The degree of acceptance of a given innovation is shaped by factors other than its inherent advantages and limitations. Campbell (1971) stated that educational innovations have historically followed a predictable life cycle, and constructed a three-stage model of that process. In the first stage, a new technique appears and develops a large following of advocates who claim to have successfully applied the technique. The second stage consists of numerous modifications of the basic technique. The third and final stage in the life cycle of educational innovations is the appearance of criticism by a few vocal opponents, which grows into an inevitable backlash. According to the model, this criticism does not serve to stimulate improvement of the technique, but to stimulate the development of a new technique. At that time the cycle starts anew.

While Campbell's model is primarily descriptive, Milsum (1968) presents a phenomenon called the "bandwagon effect" which helps explain the model. The bandwagon effect serves to transform researchable hypotheses (educational innovations) into political entities, thereby triggering the mechanism which leads to the innovation's downfall. The mechanism works as follows. As the number of researchers, developers, theorists, administrators, laboratories, schools, etc., who have vested interest in the innovation grows, the resistance to critical examination of the innovation and to the consideration of alternatives also grows. In addition, claims are made for and have become entrapped in the political arena.

The process by which the innovation attains the reputation of a panacea has an unwanted side effect. The greater the number of people who attempt to use innovations based on unfulfillable promises, the greater the number of people will be who are disappointed by it. As this number grows, the criticism and backlash predicted by Campbell's model occur and eventually result in the downfall of the innovation. According to Campbell (1971), SAT is the current innovation, and is following the life cycle predicted by his model.

That SAT has been touted as a panacea and has fallen victim to the bandwagon effect was first documented in 1968 by Hartley. He concluded that the SAT literature is "long on persuasion and short on critical self appraisal". He believed this to be the result of over-zealousness in attempts to use the new methodology without a clear understanding of what it was supposed to produce. Carter's 1969 article, "The Systems Approach to Education: Mystique and Reality" provides not only a review of the problems created by the bandwagon effect but also a realistic assessment of what can be expected from SAT.

Sugarman, Johnson and Hinton (1975) provide further support data and analysis in these two areas.

3. Systems Approach

The systems approach to training, SAT, evolved from "systems analysis" (alternatively called "the systems approach"), a methodology developed during World War II, to solve problems created by rapidly advancing weapons systems technology. After the war, the methodology was found useful in the solution of problems in a variety of fields (Saettler, 1968).

In the late 1950's, the first attempts to apply systems analysis to the design of training programs were undertaken by the Rand Corporation (Kershaw and McKean, 1958), and by the Human Resources Research Organization (Hoehn, 1960).

The goal of early SAT developers was to generate tools which could aid training programs design personnel in their day-to-day work. These tools consisted of models, that is, formalized simplifications of methods and techniques which other experts had found useful. These models were intended to be used, modified or ignored, in any particular situation, based on the discretion of the user. They were not intended to relieve him of his responsibility as a decision maker.

The early 1960's witnessed the emergence of a new technology which greatly affected the evolution of SAT. This new technology was based on the hypothesis that if training program design experts could formalize models of the methods and techniques that made them successful, then laymen could follow these models and produce the same result at lower cost. The main thrust of developmental efforts under this technology has been the production of manuals which attempt to reduce the design of training programs to a linear sequence of procedures which can be carried out by personnel inexperienced in training program design (Dicketson, Shuiz and Wright, 1970).

During the middle and late 1960's, the proceduralized SAT concept generated a great deal of literature. The original, generic concept of SAT, which remained relatively dormant during that period, has been the subject of renewed interest during the 1970's. This is, at least partially, a result of a re-evaluation of the state-of-the-art of educational psychology (Campbell, 1971; Glaser and Resnick, 1972; McKeatchie, 1974), which has concluded that the available theory and empirical evidence on the process of learning and teaching do not support the proceduralization of the training program development process. As McKeatchie (1974) points out, psychologists are much less sure of the "laws of learning" than they were a few years ago.

Recent research is attempting to develop methods, models, and techniques which training experts can use, modify or ignore. This reflects a belief that development of training is a complex problem, not solvable by proceduralized methods. For example, in the selection of training media, Braby et al (1975), and Boucher, Gottlieb and Morganlander (1973) have produced media selection models which specifically state that their goal is to assist rather than to replace the experienced specialist.

To conclude this section here are two statements, made twenty years apart, which illustrate our present problem:

> "There is a simple job to be done. The task can be stated in concrete terms. The necessary techniques are known. Nothing stands in the way but cultural inertia."
>
> B.F. Skinner (1954)

> "There is a complex job to be done. The task cannot be stated in concrete terms. The necessary techniques are not fully known. The equipment cannot always be easily provided. Other things – primarily our ignorance of the complexities of human learning – stand in the way, as well as cultural inertia."
>
> J. Hartley (1974)

A. Justification for Information Chosen for Inclusion in the Manual

In light of the previously discussed problems in current manuals on self instructional program design, a major task would be the selection and justification of information to be included in the Manual used in the present study. It was necessary to review the literature for educational practices and theories. This provided information which would enable the objectives of the Manual to be reached.

The author was not aware of any literature which sets out the process of selecting content for self instructional manuals. Shore (1973) states that there is no literature on this process and suggests that the way to decide on content is to look at existing manuals to determine their common elements found in module development. The common elements are: state objectives, order objectives (sequence), devise pre and post tests, design instructional activities, make available suitable resource materials.

Klingstedt (1971) has recommended a series of steps very closely resembling those of Kurtz (1971). Summarized, these steps are:

Step 1. Learning outcomes are determined.

Step 2. The learning outcomes are analyzed into smaller objectives and sequenced.

Step 3. Tests are constructed which measure entry skills and objectives.

Step 4. Instructional activities are designed to help the learner master the objectives.

Step 5. A post test measures the student's achievment of the objectives.

This author has chosen content of the Manual on the basis of what is required to follow his seven step model and conceptual knowledge required to understand that model. Development of the model is presented in Chapter III p.49. The major concepts are:

A. learning outcomes
B. mastery learning
C. learning processes
D. analysis of learning outcomes
E. sequencing of content
F. criterion referenced testing and measurement
G. formative evaluation, media selection and individualizing instruction
H. modular instruction

The literature providing the research basis for these concepts is presented next, followed by a statement of philosophical basis and format of the Manual.

In determining content the following were also kept in mind: criticisms outlined in the review of literature, part one; information obtained in interacting with DURC (presented in Statement of Need); and views currently being expressed in journals.

A. Learning Outcomes

The starting step of this author's model is the specification of learning outcomes. The use of the term "learning outcome" is a departure from the usual term - objective, or behavioral objective.

First a review of the behavioral objective movement is presented and then the reasons for the preference of the term "learning outcomes".

The need for objectives is documented by Tyler (1934) who advocated their use as both a goal for teaching and a measure of its effectiveness. The behavioral objective movement came into its own as part of the systems and accountability movements in education which required measurable (therefore observable) objectives. Mager (1965) responded to this need with his three part formula for writing objectives. As his first book was on objectives for programmed learning and as programmed learning was mainly due to Skinner, people have equated Mager's objectives with behavioralism. Mager himself has never termed his objectives as "behavioral"; his concern was to provide measurable objectives (a form of accountability).

Since Mager's 1965 text there have been many others who have proposed a formula for writing objectives. Gagne (1974) proposes five parts to an objective: situation, learned capability, object, action and tools. Miller (1962) proposes a skills analysis and in his view objectives should include: 1. an indicator on which the activity-relevant indication appears; 2. the indicator or cue which calls for a response; 3. the control object to be activiated; 4. the activation or manipulation to be made; 5. the indication of response adequacy or feedback.

The level of detail used in writing such descriptions is about the same as would be used for writing a set of technical instructions useful to a novice.

Recently there has been a growing reaction against the use of behavioral type of objectives (Ainsworth, 1977). Various reasons are given. Ashby (1965) points out that a learner's performance changes, according to the testing environment. Dressel (1977) describes covert learning which would not be measurable (or acceptable) if we insist that objectives call for observable behavior.

In their later writings, Gagne (1974) and Bloom (1978) have moved from strictly behavioral objectives to a much wider concept of "learning outcomes" which allow for certain learning to be covert and testing to be spread over a period of time.

MacDonald-Ross (1973) lists 16 objections to behavioral objectives. Geiss (1977) believes that there is a place for behavioral objectives in training but not in education.

Gronlund (1974) supports the concept of learning outcome and emphasizes that understanding is the objective of learning, rather than behavioral outcomes which are the responses made after understanding occurs.

A number of authors (Harrow, 1972; Armstrong, 1971; McAshen, 1977) believe in "learning outcomes" replacing "objectives".

They see thatthe learning outcome has two components – a goal and an evaluation component. The evaluation component may accept covert learning and different responses according to the environment.

McAshen (1977) expresses what may be the concern of many: Once an educator understands that the learning outcomes or competencies are not the same thing as the behavioral objectives (which rely on one-time observations of responses) he must question the value of any objective that is stated in behavioral terms only.

The Manual proposes an approach which is a synthesis of a number of researchers (Simons, 1973; Armstrong, 1971; Smith, 1972; Harrow, 1972) who advocate a more flexible "learning outcome" approach to the behavioral objective formula advocated by Mager. Learning outcomes are defined as goals, competencies or specific learning intents (McAshen, 1977). In the learning outcomes approach the objective has two components – a goal and an evaluation component. In evaluating the learner the focus will be on the achievement of the goal to be conducted through a sample of a number of behaviors over a period of time and accepting the existence of covert learning (Dressel, 1977).

Designers who prefer to present objectives in the format proposed by Mager or Gagne will not be discouraged from doing so but others who prefer a less rigorous learning outcome approach may do so.

2. Mastery Learning

The concept of mastery learning is central in the move to individualize instruction. With resistance building up against CBE it is being suggested in literature that "mastery based education" replace CBE as the major focus for improving education through design (Block, 1978). In the Manual, mastery learning is the central philosophy. The concepts of mastery learning are fully treated in the Manual through two modules. DURC faculty reaction has been very receptive.

The basic premise that most students can learn what needs to be learnt, if the process is approached sensitively and systematically, is a very old one. The Jesuit schools emphasized this before the 17th century, Pestalozzi in the 18th century, and it has been part of the English universities' tutor system since its inception (Klaus, 1971).

John Carroll's Model of School Learning (1963) and currently called Mastery Learning, is the modern approach to the notion that most students can attain a high level of learning capability. The author's interpretation of Carroll's Model is that if students are normally distributed with respect to aptitude for some subject and all students are given exactly the same instruction, then achievements measured at the completion of the subject will be normally distributed. Under such conditions the relationship between aptitude measured at the beginning of the instruction and achievement measured at the end of the instruction will be relatively high (typically about + .70). Conversely, if students are normally distributed with respect to aptitude, but the kind and quality of instruction and learning time allowed are made appropriate to the characteristics and needs of each learner, the majority of students will achieve mastery of the subject. And, the correlation between aptitude measured at the beginning of instruction and achievement measured at the end of instruction should approach zero.

Carroll's (1963, 1970) model states that the level of mastery reached by a learner on any instructional task is a function of the time actually spent learning the material and the amount of time he needs to master the material. The amount of time a student actually spends learning the material depends on two factors: time allowed, and his perseverance. The amount of time needed by the student is dependent on three factors: aptitude, quality of the instructional materials, and his ability to understand the instructional materials.

Research findings on mastery learning have been impressive (Keller, 1968; Block, 1971; Bloom, 1971). However, as Cross (1976, p.77) observes

> Those two stalwarts of the school system - grades and semesters - become almost meaningless when mastery learning is implemented. Ideally, all students would earn
>
> A grades, and they would take as much time as necessary to accomplish this level of mastery.

The Manual has two modules on mastery learning, which take a total of over four hours to complete. The emphasis is on concepts and supporting research findings to give the designer a strong knowledge base for possible attitude change (from traditional norm-referenced approach to a mastery approach). The problem of grades and semesters raised by Cross are not discussed as these are mainly organizational problems where the individual faculty member has very little control. It is a speculation on the part of the author that given the two modules on mastery learning, the designer will gradually incorporate as many mastery concepts as organizational constraints will allow.

3. Learning Processes

The Manual places great stress on the learning process; it continually asks the reader to start the design process by asking "how can the learner learn this objective?" rather than the common approach which starts with "how should I teach this?".

Since Pavlov and Thorndike began their studies of learning, thousands of experiments have been conducted on the learning process. The Manual does not follow any particular school of learning or researcher, but is a synthesis of the generally accepted theories. Consequently the theories of Thorndike (1921), Skinner (1968), Ausubel (1968), Bruner (1966, 1971) and Gagne (1974) are prominent.

Bruner (1966, 1971) is concerned with inducing active participation in the learning process on the part of the student, catalyzed by a "discovery-learning" environment, and by frequent challenges to solve novel problems. To Bruner there are three major stages of intellectual development; these are the enactive, the iconic and the symbolic representations. He has based some of his work on Piaget and in turn, much of Gagne's hierarchies are based on these three basic representations.

Ausubel (1968) is primarily concerned with meaningful reception learning and the acquisition and retention of knowledge. The major emphasis of his theory is on the inferred processes presumed to be in operation. The major concepts taken from Ausubel and used in the Manual are: advance organizer, anchoring ideas, cognitive structures, subsumption and assimilation.

Skinner (1968) and Thorndike (1921) are very similar and are treated together. Skinner, as is typical of the S-R tradition, limits his attention and discussion to observables. He is concerned almost exclusively with input-output relationships and does not write about inferred variables. The concepts used in the Manual which are directly derived from these two researchers are: stimulus, reinforcement and contingencies of reinforcement, chaining, shaping, respondents and operants.

Gagne (1974) emphasizes the learning of several kinds of learning outcomes, each requiring a different kind of mental process. The conditions for learning involve the interaction of internal conditions of the learner, and the external conditions of the learning environment. Each kind of learning outcome requires a different set of these internal and external conditions.

There is one additional theory of learning which is used in the Manual and ignored in other manuals reviewed. That is the information processing theory. According to this theory, the processes that one must conceive in order to explain the phenomena of learning are those that make transformation of inputs to outputs in a fashion somewhat analagous to the workings of a computer. These various forms of transformations are what goes on "inside the learner's head" - the learning process. Theoretical accounts of the information processing theory are: Atkinson and Shiffrin (1968), Norman (1970), Anderson and Bower (1972), Lindsay and Norman (1972).

The information processing theory is closely related to cybernetic concepts in biological-behavioral sciences. Von Bertalanffy(1966) explains the cybernetic system in this way:

> "The minimum elements of a cybernetic system are a 'receptor' accepting stimuli (or information) from outside as an input; from this information a message is led to a 'center' which in some way reacts to the message and, as a rule, amplifies the signals received; the center, in its turn, transmits the message to an 'effector' which eventually reacts to the stimulus with a response as output. The output, however, is monitored back, by a 'feedback' loop, to the receptor which so senses the preliminary response and steers the subsequent action of the system so that eventually the desired result is obtained." (p.40)

The different learning theories mentioned so far are used thoughout the Manual particularly in Step 4 (planning of the lesson) and Step 5 (construction of the lesson), when they are most applicable. The author sees no problem in this approach as the theories used are not contradictory but rather complementary. Full statements of learning theory would be beyond the scope of the Manual. Brief abstracts accompany the major bibliography for those who wish to pursue any particular theorists.

There is one exception - that of information processing theory. A module on information processing theory is included in the Manual in response to interest in this theory expressed by faculty during formative evaluation.

4. Analysis of Learning Outcomes

Usually SAT refers to this step as "task analysis" and part one of the review of literature points out that all the manuals reviewed presented only their own methodology without reference to other alternatives, thereby giving the beginning designer a naive view of straightforwardness and simplicity of the process.

In the present Manual three alternate methods are recommended, according to the learning involved. The designer is to choose the method which suits the type of learning outcome which is desired. If the learning outcome involves procedural tasks then the approach of Davis, Alexander and Yelon (1974) is recommended. When the learning outcome involves mostly cognitive processes then the approach of Gagne (1974) is recommended and when the learning outcome involves both procedural and cognitive processes then the approach of Singer and Dick (1974) is recommended.

Through interviews with target faculty and during formative evaluation, the author found that the actual choice of topic as a suitable "chunk" proved difficult. The work of Cook and Walbesser (1973) addresses this concern and their methodology is included. Briefly, they suggest the use of a topical hierarchy before developing an instructional hierarchy.

The Manual is mostly concerned with the teaching of higher cognitive skills and therefore the work of Gagne and Briggs (1974) is used more extensively. Much of their methodology calls for hierarchical analyses and sequencing; research findings in this area follow.

5. Sequencing of Content

Duncan (1972) indicates that there have been three main approaches to research on sequencing. Some investigators have taken a theoretical approach – basing their work either on Skinner's ideas about shaping behavior or on Gilbert's ideas about the chaining of sequences of responses (Gilbert, 1962; Mechner, 1967). Other investigators have looked in more detail at Mager's approach of determining the sequence preferred by the learner rather than that preferred by the teacher (Mager, 1961; Mager and Clark, 1963). Other investigators have based their approach to sequencing by manipulating the internal structure of the subject matter with which they were dealing, an approach owing much to the theoretical position of Gagne (Gagne, 1970; Gagne and Briggs, 1974). The Manual suggests that where the content has mostly cognitive skills then the methods advocated by Gagne be followed. However, as research does not identify a "best" method the Manual also mentions alternate methods (but in less detail).

Each of these approaches will now be briefly considered. As a part of his approach to programming, Gilbert advocated that a sequence which could be classified as chain-like (a followed by b then c then d etc.) should be taught retrogressively. That is, the learner should make the last response first. Gilbert advocated that doing the last response--completing the chain--was the easiest response to make and the most motivating to reinforce. He therefore advocated that learners should, in effect, be programmed to make their responses to a chain in the correct order but always building up to completing the end of the chain. Experiments have failed to indicate any superiority for this approach (Wilcox, 1974).

A number of studies have offered support for Mager's learner-controlled rather than instructor-controlled sequencing (Horn, 1964; Briggs, 1968; Issing and Eckert, 1973; Newkirk, 1973) although there have been exceptions (Allan and McDonald, 1966). In many of these studies, though, the results are confounded with other variables which could have affected the results (Merrill, 1973).

The most interesting approach to sequencing, however, has concerned itself with the implications of the argument that if a subject matter has an internal structure, then there should be a logical teaching sequence consequent upon it. Gagne argues that many subject matters have a hierarchical structure. What one has to do to discover this structure, is to ask, "What does a learner have to know in order to do this task when given only the instructions to do it?" An answer to this question provides material to which one can apply the same question, and so on, defining in a sense a subset of skills, or more technically, a cumulative hierarchy of sub-tasks. The phrase "cumulative hierarchy" simply implies that the learner must be able to succeed at one level before he can go to a higher one.

The results from recent experiments have not always supported Gagne's approach (White, 1973), but the hierarchical notion still continues to attract attention (Airasian and Bart, 1974; Kozma, 1974; Phillips, 1974; White, 1974).

6. Criterion-Referenced Testing and Measurement

In a questionnaire administered to DURC, a series of questions concerned the members' practices in grading. The results showed that only one member utilized the philosophy of criterion-referenced testing. A check of term grades posted outside offices also demonstrated that students' grades were closely along a normal curve. Consequently, criterion-referenced testing is prominent in the Manual, however, norm-referenced testing is also recommended for certain purposes.

Criterion-referenced tests are specifically designed to meet the measurement needs of instructional programs following a systematic design. In contrast, the better known norm-referenced tests are designed principally to produce test scores for ranking individuals on the ability measured by the test.

A very flexible definition of a criterion-referenced test has been proposed by Glaser and Nitko (1971): ". . . [a test] that is deliberately constructed so as to yield measurements that are directly interpretable in terms of specified performance standards." (p.653). According to Glaser and Nitko (1971):

> The performance standards are usually specified by defining some domain of tasks that the student should perform. Representative samples of tasks from this domain are organized into a test. Measurements are taken and are used to make a statement about the performance of each individual relative to that domain. (p.653)

Further distinctions between norm-referenced tests and criterion-referenced tests have been presented by Ebel (1971), Glaser (1963), Popham and Husek (1969), Glaser and Nitko (1971), Hieronymous (1972), and Livingston (1972).

Hambleton and Norvik (1973) have noted that the primary problem in criterion-referenced measurement is that of classifying a student into one of several mutually exclusive mastery states or categories. Mastery states are introduced to represent different levels of performance on the domain of items measuring each objective covered in the criterion-referenced test. Typically, a cut-off score or mastery level score is set to permit the teacher to assign students, on the basis of their performance on each subset of items measuring an objective covered in the criterion-referenced test into one of two mutually exclusive categories – masters and non-masters. (See Millman, 1973, and Block, 1972, for discussions of guidelines for setting cutting scores.) In the Hambleton-Novick formulation, criterion-referenced test reliability takes the form of an index indicating the consistency of decision-making across parallel forms of the criterion-referenced test or across repeated measurements (Swaminathan, Hambleton and Algina, 1974). Validity takes the same form except, of course, that a new test or some other appropriate measure serves as the criterion.

The Manual advocates the use of criterion referenced tests when evaluating student progress but asks the designer to consider norm referenced tests for post tests. This method is advocated by Yelon (1976) who points out that employers need to know how students stand in relation to each other.

7. Formative Evaluation

A major feature of this author's model is the heavy emphasis on formative evaluation. The Manual recommends that formative evaluation be conducted while the module is being developed. Such evaluation provides information to developers that would allow them to modify and improve their product.

The inadequacy of current use of formative evaluation procedures in the development of products has been well documented by Komoski (1971). He notes that less than one percent of all the 14,000 textbook titles being sold have been formally evaluated. Of the 80 manuals on the design of courses which this author has reviewed, only two show evidence of formative evaluation.

The heavy emphasis on formative evaluation in this author's program is based on the belief that in order to assess the effectiveness of instructional systems, a variety of data types need to be utilized in the program.

Formative evaluation is conducted through the following: embedded or in-program tests, pre and post tests, and attitudinal surveys. Each of these will be treated in turn.

1. Embedded tests have been found to be "very useful" (Baker and Alkin, 1973). Their major usefulness is to test whether the student is mastering the sub-objectives (Dick, 1968), to give constant feedback to the learner (Crowder, 1960) and as a diagnostic function, indicating what particular discriminations need additional attention. Glaser (1966) suggested that within-program errors represented an inadequacy of the program itself. Recommendations, based on research, on the sorts of data to collect in program development have been forwarded by Markle, 1967; Baker, 1973; Dick, 1978.

A number of researchers have offered formative evaluation models: Scriven (1972) and Stake (1972) imply that it is best that the formative evaluation be performed by someone external to the program. Scriven calls his approach "goal free evaluation" and establishes a rule in which the formative evaluator collects his or her own data and renders assessment on the actual effects of the program.

Stufflebeam(1971) and Alkin (1969) emphasize the necessity of structuring evaluation so that it serves decision making purposes by producing appropriate and timely information.

There are numerous models and checklists for product development processes. These vary from conceptual schemes (Schutz, 1970) to comprehensive step by step procedural checklists (Borg and Hood, 1968). All models strongly advocate the use of formative evaluation as stated by Baker and Alkin, 1973:

> "... at the core of each model, regardless of its esotericism or practicality, is the realization and recognition that product development and formative evaluation are intertwined as snake and staff and that product revision depends upon the generation of formative evaluation data."

The Manual synthesizes most of the concepts and procedures discussed here; these form Step 6 of the Manual which is enclosed as Appendix D.

2. Post test data. The form and frequency of gathering post test data is not clear. Husek and Sirotrik (1968) and Shoemaker (1972) have described a procedure to reduce the amount of testing time requisite for program revision. Samples of test items are administered to samples of learners and the sum across all items is used as an index of program success.

The number and use of subjects is an important point. Robeck (1965) used a single student as the data source and showed that this economical method significantly improved the product. The above procedure has been verified by Fleming, 1973, and Markle, 1967. The main problem was to determine which student to select.

A variation of the single student procedure is advanced by Abedor (1972) who used a small group combined with a debriefing. Baker (1973) commenting on Abedor's study points to an interesting byproduct of the study: the analysis of the data suggests that obtaining feedback through procedures utilizing a student debriefing session may serve as instructional product development training.

A number of studies have shown that when data from formative evaluation is used to revise the product then considerable improvement is achieved (VanderMeer, 1964; Gilbert, 1962). However, no research has been conducted into the form that formative evaluation should take and how early in product development should evaluation take place.

8. Modular Instruction

This general heading includes the concept of individualized instruction through the use of modules. The effectiveness of individualized instruction through the use of modules has been demonstrated in a large number of studies (Celinski, 1968; Ferster, 1968; Keller, 1968; Lloyd, 1969; Myers, 1970; Bern, 1971; Johnson, 1971; Kulik, 1974).

There is ample evidence in literature that modular instruction, be it a small part of curriculum or the whole curriculum, is working. Brown et al (1976) describe the function of College IV, one of five Grand Valley State Colleges in Allendale, Michigan. At this college, all courses are taught by a self-paced modular system of instruction. The school has attracted large numbers of non-traditional and adult students who cannot attend pre-arranged classes. The College has developed a flexible administration to allow for continuous registration and enrollment.

Bridge (1976) surveyed 43 modular, self-paced courses in physical, social and applied sciences being taught in England and Ireland. The results show an overwhelming approval of self-paced modular approach both by students and faculty.

Taveggia (1976) presents an overview of 14 studies which compared learning outcomes of self-paced modular instruction and conventionally taught courses. Student performance on course content examinations showed that modular instruction is superior to conventional methods.

The above are just three studies. Journals such as Higher Education, Educational Technology, carry a large number of similar studies. A recent issue of the Journal of Personalized Instruction (3,1 of March, 1977) carried a list of 54 major articles which give research findings supportive of modular instruction.

The basic theme of the Manual is that much of university instruction should be presented through the use of well-designed modules where the subject matter and situational constraints allow this (as outlined in Step 1 of the Manual).

9. Diffusion of Educational Innovations

The factors which encourage or impede the diffusion and acceptance of innovations in education have been discussed widely in literature (Lippitt, Watson, and Westley, 1958; Marcum, 1968; Bennis, Benne, and Chin, 1969; Havelock, Huber, and Zimmerman, 1969; Rogers and Shoemaker, 1971). The kinds of factors that students of planned change have identified as generally supporting innovation in education include, after the outline of Glasser (1971): organizational attitudes that support change; clarity of goal structures;

organizational structures that favor innovation; professionalism of staff; organizational autonomy; and strong vested interests in preserving status quo methods of operation.

Of particular concern to this study is the use of a product to encourage the diffusion and acceptance of an innovation. Under the Statement of Need (p.6) it was stated that the Manual would also serve as a change inducing mechanism. The author saw the Manual as one of the means of diffusing an educational innovation (which in this study is CBE) by having designers produce modules (visible products). The author sees the availability and trialability of products to be a necessary part of an acceptance process, because the innovation (CBE) amounts to a conceptual approach to education, made up of many concepts. The Manual transposes these concepts into concrete visible products which can be demonstrated, tried and tested.

The theoretical position for the author's assumption for the need for concrete products is supported in literature. First, the diffusion of an innovation is a process. This process is described by Katz, Levin, and Hamilton (1972) as starting with acceptance, over time, of an idea by individuals in the system. Rogers and Shoemaker (1972) also see diffusion of innovation as a process over a series of stages. They see the process as starting with awareness of the innovation, then a show of interest in the innovation, followed by opportunities to evaluate the characteristics of the innovation, then the innovation must be trialable before it is finally adopted.

Rogers and Shoemaker (1972) found that the acceptance of an innovation depended on five characteristics or attributes of that innovation as perceived by the target population: (1) the relative advantage of the innovation over other methods or products, (2) the compatability of the innovation with ideas already held, (3) the relative complexity of the innovation (a less complex innovation has a better chance of acceptance over a more complex innovation), (4) that the innovation be trialable and (5) the innovation be observable.

As stated earlier, the conceptual nature of the innovation (CBE) required that it should be presented in a trialable and observable format. Rogers (1972) provides further guidelines as to the attributes of an innovation which determine its acceptance; this is further discussed on p.

CHAPTER III

METHODOLOGY

A. Type of Research

This dissertation is a pilot study. According to Borg and Gall (1971) a pilot study is used to experiment with a variety of approaches, ideas, procedures thus allowing an appraisal of their adequacy, and also allowing unforseen problems to surface (pp. 60-61).

The dissertation follows what Borg and Gall (1971) term as "research and development" (R & D) methodology. This type of research differs from most basic and applied research projects in a number of ways. Its objective is a finished product[1] that can be used effectively by a designated population. The most critical difference between basic and applied research and educational R & D is the sequence that is followed. The typical steps in the R & D sequence are (after Borg and Gall, 1971, p.31):

1. Develop a set of objectives that the product should achieve.
2. Conduct research or review previous research to discover the deficiencies of current products and to identify approaches

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[1] The "product" in this study is the Manual

that are likely to overcome these deficiences.

3. Develop a product to the point where one may reasonably expect that it will accomplish its objectives.

4. Test this product and evaluate its effectiveness in meeting objectives.

5. Revise the product on the basis of the field test results.

6. If it is successful, put the product into operational use.

The R & D sequence proposed by Borg and Gall (1971), was followed in this way:

1. Develop a set of objectives that the product should achieve.

A set of cognitive objectives, followed by production objectives, is presented on p. 58. The designer will acquire the cognitive skills and then transfer the cognitive skills to the actual production of a module.

2. Conduct research or review previous research to discover the deficiencies of current products and to identify approaches that are likely to overcome these deficiencies.

Much of this is done in the Review of Literature (pp. 11–45). and in the Statement of Problem (pp. 1–6)

3. Develop a product to the point where one may reasonably expect that it will accomplish its objectives.

Research underlying the major components of the product (the Manual) are presented in the Review of Literature. The method of developing the Manual is described on p. 49. Development also included rigorous formative evaluation.

4. Test this product and evaluate its effectiveness in meeting objectives.

Testing takes three forms:

a. Formative evaluation of the Manual;

b. Evaluation of the products of the Manual (the module) which is done through evaluation by a panel of expert judges using criteria set out in Appendix A;

c. A field test of the modules as explained in Summative Evaluation.

The final revision of the product, so that it can be put into operational use, is not part of this study.

B. Development of the Self Instructional Manual

The process of developing the Manual was through four main steps: a) determining the philosophical basis and format, b) identifying content, c) identifying cognitive objectives, d) identifying product objectives, and e) formative evaluation. The Manual is enclosed as Appendix D.

1. Philosophical Basis and Format of the Manual

Philosophically, the Manual is to provide information in possible techniques; the term "techniques" being used in its broad sense as defined by Ellul (1967): technique is nothing more than means and the ensemble of means (p.19).

The Manual follows a philosophy which calls for the integration of a systems approach to instruction with that of a humanistic approach to education. Fox and DeVault (1974) found that the best examples of individualized instruction are those that blend these two approaches. This approach is fully explained in the Manual.

In the vernacular of the target population, the Manual offers an educational cafeteria of techniques instead of the more common educational "plat du jour". The author does not suggest a radically different view or urge the substitution of a new system for an existing one. Instead, the Manual presents a varied array of choices to achieve the same objective so as to accommodate the increasing heterogeneity of those involved in education, an approach favored by Fantine (1976). In a number of instances the Manual carries suggested further readings for alternate approaches and views. Its methods and approaches are in direct response to the needs expressed by the target population.

Competency based education, modular instruction, or individualized instruction constitute an innovation to most faculty in the target population. Therefore the findings of Rogers and Shoemaker (1971) are helpful on how to gain acceptance. Rogers and Shoemaker advocate a gradual introduction of new concepts which sould be perceived as compatible with existing methods and beliefs. Through gradual introduction, the innovation should also demonstrate its advantages, be trialable, and the process should be observable. Consequently, the Manual introduces new concepts slowly, giving concrete examples from higher education, particularly dietetics, and presents alternatives to choose from.

Generally the format of the Manual may resemble a programmed text, but cannot be equated with Skinnerian methods. The theoretical base for Skinner's (1954) views are severely criticised by Annett (1969; 1973) and others.

The Manual itself is in a modular format; therefore it often acts as an exemplar. Various techniques of presentation are used, some for the purpose of illustrating alternatives, at other times because they appear the most effective way of teaching.

The format of the Manual is print with some graphs, flow-charts and models. The use of print is considered the most effective way to achieve the learning outcomes as advocated by Brigg's (1978) method of selecting appropriate media.

Chunks of information usually vary according to the difficulty of content but usually are large, in line with the target population's capabilities as advocated by Holland (1965) and Leith (1966). As Markle (1969) points out, programs of today contain various step sizes; the size of the step is largely determined by what is considered appropriate for the learner, and the nature of the material.

The Manual used mainly linear techniques, but some branching is used for accelerated progress and remedial work. Holland (1965) and Leith (1966) showed that when comparing linear and branching programs for older, intellegent learners, there was no difference in test results, but branching programs were superior in terms of time taken to learn.

Frequency of tests is varied in the Manual. Research by

Holland (1965), Anderson (1967) and Annett (1969) show that low ability learners benefit from immediate knowledge of results. For above average learners, testing can be varied.

Attention needs to be paid to the nature of the subject matter being learned (easy - difficult), the kind of response being made (overt - covert), its frequency, and the kind of feedback deemed appropriate. A study by Grundin (1969) indicates how these features may interact. In Grundin's study, overtresponding produced better results than did covert responding, but the older the learners, the less the difference. However, in his study, the effect of overt responding interacted with the frequency of feedback. In this experiment, with overt responding, frequent knowledge of results seemed superfluous, or even detrimental.

While immediate knowledge of results does not always lead to increased learning, this does not mean that the technique of providing immediate feedback is always erroneous. Indeed, providing knowledge of results is probably one of the most important principles of teaching (Annett, 1969). In the context of programmed learning, Annett (1973) says, " Reinforcement of each step? Well you can hardly argue with that. One does not have to be an ardent S-R theorist to see that at some stage the student must be aware of what the right answer is."

Annett's argument is with the reinforcement interpretation of this principle (Annett, 1969; 1973), not with the idea of frequently telling a student how well he is doing. Information about the adequacy of a response is more important than reinforcement. Consequently, in the Manual answers are often lengthy, providing a "suggested" or "expected" answer.

Research on overt versus covert responding produced similar mixed results. In many cases no significant differences were found between the test results of learners who wrote their answers down or learners who merely "thought" them. Again, however, there were indications of where overt responding was superior - for example (i) when the learners were young children; (ii) when the material was difficult; (iii) when the programs were fairly lengthy; and (iv) when particular (novel or specific) terminology was being taught (Holland, 1965; Leith, 1966).

A more careful analysis is required of what is meant by the phrase "active responding". As Annett (1973) wrote, activity on the part of the learner seems a good idea, but what sort of activity?

It is important to note that with intelligent learners covertly responding to programmed instruction there is still far more questioning of the learner than there is in a conventional teaching-learning situation. There is evidence in other instructional contexts to indicate how important this questioning might be (Glaser and Resnick, 1972; McKeachie, 1974; Prosser, 1974).

There are times when the Manual suggests that for certain types of learning there be a departure from individual learning to pairs or even groups. Several experiments have been performed which have compared the results obtained from learners working in pairs, in trios, in small or even in large groups (Hartley, 1968). In the majority of cases no significant differences in test results have been reported. However, for learning outcomes which deal with the affective domain, group interaction has resulted in better clarification of values and more lasting learning.

The Manual also suggests that at times the instructor and modular learning be integrated. Hartley (1972) gives research evidence that the instructor and module working together provide a more efficient teaching technique than either working in isolation.

Individualized learning is usually self-paced, and that is also the method advocated in the Manual. However, there are reminders throughout that a steady pace needs to be maintained, for as Landy et al (1969) points out, the rate of work expands to fit the timetable.

2. Identification of the Manual's Content

The need for the Manual is based on the Statement of Problem (p. 1) and the Statement of Need (p. 6) earlier in this dissertation.

To meet the stated needs, the Manual must serve two functions. First, provide the cognitive skills necessary for the construction of modules. Second, provide the step by step guidelines for designing and producing a module.

For the first function of the Manual (that of providing the necessary conceptual information) the content was identified partly through the use of Gagne's (1975) hierarchical analysis, which (paraphrased) states:

> What simpler knowledge would a learner have to possess in order to learn skill x, the absence of which would make it impossible for him to learn skill x. That is to say, in conducting such an analysis, one seeks to identify essential prerequisites, those subordinate skills which are actually incorporated into the skill to be learned.[1]

A full account of the hierarchical analysis which followed

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1 Research on Gagne's hierarchical analysis is in the Review of Literature.

is too lengthy for inclusion here, however the main required intellectual skills which were identified included the concepts associated with systems approach, mastery learning, criterion referenced evaluation, specification of learning outcomes and hierarchical analysis of cognitive skills.

The format and amount of content presented was partly decided on the evidence provided by questionnaires and quizzes which faculty completed during DURC Learning Sessions (mentioned in Statement of Problem) as well as by the questions asked by faculty when interviewed in the summer of 1976.

The second function of the Manual is to provide quidelines step by step, for the design and production of a module. One very useful conceptual model was developed at Florida State University and presented on the next page (Figure 1). The Florida State Model has been in use for nearly ten years. The author's main criticism of this model is that its concurrent activities are confusing in a self instructional manual. Some of the other models considered were the IDI[1] and Learning System Design (Davis, Alexander and Yelon, 1974). The IDI, with its nine major steps appeared too task oriented and lacked sufficient guides for product development. From the three models just mentioned, as well as a number of

1 Instructional Development Institute of National Special Media Institute (1972).

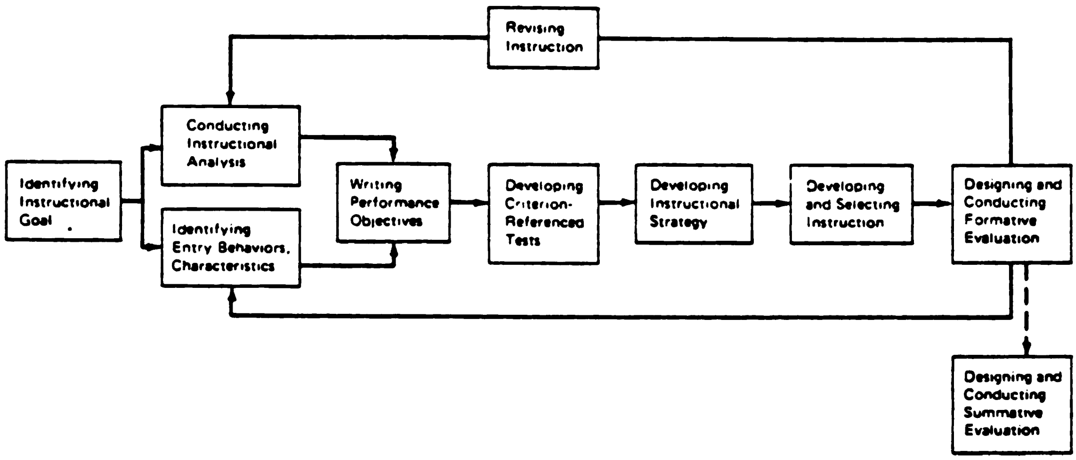

Fig. 1 -- Systems Approach Model for Designing Instruction from Dick and Carey, The Systematic Design of Instruction, Scott Foresman and Co.

others the author developed a conceptual model intended to meet the particular needs of DURC. The seven step model is presented on the next page (Figure 2) followed by the objectives for each step. It was primarily from this conceptual model that the content of the Manual was derived.

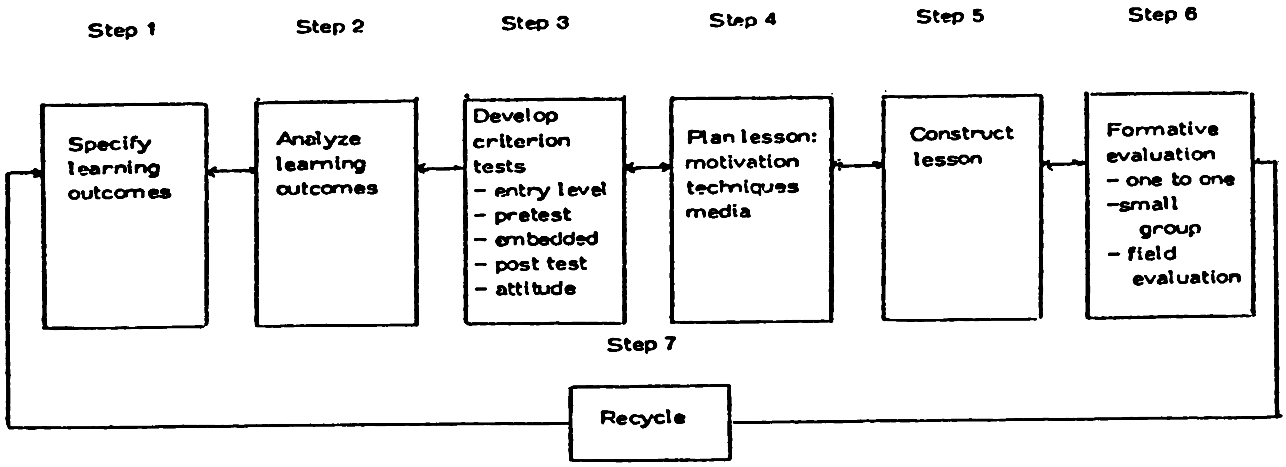

Fig. 2 — The M.S.U. Dietetic Model
The Model is named the M.S.U. Dietetic Model as it was developed largely through support and co-operation provided by the M.S.U. Dietetic Faculty.

3. Cognitive Objectives of the Manual

Step 1. Specify Learning Outcomes

1. Be able to identify learning outcomes which meet the criteria for initiating the development of a module.

2. Be able to state learning outcomes for a module of your own choosing. The learning outcome will meet the major criteria required for initiating the development of a module.

Step 2. Analyze the Learning Outcomes

1. Be able to identify and describe procedural, hierarchical and combination approaches to instructional analysis.
2. Be able to describe the relationship among the tasks which are identified through an instructional analysis.
3. Be able to apply instructional analysis techniques to identify subskills required to attain specified learning outcomes.
4. Be able to describe entry behaviors and distinguish them from general characteristics of students in a target population.

Step 3. Develop Criterion Tests

1. Be able to identify the purposes for entry tests, pretests, embedded tests and post tests.
2. Given a variety of learning outcomes, be able to write appropriate criterion referenced test items which reflect the learning required of the learner as stated in the learning outcomes.

Step 4. Plan Lesson

1. Be able to identify and describe the major components of an instructional strategy.
2. Be able to develop an instructional strategy for a set of objectives for a particular group of learners.

Step 5. Construct Lesson

1. Given an instructional strategy, be able to describe the procedures for developing instructional materials.
2. Be able to develop instructional materials based on a given instructional strategy.

Step 6. Formative Evaluation of the Lesson

1. Be able to state the purpose of formative evaluation.
2. Be able to state the purpose of summative evaluation.
3. Be able to state the procedures of formative evaluation.
4. Be able to state various methods of collecting data for formative evaluation.

4. Product Objectives of the Manual

1. You will write an instructional goal for a module of your own choosing.
2. You will identify the skills required to reach your instructional goal through the application of the appropriate instructional analysis technique.
3. You will derive the entry behaviors from your instructional analysis.
4. You will write performance objectives for the skills which have been identified in your instructional analysis.

5. You will write appropriate criterion-referenced test items which match the behavior required in your behavioral objectives.

6. You will place your identified subskills, behavioral objectives, and criterion-referenced test items in a chart to enable the evaluation of your design. In addition, you will draw an instructional analysis diagram which illustrates the sequence and relationship of your subskills. The components of the instructional analysis should be numbered to correspond to the subskills in your evaluation chart.

7. You will describe the instructional strategy for your set of objectives and target population.

8. You will develop a module based upon your instructional strategy.

9. You will develop an appropriate formative evaluation plan and instruments for your instructional module.

10. You will identify the problems and revise your module based on the data from your formative evaluation.

11. You will write a report which describes the design, development evaluation and proposed revisions of your instructional modules, according to the guidelines provided in this Manual.

5. Formative Evaluation of Manual

This evaluation was carried out along the guidelines suggested in Step 6 of the Manual presented in Appendix D.

Formative evaluation of the Manual was conducted in three phases. First a one to one phase; second, a small group phase; and third, one extended small group situation.

The one to one testing was conducted with three subjects: a graduate student from Instructional Development and Technology Department, a graduate student from Food Science and Human Nutrition and an instructor from Food Science and Human Nutrition. The form of the testing was for the author and the "learner" to go through all the components word by word. The learner would comment on anything which seemed unclear and the author noted the comment and recorded the possible alternatives. As a result of this phase, the Manual was extensively rewritten.

The extended small group phase was conducted with DURC starting August 1977. Participants were asked to work through a segment of the materials and make comments and suggestions prior to coming to the weekly meeting. At the meeting participants expressed their reactions to the materials and took the post test. All the materials were collected, comments considered and tests evaluated.

After revisions based on this phase were concluded, it seemed that the Manual could be put to its intended use. In addition, a Masters' candidate (Morrissey, 1978) in the Department of Food Science and Human Nutrition selected the Manual as the topic for her thesis.

C. Method of Pilot Testing: An Overview

Pilot testing consisted of an evaluation of the modules and the reports which were produced by the designers as a result of working through the self instructional Manual. These reports provided documentation on the processes which went into developing the module and were thereby helpful in the evaluation of the module. Guidelines as to what should be included in the report are stated in the Manual.

1. Sample Selection

Instructors in higher education who expressed interest in new methodology to improve their teaching were approached at random to see if they were interested in developing a module. The instructor needed to be in a field other than education and not have had formal training in instructional design. The interested instructor (designer) was given a copy of the Manual and encouraged to follow the directions. The designers were fully briefed as to the whole process and what the process entailed in terms of resources.

It was agreed earlier that the minimum number of instructors to be included in this study should be at least five while the actual number turned out to be seven.

Designers were geographically dispersed with some in Australia and others in Hawaii; this prevented input or 'contamination' by the author.

2. Data Collection

Each module was evaluated by different pairs of instructional designers who were either faculty or advanced degree students in Instructional Development and Technology at Michigan State University. The evaluation consisted of assessing each module with respect to each of 26 questions developed by the author. Each question was worth a stated number of points for a total of 100 and each question had a stated criterion level. Points were awarded by each evaluator as outlined in the rationale which accompanied the evaluation instrument. (The evaluation instrument and rationale for awarding points are appended as Appendix A.) Development of the 26 question evaluation instrument, rationale and objectives was started by the author as partial requirement for IDD 633 at Florida State University with Dr. L. Briggs, as instructor. At the time, modifications had to be made to the evaluation instrument and the rationale to bring about agreement with the stated objectives. Since that time, changes have been made to the objectives and consequently to the evaluation instrument. In April 1978, the author visited Florida State University and took the objectives and evaluation instruments to Dr. W. Dick, another author in the field. Dr. Dick suggested several changes and also gave a copy of an evaluation instrument which he has developed, for possible further development of the author's evaluation instrument.

Inter-evaluator reliability was determined by comparing the judgements of the two evaluators who independently reviewed each module and its accompanying report.
Evaluators were guided by the rationale which accompanies the criterion referenced evaluation instrument.

3. Attitudinal Questionnaire

Each designer was asked to complete an attitudinal questionnaire at the completion of the study. The purpose of this questionnaire was to guage the designer's attitude to the whole process of learning through the Manual, and the design and testing of their module.

Questions of particular interest are: would they design another module; if they designed another module how long would it take in relation to their first attempt; would they recommend this method to a colleague; has this experience changed their attitude and methods to their everyday teaching? A copy of the questionnaire is in Appendix E.

4. Summative Evaluation

Summative evaluation, e.g. experimental comparison of modules with conventional instruction, was not included in this dissertation due to the extensive logistics involved. Designers were not able to carry out their summative evaluation and report their findings before the deadline set for this dissertation. However, the summative evaluation of one module (Morrissey, 1978), which was produced as partial requirement for a Masters' degree, is reported in Chapter IV and Appendix C as a possible example or for replication studies.

CHAPTER IV

DESCRIPTION AND RESULTS OF PILOT TESTING OF THE MANUAL

The purpose of this chapter is to report the results of the pilot testing of the Manual. The chapter is divided into two sections, 1) description and 2) report of findings.

Description

The purpose of this pilot study was the evaluation of the Manual. As outlined in Chapter III, this was done through the evaluation of six products (modules), designed along the conceptual, information and step by step procedures provided in the Manual. Evaluation of each module was carried out by two competent instructional designers using a criterion referenced instrument (enclosed as Appendix A) and following a set rationale for the awarding of points (also in Appendix A).

The designers were instructors in higher education, three in Australia and three in Hawaii; each designer produced one module. Choosing designers geographically distant from the author controlled for author "contamination".

Designers in Australia were affiliated with the Caulfield Institute of Technology in Melbourne and the designers from Hawaii included a former professor attending the University of Hawaii as a graduate student, an instructor at the University of Hawaii, and a former professor now working as a consultant, living in Honolulu.

The designers in Australia were contacted when the author visited Australia in December, 1977 and the designers in Hawaii were contacted while the author worked at the University of Hawaii in January to March, 1978.

A designer was accepted when in conversation it became clear that he/she had very little, if any, training in the theory or methods of education. This lack of education background needed to be later verified by the responses to a pre entry test which the prospective designer was asked to complete. This pre entry test was essentially the same as used in DURC except that questions 10 and 11 were omitted, and questions 3 and 4 were changed to percentages for the prospective designers in Australia because grade points are not used there. Questions 3 and 4 were also marked as not applicable to the prospective designers in Hawaii who was working as a consultant. The pre entry test is enclosed as Appendix B; it was still titled "Survey on CBE" as the author considered such terms as "test" or "examination" to be inappropriate with the prospective designers.

Results of the pre entry test or "Survey on CBE" are also found in Appendix B. Suitable prospective designers were given a copy of the Manual (as in Appendix D) and asked to work through it. Designers were instructed to keep in touch to report the progress made on the module. Completed modules and reports were expected to be with the author by June 30, 1978.

The first module arrived in late May and the last module towards the end of July. Designers were then sent a Post Module Development Survey which they were asked to complete and return to the author. This survey is enclosed as Appendix E.

When a module arrived, the author sought out competent evaluators. The evaluation was carried out by three advanced degree students and four faculty, all associated with Instructional Development and Technology at Michigan State University. No evaluator was asked to evaluate more than two modules and for each module that was evaluated by a graduate student the other evaluator was a faculty member.

Findings

Altogether there are six findings which can be supported by data. Findings 1,2, and 3 relate directly to the research questions posed in Chapter 1:

1. Can a self instructional manual on designing modules be developed where those who complete the manual reach mastery level on its contents?

2. Will attainment of mastery of the self instructional manual result in a module which meets some minimum acceptable standards?

3. Will the module so developed obtain results at least as good as those obtained through traditional methods of instruction?

Findings 4,5, and 6, while not directly related to the above research question, are, neverthless of interest.

Finding 1: Mastery of Key CBE concepts was acquired through the Manual.

Data relevant to this finding is presented in Table 1. Key concepts, considered as essential for the design of a module had earlier been identified (p. 21). Mastery of these concepts was operationally defined as scoring above criterion on the 26 item evaluation instrument (in Appendix A) on which the modules and accompanying reports were evaluated.

Perusal of Table 1 indicates that the designers achieved considerable mastery of key concepts as measured by the modules actually produced. Of the 312 evaluations made, only nine were below the criterion level. However, each of the nine below the criterion level, judgements were made by one evaluator but not the other evaluator. From personal interviews with evaluators it seems that the "fail" judgements were either because of the ambiguity of the rationale given in the evaluation instrument or that the item did not seem applicable for that particular module or its intended users. For example, item VI A, preinstructional activities, was not fully addressed by two designers who maintained that they knew their learners to be highly motivated and therefore saw the need for only minimal amount of motivational preinstructional activity. In both of these cases one evaluator rated the item 0 but the other evaluator awarded at least the criterion level of points as a sign of accepting the designer's rationale. A close study of all of the items which were judged as not reaching the criterion level revealed that the designer understood the concepts involved but considered their use in the module as inappropriate.

As mentioned earlier, the designers chosen for this pilot study had very little knowledge of key CBE concepts. From the data in Table 1 it is clear that the vast majority of key concepts have been mastered by all designers and thus it is suggested that these key concepts can be and were acquired primarily through the Manual.

Finding 2: The Manual led to development of acceptable modules

A total of six modules were designed. All six modules reached the criterion level; findings are reported in Tables 1 and 2. It is reasonable to conclude that the Manual led to the development of acceptable modules as all designers had stated at the outset that they had no knowledge of how to design modules and their knowledge of key concepts was very low (see Appendix B). The question which remains unanswered concerns the amount of assistance the designers required and received apart from the information provided in the Manual.

Judging from the evaluation questions sent to the author, four stated that they required further reading of the recommended texts, particularly Gagne (1975); three stated they required no further readings. No designer reported having sought any consultative help from anyone.

There was one deficinecy in the Manual expressed by the designers. They indicated the need for a finished product as a model of what was expected; this requirement was expressed by all designers. As the designers were the first group to produce modules there were no finished products available as models. While there were no finished products which met the criterion set down, there were some which in some ways resembled the required product. The first such module was the one developed by the author, called Renal which is on Control Data Corporation's Plato system. The designers in Hawaii had access to this program but the ones in Australia did not. To fill this need for models, the designers were referred to Briggs (1977) where three modules are included. However, those modules had been developed on a different format and therefore would have only been of minimal help to the designers (perhaps even confusing).

However, the point was made that the designer experienced certain (unnecessary) anxiety which could have been avoided by the inclusion of a completed product. The absence of a finished product as a model for the designers in Australia seemed to have very little effect on the quality of their modules as the evaluations were equivalent to the evaluations of the modules designed in Hawaii where the designers had the opportunity to see a module.

Table 1 Evaluation of Modules

	Maximum points	Criterion level	MODULES											
			A		B		C		D		E		F	
			Ev.1	Ev.2	Ev.1	Ev.2	Ev.1	Ev.2	Ev.1	Ev.2	Ev.1	Ev.2	Ev.1	Ev.2
I. Instructional Goal														
A. rationale for module (criteria used for selecting instructional goal)	5	4	4	4	5	4	5	3	5	5	4	4	5	5
B. statement of instructional goal	2	2	2	2	2	2	2	2	2	2	2	2	1	2
II. Instructional Analysis														
A. rationale for methodology selected.	2	2	2	2	2	2	2	2	2	2	1	2	2	2
B. completeness of diagram of subskills.	10	8	8	9	8	9	8	8	8	10	8	8	8	10
C. description of relationship among subskills. . .	2	1	0	1	2	2	2	1	2	2	2	2	2	2
D. clarification between subskills included as entry behaviors and those included as skills to be learned through materials	2	1	1	1	1	2	1	1	2	2	2	2	1	2
III. Description of Target Population														
A. description of general characteristics of target population and implications these have for instructional materials	4	3	2	3	4	4	3	4	4	4	3	4	4	4

Scores below criterion are underlined

Table 1 cont'd.

	Maximum points	Criterion level	MODULES A Ev.1	A Ev.2	B Ev.1	B Ev.2	C Ev.1	C Ev.2	D Ev.1	D Ev.2	E Ev.1	E Ev.2	F Ev.1	F Ev.2
IV. Learning Outcomes														
A. derivation from instructional analysis	4	3	3	3	3	4	4	3	4	4	3	3	4	4
B. statement of the learning outcome	6	4	5	5	5	6	5	5	6	6	4	5	6	6
V. Criterion-Referenced Tests														
A. relationship of items to learning outcomes	4	3	3	3	4	4	3	3	4	4	3	3	3	4
B. criterion level or mastery level of performance clearly identified. . . .	3	2	3	3	3	3	3	3	3	3	1	2	3	2
C. appropriate tests based upon materials and target population (pretests, post-test, embedded test, entry behaviors test) . .	9	7	8	9	7	8	7	8	9	8	7	8	8	9
VI. Instructional Strategy														
A. preinstructional activities.	2	1	2	2	0	2	2	1	2	2	0	1	2	1
B. information presentation.	4	3	4	4	3	4	3	4	4	4	3	3	4	4
C. student participation activities.	4	3	3	3	3	4	3	4	4	4	3	3	3	4
D. follow-through activities	2	1	1	1	1	2	1	2	2	1	0	1	2	2
E. strategy congruent with materials	6	5	6	5	5	5	5	6	6	6	5	6		6

Scores below criterion are underlined

Table 1 cont'd.

	Maximum points	Criterion level	A Ev.1	A Ev.2	B Ev.1	B Ev.2	C Ev.1	C Ev.2	D Ev.1	D Ev.2	E Ev.1	E Ev.2	F Ev.1	F Ev.2
VII. Formative Evaluation														
A. description of one-to-one data collection procedures	4	3	3	4	4	3	4	4	4	4	4	4	4	3
B. results and revisions based upon one-to-one testing	6	4	4	5	6	4	5	4	6	6	4	5	5	6
C. description of small-group evaluation procedures														
1. sample group characteristics	2	1	2	2	2	2	1	1	2	1	1	1	2	2
2. design of formative evalaution study	4	3	3	3	4	4	3	1	3	4	3	3	3	4
3. instruments and procedures used for data collection	4	3	4	4	4	4	3	3	4	4	3	3	4	4
4. data summary and display	4	3	4	3	3	4	3	4	4	4	3	3	4	3
VIII. Suggested Revisions														
A. materials	2	1	1	1	2	2	2	2	2	1	2	2	2	2
B. tests	2	1	1	2	2	2	2	2	2	2	1	2	2	2
C. procedures	2	1	1	1	2	2	2	2	2	2	1	2	2	2
TOTAL	100	73	80	85	87	98	84	83	98	97	73	84	86	87

Scores below criterion are underlined

Table 2 - Evaluation of Modules--A Summary

Evaluators were asked if the Module met the criterion level.

Module	Did the Module meet the criterion?		Total points awarded	
	Evaluator		Evaluator	
	1	2	1	2
A	Yes	Yes	80	85
B	Yes	Yes	98	87
C	Yes	Yes	84	83
D	Yes	Yes	98	97
E	Yes	Yes	73	84
F	Yes	Yes	86	87

Finding 3: There is some evidence that students taught through a module produced from the Manual would perform, on the average, as well as those taught by a traditional lecture method.

Due to complex logistics, none of the designers overseas were able to complete an experimental comparison of their module in time to be reported in this study. However, one module was experimentally tested[1]. The designer was able to arrange three experimental situations where equal ability students were divided into two groups. Students in the control group were taught using conventional lecture methods while students in the experimental group were taught the same topic in the form of a module. A full account of the methodology used and the results are reported in Appendix C.

Both groups (experimental and control) in all three experiments showed considerable gains. Table 3 is presented to illustrate this gain, other tables showing pre and post test differences are presented in Appendix C. When the post test means of the control groups (traditional lecture method) were compared with the post test means of the experiemtal groups (the module) in each case the means of the experimental group were higher; however the differences were not statistically significant at the .05 level.

In this experiment the students taught through the module received, on the average, as good if not better results as the students taught by the conventional method.

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1 This module was designed to satisfy the requirements of a Master's Thesis. The formative evaluation of this particular module is not reported in this dissertation because it went through evaluation processes required by the designer's committee which were different to those required for this dissertation.

Table 3.--Results of T-test for Difference Between Pretest and Posttest Percentage Mean Scores in Lecture and Module Treatments for Michigan State University and the University of Hawaii Dietetic Students. (Morrissey, 1978)

Group	Pretest	Posttest	Difference (Posttest-Pretest)	T Value	df	p
Lecture (N = 15)						
Mean	67.2667	90.5333	23.2667	8.03	14	.001[a]
Standard deviation	9.354	6.621	11.222			
Standard error	2.415	1.710	2.897			
Module (N = 32)						
Mean	61.5000	93.4063	31.9063	11.72	31	.001[a]
Standard deviation	15.268	5.223	15.395			
Standard error	2.699	.923	2.721			

[a]Significant at $\alpha < .001$.

Finding 4: The Manual promoted a positive attitude toward CBE and module design.

When asked in the Post Module Development Survey (Appendix E) if they would design another module following the Michigan State University model, all designers answered yes. A further question in the same survey asked: would you recommend this model to anyone else? The answer again was yes from all designers. With these positive findings and an absence of negative findings, it may be concluded that the Manual develops positive attitudes to CBE and module design.

Finding 5: Designers reported that the Manual had affected their method of teaching.

When designers were asked in the Post Module Development Survey* if designing their module had changed their way of teaching, the answer was yes. Three designers reported that the experience had greatly changed the way they teach while the other three designers reported that their method of teaching had not changed a great deal but that they approached the process of teaching in a different way.

Finding 6: The diffusion and acceptance of CBE concepts by DURC was partly attained through the co-operative development of the Manual.

As reported earlier in this dissertation, there had been resistance to CBE concepts by DURC; it was hoped that the co-operative

* Question , Appendix E

development of the Manual would overcome this resistance. While the evidence is not tangible or measurable, there are signs that CBE concepts have become more acceptable to members of DURC. The supporting evidence is as follows:

a. One member of the group has completed a module (following the Manual) which has been summatively evaluated.

b. One module is being designed for the purposes of a Doctoral Dissertation.

c. Three instructors are in the process of designing modules for their own use with learners.

d. Seven members of the DURC group are presenting the Manual as a workshop at the annual convention of the American Dietetic Association.

e. The Manual has been cited in a number of presentations at conventions by members of DURC.

In the next chapter (Chapter V, Summary and Conclusions) these findings are further discussed.

CHAPTER V

SUMMARY AND CONCLUSIONS

This concluding chapter has four sections (a) summary of the pilot testing of the Manual, (b) major conclusions of the study, (c) heuristics[1] related to this study and (d) recommendations for further research.

Summary of the Pilot Testing of the Manual

The purpose of this study was to see if a self instructional Manual could be developed, for a broadly defined group, so that members from that group could independently design modules for use in higher education where higher level cognitive skills were required. At least five modules were to be designed. The completed modules were to be evaluated on a criterion-referenced instrument. Designers

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1 By the term "heuristic" the author takes to mean findings based on evidence of experience from the conduct of this study, which may need further verification by more scientific methods. Some of the conclusions need to be presented as heuristic because (a) the small N upon which these generalizations are based do not allow for more definitive statements and (b) these heuristics are worthy of further consideration by other instructional developers.

were also asked to complete an attitudinal questionnaire on their perception of the effectiveness and usefulness of the Manual as well as their reaction to the whole process of designing a module.

A total of six modules were developed for this study, three in Australia, and three in Hawaii. A further module was developed at Michigan State University; it was designed and tested as partial fulfillment of a Master's Degree and was not evaluated on the criterion-referenced instrument and therefore is not reported in Tables 1 and 2 (pp.74-77). However, as the module was tested experimentally, those findings are reported in Chapter IV and Appendix C.

Conclusions of the Study

Conclusion 1: INFORMATION PROVIDED IN THE MANUAL RESULTED IN THE DESIGN AND PRODUCTION OF SATISFACTORY MODULES.

Of concern to educators is the frequent inability of the learner, who has demonstrated possession of certain cognitive knowledge, to transfer such knowledge into practice. The designers in this pilot study clearly transferred the cognitive skills they acquired from the Manual to the design and production of their module.

Conclusion 2: HIGHER LEVEL COGNITIVE SKILLS WERE TAUGHT THROUGH THE MANUAL.

The cognitive skills to be mastered in the Manual ranged from low level discrimination to higher order rules. Designers demonstrated acquisition and capabilities of these skills by designing and producing modules where each module included higher order rules. By judging the evidence provided in the designer's formative evaluation of their own module, it was clear that their subjects also reached mastery of higher order rules.

Conclusion 3: THE MANUAL WAS FOUND TO BE USEFUL IN MEETING THE NEED FOR WHICH IT WAS DESIGNED.

Common criteria for assessing the usefulness of an educational product such as the Manual is to question its validity, feasibility, and effectiveness.

1. Validity—Did the Manual do what it was supposed to do? The Manual would be considered valid if (a) designers were able to gain knowledge of key CBE concepts and information from it and (b) if those concepts would result in an acceptable module.

With respect to the criterion of validity, evidence in this pilot study indicated that designers did gain cognitive knowledge of the key CBE concepts. Further, all designers produced modules which exceeded set criteria. On the evidence available, the Manual was valid.

2. Feasibility--The Manual would be considered feasible if five or more college level instructors, with only minimal knowledge of CBE, and geographically distant from the author, would complete modules which met the criterion level.

With respect to the criterion of feasibility, evidence in this pilot study showed that six college level instructors, all meeting the stipulations of this study, began and completed their modules, and all met the criterion level. Therefore, for the conditions set out in this pilot study, the Manual can be considered feasible.

3. Effectiveness--The Manual would be considered effective if (1) designers reached mastery level on key CBE concepts and (2) the modules which they designed and produced would meet a criterion level.

Evaluation indicated that on (1) there were 52 evaluations made on each designer and 312 for the group of six. Of the total of 312 evaluations, nine were below the criterion level. Of these nine, some judgements may be reversed because of dubious validity of the test item. Because of the large number of positive evaluations (303 or more) the Manual can be accepted as effective within the design of this pilot study as enabling designers to reach mastery level.

Evaluations on (2), that the modules would meet a criterion level, were all positive. Consequently, the Manual was effective in this pilot study.

Heuristics

As a consequence of the development and pilot testing of the Manual the author formulated certain heuristics which may be of interest to other instructional developers. The heuristics mentioned here are only a sample (in the author's view, the most important ones). However, a large number of heuristics emerged throughout the formative evaluation stage of the Manual which is not a part of this pilot study and therefore not reported here.

> Heuristic 1: A democratic responsive development of a product is more likely to result in its acceptance.

Often, in instructional development, potential clients or designers are given a model which they are to follow. This method amounts to the imposition of a method of accomplishing goals perceived by the developer of the model rather than the target population. The situation is compounded where the designer has not met the target audience and is not aware of the particular group's concerns.

In this pilot study the Manual was developed for the expressed needs of the target population. This meant that every word of the Manual was critically read by at least fifteen members from the target population. As a result of the feedback, areas of concern to the target population were re-written and submitted for further review until the refinements were accepted and no major concerns were found.

Heuristic 2: Learners are likely to closely follow a completed product.

All modules developed for this pilot study followed closely the format of the Manual itself. That is, they all used print format, incorporating many of the techniques of programmed learning. While it was suggested to the designers that the modules which make up the Manual could serve as models, it was also stated that the format and medium of their own modules should be determined by an analysis of the learning outcomes; on that criterion, a number of modules should have utilized visuals, movement, and in one case, a musical instrument. It appears that the novice designer requires examples of the different media mentioned in the Manual to fully operationalize cognitive knowledge.

Heuristic 3: Technical terms and jargon of education should be avoided, if possible.

Many of the terms used in CBE are threatening to people outside education. Often the threat is due to an impression that the term represents technical precision, and implies an entirely new form of operation which required a great deal of effort for anyone unfamiliar with it. For example, the term "module" seems to arouse such fears; the term is used in other fields such as the building industry, electronics and space technology, and to add to the confusion, in education it is used to mean different things, such as a block of timetable or components of a school system.

In such a situation, the author found it helpful to introduce new educational terms through terms that were already understood. For example, the term "module" was introduced initially as a "well designed lesson". Then as time went on and examples of modules became available and the components of a module became known, the correct technical term came into more frequent and accepted use.

> Heuristic 4: The design of modules is a time consuming, frustrating and difficult task; only people with special motivation will see the task through.

The author knew from previous experiences and from literature that it is very difficult to get faculty members to design and report on complex modules. The fact that, for this pilot study, six faculty members started and completed their modules is due to a combination of factors. At the start of the project, the author developed a mental profile of the faculty member most suitable for the pilot study. The person must feel a personal need to improve the quality of teaching. Such a person is usually already a good teacher and has drawn attention to him/herself for this reputation, but now is seeking further improvement and is looking for outside help. Usually this person is a strong scientist or researcher in his/her own field and feels a need to also be successful as a teacher.

Recommendations for Further Research

This was a pilot study. Pilot studies are used to refine a product, the methodology used and measures employed. As a result of the present study, a number of recommendations for further development and research can be made. These recommendations can be classified as (1) improvements or refinements to the Manual, and (2) improvements in the methods of investigation to make the findings more generalizable.

Improvements to the Manual

A number of improvements need to be made to the Manual. According to the feedback received from the designers, it is necessary to include a finished product with the Manual to serve as a model. This seems an obvious point as the diffusion of innovation literature stresses the necessity for innovators to see a finished product. Research needs to be carried out as to the type of model to be provided, for example, should it be slide/tape, print, video, or a combination. Would a model using one medium influence designers to design similar medium modules? What should the length of the model be? Would a lengthy model encourage similarly lengthy products? How elaborate should the model be? How does a costly, professionally designed and produced module affect the beginning designer, for example, would it be threatening or would it be motivational?

Designers commented on the presentability of the Manual. The point was made that the total number of pages approaches 300 and it is difficult to find a section of interest without spending a lot of time searching. Suggested changes include the use of colored pages according to a code, e.g. white paper denotes conceptual background information, green paper for the seven steps of the model and so on. Another improvement could be the use of plastic tabs attached to the different sections which would act as "thumb tabs".

One unanswered question concerns the adequacy of the Manual; is all the necessary material available in the Manual? The evidence indicates that designers need to go to further outside sources for more information. The author considers this to be acceptable; to include everything that is possibly required in the Manual would make it a frightfully heavy volume. In the present Manual there are a lot of references to which the designer could turn for further information. However problems could arise where the references are not available, particularly in another country.

Designers also pointed to a few typographical errors, areas where improvements in expression are needed and a total of three missing pages.

The obvious shortcomings in the Manual need to be corrected and further development cycles could look into the question of the amount of information included. Further research should also look at the different styles of expression used in the Manual. At the present, the styles are varied, ranging from harangues to adopt different attitudes, to humor, to matter-of-fact presentations of research findings.

Generally there were insufficient comments on the construction, content and presentation of the Manual itself, possibly because such information was not actively sought by the author. Further development cycles need to solicit more feedback from the designers.

Improved Methods of Investigation

There is a need for better evidence on the validity, feasibility and effectiveness of the Manual. The methods used in this pilot study provided tentative evidence until the next cycle of refinement. In the next cycle of refinement the following areas could be considered.

Validity.-- The validity of the evaluation items (in Appendix A) should be further studied to see if they correspond with, and consequently measure, the content of the Manual. Further, do the evaluation items accurately measure the designer's knowledge and product? It seems that evaluation item VI A in particular needs to be further tested. The validity of pre and post test items, throughout the Manual need to be established.

Feasibility.--One area to be further researched is the feasibility of the Manual as a self instructional entity. In this pilot study the six designers were guided to some extent by corresponding with the author where they were constantly encouraged to keep to their time lines and complete their modules. However, without this constant monitoring would the designers carry on their task to completion? What factors could be built into the Manual which would ensure completion, e.g. the effectiveness of time lines designed into the Manual for purposes of self pacing?

Effectiveness.-- In the next cycle of research and development better measures of effectiveness need to be used; measures which can provide better quantitative evidence on the effectiveness of the Manual. Two areas are of immediate interest. One area concerns the designer's knowledge gain and changes in attitude measured through pre and post test results. Such measures should provide clear data as to the designer's knowledge of key concepts and attitudes towards CBE, for pre and post treatment comparisons.

The second area is the effectiveness of the modules produced by the designers compared to traditional teaching methods. The experimental design presented as Appendix C is a possible guide to such experimentation and deserves replication.

Concluding Remarks

The Manual provides the cognitive skills and the procedural guidelines for the design and development of a module. Two additional features of the Manual are (1) that it is self instructional and (2) that it particularly addresses the acquisition of higher order skills. The development of the Manual was through responsive interaction with a particular target group (college level instructors with minimal CBE background) where this author attempted to respond to the needs of that group.

In this pilot study, the Manual has been successful; it is now ready for a further cycle of development and evaluation. In this next cycle, summative evaluation in the form of comparing performances of control and experimental groups should provide further data as to the validity, feasibility and effectiveness of the Manual.

It is hoped that the product (the Manual) and the principles used in its development will prove useful to educators who are sufficiently concerned with the needs of learners to engage in the learning and growth process themselves.

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APPENDIX A

1. Evaluation Instrument for Module

2. Rationale for Evaluation

MODULE EVALUATION

	Maximum Points	Criterion Level	Points Awarded
I. Instructional Goal			
A. rationale for module (criteria used for selecting instructional goal)	5	4	
B. statement of instructional goal	2	2	
II. Instructional Analysis			
A. rationale for methodology selected	2	2	
B. completeness of diagram of subskills	10	8	
C. description of relationship among subskills	2	1	
D. clarification between subskills included as entry behaviors and those included as skills to be learned through materials	2	1	
III. Description of Target Population			
A. description of general characteristics of target population and implications these have for instructional materials	4	3	
IV. Learning Outcomes			
A. derivation from instructional analysis	4	3	
B. statement of the learning outcome	6	4	
V. Criterion-Referenced Tests			
A. relationship of items to learning outcomes	4	3	
B. criterion level or mastery level of performance clearly identified	3	2	
C. appropriate tests based upon materials and target popultaion (pretests, posttest, embedded test, entry behaviors test)	9	7	
VI. Instructional Strategy			
A. preinstructional activities	2	1	
B. information presentation	4	3	
C. student participation activities	4	3	
D. testing (covered in No. V)			
E. follow-through activities	2	1	
F. strategy congruent with materials	6	5	
VII. Formative Evaluation			
A. description of one-to-one data collection procedures	4	3	
B. results and revisions based upon one-to-one testing	6	4	
C. description of small-group evaluation procedures			
1. sample group characteristics	2	1	
2. design of formative evaluation study	4	3	
3. instruments and procedures used for data collection	4	3	
4. data summary and display	4	3	
VIII. Suggested Revisions			
A. materials	2	1	
B. tests	2	1	
C. procedures	2	1	
TOTAL	100	73	

RATIONALE FOR MODULE EVALUATION

I. Instructional Goal

A. The designer should clearly indicate the rationale for selecting the topic for their instruction. The rationale should include such items as their expertise in the content area, ability to provide the instruction within a reasonable amount of time, the availability of students to try out the materials in the formative evaluation, and the need for this type of instruction.

B. The goal statement should be a clear indication of the outcome of the instruction. Although the goal does not need to be stated in precise behavioral terms, it should reflect, in general, what students should be able to do when they have completed the instruction.

II. Instructional Analysis

A. The designer should indicate which instructional analysis methodology has been chosen and why it was selected.

B. The designer should include a complete instructional analysis chart that lists all the subskills associated with the instructional goal. The subskills should be stated in behavioral terms. Entry behaviors should be included on the chart and clearly indicated as such.

C. The designer should describe the diagram previously described in B and indicate the relationship of the subskills to each other.

D. The designer should describe the entry behaviors that have been identified and explain the rationale for including them. For instruction that has no relevant entry behaviors, students should explain why none are required.

III. Description of Target Population

A. The designer should describe the general characteristics of the target population for whom their instruction is being prepared. The target populations may vary from a particular classroom group to a national category of students. Important aspects of this component are that the target population is identified and that there is some statement of the implications of the relationship between the general characteristics of target students and the instruction to be provided for them.

IV. Performance Objectives

A. The designer should include in the documentation report a chart that indicates in one column the subskills and instructional goal as identified in the instructional analysis and in a second column, the corresponding performance objectives and terminal objective for the instructional unit. Subskills and objectives should be numbered similarly in order to indicate their relationship.

B. The objectives for the instruction should be stated using the three components suggested by Mager. These include the conditions, performance, and criteria. The alternative approach to writing objectives suggested by Gagne and Briggs is also appropriate. Student should indicate which format they have used for the objective statements.

V. Criterion-Referenced Tests

A. The designer should provide a clear indication of the relationship between their test items and their instructional objectives. This relationship can be indicated by assigning the same numbers to test items as was used to number the corresponding subskills and objectives, or, a chart can be developed which indicates the item number of each performance objective and the corresponding test items.

B. The designer should indicate the criterion used to judge the mastery level of learners' performance relative to each of the objective and to the total test.

C. After reviewing the test, the instructor should determine if there are adequate number of test items and whether the items are appropriate for the target population and the content of the instruction.

VI. Instructional Strategy

A. The designer should describe how their instruction will motivate learners, inform them of what they are going to learn, and remind them of related information which they already know.

B. The designer should describe how the content will be presented to learners. This explanation should not simply be a running description of the specific content, but rather an indication of how "chunk" size will be determined and sequenced.

C. A description should be included of the activities provided to learners to practice the behavior taught in the instruction. The provision of feedback for learners' performance should be described.

D. The evaluation of testing strategies was discussed previously in Section V.

E. Although the designer is not typically required to develop any remedial or enrichment activities, a brief description of suggested ones should be included.

F. After examining the instructional strategies described by the designer, the instructor should examine the instructional unit itself to determine whether the materials are consistent with the strategies described by students in their documentation sections.

VII. Formative Evaluation

A. The designer should describe the preparation of instruction for the one-to-one formative evaluation. This description should include the format of materials to be evaluated, the characteristics and entry behaviors of learners who participated in the evaluations, the criteria for the selection of the learners, and the procedures followed in conducting the one-to-one evaluation.

B. The designer should describe the results of the one-to-one evaluation, particularly the major comments received from learners during the evaluation. There should be a description of the types of revisions made in the materials and the rationale for these revisions based on the results of the one-to-one evaluation.

C. The designer should provide a complete description of the characteristics and entry behaviors of learners who participated in the small-group evaluation. There should also be a complete description of the procedures employed in implementing the evaluation. The description should include the format of the materials, the procedures which were used for testing, the instructions given to learners, and the feedback received at the end of the instruction. There should be a description of all instruments and procedures used to collect data. These descriptions can be used to document the effectiveness of the instruction and to identify points in the materials that still need revision. Students should summarize the data collected, including the display of such items as pretest and posttest performance, performance on embedded-test items, learning time, performance by objectives, and learner attitudes as indicated on questionnaires.

VIII. Suggested Revisions

A. The designer should describe, based on the data and information gathered during the small-group evaluation, the revisions which remain to be made in their materials. The relationship between these revision recommendations and the data obtained during the small-group evaluation of the materials should be apparent.

B. The designer should indicate revisions that remain to be made in the test instruments as a result of the data and information gathered during the small-group evaluation.

C. The designer should indicate any instructional procedures that need to be revised as a result of information gathered during the small-group evaluation. They should describe any changes in procedures or materials needed if materials were used in a regular classroom setting.

Criteria for Evaluating Designer-Prepared Instructional Materials

1. Materials should include objectives, pretests/posttests, and the instruction.
2. The instruction should follow the instructional strategy established for the unit as described in the documentation report. Some general guidelines:
   a. Have adequate <u>motivation</u> and attention getting ideas been provided for the <u>content</u> to be taught and the <u>characteristics</u> of the target learners?
   b. Have learners been informed of necessary <u>prerequisite knowledge</u> or <u>skills</u>?
   c. Have students been informed about what they will be learning to do (common language objectives)?
   d. Have ideas and concepts been presented in a logical sequence?
   e. Is enough explanation provided for pupils to actually "learn" the ideas, concepts, and skills?
   f. Are accurate and adequate examples included of ideas, concepts, and skills being taught?
   g. Are there embedded tests to provide pupils with the opportunity to practice skills?
   h. Is adequate and accurate feedback provided to pupils responses to the embedded tests?
3. Are materials legible, clear, and easy to follow?

It may be expected that the instructional materials will be prototype or first drafts that are inexpensively produced. Drawings and illustrations should be stick figures or magic marker drawings and materials should be inexpensively duplicated. This "draft" nature of the materials should not detract from the students' evaluation of their materials. The important issue is that the materials include the information on the right pages, and in the right order, so that it can be tested with target learners, analyzed, and revised before being produced in a more polished format.

APPENDIX B

SURVEY ON

COMPETENCY BASED EDUCATION

Survey on CBE

1. Mager suggests that there are three components to a well written objective. What are these components?

   A. ____________________

   B. ____________________

   C. ____________________

2. In the space below write an objective (no matter in what field).

   ____

   ____

   ____

   ____

3. Taking your previous classes as a guide, what percent of your students do you:

   A. expect will get 3.5 or better? _____%

   B. expect will get satisfactory 2.0 to 3.0% _____%

   C. expect of fail, less than 2.0? _____%

4. Do you believe that with proper instruction and more time (if needed) nearly all of your students could earn 4.0?

____

5. What do you understand by the term "competency"?

____

____

6. Do you agree with the following statement:

At the undergraduate level we should assign challanging work so that the good students can stand out and be identified for graduate work or for leadership in the field?

____

7. Do you identify the knowledge and skills of the students who come to your class at the start of an academic quarter?

Yes/No

If yes, how?_______________________________________

____

8. Please indicate your true belief and considered opinion to the following statements:

S.A=strongly agree M=neutral S.D=strongly disagree

A =agree D=disagree N.A=I don't understand

	S.A	A	N	D	S.D	N.A
A. In most cases if a student fails to learn the teacher should be considered primarily responsible						
B. Teaching is the application of scientific principles.						
C. A teacher's job primarily should be to give students information.						
D. Instructional technology is the use of machines in teaching.						

9. How well do you know the following concepts? Please indicate with:

N=nothing L=a little O.K.=enough to explain to others

	N	L	O.K.
A. Mastery Learning			
B. Competency Based Education			
C. Bloom's Toxonomy			
D. Gagne's hierarchy			
E. Criterion referenced measures			
F. Norm V. criterion referenced tests			
G. System approach to education			
H. Principles of learning			
I. Formative Evaluation			

10. Are there concepts which we use in DURC which you are uncomfortable with and would like to have explained?

____

____

____

11. Do you think that DURC meetings devoted to working through CBE and related concepts would be:

Very helpful Helpful Waste of time

APPENDIX C

Results of Summative Evaluation

of a module designed as partial

requirement of a Master's degree

CHAPTER V

RESULTS/DISCUSSION

These null hypotheses have been written: (A) dietetic students at MSU and the University of Hawaii given a self-instructional module or equivalent lecture presentation to learn the application of the POMR concept to client nutritional care will show no significant gain in score from pretest to posttest (both tests measuring equivalent content) to indicate that learning has taken place, (B) dietetic students at MSU given a self-instructional module to learn the application of the POMR concept to client nutritional care will show no significant difference in achievement on the posttest compared to dietetic students at MSU given an equivalent lecture presentation on POMR and same posttest and (C) dietetic students at MSU given a self-instructional module to learn the application of the POMR concept to client nutritional care will show a significant difference in achievement on the posttest compared to dietetic students at the University of Hawaii given the same self-instructional module and same posttest.

Also an achievement at the Mastery level of ninety percent accuracy on the posttest would indicate that the dietetic student can apply Problem-Oriented Medical Record (POMR) knowledge into accurately writing a dietetic problem, plan of action and SOAP progress note.

When the hypothesis predicts that differences will exist in the data and allows this difference to be in either direction (larger or smaller), a two-tailed test of its null hypothesis is performed since the difference can fall in either tail of sampling distribution (Nie et al., 1975).

The T-test provides the capability of computing whether or not the difference between two sample means is significant. Two types of tests may be performed.

1. Independent samples: the cases are classified into two groups and a test of mean differences is performed for specific variables.

2. Paired samples: for paired observations arranged casewise, a test of treatment effects is performed. An example would be the same (or similar) individual being measured before and after treatment.

The goal of the T-test statistical analysis is to establish whether or not a difference between two samples is significant. "Significant" is used to mean "indicative of" or "signifying" a true difference between the two samples (Nie et al., 1975).

A significance level for testing the null hypothesis was chosen and set at equal to or less than .05. This significance level is exactly the probability of rejecting the null hypothesis when it is true (Nie et al., 1975).

If it is known whether the two populations have the same variance, an F test of sample variances may be performed. The null hypothesis with alternative hypothesis and a significance level α' is chosen. An α' level of .05 was chosen. From the sample variances, F was computed. If the probability for F is greater than α', the t value based on the pooled-variance estimate is used to determine probability.

If the probability for F is less than or equal to α', the t value is based on the separate variance estimate to determine probability (Nie et al., 1975).

Results of Hypothesis Testing

Each hypothesis is presented along with a report of findings. Five of the pretests of the Michigan State University Conventional Study Plan Dietetic Students were misplaced so the data from these students could not be included in the analysis of data.

Hypothesis A: Dietetic students at MSU and the University of Hawaii given a self-instructional module or equivalent lecture presentation to learn the application of the POMR concept to client nutritional care will show no gain in score from pretest to posttest to indicate that learning has taken place.

This hypothesis was tested using the dependent T-test. Results are reported on Table 1.

Findings: The null hypothesis was not supported. There was a significant gain from pretest to posttest for all groups ($\alpha < .001$). The pretest scores for both treatments showed greater deviation compared to the deviation in the posttest scores, which may also indicate that more students learned the POMR concept in an equivalent manner.

Hypothesis B: Dietetic students at MSU receiving the self-instructional module on POMR will not show a significant difference in achievement on the posttest compared to dietetic students at MSU given an equivalent lecture presentation on POMR and same posttest.

This hypothesis was tested using the independent T-test. As the dietetic curriculum had two offerings, the Coordinated Study Plan

Table 1.--Results of T-test for Difference Between Pretest and Posttest Percentage Mean Scores in Lecture and Module Treatments for Michigan State University and the University of Hawaii Dietetic Students.

Group	Pretest	Posttest	Difference (Posttest-Pretest)	T Value	df	p
Lecture (N = 15)						
Mean	67.2667	90.5333	23.2667	8.03	14	.001[a]
Standard deviation	9.354	6.621	11.222			
Standard error	2.415	1.710	2.897			
Module (N = 32)						
Mean	61.5000	93.4063	31.9063	11.72	31	.001[a]
Standard deviation	15.268	5.223	15.395			
Standard error	2.699	.923	2.721			

[a]Significant at $\alpha < .001$.

and Conventional Study Plan, the data were collected separately for students enrolled in each plan. Results are reported on Table 2.

Findings: The null hypothesis was supported. The difference in achievement on the posttest scores for the module and lecture groups was not significantly different. Further analysis revealed that the Conventional Study Plan students in the module group had the lowest standard deviation. The Coordinated Study Plan students in the module treatment may have been a more homogeneous group. The pretest scores were analyzed at the same time the posttest scores were analyzed and so were also included on Table 2. There was a significant difference in pretest scores between the lecture and module groups of the MSU Coordinated Study Plan students (.001) whereas pretest scores in the lecture and module treatments for the MSU Conventional Study Plan students were not significantly different.

Hypothesis C: Dietetic students at Michigan State University receiving the self-instructional module on POMR will show a significant difference in achievement on the posttest compared to dietetic students at the University of Hawaii given the same self-instructional module and posttest.

This hypothesis was tested using the independent T-test. As the dietetic curriculum had two offerings, the Coordinated Study Plan and Conventional Study Plan, the data were collected separately for students enrolled in each plan. Results are recorded on Table 3.

Findings: The null hypothesis was not supported. The differences in achievement on the posttest percentage mean scores were not significant.

Table 2.--Independent T-test for Difference in Pretest and Difference in Posttest Percentage Mean Scores Between Lecture and Module Treatments for Michigan State University Coordinated (Coord.) and Conventional (Conv.) Study Plan Students.

Test	Lecture		Module		T Value	df	Two-Tail prob.
	MSU Coord. (N=10)	Hawaii Conv. (N=5)	MSU Conv. (N=10)	Hawaii Conv. (N=7)			
Pretest							
Mean	66.2000		49.3000		3.98	18	.001[ab]
		69.4000		75.2857	1.04	10	.322[a]
Standard deviation	10.486	7.092	8.367	11.2041			
Standard error	3.316	3.172	2.646	4.173			
Posttest							
Mean	92.8000		95.3000		1.15	11.57	.273[c]
		86.4000		91.4286	1.17	10	.270[b]
Standard deviation	6.426	4.690	2.452	9.519			
Standard error	2.032	2.098	.775	3.598			

[a]Significant at $\alpha < .05$.

[b]A pooled variance estimate was used.

[c]A separate variance estimate was used.

Table 3.--Independent T-test for Difference in Pretest and Difference in Posttest Percentage Mean Scores in Module Treatment for Michigan State University Coordinated (Coord.) and Conventional (Conv.) Study Plan Dietetic Students and the University of Hawaii Conventional (Hawaii Conv.) Study Plan Students.

Test	Module		Module		T Value	df	Two-Tail prob.
	MSU Coord. (N=10)	Hawaii Conv. (N=15)	MSU Conv. (N=7)	Hawaii Conv. (N=15)			
Pretest							
Mean	49.3000	63.2000			2.71	23	.013[ab]
			75.2857	63.2000	1.93	20	.068[b]
Standard deviation	8.367	14.644	11.041	14.644			
Standard error	2.646	3.781	4.173	3.781			
Posttest							
Mean	95.3000	93.0667			1.70	23	.102[c]
			91.4286	93.0667	.44	6.82	.673[c]
Standard deviation	2.452	3.615	9.519	3.615			
Standard error	.775	.933	3.598	.933			

[a]Significant at $\alpha < .05$.

[b]A pooled variance estimate was used.

[c]A separate variance estimate was used.

Further analysis (Table 3) revealed that the pretest percentage mean scores of the Michigan State University Coordinated Study Plan students and the University of Hawaii Conventional Study Plan students were significantly different (.013). In comparing the Conventional Study Plan students at Michigan State University and the University of Hawaii Conventional Study Plan students, it is seen that neither their pretest or posttest percentage mean scores were significantly different as also seen on Table 3.

The dietetic students at Michigan State University and the University of Hawaii achieving ninety percent on the posttest are recorded on Table 4. The majority of students in each group achieved the ninety percent criterion level.

Reliability of Posttest Evaluators

The calculation of a Reliability Coefficient was used for estimating the reliability of the two independent evaluators of the posttest (Ebel, 1972).

The formula is:

$$r = \frac{n\Sigma xy - \Sigma x\Sigma y}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2] \cdot [n\Sigma y^2 - (\Sigma x)^2]}}$$

The results of the formula indicated that the reliability coefficient was .69 indicating that the two evaluators had sixty-nine percent reliability. The score can range from zero to one with scores near one indicating high reliability between raters.

Table 4.--Number of Dietetic Students in Lecture and Module Treatments of Conventional and Coordinated Study Plan Students at Michigan State University and the University of Hawaii Achieving Ninety Percent on the Posttest.

Treatment	Number of Students	Number of Students Achieving 90% on Posttest
Lecture		
MSU		
Conventional	5	4
Coordinated	10	9
Module		
MSU		
Conventional	7	5
Coordinated	10	9
Module		
University of Hawaii		
Conventional	15	14
TOTAL	47	41

Comments

The students' feelings (affect) regarding the module were recorded. They felt that more time was needed to be spent on the Assessment Component of the SOAP Progress Note and less time on learning about Dietetic Problems. The students felt that they derived benefit from the embedded test questions while going through the module. The affective aspects of the module (music, cartoons and statements about their success, e.g., You're Doing Fine!) were enjoyed by all of the students and recommended to be left in the module. The dietetic students at the University of Hawaii thought that the cartoons of lesson two of the module needed to be more relevant to the content. Students reported there was confusion when they had to move back and forth between the slide tape and student booklet but this confusion decreased as the student kept going through the module. Also clarity as to whether or not only one answer is acceptable for the embedded test questions is needed. Those students attending the lecture treatment felt that the lecture was lengthy and repetitious but that the case study examples used were helpful. The students overall felt that they learned how to write SOAP notes in the correct format.

CHAPTER VI

CONCLUSIONS/RECOMMENDATIONS

Conclusions

Major conclusions from this study concern Hypotheses A, B and C. Null Hypothesis A states that dietetic students at MSU and the University of Hawaii given a self-instructional module or equivalent lecture presentation to learn the application of the POMR concept to client nutritional care will show no gain in score from pretest to posttest (both tests measuring equivalent content) to indicate that learning has taken place. Hypothesis A was rejected since there was a significant gain in score from pretest to posttest to indicate that learning had taken place. Null Hypothesis B states that dietetic students at MSU given a self-instructional module to learn the application of the POMR concept to client nutritional care will show no significant difference in achievement on the posttest compared to dietetic students given an equivalent lecture presentation to learn the application of the POMR concept to client nutritional care and same posttest. Null Hypothesis B was accepted since there was not a significant difference in posttest percentage mean scores between the module and lecture groups in either the Coordinated Study Plan or Conventional Study Plan dietetic students at Michigan State University. Null Hypothesis C states that dietetic students at MSU given a self-instructional module to learn the application of the POMR concept to client nutritional care will show a significant difference in achievement on the posttest compared to dietetic students at the University of Hawaii given the same self-instructional module to learn the application of the POMR concept to client nutritional care and same posttest.

Null Hypothesis C was rejected since the posttest scores of the dietetic students at the University of Hawaii receiving the module treatment were not significantly different than the posttest scores of the Michigan State University dietetic students in the module groups. The University of Hawaii's dietetic students' high posttest scores may be accounted for by the fact that they were being offered an opportunity to participate in a project being offered by another large mainland university. These students could have developed interest and curiosity with a desire to perform well.

Forty one of the forty seven students (93%) participating in this study were able to achieve at the ninety percent criterion level on the posttest regardless of being in the lecture or module group. Over ninety percent of the University of Hawaii dietetic students achieved ninety percent on the posttest which may indicate that the POMR module has the potential of being used with other dietetic programs with their students achieving the ninety percent criterion level on the same posttest.

The raters of the posttest for all groups showed a sixty nine percent reliability coefficient between each other. The use of the performance criteria checklist used in scoring the posttests probably accounted for this reliability and further clarification of the criteria may yield higher results.

Recommendations

A major recommendation would be that the module be revised for clearer understanding based on the comments of the students. The whole module is being reviewed by the designer's Graduate Committee Members and Clinical Faculty of the Coordinated Study Plan in Dietetics at Michigan State University in order to convert it from a prototype into a Professional Instructional Module.

A self-instructional module should be produced using a content area that does not change frequently in order to have the time spent in design and production worthwhile.

Evaluation of more pre- and posttests of the module with more dietetic students could be conducted to increase the validity of the module.

It appears that the hierarchical process used to develop a final learning outcome (Hiob, 1978) has application for other types of cognitive learning in order to develop a sequential path leading the student to mastery of a subject. This thesis study has shown that the hierarchical process is successful in aiding the dietetic student in learning the application of the POMR concept to client nutritional care and, in the designer's opinion, be applied to the development of other materials in the cognitive domain in dietetic curriculums.

APPENDIX D

THE SELF INSTRUCTIONAL MANUAL

A Self Instructional Manual for the
Systematic Development of Modules:
The M.S.U.* Dietetic Model.

Frank Hiob
January, 1978.

*Michigan State University

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A number of people have been very supportative throughout this project, especially Professor B. Wenberg, together with the faculty and graduate students of the Department of Food Science and Human Nutrition at Michigan State University

Many of the modules in this Manual have been adapted from existing materials. Whenever possible, permission to adapt the original materials has been sought from authors when they could be identified.

Two sources of materials need further acknowledgement: first, unpublished material acquired mainly as class notes at Florida State University, especially the text <u>The Systematic Design of Instruction</u> by Walter Dick and Lou Carey (roneod) which has subsequently been published by Scott, Foresman and Co., Glenview, Illinois (1978) under the same title; and second, unpublished materials from various sources at Michigan State University, particularly from Dr. C. Gentry's classes.

Many people have contributed in providing suggestions and testing the Manual -- to all these people I wish to express my gratitude.

WELCOME

This is a self instructional Manual on how to design and produce modules. It has been formatively tested and is currently going through wider field testing. The author would be grateful for comments and suggestions to the further improvement of this Manual.

The Manual is made up of a series of modules. You are asked to work through them all. Tests in various forms throughout the Manual will give you an indication of your progress; there may be a number of modules which you can skim through while others may need considerable concentration.

The more effort you put into your work the greater will be your reward (anon.).

Introduction

The use of individualized self instructional programs is growing faster than any other method of improving instruction (Cross 1976). The reason for this focus is quite simple: students differ along numerous dimensions and well designed individualized instruction considers these individual variations and attempts to provide for them. The effectiveness of individualized instruction has been demonstrated in a large number of studies (Kulik 1974, Keller 1968).

What is individualized instruction? If asked, each reader could probably provide a definition of individualized instruction and believe it was fairly accurate and reflective of the current thinking of most educators about individualization. However, if these definitions were shared, it would be found that there are almost as many definitions of individualized instruction as there are persons using the term. Current definitions vary from those which indicate that students will proceed at their own rate through a prescribed set of materials to reach a predetermined set of objectives, to definitions which indicate that students will be free to select their own means of achieving their own objectives. These two types of definitions reflect in part the two traditions which have contributed the most to the growth of individualized instruction. These two approaches may be characterized as the humanistic approach and the behavioral science or systems approach.

Educators who consider themselves in the humanistic camp have a genuine interest in the total development of individual children. They recognize the importance of individual differences and believe that the essence of an outstanding education is the display of genuine care and concern for students as they attempt to define those areas of learning which are important and relevant to them. There is a strong focus on the personal growth and development of the individual student. This emphasis on individual personal development and human relationships is an attempt to counteract the increasing alienation which students encounter in their society and perhaps in their own homes. The rapid growth of the book sales in the personal development area and the establishment of various personal development groups reflect our society's interest in these same problems.

Those educators who favor the behavioral science or systematic approach to education have also had a significant impact on the individualization of instruction during the past decade. This approach emphasizes the consideration of the inputs, processes and outputs of the education process. Research has been conducted on how to identify content for inclusion in the curriculum, how to better assess the knowledge and abilities of students, how to better design classroom procedures and instructional materials, and how to make instruction more effective.

The systematic approach to instruction had its initial impact in the development of programmed instruction. This medium of instruction emphasizes the importance of a precise definition of what it is that the student will learn and the importance of careful structuring of instructional materials. Programmed instruction utilizes active student participation in instruction to facilitate achievement of given objectives. Many of the teaching principles of programmed instruction are applied today in the systematic design of instructional materials, although programmed instruction per se is not in great use.

Both of these instructional approaches - the humanistic and the systems - emphasize the significance of individual differences and the necessity of providing appropriate instruction to the student.

Self Test

After each of these statements write (H) for humanistic or (S) for systematic approach:

1. Programmed learning is an example of which major approach? ( )
2. Behavioral science prefers an approach which is ( ).
3. A precise definition of leaning is a feature of ( ) approach.
4. Personal growth and development of the total individual is the major concern of ( ) approach.

It should be noted that while in academic circles representatives of humanism and behaviorism debate the merits of their approaches, there is little evidence of this conflict when one views individualized instruction in use in classrooms. Recent studies by Fox and DeVault (1974) have indicated that the best examples of individualized instruction are those which blend the best of both the humanistic and the systems approaches to instruction.

While the MSU dietetic model will advocate the behavioral science approach to designing, developing, and evaluating instructional materials, the authors are in full accord that humanistic and systems approaches must be integrated to provide the best atmosphere for effective student learning.

Feedback:

1. Systematic
2. Systematic
3. Systematic
4. Humanistic

There are three major components in the implementation of individualized instruction. The first involves the role of teachers; the second is the preparation of instructional materials; and the third is the delivery of instruction to students in the classroom. With the emphasis on selfinstructional materials, the instructor no longer plays the role of disseminator of all information. However, it is not totally agreed upon as to what the new role of the instructor should be. In some settings the instructor's role has been downgraded to a scorer of test papers and in others it has been upgraded to a general learning consultant to students. Clearly this is an area in need of continuing research because of the tremendous implications for the total instructional setting.

Instructional designers who are preparing materials for use in individualized systems have neither ignored the role of teachers nor have they had it as their major concern. Their central purpose has been to identify those objectives that are to be achieved and to design instructional strategy and evaluation techniques that are employed. Therefore new materials designed specifically for selfinstruction are needed.

The third area of concern is the delivery of instruction. A delivery system is defined as the integration of the instructor, students, and the instructional materials in a given setting in order to bring about the desired learning outcomes. Various individualized delivery systems have been developed, and teachers have implemented methods for meeting the needs of their students which reflect the instructor's preferred styles of teaching. No one pattern has universally emerged as the best and most appropriate one.

Modular Instruction

The types of instructional materials which are typically used in individualized instruction have come to be referred to as modules. Just as there is no universally accepted definition of individualized instruction, similarly there is no general definition of a module. An analogy may help in this explanation of what constitutes a module. Consider the technique known in the building industry as modular construction. Various components of a building are constructed in a factory and shipped to the construction site. These modules are then placed together in a particular configuration that results in the construction of a new building. Workers are still required to drive the nails and place the screws and bolts which hold the entire structure together. They also pour the foundation and add the finishing touches which make it a sound and secure building.

Modular instruction may be considered in much the same way. A module is a selfcontained or selfinstructional unit of instruction which has an integrated theme, provides students with information needed to acquire specified knowledge and skills, and serves as one component of a total curriculum.

Most instructional designers would agree with the definition given above. However they would differ on a number of the specific characteristics of modules. For example, the length of time required for students to study a module may vary from say one to fifteen hours. Some designers will insist that a module of instruction should include at least two alternative presentations of the instructional materials and preferably two or more modes of presentation to accommodate individual differences.

In addition, some designers would argue that a module should be strictly self-contained. That is, a student should be able to achieve all the objectives which are stated in the module without interacting with the teacher or other individuals. Other designers will specifically include in the design of the module the participation of peers, teachers, and outsiders in order to involve the student in a variety of interactive activities.

Designers even differ on whether students should be informed of the major objectives for a module. Some designers insist that students should receive precise statements of the objectives for a module while others argue that objectives may be reworded at a level more appropriate for the student, or that objectives may be omitted all together.

Regardless of the issues listed above, most modules involve some type of active participation by the student in terms of interacting with the instructional materials rather than being a passive reader of the materials. The student is asked to perform various types of learning tasks and receives feedback on that performance. There is some type of testing strategy which indicates to students if they have achieved mastery of the content, and what they should do if they have not yet achieved mastery.

Based upon the description of prior paragraphs, how would you recognize a module if you saw one? In its most simple form, a module might be a typewritten statement to students which indicates what it is they are about to learn and how they will be tested. It would provide printed or typed instructional materials as well as some practice test items. A self-test which might be used prior to taking a terminal test could also be included.

The most complex module might contain all of the items listed above, but also incorporate a number of alternative sets of materials from which the student might choose and the most appropriate one for him or herself.

Alternative media forms such as an audiotape or a filmstrip might be included. In addition, the student might go to a laboratory to conduct an experiment or go outside the school to gather information.

Regardless of the simplicity or complexity of a module, it should be validated, that is, it should be demonstrated that students learn from it-that they can perform the skills as described in the objectives for the module. Methods have been developed which are used to obtain information from students as a module is being developed to improve the quality of the module. After the module has been completed, data is collected which is used to demonstrate the extent to which the module is effective in bringing about anticipated changes in student ability.

Self Test

A. Judge the following statements as True or False

1. Most modules require active interaction by the student with instructional materials. ______
2. Tests are an important part of a module. ____
3. Tests are used to determine where the student stands in relation to other students. ______
4. The types of instructional materials which are typically used in personalized instruction have come to be referred to as modules. ______

B. In a sentence or two state what you understand a module to be:

Feedback: 1. True 2. True 3. False 4. True

B. A module is a self-contained or self-instructional unit of instruction which has an integrated theme, provides student with information needed to acquire specified knowledge and skills, and serves as one component of a total curriculum.

Quiz

1. The major trend over the past 10 years in the method of instruction has been towards

   a. Standardizing

   B. Individualizing

   c. discovery

   d. none of the above.

2. Educators in the humanistic camp believe in

   a. strong personal growth of the individual student

   b. the total development of individual children

   c. the importance of individual differences

   d. all of the above

3. The M.S.U. Dietetic model is based on

   a. humanistic philosophy

   b. behavioral sciences approach

   c. on both a and b

   d. none of the above.

4. The educators who prefer the behavioral science approach believe also

   a. in the systematic approach

   b. in the precise statement of objectives

   c. the effectiveness of programmed instruction

   d. all of the above

5. Do you consider this statement true or false?

   Both the humanistic and the systems approach emphasize the significance of individual differences and the necessity of providing appropriate instruction to the student. _________

6. What is a module? Do you agree with this definition: a module is a self-contained or self-instructional unit of instruction which has an integrated theme, provides students with information needed to acquire specific knowledge and skills and serves as one component of a total curriculum.

<u>Feedback</u>:

1. (b) 2. (d) 3. (c) 4. (d) 5. False 6. Yes

The focus of this Manual is on learning. We will constantly ask the question "how does the person learn?" This approach differs markedly from the usual "how will I teach?"

Well then, how does the person learn? The answers are provided in this Manual, starting with the next module on how we process information.

Our Model

Given the need to develop individualized instructional materials and being acquainted with the systems concept, what should we do next? One seemingly reasonable approach would be to use an already existing module as a model. There are several problems associated with this approach. Any given module is designed to teach a particular type of learning to a particular type of student. What is needed is a more generalized model - one which will describe the procedures for developing a module regardless of the type of learner or the type of learning which is to occur.

One general model for designing instructional materials is referred to as the systems approach model. It must be emphasized that there is no single systems approach model for designing instruction. There are a number of models which bear the label "systems approach," and all of them include most of the same basic components. The systems approach model which will be presented includes the major components which are included in other models.

The systems approach models are an outgrowth of over 20 years of research into the learning process. Each component of the model is based upon theoretical and/or research outcomes which demonstrate the effectiveness of that component. The model brings together in one coherent whole many of the concepts which you may have already encountered in a variety of educational situations. The model is graphically presented on the next page. It includes six interconnected boxes. The boxes (each step) refer to sets of procedures and techniques which are employed by the instructional designer to design, produce, evaluate and revise an instructional module.

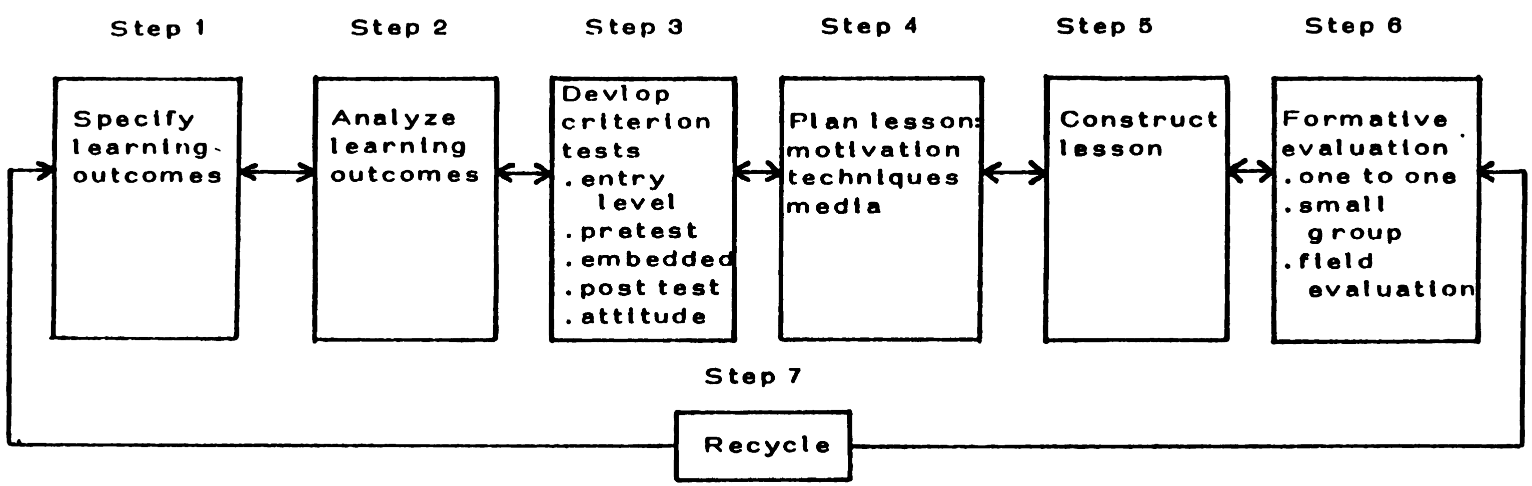


Figure 1.--The M.S.U. Dietetic Model for Module Design.

How We Process Information

Recent research on human learning has focused on how people think rather than how they respond to stimuli (the old Pavlov's dog, stimulus response idea). This recent research has generated a body of theory that explains how people take in information and how they organize information in memory. These activities of assimilating and arranging information are known collectively as information processing.

By and large, researchers agree that human perception and human memory impose rigorous organization on what is learned and on how it is learned. Concepts are not stored randomly, but rather are related to other similar concepts in clusters, which in turn are related to other clusters of concepts. The whole forms a logical and often measurable cognitive structure. In addition, it is generally agreed that cognitive structures are changed when new concepts are learned, and also that they in turn act upon those new concepts to make them more congruent with existing structures. What we learn changes what we know and what we know changes what we learn.

The interesting question to ask now is: What is it that goes on inside the student's head when he learns? What is the <u>process</u> of learning like?

Comtemporary theories conceive of learning as a matter of information processing. Stimulation from the learner's environment affects his central nervous system by a series of processing stages. The transformed information is stored in memory, and a final transformation makes possible a performance that is evident to an external observer. A more-or-less standard model employed in these theories is on next page:

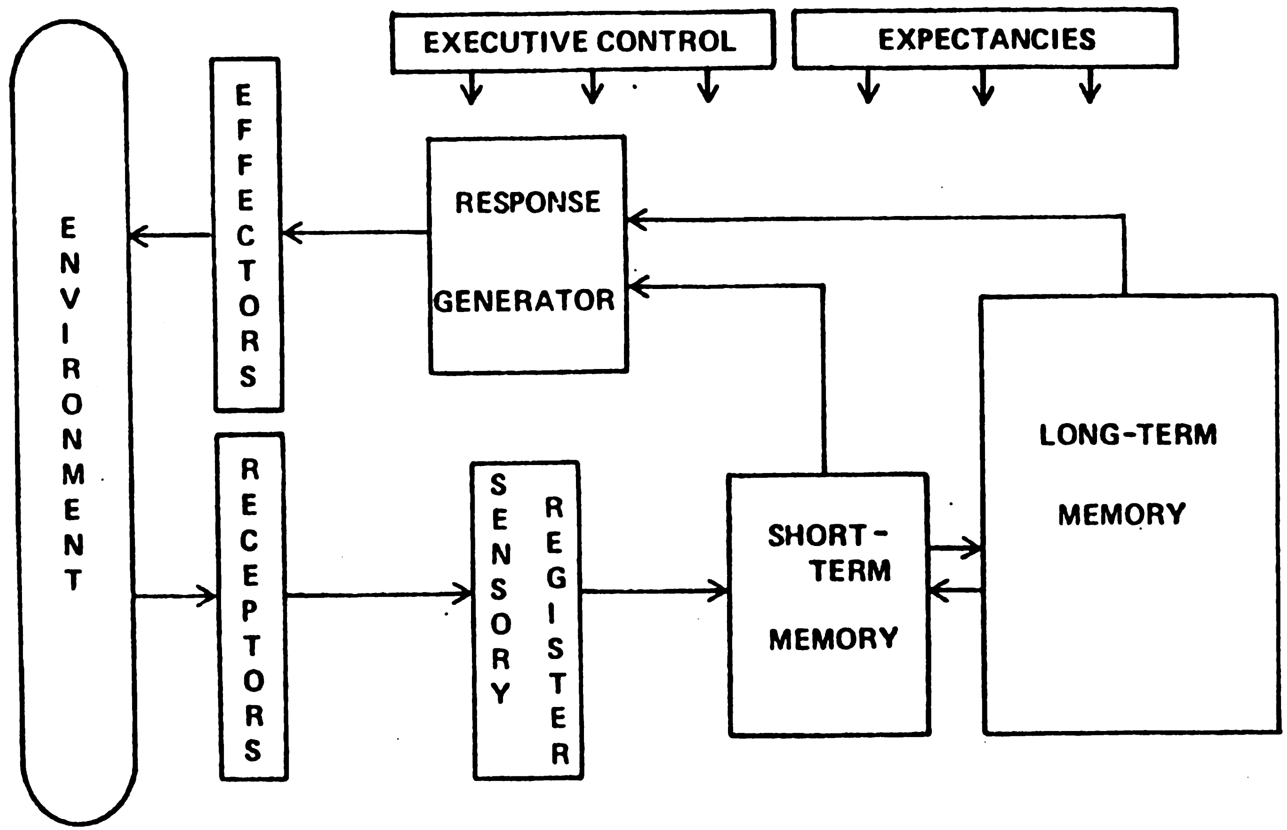


Figure 2.—(From Gagné, R. M. <u>Essentials of Learning for Instruction</u>. Dryden Press, 1974)

(1) A number of contemporary learning theories treat learning and memory as <u>information-processing</u>, deriving their constructs from computer science and linguistic theory, as well as from psychology. Atkinson and Shiffrin, 1968; Linday and Norman 1972. We use Atkinson-Shiffrin as an example of the general model.

This is the way the model works.

Stimulation from the learner's environment affects his receptors and enters the nervous system via a sensory register. This is the structure responsible for the initial perception of objects and events that the learner sees, hears, or otherwise senses. The information is "coded" in the sensory register, that is, it has the form of a patterned representation of the original stimulation. The information remains in this form for only the smallest fraction of a second.

Entering the short-term memory, the information is again coded, this time into a conceptual form. Thus, a figure like X becomes a representation such as an "X", a figure like 2 becomes the concept "two". (not the word two). Persistence in the short-term memory is relatively brief, a matter of seconds. However, the information may be processed by internal rehearsal and thus preserved in the short-term memory for longer periods. Rehearsal may also play a part in another operation; if the information is to be remembered, it is once again transformed and enters the long-term memory, where it is stored for later recall. Most theories assume that storage in long-term memory is permanent and that later failures to recall result from difficulties of "finding" the information.

It is important to note that the short-term and long-term memories may not actually be different structures, but only different ways of functioning of the same structure. Notice also that information that has passed from the short-term memory to the long-term memory may be retrieved back to short-term memory. The latter is sometimes spoken of as the "working memory" or the "conscious memory". When new learning depends partly on the recall of something that has previously been learned, this something must be retrieved from long-term memory and must re-enter the short-term memory.

Information from either short-term or long-term memory, when retrieved, passes to a response generator, which has the function of transforming the information into action. The neural "message" from this structure activates the effectors (muscles), producing a performance which affects the learner's environment. This action is what enables the external observer to tell that the stimulation has had its expected effect—that the "information has been processed", and the learner has indeed learned.

A very important set of structures has yet to be described. These are labeled executive control and expectancies. Signals from these structures are presumed to activate and modify the flow of information. For example, the learner has an expectancy of what he will be able to do once he has learned, and this in turn may affect how an external stimulus is perceived, how it is coded in memory, and how it is transformed into action. Control processes originating in the executive control structure may determine how the information is coded when it enters long-term memory and how the search and retrieval are conducted for recall, among other things. (References to various theoretical accounts are: Atkinson & Shiffrin, 1968; Norman, 1970; Anderson & Bower, 1972; Lindsay & Norman, 1972).

Quiz

1. According to modern learning theory, stimulation from the learner's environment affects his sense organs, and is transformed to patterns of neural "information" which are held for very brief periods in this form. What is the structure called that performs this function?

   ....

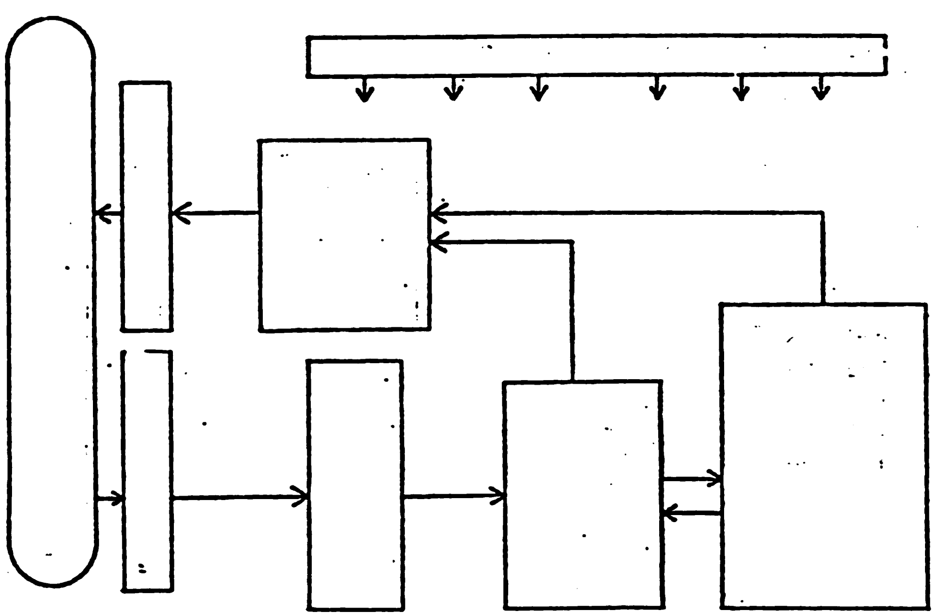
2. A learner has acquired and stored the skill of expressing ounces as pounds and fractions of pounds. Some days later, he is required to use this skill in comparing the contents of cans of coffee. In recalling the skill, what process is involved?

   ....

3. In the example of 7, if what has been learned is stored in Long-term Memory, to what structure does it fow, when recall occurs?

   ....

4. This is the most widely accepted information processing model. Please label the processes.

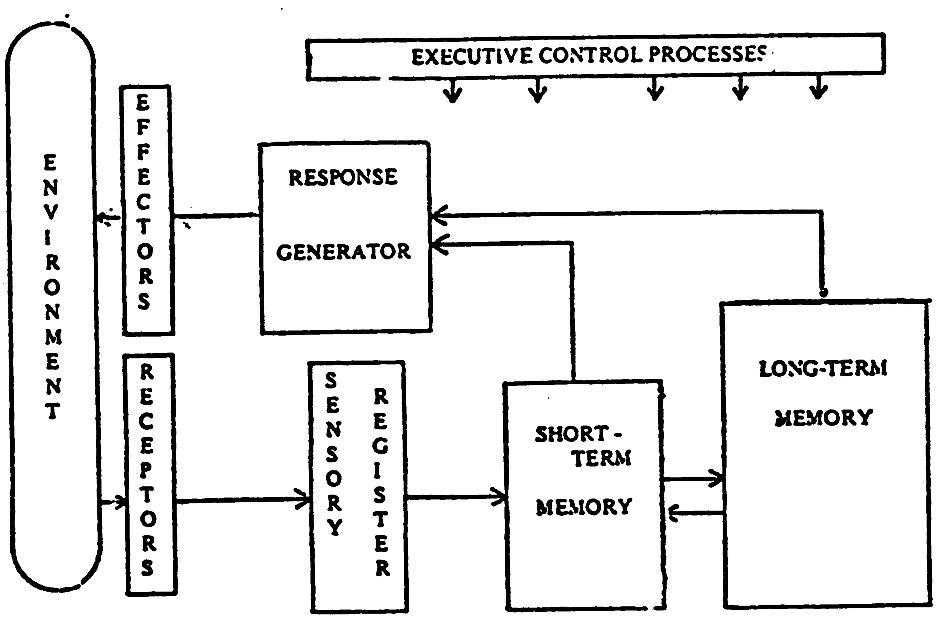


Feedback to Quiz

1. Sensory Register. The initial transformation of sense organ stimulation leads to very brief (of the order of hundredths of a second) neural effects, a kind of "registration" or pure "perception" of this stimulation. To be further processed, the information must be transformed and enter Short-term Memory in a "coded" form.

2. Retrieval. The skill of expressing ounces as pounds and fractions of pounds must be retrieved from Long-term Memory.

3. Short-term Memory. The process of retrieval frequently results in the stored skill being returned to the Short-term Memory, which is sometimes called the "working memory".



In recent years a great deal has been written about Competency Based Education (CBE). Unfortunately there do not seem to be any successful programs in operation which are entirely competency based. It seems that a CBE program is too complex and radical to be fully implemented and accepted.

This Manual follows many concepts of CBE, however it prefers to learn from realities of the world and therefore picks and chooses. A reasonably accurate label for this Manual is to say that it is "mastery based". The two following modules will acquaint you with this all important concept of mastery and mastery learning.

Pretest Mastery Learning

Answer

___ 1. In mastery learning, which of the following is (are) held constant?

a) Time.
b) Instructional activities.
c) Achievement.
d) All of the above.
e) None of the above.

___ 2. Which of the following may vary with each student in mastery learning?

a) The time it takes to achieve mastery.
b) The number of activities undertaken to achieve mastery.
c) The number of post-assessments.
d) All of the above.
e) None of the above.

___ 3. One (or more) basic beliefs underlying mastery learning is (are):

a) Most students can be competent at almost anything if sufficiently enticed by grades.
b) Most students can become competent at almost anything if given enough time.
c) Most students can become competent at almost anything if they have a high I.Q.
d) All of the above.
e) None of the above.

___ 4. In a competency-based program which one of the following is more likely to happen than the others?

a) The raising of standards.
b) Lowering of standards.
c) None of the above.

___ 5. In mastery learning you bring all students to a designated level of performance. This statement is essentially:

a) True.
b) False.

___ 6. How do you handle the concept of failure in mastery learning?

a) We fail only a very small percentage of students.
b) We fail a relatively large percentage of students.
c) We fail only the normal amount of students.
d) None of the above.

___ 7. In developing a mastery learning type program which of the following would be considered an essential task?

a) Obtain objectives and state them clearly to students before the pre-assessment.
b) Obtain objectives and do not give them to the students.
c) Obtain objectives and give them to students after the instructional activities.
d) All of the above.
e) None of the above.

___ 8. An important concept in the building of a mastery learning type program is:

a) To hold achievement constant and vary the time.
b) To make objectives explicit to the students.
c) To see that students receive adequate entry skills in order to tackle the program successfully.
d) All of the above.
e) None of the above.

___ 9. For evaluation in a mastery learning type program, which of the following is acceptable?

a) Test the student in reference to the published instructional and expressive objectives.
b) Since students do not know what they have to learn, eliminate tests.
c) Use the tests to separate the best students from the worst students.
d) All of the above.
e) None of the above.

___ 10. If a student does not pass the post-assessment in a competency-based program you would:

a) Drop him from the course.
b) Provide alternate routes of instruction.
c) Allow him to proceed to the next module.
d) All of the above.
e) None of the above.

___ 11. In mastery learning, ability to learn may be defined by:

a) The amount of time it takes a student to learn.
b) The score on an intelligence test.
c) The grade he received in previous subjects.
d) All of the above.
e) None of the above.

___ 12. Mastery learning places heavy emphasis on:

a) Entrance requirements.
b) Grading.
c) Keeping time constant for each student.
d) All of the above.
e) None of the above.

Feedback:

1. e	5. a	9. a
2. d	6. d	10. b
3. b	7. a	11. a
4. a	8. d	12. a

MASTERY LEARNING

The most wasteful and destructive aspect of our present educational system is the set of expectations about student learning each teacher brings to the beginning of a new course or term. The instructor expects a third of his pupils to learn well what is taught, a third to learn less well, and a third to fail or just "get by". These expectations are transmitted to the pupils through school grading policies and practices and through the methods and materials of instruction. Students quickly learn to act in accordance with them, and the final sorting through the grading process approximates the teacher's original expectations. A pernicious self-fulfilling prophecy has been created.

Such a system fixes the academic goals of teachers and students. It reduces teachers' aspirations and students' desires for further learning. Further, it systematically destroys the ego and self-concept of a sizeable proportion of students who are legally required to attend school for ten to twelve years under conditions which are repeatedly frustrating and humiliating. The costs of such a system in reducing student opportunities for further learning and in alienating youth from both school and society are too great to be borne for long.

Most students (perhaps over 90 per cent) can master what we teach. Our basic instructional task is to define what we mean by mastery of a subject and to discover methods and materials to help the largest proportion of our students reach it.

--Benjamin S. Bloom
Human Characteristics and School Learning,
McGraw Hill, N.Y., 1976.

Introduction.

Currently the strongest movement is the development of instructional programs to meet individual student needs. This is not a new theme but it has only been in the last decade, with developments in Technology and the systems approach, that such programs have been implemented on any large scale basis.

The basic argument in favor of individualizing instruction comes from a multitude of research and evaluation studies that suggest student differences in interests, motivation, learning rate, goals, and capacity for learning, among other things; and, therefore, group-based instruction on a common curriculum is inappropriate to meet their educational needs. In addition, present group instruction practices fail to help the student to cultivate a sense of responsibility for his educational, personal, and social development or to make realistic educational decisions and choices about his future.

The trend toward individualization of instruction has resulted in the development of a diverse collection of attractive alternative models. In this paper I will discuss Mastery Learning and allude to Individually Prescribed Instruction (IPI) and Program for Learning in Accordance with Needs (PLAN). For descriptions of IPI see Glaser 1968,1970, and for PLAN see Flanagan 1967,1971.

The mastery learning concept was introduced to American schools in the 1920's with the work of Washburne (1922) and others in the format of the Winnetka Plan. The program flourished in the 1920's; however, without the technology to sustain a successful program, interest among developers and implementers steadily diminished (Block, 1971). According to Block (1971), mastery learning was revived in the form of programmed instruction in the late 1950's in an attempt to provide students with instructional materials that would allow them to move at their own pace and receive constant feedback on their level of mastery. But programmed instruction was not effective for all students, and so, in an attempt to handle individual differences better, Bloom (1968) and his students (Airasian, 1971; Block, 1971) improved on the standard programmed instruction model by combining it with a model of school learning developed by Carroll (1963, 1970). Carroll's model of school learning provided the conceptual framework for more effective handling of individual differences within an objective-based curriculum. In brief, Carroll's model states that the level of mastery reached by a student on any instructional task or school objective is a function of the time actually spent learning the material and the amount of time he needs to master the material. The amount of time a student actually spends learning the material depends on two factors –

time allowed, and his perseverance. The amount of time needed by the student is dependent on three factors - aptitude, quality of the instructional materials, and his ability to understand the instructional materials. Carroll goes on to explain how these five factors interact to effect student success in school learning.

Since Bloom's original paper in 1968 describing mastery learning, a considerable amount of mastery learning research has been conducted, and the results suggest that the mastery learning model can be easily and inexpensively implemented in courses at any level of education and in a wide range of content areas (Block, 1970). In particular, Block (1971) notes that the best results have been obtained when the course requires either minimal prior learning or previous learning, which all or almost all of the students possess. In addition, various research findings have shown better results in courses when the content is highly structured and sequential in nature.

The outstanding features of mastery learning appear to be that it is easily implementable, does not require the use of a computer to manage instruction, and is appropriate for almost any content area. Also, if mastery learning is carried out properly, previous research suggests that students will achieve higher scores and have more interest and a better attitude toward school.

The curriculum is organized into units of instruction defined by homogeneous clusters of behavioral objectives. Initial instruction on the objectives covered in the unit is group-based. In this respect, mastery learning is structurally different from IPI and Project PLAN. For each unit, one or more criterion-referenced tests, called formative tests, are used to assess mastery of the objectives. These tests are administered immediately following the completion of the group-based instruction. Individualization is handled via supplemental materials, feedback, and corrective techniques, applied to students who fail to achieve the defined level of mastery on the test items covering the unit objectives. Following the last unit of instruction in the course, a final test covering a representative sample of course objectives is administered, and the data used for grading purposes.

In describing the mastery learning model, Mayo (1971) notes that:

1. Students are made aware of course and unit expectations, so that they view learning as a cooperative rather than as a competitive venture.
2. Standards of mastery are set in advance for the students, and grading is in terms of absolute performance rather than relative performance.
3. Short diagnostic tests are used at the end of each instructional unit.
4. Additional learning is prescribed for those who do not demonstrate unit mastery.
5. Additional time for learning is prescribed to students who seem to need it.

In summary, it should be noted that many variations on the basic mastery model, as originally proposed by Bloom (1968), are being implemented in schools. For example, different implementers tend to vary in the extent to which feedback/correction procedures are available and used (Block, 1971., Kim, 1971).

Block (1971) notes that "To individualize instruction within the context of ordinary group-based instruction, mastery learning relies heavily on the constant flow of feedback information to teacher and learner(p.9)." However, it would seem that there is substantially less testing in a mastery learning program than in either IPI or Project PLAN.

As compared to IPI, there is no placement testing, and unit pretesting and curriculum-embedded testing are not emphasized. Unit posttesting and final assessment represent the two major kinds of testing in the program. In the spirit of Scriven (1967), tests to achieve these two purposes are called "formative" and "summative" tests, respectively. It should be noted, however, that formative tests, or unit posttests as they are called in IPI, are not used for grading. The student data derived from a formative test is used exclusively for diagnosing learning difficulties.

A formative test, or alternately called a diagnostic-process test, is a criterion-referenced test that is designed to cover the objectives over a unit of instruction in the mastery learning program. It is used to determine whether or not a student has mastered the material and to serve as a basis for prescribing supplemental work in areas where the student is weak (Airasian, 1971). It is expected also, that the test will reinforce the learning of high-achieving students. Implementers of the mastery learning model have set the passing standard anywhere from 75% to 100%. There is no set number of items or format suggested to measure each objective; in addition, there is a suggestion that instructional decisions are made on the basis of responses to individual items.

The formative tests in mastery learning represent the key to individualizing instruction since it is on the basis of the scores on these tests that individualization of instruction can take place. Units are kept small so that unit testing takes place frequently in order to increase the effectiveness of the individualization of instruction component of the program.

Although it remains an unresolved problem, the matter of setting mastery levels or cutting scores, by which students can be separated into mastery and non-mastery states on the basis of their performance on test items designed to measure objectives included in the criterion-referenced tests, has been more actively researched in the context of the mastery learning program than anywhere. In addition to the usual concern for setting mastery levels high enough to guarantee that students will have sufficient amounts of skill to begin the next segment of instruction, Block (1970) has noted that, in mastery learning, the mastery level is set in a way that will maximize interest in and attitude toward learning. Some interesting controlled research studies have revealed that a mastery level of about 80–85% is substantially better than a level that is higher or lower. Block's results suggest that setting mastery levels high (95%) may be best for cognitive learning but, in the long run, positive attitudes and interest in the subject are less likely to develop. With a reduction in the mastery level to 85%, there was a reduction in cognitive learning, but selected affective outcomes were maximized. If the mastery level is set lower than 80–85%, students do not usually have sufficient mastery of the skills to proceed effectively with the instruction.

The primary purpose of the summative test in the mastery learning model is to grade students on the basis of their achievement of course objectives. The items in the test are keyed to objectives and are selected to be representative of the total pool of course objectives. A criterion-referenced interpretation of the scores is recommended. Bloom (1971) proposed that cutting points be located on the ability continuum and that grades be assigned on the basis of a student's position on the continuum and not relative to other students in the course. A norm-referenced interpretation of the scores is also possible (Popham, 1976).

A key part of the mastery learning program is the availability of an extensive number of instructional methods for use by students who fail to demonstrate mastery of the objectives covered on the formative test. A formative test is administered at the end of the group-based instruction on the unit objectives.

Among the alternative resources that are typically available to the student are: small-group problem sessions, individual tutoring, and programmed instruction, audiovisual methods, academic games and puzzles, and reteaching.

The developers of the program have left the decision on the appropriate instructional correctives to the student. It is expected that, through experimentation with many of the instructional correctives, the student will eventually learn which is "best" for him. This would seem to be a very realistic solution to the problem because of the shortage of available data on the appropriate matches between student characteristics and instructional correctives.

POST TEST ON MASTERY LEARNING

1. By the term "mastery level" we mean

   A. the learner has perfected a particular task

   B. the minimum accepted level of learner achievement

   C. the maximum measurable achievement level

   D. none of the above

2. In a typical mastery based instructional unit, the learner will

   A. always work by himself and not in a group

   B. always work in a group

   C. work in a group or by himself, depending on how the unit is organized

3. In a typical mastery (or competency) based program, the learner

   A. is given constant feedback in the form of quizzes or questions

   B. is given a test where the scores indicate his level of success

4. In mastery learning the resolution of a learning problem by a student usually requires one of the following measures:

   A. more time for learning

   B. different media or materials

   C. diagnosis to determine what missing prerequisites, knowledge, or skills he must first acquire to master the objective

   D. consultation with his teacher

   E. all of the above

5. Does Carroll's Model of School Learning (Mastery Learning) deal with matters such as (a) perseverance, (b) aptitude, (c) ability to understand instruction, (d) opportunity to learn?

   A. Yes, all of them

   B. No, none of them

   C. Only (a) and (b)

   D. Only (c) and (d)

6. Carroll's Model of School Learning (Mastery Learning)

   A. ignores the question of quality of instruction, as it should

   B. ignores the question of quality of instruction and therefore is not very valid

   C. takes into consideration the question of quality of instruction

   D. quite firmly states that given enough time, the learner can overcome shortcomings in the quality of instruction

7. In Carroll's Model for Mastery Learning, the independent variable achievement has:

   A. seven independent variables

   B. no independent variables

   C. ten independent variables

   D. as many independent variables as there are learners

   E. I don't really care

8. According to Carroll, the degree of learning equals:

   A. time allowed for the task

   B. learner's aptitude

   C. interest of the learner

   D. $f\left(\frac{\text{time actually spent}}{\text{time needed}}\right)$

9. Do you think there is any difference between education and training?

   A. Yes

   B. No

Feedback

1. B	5. A
2. C	6. C
3. A	7. A
4. E	8. D

9. A question which always generates a lot of energy but no "light" on the subject. Personally, I do think there is a difference, as I heard a colleague once say: the trained person knows the price of a certain object, the educated person knows its value.

WE HAVE WAYS FOR YOU TO MASTER

Mastery Learning

Evidence shows that most instructors begin each new quarter with the expectation that about a third of his students will adequately learn what he has to teach. He expects about a third of his students to fail or to just "get by." Finally, he expects another third to learn a good deal of what he has to teach, but not enough to be regarded as "good students." This set of expectations, supported by policies and practices in grading, becomes transmitted to the students through the grading procedures and through the methods and materials of instruction. The system creates a self-fulfilling prophecy such that the final sorting of students through the grading process becomes approximately equivalent to the original expectations (Bloom 1977).

---

1. Most educational institutions employ grading practices such that inevitably one third of their students will be labeled as

    a. having failed or learned only enough to just "get by".
    b. having learned only an average amount of what was taught.
    c. having learned quite adequately what was taught.
    d. all of the above

This set of expectations, which fixes the academic goals of teachers and students is the most wasteful and destructive aspects of the present educational system. It reduces the aspirations of both teachers and students; it reduces motivation for learning in students; and it systematically destroys the ego and self-concept of a sizable group of students.

Most students (perhaps over 90 percent) can master what we have to teach them, and it is the task of instruction to find the means which will enable our students to master the subject under consideration. Our basic task is to determine what we mean by mastery of the subject and to search for the methods and materials which will enable the largest proportion of our students to attain such mastery.

2. Under Bloom's concept of "Learning for Mastery", with appropriate learning conditions, real mastery of a subject can be achieved by

   a. at least 90% of all students
   b. at least 75% of all students
   c. at least 65% of all students
   d. at least 50% of all students

Part of our problems stem from the use of the bell curve for assessment. We have for so long used the normal curve in grading students that we have come to believe in it. Our achievement measures are designed to detect differences among our learners, even if the differences are trivial in terms of the subject matter. We then distribute our grades in a normal fashion. In any group of students we expect to have some small percent receive A grades. We are surprised when the percentage differs greatly from about 10 percent. We are also prepared to fail an equal proportion of students. Quite frequently this failure is determined by the rank order of the students in the group rather than by their failure to grasp the essential ideas of the course. Thus, we have become accustomed to classify students into about five categories of level of performance and to assign grades in some relative fashion. It matters not that the failures of one year performed at about the same level as the C students of another year. Nor does it matter that the A students of one school do about as well as the F students of another school.

____

____

3. Using the 'normal' distribution curve as the basis for grading students assures that

   a. measured differences in achievement among students are important and significant differences.

   b. failure in a subject area is determined by the failure to grasp the essential ideas of the course.

   c. both a and b   d. neither a nor b

Having become "conditioned" to the normal distribution, we set grade policies in these terms and are horrified when some teacher attempts to recommend a very different distribution of grades. Administrators are constantly on the alert to control teachers who are "too easy" or "too hard" in their grading. A teacher whose grade distribution is normal will avoid difficulties with administrators. But even more important, we find ways of convincing students that they can only do C work or D work by our grading system and even by our system of quiz and progress testing. Finally, we proceed in our teaching as though only the minority of our students should be able to learn what we have to teach.

4. Given students 'normally' distributed for aptitude in a subject, and providing <u>all exactly the same learning conditions</u> will result

   a. in a normal distribution of achievement.

   b. in a + .70 or higher correlation between achievement and aptitude.

   c. both a and b   d. neither a nor b

There is nothing sacred about the normal curve. It is the distribution most appropriate to chance and random activity. Education is a purposeful activity and we seek to have the students learn what we have to teach. If we are effective in our instruction, the distribution of achievement should be very different from the normal curve. In fact, we may even insist that our educational efforts have been <u>unsuccessful</u> to the extent to which our distribution of achievement approximates the normal distribution.

Individual differences in learners is a fact that can be demonstrated in many ways. That our students vary in many ways can never be <u>forgotten</u>. That these variations must be reflected in learning standards and achievement criteria is more a reflection of our policies and practices rather than the necessities of the case. Our basic task in education is to find strategies which will take individual differences into consideration but which will do so in such a way as to promote the fullest development of the individual.

A learning strategy for mastery may be derived from the work of Carroll (1963), supported by the ideas of Morrison (1926), Bruner (1966), Skinner (1954), Suppes (1966), Goodlad and Anderson (1959), and Glaser (1968). In presenting these ideas we will refer to some of the research findings which bear on them.

Put in its most brief form the model proposed by Carroll (1963) makes it clear that if the students are normally distributed with respect to aptitude for some subject (mathematics, science, literature, history, etc.) and all the students are provided with exactly the same instruction (same in terms of amount of instruction, quality of instruction, and time available for learning), the end result will be a normal distribution on an appropriate measure of achievement. Furthermore, the relationship between aptitude and achievement will be relatively high (correlations of + .70 or higher are to be expected if the aptitude and achievement measures are valid and reliable). Conversely, if the students are normally distributed with respect to aptitude, but the kind and quality of instruction and the amount of time available for learning are made appropriate to the characteristics and needs of each student, the majority of students may be expected to achieve mastery of the subject. And, the relationship between aptitude and achievement should approach zero.

---

5. Given students 'normally' distributed for aptitude in a subject and providing learning conditions appropriate to the needs of each individual student will result in

   a. the majority of the students achieving mastery in the subject.

   b. a correlation between achievement and aptitude approaching zero.

   c. both a and b

   d. neither a nor b

We have come to recognize that individuals do differ in their aptitudes for particular kinds of learning and over the years we have developed a large number of aptitude tests to measure these differences. In study after study we have found that aptitude tests are relatively good predictors of achievement criteria (achievement tests or teacher judgments). Thus, a good set of mathematic aptitude tests given at the beginning of the year will correlate as high as + .70 with the mathematics achievement tests given at the end of the course in algebra, or some other mathematics subject.

The use of aptitude tests for predictive purposes and the high correlations between such tests and achievement criteria have led many of us to the view that high levels of achievement are possible only for the most able students. From this, it is an easy step to some notion of a causal connection between aptitude and achievement. The simplest notion of causality is that the students with high levels of aptitude can learn the complex ideas of the subject while the students with low levels of aptitude can learn only the simplest ideas of the subject.

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6. The high correlation usually found between aptitude tests and achievement tests indicate that

   a. high achievement is possible only for the high aptitude students.

   b. students with low aptitude can learn only the simplest ideas.

   c. both a and b

   d. neither a nor b

Carroll sees aptitude as the amount of time required by the learner to attain mastery of a learning task. Implicit in this formulation is the assumption that, given enough time, all students can conceivably attain mastery of a learning task. If Carroll is right, then learning mastery is theoretically available to all, if we can find the means for helping each student.

One type of support for this view is to be found in the grade norms for many standardized achievement tests. These norms demonstrate that selected criterion scores achieved by the top students at one grade level are achieved by the majority of students at a later grade level. Further support is available in studies where students can learn at their own rate. These studies show that although most student eventually reach mastery on each learning task, some students achieve mastery much sooner than do other others (Glaser, 1968; Atkinson, 1967).

Can all students learn a subject equally well? That is, can all students master a learning task at a high level of complexity? As we study aptitude distributions in relation to student performance we have become convinced that there are differences between the extreme students and the remainder of the population. At the top of the aptitude distribution (1 percent to 5 percent) there are likely to be some students who have a special talent for the subject. Such students are able to learn and to use the subject with greater fluency than other students. The student with special aptitudes for music or foreign languages can learn these subjects in ways not available to most other students.

Whether this is a matter of native endowment or the effect of previous training is not clear, although this must vary from subject to subject.

We believe (as does Carroll) that aptitudes are predictive of rate of learning rather than the level (or complexity) of learning that is possible. Thus, we are expressing the view that, given sufficient time (and appropriate types of help), 95 percent of students (the top 5 percent + the next 90 percent) can learn a subject up to a high level of mastery. We are convinced that the grade of A as an index of mastery of a subject can, under appropriate conditions, be achieved by up to 95 percent of the students in a class.

It is assumed that it will take some students more effort, time and help to achieve this level than it will other students. For some students the effort and help required may make it prohibitive. Thus, to learn high school algebra to a point of mastery may require several years for some students but only a fraction of a year for other students.

---

7. The fact that, on standardized achievement tests, the top scores achieved by only a few students at one grade level are achieved by the majority at a later grade level, supports the view that

   a. aptitude is the amount of time required to attain mastery of a learning task.

   b. given enough time, the majority of students can achieve mastery of a learning task.

   c. both a and b

   d. neither a nor b

Whether mastery learning is worth this great effort for the students who may take several years is highly questionable. One basic problem for a mastery learning strategy is to find ways of reducing the amount of time required for the slower students to a point where it is no longer a prohibitively long and difficult task for these less able students.

We do not believe that aptitude for particular learning tasks is completely stable. There is evidence (Bloom, 1964; Hunt, 1961) that the aptitude for particular learning tasks may be modified by appropriate environmental conditions or learning experiences in the school and the home. The major task of educational programs concerned with learning to learn and general education should be to produce positive changes in the students' basic aptitudes. It is likely that these aptitudes can be most markedly affected during the early years in the home and during the elementary years of school. Undoubtedly, however, some changes can take place at later points in the individual's career.

However, even if marked changes are not made in the individual's aptitudes, it is highly probable that more effective learning conditions can reduce the amount of time required to learn a subject to mastery for all students and especially for the students with lower aptitudes. It is this problem which must be directly attacked by strategies for mastery learning.

8. Which of these statements is a <u>mistaken</u> assumption?

   a. Aptitudes are predictive of rate of learning rather than level of learning.

   b. Aptitudes for particular learning tasks are stable and cannot be modified by the environment or learning experiences.

   c. There are real differences in aptitudes for particular learning tasks at the extremes of the student population.

   d. Each individual student can vary considerably in his aptitudes for different learning tasks and subject areas.

One may start with the assumption that individual students need very different types and qualities of instruction to achieve mastery. That is, the same content and objectives of instruction may be learned by different students as the result of very different types of instruction. Carroll (1963) defines the "quality of instruction in terms of the degree to which the presentation, explanation, and ordering of elements of the task to be learned approach the optimum for a given learner."

Much research is needed to determine how individual differences in learners can be related to variations in the quality of instruction. There is evidence that some students can learn quite well through independent learning efforts while others need highly structured teaching-learning stiuations (Congreve, 1965). It seems reasonable to expect that some students will need more concrete illustrations and explanations than will others; some students may need more examples to get an idea than do others; some students may need more approval and reinforcement than others; and some students may even need to have several repetitions of the explanation while others may be able to get it the first time.

---

9. One of the more pressing requirements of instructional research today is

    a. to find the <u>one</u> method, material, and curriculum that is best for all students.
    b. to define the qualities and kinds of instruction needed by various types of learners.
    c. both a and b   d. neither a nor b

If the student has difficulty in understanding the teacher's instruction and/or the instructional material, he is likely to have great difficulty in learning the subject. The ability to understand instruction may be defined as the ability of the learner to understand the nature of the task he is to learn and the procedures he is to follow in the learning of the task.

Here is a point at which the student's abilities interact with the instructional materials and the instructor's abilities in teaching. For the student in our highly verbal schools it is likely that this ability to understand instruction is primarily determined by verbal ability and reading comprehension. These two measures of language ability are significantly related to achievement in the majority of subjects and they are highly related (+ .50 to + .60) to grade point averages at the high school or college level. What this suggests is that verbal ability (independent of specific aptitudes for each subject) determines some general ability to learn from teachers and instructional materials.

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10. Giving students a choice of alternative instructional methods and materials

    a. probably will have the greatest payoff in the ability of students to understand instruction.
    b. should help students to become more independent and to overcome feelings of defeatism and passivity about learning.
    c. both a and b
    d. neither a nor b

Carroll defines perseverance as the time the learner is willing to spend in learning. If a student needs to spend a certain amount of time to master a particular task, and he spends less than this amount in active learning, he is not likely to learn the task to the level of mastery. Carroll attempts to differentiate between spending time on learning and the amount of time the student is actively engaged in learning.

In our own research we are finding that the demands for perserverance may be sharply reduced if students are provided with instructional resources most appropriate for them. Frequent feedback accompanied by specific help in instruction and material as needed can reduce the time (and perseverance) required. Improvement in the quality of instruction (or explanations and illustrations) may reduce the amount of perseverance necessary for a given learning task.

There seems to be little reason to make learning so difficult that only a small proportion of the students can persevere to mastery. Endurance and unusual perseverance may be appropriate for long-distance running -- they are not great virtues in their own right. The emphasis should be on learning, not on vague ideas of discipline and endurance.

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11. Perseverance at a particular learning task will probably <u>decrease</u>

    a. with frequent positive feedback on progress.
    b. with frequent reward for correct performance.
    c. with evidence of coming success at the task.
    d. with repeated failure to achieve mastery of the task.

OPERATING PROCEDURES

The operating procedures we have used are intended to provide detailed feedback to teachers and students and to provide specific supplementary instructional resources as needed. These procedures are devised to insure mastery of each learning unit in such a way as to reduce the time required while directly affecting both quality of instruction and the ability of the student to understand the instruction.

Formative Evaluation. One useful operating procedure is to break a course or subject into smaller units of learning. Such a learning unit may correspond to a chapter in a textbook, a well-defined content portion of a course or a particular time unit of the course. We have tended to think of units as involving a week or two of learning activity.

Using some of the ideas of Gagne (1965) and Bloom (1956) we have attempted to analyze each unit into a number of elements ranging from specific terms or facts, more complex and abstract ideas such as concepts and principles, and relatively complex processes such as application of principles and analysis of complex theoretical statements. We believe, as does Gagne (1965) that these elements form a hierarchy of learning tasks.

We have then attempted to construct brief diagnostic-progress tests which can be used to determine whether or not the student has mastered the unit and what, if anything, the student must still do to master it. We have borrowed the term "Formative Evaluation" from Scriven (1967) to refer to these diagnostic-progress tests.

Frequent formative evaluation tests pace the learning of students at the appropriate time. The appropriate use of these tests helps to insure that each set of learning tasks is thoroughly mastered before subsequent learning tasks are started.

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12. Formative evaluation tests

    a. are essentially diagnostic, self-study guides and, thus, a part of the learning process.
    b. are usually given at least six weeks apart to provide general review.
    c. are essentially comprehensive achievement tests.
    d. none of the above.

Each formative test is administered after the completion of the appropriate learning unit. While the frequency of these progress tests may vary throughout the course, it is likely that some portions of the course -- especially the early sections of the course -- may need more frequent formative tests than later portions. Where some of the learning units are basic and prerequisite for other units of the course, the tests should be frequent enough to insure thorough mastery of such learning material.

For those students who have thoroughly mastered the unit, the formative tests should reinforce the learning and assure the student that his present mode of learning and approach to study is adequate. Since he will have a number of such tests, the student who consistently demonstrates mastery should be able to reduce his anxiety about his course achievement.

For students who lack mastery of a particular unit, the formative tests should reveal the particular points of difficulty - the specific questions they answer incorrectly and the particular ideas, skills, and processes they still need to work on. It is most helpful when the diagnosis shows the elements in a learning hierarchy that the student still needs to learn. We have found that students respond best to the diagnostic results when they are referred to particular instructional materials or processes intended to help them correct their difficulties. The <u>diagnosis</u> should be accompanied by a very specific <u>prescription</u> if the students are to do anything about it.

13. Which statement is <u>correct</u>?

a. Students respond best to the diagnostic results of a formative test when they are given a general remedial prescription rather than a specific prescription.

b. For students who <u>fail</u> to master a particular unit of material, the formative test should reinforce the learning and assure the student that his present mode of learning and approach to study is adequate.

c. both a and b

d. neither a nor b

These formative tests may also provide feedback for the teacher since they can be used to identify particular points in the instruction that are in need of modification. The formative evaluation tests also can serve as a means of quality control in future cycles of the course. The performance of the students on each test may be compared with the norms for previous years to insure that students are doing as well or better. Such comparisons can also be used to insure that changes in instruction or materials are not producing more error and difficulty than was true in a previous cycle of the course.

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14. Which statement is incorrect? Formative evaluation tests

    a. should provide detailed feedback to the teacher on the particular points of instruction that need modification.
    b. should be graded to maintain high student motivation and to determine student capabilities.
    c. can serve as a means of quality control in future cycles of a course.
    d. provide detailed diagnosis and prescription of what is yet to be done before mastery is complete.

Feedback:

1.d	2.a	3.d	4.c	5.b	6.d
7.c	8.b	9.b	10.c	11.d	12.a
13.d	14.b				

Post Test on Mastery Learning

Directions: Select the best answer.

1. Students can be motivated to expend even further effort in correcting their own errors on formative tests, and thus increase their achievement scores, if
   a. they are given specific suggestions and instructions on the formative test itself as to what they need to do.
   b. they meet in small groups once a week to help each other.
   c. both a and b d. neither a nor b

2. If scores on achievement tests are 'normally' distributed and highly correlated with aptitude tests, it can be claimed that
   a. the educational efforts have failed.
   b. there is a causal relationship between aptitude and achievement.
   c. both a and b d. neither a nor b

3. Advanced technological societies should have an educational system that
   a. emphasizes prediction and selection of the talented few, rather than development of talent of many.
   b. increases to the optimum the proportion of students that can
   c. both a and b d. neither a nor b

4. To be successful, a strategy for "Mastery Learning" should
   a. make frequent use of diagnostic and prescriptive procedures.
   b. depend heavily on individual tutoring.
   c. make no attempt to decrease the amount of time needed by students to reach mastery.
   d. be primarily concerned with providing each student all the time he needs to reach mastery.

5. Intrinsic motivation is usually highest when
   a. each student is to be judged in terms of his relative position to and in competition with his classmates.
   b. standards of master and excellence are set apart from interstudent competition, followed by instruction that enables the majority to come up to those standards.
   c. both a and b
   d. neither a nor b

6. Evaluation procedures are very important to the concept of "Mastery Learning" because
   a. both teachers and students need to know what constitutes master and what the criteria are for achieving it.
   b. both teachers and students must have a <u>continuous</u> check on progress toward mastery.
   c. both a and b
   d. neither a nor b

7. By the term "masterylevel" we mean

   a. the learner has perfected a particular task.

   b. the minimum accepted level of learner achievement.

   c. the maximum measurable achievement level.

   d. none of the above

8. In a typical masterybased instructional unit, the learner will

   a. always work by himself and not in a group.

   b. always work in a group.

   c. work in a group or by himself, depending on how the unit is organized.

9. In a typical mastery (or competency) based program, the learner

   a. is given constant feedback in the form of quizzes or questions.

   b. is given a test where the scores indicate his level of success.

10. In masterylearning the resolution of a learning problem by a student usually requires one of the following measures:

    a. more time for learning.

    b. difficult media or materials.

    c. diagnosis to determine what missing prerequisties, knowledge, or skills he must first acquire to master the objective.

    d. consultation with his teacher.

    e. all of the above.

Expected responses:

1. c	2. c	3. b	4. a	5. b
6. c	7. b	8. c	9. a	10. e

This Manual calls for a Systematic development of modules. What is meant by such terms as: system, systematic, systems approach? The following module, adapted from National Special Media Institutes provides the truth about systems.

Self Evaluation Quiz on Systems

1. Give a definition of a systems approach:

____

____

____

2. Which of the following is included in a systems approach to teaching?

_____ A. techniques for precisely specifying the purpose of teaching

_____ B. selecting among alternative teaching strategies

_____ C. ways to make teaching more individualized

_____ D. ways for determining changes which would make teaching strategies more effective and efficient

3. A systems approach is mainly concerned with:

_____ A. learning efficiency

_____ B. administrative efficiency

_____ C. teaching efficiency

_____ D. concepts of management

4. If the system is a car then the suprasystem is:

_____ A. the driver

_____ B. gas

_____ C. transport

_____ D. road

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5. A system is considered to be open when

_____ A. there is a great deal of interaction between the system and its environment

_____ B. the system is incomplete

_____ C. people are free to leave whenever they like

6. Which is/are true for all systems

_____ A. all systems are purposeful

_____ B. all systems use the same approach

_____ C. all systems operate according to rules

_____ D. all systems precisely

7. When we say that a system is synergetic, it is

_____ A. another way of saying that the whole is greater than the sum of its parts

_____ B. a straight forward input, throughput, output phenomena

_____ C. capable of fixing its own problems

8. The science of communications and control through feedback is called

_____ A. recycling

_____ B. dynamics

_____ C. cybernetics

_____ D. latent control

FEEDBACK

1. A possible definition of a systems approach is:

   "a problem solving process that organizes decision making systematically so that the relevant factors in a given problem are considered."

2. All, A, B, C and D.

3. A,B,C.

4. C.

5. A.

6. A.

7. A.

8. C.

<u>The Truth About Systems</u> (1)

You will see that we have ways to teach you about systems which have proven useful to educators responsible for instructional development. This program makes use of programmed instruction techniques. These require regular responses from you, and provide you with immediate knowledge of the correctness of your responses. If you have not previously learned through the programmed instruction method, you may be inclined to look ahead to the answers provided, without writing your own answers first. The evidence indicates that by making your own response <u>before</u> looking at the program answer, your understanding and retention will be significantly greater. Good luck!

(1) Based on a program developed for National Special Media Institutes, 1972.

For a wider understanding on Instructional Systems see B.H. Benathy, <u>Instructional Systems</u>.

The "systems approach" doesn't exist, but many "systems approaches", do. As you may be aware, there are many complex definitions of systems available, but put simply, a systems approach is a problem-solving process that organizes decision-making systematically, so that one relates all of the relevant factors in a given problem, at the time when they need to be related. While the many systems approach models appear to be different, they all depend on the same basic concepts, rules, and techniques.

Teachers have found a systems approach to be a very useful tool, once they have come to understand and apply the few basic concepts, rules, and techniques to a particular systems model.

Despite all of the bally-hoo there is no one model of the s____________ a__________. But all of them do have in common basic c__________________. r__________, and techniques.

____

____

systems approach
concepts, rules

Go back and underline our simple explanation of what a systems approach is.

Nowadays, no matter which rock is turned over, or TV channel tuned to, one is likely to find a critic of education and of teaching. As in the case of religion and politics, everyone feels free to speak like an expert when the subject of teaching comes up. No one really disagrees about the importance of religion, politics, or education, but there is great difference across the land about the "goodness" of decisions made in the name of any of these three. We believe that all three suffer from the same conditions: leaders in these fields seldom analyse, systematically, what it is that should be done. The means chosen for accomplishing their fuzzy goals, are often confused, and techniques for checking how well the method worked in accomplishing the goal are either ignored, inadequately carried out, or hidden in someone's head. As long as those conditions prevail, the appearance of doing something is probably as acceptable as a genuine accomplishment. A systems approach attempts to replace the folklore, underpinning most of our teaching practice, with the systematic application of what we know through research and experience about learning.

A _________ ________ includes a set of techniques for precisely specifying the purposes of our teaching, for selecting among alternative teaching strategies, and for determining changes that need to be made to make our teaching strategies more effective and efficient.

Systems approach

The concepts of efficiency threatens many educators, partly because they're not sure about how to make their teaching more efficient, and partly from a genuine concern that administrative efficiency may take precedence over student needs. The latter could and does happen, of course, and over-emphasis of administrative efficiency needs to be controlled, but we are more concerned with <u>teaching</u> and <u>learning</u> efficiency. Consider the number of times that a teacher finds it necessary to repeat a particular instruction, or the number of times a student has to practice a particular learning behavior, regardless of whether he learned the behavior on the first trial, or still hadn't learned after many trials. Think of all the students who graduate without being able to read adequately or to use basic arithmetic skills in his every day life. Or think about the youngster who did understand early, but had to go through the same activity again and again, either because many of his slower fellow students didn't pick up the understanding, or because the teacher wasn't aware of all of the other times the students had been subjected to the same activities. That's the kind of inefficiency that is so wasteful of our teachers' and students' time.

A systems approach greatly increases the efficiency of t__________ and l__________. Given that a systems approach is a tool for s__________ p__________, and that it is as valid for solving instructional problems as any other, let us examine some of the characteristics necessary to a systems approach.

---

teaching, learning
solving problems

A system is part of a larger environment, that can and may effect the desired functioning of the system. This larger____________is sometimes called the suprasystem. For example, if the dietetics department were the system being considered, then the suprasystem or the_________would be the university.

---

environment
environment

By the same token, if dietetic education is the system under consideration, then the _________, or the environment, would be A.D.A. Or if the classroom is the system we are looking at, then the suprasystem could be the school. On the other hand, if the system were the school, then the _____________ could be the school district. The suprasystem for our school district, to carry our example a step further, would be the State Department of Education.

---

suprasystem
suprasystem, or environment

The point that is important to remember is that the determination of the suprasystem depends on the system we are studying. The same condition holds for subsystems or components. If the car was the system we were concerned with, then some of its subsystems, or________, would be steering, motor, transmission, and heating subsystems. The Major parts that make up a system then, are called either________ or __________.

---

components
components or subsystems

In like manner, the seating, devices for presenting information, air conditioning, student response devices are __________ or __________ of the physical system called the classroom.

---

subsystems, components (order not important)

A system may be open or closed, depending on the amount of interaction with, and exchange of information and energy with its' environment. China, during many years of its' history, did not permit foreigners to enter its borders, nor its citizens to leave. To the degree its leaders were able, all communication and trade was cut off. These conditions made China a c__________ system. The Romans, on the other hand, imported and exported goods to most of the major nations. The Romans were constantly trading ideas as well, whether architectural, philosophical, militarial, or artistic. Rome would be considered an_______________system.

---

closed
open

A classroom may also be labeled an open or closed system. The self-contained classroom that depends primarily on the resources within a classroom to the exclusion of most of the resources in the system's environment or _____________, is called a/an_______________system.

---

suprasystem
closed

Of course, a classroom may be designed to take advantage of external resources. For example, classrooms which emphasize individualized instruction, would have to call on all of the resources available, in order to provide the many kinds and numbers of experiences required to carry out such strategies. Such classrooms would be termed_______________systems.

______________systems tend to change and adapt to new conditions and requirements more readily than do______________systems.

---

open
open
closed

Unfortunately, the large majority of our classrooms fall into the static, or_________system category. Because of the strong defenses built up by such systems, much time and effort is required to get new ideas adopted. However, by being aware of characteristics of open and closed systems, teachers are better equipped to identify what must be done to change static systems into____________systems.

---

closed
open

All systems are <u>purposeful</u>, whether or not they use the same approach. They are designed to insure some desired outcome or <u>output</u>. They are considered successful to the degree they can effectively and efficiently produce that desired outcome. Unfortunately, many systems do not clearly define their desired outcomes. That is, they do not state their outcomes so that they can be measured with any precision. Education is notorious for its ambiguous statements of purpose. The existence of most industrial systems depends on their knowing precisely how to measure their products, and the efficiency with which the product was produced.

The systems approach requires the statement of measurable objectives. In education we call these__________ objectives. We would all agree that it is much easier to precisely define the outcomes of an automobile production system than it would be for an educational system, but that doesn't make it less worth doing.

---

behavioral, measurable

Every system has built-in limitations and options. Usually, the limitations are called constraints, and the options are called controllable variables. A sad discovery by researchers is that many teachers who have been practicing for years, may have only a limited knowledge of the constraints they are operating under, and the options that are available to them. In many cases, it has been found that what appeared to be a limitation or __________ was something over which the teacher could exert some control.

---

constraint

If a teacher has no choice, but to teach a particular grade, or to use a particular textbook, or to teach a specified number of hours, then all of those things would be called __________. However, if she were able to choose the grade that she would teach, the textbook that she would use, the grading system that she considered best, the hours that she would teach, then those would be called __________.

---

constraints
controllable variables, options

In a profession where resources are hard to come by, a clear knowledge of the systems __________ and __________ is necessary if the teacher is to take maximum advantage of her resources for teaching.

---

constraints (order not important)
controllable variables, options

A unique characteristic of the systems __________ is that at least two alternative means for accomplishing a desired outcome, must be analyzed and compared in terms of effectiveness and efficiency. Few teachers know how to make such a comparison. Most do not consider such a role appropriate, if they consider it at all. But the determination of the respective costs and benefits of two or more____________for solving an instructional problem have allowed those teachers practicing such comparison, to greatly extend the effect of their meager resources.

---

approach
alternatives

As an example, there are numberous methods of instruction of which drill, field experience, lecture, programmed instruction, project, recitation, role play, and seminar, are but a few. Suppose that a teacher had some objectives that could be met either through lecture or through self-instruction (this learning program would be an example). What are the constraints and options that you need to consider in choosing between these two_________? Suppose we consider the time variable. If teacher presentation time is limited, but independent study time for students is not, then it would appear that the self-instructional program is the best______________. If, however, the time or cost of procuring or developing the self-instructional program is excessive, it may be more desirable to choose the lecture____________. On the basis of this kind of <u>trade-off</u> between cost and benefit, the teacher is able to choose the__________which provides the most effective learning at the least cost of her limited resources.

---

alternatives
alternative
alternative
alternative

By now you are aware that a_____________consists of <u>functions</u> that cooperatively contribute their <u>inputs</u> toward the desired___________of the system. The operator of an instructional system (the teacher) requires continuous information about how well the individual functions are efficiently and ____________accomplishing the purposes of the sustem. The mechanisms set up to provide this information are called feedback mechanisms.

---

system
output, outcome
effectively

By providing the operator of the system with information about how well the functions are being carried out, the ____________ mechanism makes it possible to adjust the functions for maximum effectiveness and ____________. The techniques for acquiring information on the effectiveness of a systems functions, and for making that information available to the teacher when she needs it, are key factors in making sure that a teaching-learning system improves. One of the most obvious feedback mechanisms, and most used (misused?), is the teacher-made test. But there are a multitude of others, including; rating scales, checklists, questionnaires, interviews, self-evaluation measures, peer nominations, and projective devices, not to mention, standardized instruments. Feedback has become so important that a whole new science has grown up around it, called cybernetics. More formally, cybernetics is called the science of communications and control through feedback. Useful improvement of instructional ____________ can only occur through continued application of the empirical data (supported through experience or experimentation) provided by ____________.

---

feedback
efficiency
alternatives
feedback, cybernetics

The improvement or revision of our instructional alternatives is a necessary condition for the systems approach. Most systems improve through successive approximations. Few instructional systems begin as perfect systems, and even if they did the changes in constraints and options over time would make them imperfect. To continually improve, a system must be revised using the empirical data provided by ____________. Successive approximation means coming closer and closer to a model of student learning effectiveness and efficiency, after each r_____________.

---

feedback
revision

Probably one of the best aids to revising an instructional system, is a match among objectives, methods, and criteria for accomplishing the objectives. That is, each of the instructional objectives must be matched with the methods chosen for teaching the objective, and the test items for determining how well the objective was met. This_______________among objecitves, methods, and criteria provide the teacher with hard information about which components are not functioning properly, and which ones are. The_____________-_________-_________match can tell the teacher and student where, in the instruction, that they are being unsuccessful.

---

match
objectives-methods-criteria

The systems approach requires that the criterion items (test items) relate specifically to the behavioral objective, rather than a specific method or teaching material. Teachers often relate their________items to a particular page in a book, or to what a particular person might have said, as evidence that the student has acquired the desired behavior. This means, that if teachers choose a new or more adequate material to teach the same objective, they must then rewrite their criterion items. Since this is a difficult and time-consuming task, it usually goes undone, or is done inadequately; or the teacher sticks with poor methods and materials because they do not have time to change the _____________items.

---

criterion, tests
criterion, tests

Finally, systems are synergetic. This is another way of saying that the whole is greater than the sum of its' parts. More specifically, there are effects resulting from the interaction of the components of a system, which are not predictable from examining the individual components. These effects may be detrimental or beneficial in terms of the planned outcomes of the system. Engineers are often made aware of this phenomenon; the automobile that mysteriously develops an undesired vibration at high speeds, a suspension bridge which collapses because of reciprocating harmonics caused by a strong crosswind, or the crack that suddenly appears in the retaining wall of a dam. An understanding that an instructional system is s_____________, serves to alert teachers who try out new systems, that effects not predicted may occur. The___________mechanisms, which compare input with output should be designed to point up synergetic effects.

---

synergetic
feedback

Is there a procedure for designing instruction which follows a systematic approach? Yes, when we get to the model advocated in this volume, you will find that our model is based on the systems approach.

In the meantime, if you look at the next page (Figure 3) you will find a basic systematic model of instructional design.

The basic model is also presented with two alternate strategies (B and C). Strategy B represents alternate learning experiences if the designer wishes to use these. This is particularly useful if the learner did not perform well enough on the basic module.

Strategy C uses tracking as a way to provide alternate learning experiences when the learners show a great deal of heterogenuity.

Where Have All The Objectives Gone?

In the chapters which follow, some of the favorite phrases of the 1970's are missing. We seldom refer to terms such as behavioral objectives or performance objectives. Ten years of experience with behavioral objectives has convinced us that they are often inadequate for University level education.

Behavioral objectives are inadequate as they do not indicate why certain behavior is required, what goal they will achieve or the specific level of internalization or understanding that is being required. Their value can be further questioned by their reliance on the usual one time observation of behavioral responses as a measure of assessment. We believe that our aims are better achieved by specifying <u>learning outcomes</u>*. Our rationale follows; this diagram will illustate part of our rationale.

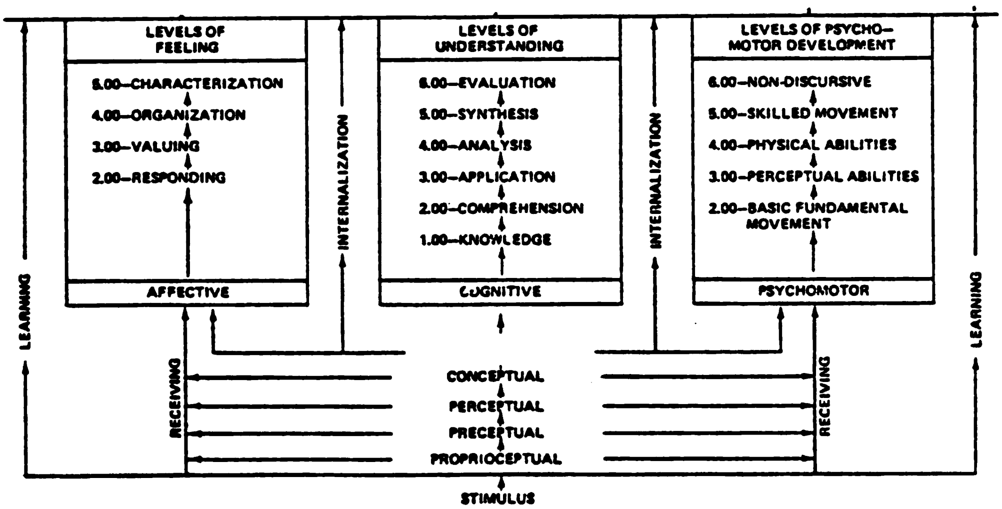

Figure 3.—Relationships among learning and the three taxonomies.

*Learning outcomes are the abilities or capabilities that become part of the learner after instruction.

Internalization phase of learning is our primary focus of the learning process. This is where the desired learning outcomes occur and are stored. This phase is characterized by the changes that take place within the learner and which become part of the learner. These changes represent the learner's cognitive, affective and psychomotor development or, in other words, the capabilities that the learner has acquired with reference to understandings, feelings or movement activities.

These capabilities or acquired attributes can represent many levels of learning that have occurred and are based upon the amount of internalization of feelings, understanding or movement capability that has taken place. Perhaps the best way to interpret this internalization of learning is through the taxonomies by Bloom (1956), Krathwohl, et al. (1964), and Harrow (1972). Each of these taxonomies portrays several hierarchical levels of capabilities that can be acquired by learners through the learning process.

Figure (3) depicts the relationships among learning and the three taxonomies. It can be assumed that the outcomes of learning should result in the acquisition of capabilities which can be placed into Levels 2.00-5.00 of the affective taxonomy, 1.00-6.00 of the cognitive taxonomy and 2.00-6.00 of the psychomotor taxonomy.

It should be noted that the learning outcomes are the ends for which all enabling instructional activities are performed. Since the learning outcomes are ends, they may be viewed as having the only intrinsic value to be found in the instructional program. These learning outcomes are the prime purposes of education. All other components of the instructional program, such as the enabling strategies and evaluation processes, are merely means for producing learning outcomes or for evaluating successful achievement of learning outcomes.

Gagne (1974) states it this way: "What is learned is something new that remains a part of the learner. Some would call these abilities but I prefer to speak of them as capabilities....It is these capabilities that constitute the outcomes of learning" (p. 3). Gronlund (1974) supports this concept through his emphasis on understanding as being the objective of learning, rather than on behavioral outcomes which are the responses made after understanding occurs. He states that behavioral outcomes "are simply samples of the types of performance that represent understanding" (pp. 4-6). One must recognize that the learning is never purely affective, or cognitive, or psychomotor, but that the student may develop in all three areas simultaneously. The educator must choose, however, which of these three areas is of primary concern at any particular time when formulating the competencies and/or objectives to be achieved.

Regardless of a person's acceptance or non-acceptance of the hierarchical nature of the taxonomies, it appears safe to say that the learning outcomes, defined as the abilities or capabilities that become part of the learner, should constitute the competencies which a learner should achieve. Furthermore, most educators will agree that competencies can be placed into one or more of the three domains. Thus, learning outcomes should represent the attainment of specific learning intents or competencies*, and these should become the goals of instruction.

The key to writing good competency statements is to determine first the level of learning outcome that is desired for a specific skill or content unit and then to state it in terms of a specific goal to be achieved. Gagne suggests that we use standardized verbs.
The following two statements of goals serve as examples for the identification of specific learning outcomes or competencies to be achieved:

1. The learner will state the basic nutritional needs of a

*Competency can be defined as "possession of required knowledge skills, attitudes and abilities".

person in good health, without referring to an outside source of information. She will do this without error.

2. The learner will generate a diet for a person in good health which contains all the basic nutritional needs for that person. She will do this without referring to an outside source of information and will make no mistakes.

In the first example, the learner will need to state information. This is an outcome of learning which requires capabilities of recall. In the second example, the learner will need to generate a diet. This is an outcome of learning where the learner needs capabilities to synthesize applicable rules to arrive at the end product.

There should be a match between the learning outcomes or competencies that a learner is to achieve and the behavioral outcomes that are chosen as indicators of success in competency attainment. For example, if a goal is established for the achievement of a competency at the application level, Level 3.00 of the cognitive domain, then the behavioral outcome chosen as an indicator of successful competency achievement should also require a response at the application level. A competency stated at Level 5.00 would likewise require a learning outcome or response at Level 5.00 in competency assessment.

This same relationship exists between the learning outcomes in all three of the domains according to the hierarchical order portrayed in the cognitive, affective and psychomotor taxonomies. In other words, there should always be congruence between the learning intent or learning outcome and the response or learning outcome that is used to evaluate success in achieving the desired learning.

You may be confused by our use of several terms such as learning outcomes, competencies and learning intents to mean the same thing. For our purposes, they are the same thing and will be used interchangeably to to take the place of the more familiar, but limited term "behavioral objective".

Summary We prefer the wider concept of learning outcomes to behavioral or performance objectives. By specifying, (1)_____________________ we can indicate why certain behavior is required. Learning outcomes will also specify the (2)__________of internalization or understanding (3)___________ _________do not rely on the usual one time observation of behavioral responses as a measure of assessment.

1. learning outcomes
2. level
3. learning outcomes

There are three main domains of learning, they are the (1)_________ ___________and ___________domains. Each domain is organized into (2)__________. In the cognitive domain the highest hierarchy, according to Bloom, is (3)_____________. Learning is never purely affective, or cognitive. Students may develop in all three areas (4)_______________.

1. cognitive or understanding; affective or feeling; psychomotor or movement.
2. hierarchies
3. evaluation
4. simultaneously

Learning outcomes are the abilities or (1)_____________that become part of the learner. Learning outcomes should constitute the competencies which a learner should achieve; so learning outcomes and (2)_________are closely related. Learning outcomes represent specific learning intents or (3)______________.

capabilities

capabilities

capabilities

When specifying learning outcomes (or competencies), you need to determine the (1)_______ of learning outcome that is necessary for a specific skill. A high level skill requires a high (2)________ of learning outcome.

Further, your methods of assessment should be at the same (3)_____ as the learning outcomes which you specified.

1. level
2. level
3. level

Specifying Learning Outcomes

A learning outcome specifies the skills, attitudes and abilities you want learners to demonstrate as a result of instruction. A learning outcome describes the intended result of instruction, and NOT the process of instruction itself.

Specifying learning outcomes is important, otherwise there is no sound basis for the selection or design of instructional materials, content or methods. If you don't know where you are going you will not be able to say how you are going to get there. Instructors simply exist in confusion and disarray of their own making unless they can specify what they want their students to accomplish as a result of their instruction.

Another important reason for specifying learning outcomes has to do with finding out whether instruction has accomplished what you intended it to do. Tests are the hurdles on our learning track and are supposed to tell instructors and students alike whether they have been successful. But unless learning outcomes are clearly and firmly fixed in the minds of both parties, tests are at best misleading; at worst, they are irrelevant, unfair or uninformative.

Another advantage of clearly defined learning outcomes is that they provide students with the means to organize their own efforts (Towle, 1975; Merrill, 1973). With clearly specified learning outcomes students are better able to decide the activities which on their part will help them get to where it is important for them to go.

The next pages are a guide which will help you to specify learning outcomes.

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The next pages provide a guide which will help you to <u>specify</u> learning outcomes.

Learning Outcomes

Question 1:

The purpose for college curriculum is to

A. Lead students to gain certain skill, attitudes and abilities.

B. Determine how to teach or what materials to make available.

C. A guide to the instructor, formulated by the curriculum committee.

Answer:

A. The purpose of curriculum is to state learning outcomes in the areas of skills, attitudes and abilities. (Skills, attitudes and abilities are often referred to by the one term: competencies.)

Question 2:

The first step in writing learning outcomes is to determine

A. What you will do during class.

B. What the student will be able to do at the end of the course.

Answer:

The correct answer is B, as the purpose of the course is to lead students to specified capabilities (competencies).

Question 3:

Pick the best stated objective (learning outcome) from this list:

A. The course will cover dietetic decision making.

B. The student will make correct dietetic decisions.

C. The instructor will analyze for the class the process of making correct dietetic decisions.

Answer:

The expected answer is B. Although A and C may be necessary to bring the student to the ability to make correct decisions, learning outcomes (objectives) should be stated in terms of what the student will be able to do after completing the course.

Question 4:

Suppose students should know acceptable standards of clinical behavior, which of these learning outcomes best states this

A. The course will include 12 rules on clinical behavior.

B. The students will recognize examples of acceptable and unacceptable clinical behavior.

Answer:

B is the better statement.

Question 5:

The previous example dealt with knowing acceptable clinical behavior. Usually, just knowing is not sufficient; we require the student to demonstrate favorable attitudes. Which of these learning outcomes best states this

A. The student will develop a positive attitude to acceptable clinical behaviors.

B. The student will choose to behave in ways acceptable in clinical situations.

Answer:

B is the expected answer because by choosing to behave in a certain way the student is demonstrating the desired learning outcome.

Learning outcomes should be specified in terms of that which is to happen to students themselves. The examples given have dealt with students' knowledge, understanding, and attitudes to be gained. Objectives may also be stated in terms of skills or abilities to be gained by students. The first principle, always, is the objectives must state the ways in which students will change. They cannot properly be written in terms of what the instructor will do or what the course will cover.

The next matter to consider in specifying course outcomes is knowledge of results. How will you know what has happened to the students? How will you know what they have learned?

Let us take another example. Say our course dealt with the Bill of Rights, understand the differences between democracy and authoritarianism, and appreciate democratic processes. One can not simply assume that, as a result of their attending the course, the students gained this knowledge, understanding, and appreciation. The instructor must attempt to gather evidence of learning achieved.

The second step in specifying learning outcomes, then, is determination of attainment--demonstration that the desired change has taken place.

Perhaps the most common method of determining student change in a college course is the written examination. If the instructor chooses to use this method, which of these statements would best be incorporated in his objective?

A. The student will show that he knows the Bill of Rights.

B. The student will give evidence of his knowledge of the Bill of Rights.

C. The student will respond to test items on the Bill of Rights.

Answer:

The best answer is C. It specifies that performance will be measured by test items.

It is desirable to specify also the type of test to be administered, for there are many forms of written examinations, each of which may demand separate skills. Pick from this list the response that best states the objective.

A. The student will demonstrate his knowledge of the Bill of Rights by responding to test items.

B. Given 10 multiple-choice questions, asking rights guaranteed in the Bill of Rights, the student will select the correct responses.

C. The student will write an examination on the Bill of Rights.

Answer:

The expected response is B. Answers A and C also specify examination performance. However they do not state the type of exam as the number of items necessary for the student to show that he knows the provisions of the Bill of Rights.

Moving to our second earlier example, how can we tell when the student "understands the difference between democracy and authoritarianism?" The instructor might ask that an essay demonstrating that understanding be written. Which of these statements would then best be incorporated in the objective?

A. The student will write 500-1000 word essay comparing and contrasting democracy and authoritarianism.

B. The student will wirte a 500-1000 work essay on democracy and authroitarianism in which he includes the following points:

a) definition of terms;

b) three examples of each type of behavior.

Answer:

The correct response is B. It is not enough to specify an essay in which the student "compares and contrasts." Comparing and contrasting are general terms that mean many things to many people. The objective should include approximate length of the paper expected and directions regarding points to be included. Note that precise specification of expected student action also lends precision to the instructor's examination items.

Another type of test might be specified--one in which the student demonstrates his understanding of the differences between democracy and authoritarianism and the instructor so spared the chore of reaching a mass of papers. In such an exam, the student is asked to identify, from given statements of political events, those indicating domocratic and those suggesting authoritarian behavior. In which of these ways would the object then be stated?

A. Given 10 paragraphs descriptive of political events, the student will differentiate among them by marking those which typify democratic and those which indicate authoritarian behavior.

B. On a multiple choice examination of 10 items dealing with democratic and authoritarian behavior, the student will select the correct answers.

Answer:

The better answer is A, for there is little ambiguity as to the nature of the test and the type of thinking which the student must apply to the problem.

We can set an attitudinal objective--"The student will appreciate the American democratic process." How do we determine the extent to which the student appreciates democracy? How do you write a test to measure an attitude?

Knowledge, understanding, and appreciation can all be assessed by observing student actions or products of those actions. If we cannot measure student achievement in classroom exams, perhaps our students' appreciation of democracy can be determined by out-of class behavior.

Suppose the instructor decided that students' appreciation of democracy could be assessed by determining whether or not the students voted when they became eligible; he could then set out to gather evidence of their independent actions. How would such an objective be stated?

A. Eligible student will vote.

B. Eligible students will vote in the next general election.

C. Eligible students will vote many times during their lifetimes.

Answer:

The correct response is B. Although a general aim may be for the student to vote many times during his life, such a statement is itself vague. It is relatively easy for an instructor to determine if his students voted on one election. Objectives must be written so that their attainment can be assessed.

These are, then, the main principles to be followed in specifying learning outcomes: Objectives must be stated in terms of student learning and they must be stated in such a way that the instructor may determine whether or not learning has occurred.

Two additional matters must be considered before the task of specifying instructional outcomes is complete. The first concerns the conditions under which the learning is to be demonstrated; the circumstances surrounding the student's performance. Our earlier example had the student moving toward responsible citizenship through knowledge of the Bill of Rights; he was demonstrating this knowledge on an examination. But under what conditions was this examination to be administered? Could the student use reference works? Was it a "take-home" exam?

Pick the statement which restates the objective better.

A. Given 10 multiple-choice questions dealing with recall of provisions of the Bill of Rights, the student will select the correct responses.

B. In an open-book examination, the student will select the correct responses on 10 multiple-choice questions dealing with recall of provisions of the Bill of Rights.

Answer:

B is a better objective because it communicates more information. Conditions of performance in B indicate that the student will be allowed to use a reference work while answering the questions.

In our third example, the student was to indicate his appreciation of the democratic process by voting.

Which of these statements, added to the objective, indicates conditions under which the performance is to occur?

Eligible students will vote in the next general election:

A. If they are registered.

B. Voluntarily.

C. For the candidates of their choice.

Answer:

The best response is B. "Voluntarily" suggests that the student has been stimulated to act on his own.

In all cases, objectives must specify the conditions under which the performance will occur. These might be instances of voluntary or mandatory behavior; in-class or out-of-class action; written or verbal performance; whether or not reference works will be permitted, and so forth.

One more specification and the objective is complete: The demonstration of learning, the conditions of performance and, last, the criterion or standard. Setting the criterion simply involves a decision as to the degree of accuracy which the instructor considers adequate for the achievement of the particular objective. The standard might range from 100%, on objectives which are themselves prerequisite to later objectives, down to a much lower level for complex, higher-order behaviors.

Keep the following in mind:

1) What learning is to be achieved by the student, and how will the learning be demonstrated?
2) Under what conditions is the student to demonstrate his gained ability?
3) What standard is to be considered adequate for achievement of the objective?

Here is a learning outcome:

Recognizes format of medical records.

Question:

Does the learning outcome include provision for the student to demonstrate a particular attitude or ability?

Are the conditions under which the student's performance is to occur noted?

Is a specific criterion or standard of performance given?

Answer:

The first requirement of a well specified learning outcome is satisfied; the student will demonstrate ability by recognizing the format of medical record. But you will agree that this is a very low level of skill. There is no evidence of conditions or criterion. Such a statement gives no direction to your students.

Question:

Mark your response for this example:

Verbally, without references, the student will state with

A. 100%

B. 75%

C. 50%

accuracy the three essential components in writing specific learning outcomes.

Answer:

The correct response is A. A learning outcome that does not indicate the student's performance, the conditions, and the degree of accuracy, is not at all a specific learning outcome.

Consider this example:

Given a list of 10 basic terms commonly used in renal physiology, the student will, without references, select the correct definition with

A. 100%

B. 75%

C. 50%

accuracy from a list provided.

Answer:

The expected answer is A. If terms are basic to understanding the course, the student should know all of them before being allowed to continue.

Other objectives may well require less than 100% performance. For example:

> In an open book examination, the student will write an essay of 500-1000 words in which he selects and explains 4 examples of authoritarian behavior demonstrated by Franklin Delano Roosevelt during his first term. Essay to include definition of authoritariansim, description of events, and rational for Roosevelt"s action.

For this objective, the instructor may be satisified that the student understands authoritarian behavior if he can find and explain three examples--thus, 75% accuracy would suffice.

Criteria to be included, then, depend on the nature of the task and its position in the sequence of tasks required for completion of the course or curriculum. Objectives requiring abilities prerequisite to the successful fulfillment of later objectives would carry higher criterion standards. Terminal tasks often demand less than 100% performance.

Now for the terminal task for this program. Here are the three criteria which must be applied to all specific instructional objectives:

Provision must be made for the student to demonstrate a particular attitude or ability.

The conditions under which the student's performance is to occur are to be noted.

A criterion or standard of performance must be given.

The student will understand and be able to use terms and concepts basic to the study of dietetics.

The objective includes provision for the student to demonstrate a particular attitude or ability.

The conditions under which the student's performance is to occur are noted.

A specific criterion or standard of performance is given.

This is an example of a general unit goal--a lead-in to specific objectives. How will the student show he understand terms? By defining them on an exam? By using them properly in his written papers or in class discussions? Under what conditions? How many terms? With what degree of accuracy?

As stated, the objective meets none of the criterion, but you can make it meet all of them.

Your final task for this program is to write a specific, measurable learning outcome which stems from the general goal before you. On the following page restate the goal as an objective that meets all three criteria.

The student will understand and be able to use terms and concepts basic to clinical nutrition.

Demonstrate what? ____

____

____

Under what conditions? ____

____

What criterion? ____

____

____

Write True or False after the following statements:

1. The majority of university level instruction is aimed at the students' cognative domain. ____________

2. The affective domain deals with attitudes, values, dispositions, motivation and the broad area of aesthetic concerns for feeling, beauty and form. ____________

3. Thinking processes operate without feeling processes. ____________

4. All cognative processes have an affective component. ____________

5. Affective behavior can be inferred from a person's approach and avoidance behavior. ____________

Feedback

1. Most people would say that this is the case (True).
2. True
3. False
4. True
5. True (usually)

Specifying Affective Learning Outcomes

The majority of University level instruction is aimed at the students' cognitive domain. This includes skills such as remembering, thinking logical and rational concerns and algorithmic truths. The emphasis is on academic excellence, subject matter mastery, and the learning of someone else's information.

While cognitive development is, undoubtedly, an important learning outcome, it is only part of the intellectual growth process. A seriously neglected area is the affective domain which deals with attitudes, values, dispositions, motivation and the broad area of aesthetic concerns for feeling, beauty and form.

We often forget that thinking processes cannot operate without feeling processes (Krathwohl 1964). Nearly all cognitive behaviors have an affective component. One involves the other, and they cannot be separated.

Quiz :

Instructors usually address the (1) __________ domain in their teaching. Remembering, intellectual skills and rational concerns are examples of processes in the (2) __________ domain. However, attitudes and values belong to the (3) __________ domain. Aesthetic concerns are a development of the (4) _________ domain. Thinking processes (can/cannot) operate without feeling processes. Nearly all affective components have a(n) (5) __________ component; the two (can/cannot) be separated.

Answers:

(1) cognitive	(4) affective
(2) cognitive	(5) cannot, cognitive
(3) affective	(6) cannot

It is possible to obtain affective learning outcomes by the use of mainly the cognitive domain; and viceversa. The better the learner feels about a subject, the more likely she is to learn more about it. Then, the more she knows about the subject the more she appreciates it and values it. Effective human development for the fully functioning creative individual is based on a combination of both domains, cognitive and affective (Williams 1969).

Piaget writes, "There is a close parrallel between the development of affectivity and that of the intellectual functions, since these are two indissociable aspects of every action".

Even though educators have for a long time talked about motivating the learner, the building of positive self-concepts, attitudes and values, is hardly ever planned as part of the instruciton.

There are many reasons for the neglect; one of them is comparative ignorance of how to plan for affective teaching, how to bring it about and how to evaluate it. In this short program we will address this area.

Krathwohl (1964) has provided a taxonomy of the effective domain, with five levels of hierarchy. The taxonomy is presented here:

Here is the taxonomy in more detail:

1.0 Receiving (Attending). Sensitivity to the existence of certain phenomena and stimuli.

- 1.1 Awareness. Learner is conscious of stimuli.
- 1.2 Willingness to receive. Involves suspended judgement.
- 1.3 Controlled or selected attention. Differentiation of stimulus.

2.0 Responding. Active attention to stimuli, e.g. compliance and commitment to rules and practices.

- 2.1 Acquiescence in responding.
- 2.2 Willingness to respond.
- 2.3 Satisfaction in response.

3.0 Valuing. Consistent belief and attitude of worth held about a phenomenon.

- 3.1 Acceptance of a value.
- 3.2 Preference for a value.
- 3.3 Commitment.

4.0 Organization. Organizing, interrelating, and analyzing different relevant values.

- 4.1 Conceptualizing of a value.
- 4.2 Organization of a value system.

5.0 Characterization by a value or value concept. Behavior is guided by values.

- 5.1 Generalized set.
- 5.2 Characterization.

The major categories of the affective domain are summarized above. As was the case with the cognitive domain, a continuum is implied by the sequencing of the categories. The Major characteristics of the affective continuum are as follows: (1) increasingly emotional quality of responses; (2) responses become more automatic as one progresses up the continuum; (3) increasing willingness to attend to a specified stimulus; and (4) developing integration of a value pattern at the upper levels of the continuum. The overall organizing principle which theoretically accounts for the affective phenomena in the process of learning and growth is referred to as internalization. This term generally refers to "the inner growth that occurs as the individual becomes aware of and then adopts the attitudes, principles, codes, and sanctions that become a part of him in forming value judgements and in guiding his conduct". The term internalization has much in common with a term frequently used by social psychologists - socialization.

It would be too time consuming to analyze our affective learning outcomes and to determine the exact hierarchy into which it fits on Krathwohl's Taxonomy.

Instead we have divided the taxonomy roughly in two. The lower levels cover interest and motivation, the higher levels cover attitude and value.

First, we will discuss the lower levels which deal with interest and motivation. When a learner likes or desires something, or some activity, she engages in behavior which enables her to obtain these objectives or participate in the activity. Engaging in such seeking behaviors as in behaviors which make a given activity last longer are evidences of interest or motivation. Your learning outcome requires an interest or motivational strategy if the learner is to domonstrate: increased persistence in working at some task; or more frequent participation in some task.

Interest and motivation are clearly in the (1) __________ domain. They are the starting levels of the (2) __________ domain; so (3) i_________ and (4) m__________ are the required foundation before we can move on to attitudes and values. A learner who shows increased persistence and more frequently volunteers participation is showing more (5) i__________ and (6) m__________.

---

(1) affective

(2) affective

(3) interest

(4) motivation

(5) interest

(6) motivation

Affective behavior can be inferred from a person's approach and avoidance behaviors. While many factors can complicate such choices, the following oversimplified description should assist in planning affective strategies.

When a person likes or desires a particular thing or event, he makes an effort to obtain or seek after the thing that attracts him. This type of behavior is called approach. On the other hand, when a person does not like or fears a particular thing or event, he tries to prevent contact with it. This type of behavior is called avoidance. When a person really wants to do something, we say he is motivated; in other words, he demonstrates an approach behavior. If a person who is not forced in some way, persists in working at a task or goes back to a particular kind of event again and again, we say he is interested in this event; or in other words, he demonstrates an approach behavior. An affective learning outcome identifies particular approach behaviors from which we can infer interest or motivation in particular objects or events.

When we attempt to promote interest or motivation, the desired learning outcome should not be designed to have all students equally motivated or adopt common interests. Rather, they are to modify the negative extreme of behavior, to promote interest in something where there was not interest before, to motivate in socially acceptable ways where exisiting motives are disruptive or socially unacceptable, and to empathize with the acceptable motives and interests of other.

One way to provide interest and commitment is to set up practice conditions so that participating in a particular reinforcing event depends on the learner's accomplishment of a specified learning activity.

Motivation or interest is increased when a learner successfully engages in a particular task. The most successful procedure yet identified for insuring involvement consists of establishing a contract with each student whereby a certain amount of involvement with the task results in an opportunity for activity the student finds rewarding (Blaine and Merrill 1971).

A person's approach and avoidance behavior is an indication of that person's (1) m________. A person interested in some event or task is displaying (2) a________ behavior, an indication that the person is (3) m________. Approach is clearly the opposite of (4) a________. One technique of increasing motivation consists of establishing a (5) c________.

(1) motivation

(2) approach

(3) motivation

(4) avoidance

(5) contract

Does your learning outcome specify a change in values or attitudes? Attitudes and values are very complex sets of behavior which include cognitive behaviors, psychomotor behaviors, as well as emotions and feelings. Part of acquiring an attitude or value involves knowing the concepts involved. There are three levels at which a student can express attitude or value behavior. Level one is verbal expression wherein he accepts a given attitude or value; level two is reported behavior where he tells what he would do in a given situation; level three is what he actually does in a given situation. All three levels are probably necessary to affirm a student's attitude or value. Since the first two levels can readily be faked, it is crucial during evaluation that the student be unaware of which situations are to be used to evaluate attitudes when attitudes are being observed.

On the next page, there are a number of evaluation strategies for attitude or value learning outcome. Perhaps you would like to take this short quiz before you turn over the page?

The most reliable evaluation for attitude and value behavior is through__________. Verbal reports are not reliable because the student will quite likely provide you with the answer you _________. Reported behavior can be made more reliable as a measure by meeting certain conditions; can you suggest some of these conditions?

Verbal Report: It is possible, but difficult, to obtain valid measures of given attitude or value by verbal report. A measure which merely asks the student whether or not he subscribes to a given attitude or value is the most unreliable of all measures for several reasons. First, asking the question tells the student he is being asked his position relative to a given value. If he wants to please the questioner, he will answer according to what he thinks the questioner wants, rather than according to his feelings. Mere verbal expression does little to measure how a student would act were he required to take a position with respect to the attitude or value under question.

Reported Behavior: Asking the student to state how he would act in described situations can be a more reliable measurement, if the following conditions are met. First, the student is led to believe that the instrument is for some purpose other than to measure his attitudes or values. Second, the student makes his choice for specific situations rather than for abstract statements. Fourth, the descriptions are worded without clues about the desired or anticipated response.

Observed Behavior: Observing a student's choices without his knowledge is the most reliable evaluation procedure for attitude and value behavior. The following suggestions may assist in establishing such observation conditions.

First, identify those situations which, if chose, would provide the student the possibility to indicate his position relative to the value or attitude under question. Be sure that the situations identified are likely to occur with some frequency.

Second, be certain that a given situation presents the student a choice where alternatives would indicate different positions relative to the value.

Third, be sure the student has a free choice. If, during the presentation, the situation was described and the alternatives identified relative to the value or attitude, or if the student is aware that she is being observed, then there is no assurance of free choice. Clues hidden in the situation itself may give some indication of the preferred choice and constrain the decision.

Criteria: A single choice is not adequate to infer adoption of a given attitude of value. Several choices in several different situations assure a more reliable inference.

It is usually inappropriate to award grades or other sanctions for one value position over another. The purpose of observations should be to evaluate the effectiveness of the experiences employed, rather than to give awards to the students for conforming.

Perhaps the most effective way to teach values or attitudes is through group (1) a________ or (2) s________. In any case, the learner should be given a variety of (3) e________, because attitude change is a slow process. We advocate three experiences in particular, they are: (4) g________ p________; (5) s________ and (6) g________ d________.

---

(1)	activities	(4)	group participation
(2)	simulations	(5)	simulation
(3)	experiences	(6)	group discussion

If your learning outcome specifies attitude change, then there are practical strategies to accomplish this. You could provide opportunities for the learner to participate in group activities or simulations where accomplishing a desirable group goal depends on his adopting (at least temporarily) the value system or attitudes of the group. Provide the necessary congnitive information concerning the attitude or value by using the appropriate cognitive strategies.

<u>Cognitive Presentation</u>: When teaching values and attitudes, there is usually a considerable amount of cognitive understanding necessary before a student can rationalize a given value or attitude positon. Consequently, teaching values frequently involves teaching cognitive information.

<u>Variety of Experiences</u>: Attitude change is usually a slow process involving a variety of experiences with the new attitude or value, which is not difficult to realize considering the old attitude may have been held for some time and reinforced on numerous occasions. It is important, therefore, that each student have a variety of experiences, each designed to promote adoption of the new attitude or value.

<u>Group Participation</u>: Perhaps the most successful way to change an attitude or value is to put the student in a situation where he is required to adopt the value or attitude in order to accomplish a crucial group goal. This is the "act as if" phenomenon. All of us have observed that a group of people holding very different views suddenly adopt a common code when faced with a crisis.

<u>Simulation</u>: A student's attitudes or values can be significantly affected in carefully designed role playing or simulation situations.

These situations can cause the learner to experience negative outcomes as a result of holding to his currently held values, or positive outcomes as a result of temporarily adopting the new value or attitude.

Group Discussion: While not as effective as presentations, group participation or simulation discussions which help a student examine the consistencies and inconsistencies of currently held values, may help him change his attitude. This experience is much more effective when used in conjunction with some of the previously described procedures.

A way to operationalize attitude change is to present the student a statement of the attitude(s) or value(s) of concern. Recreate situations illustrating the value or attitude, but avoid the specific situations to be used in assessing whether or not he has adopted the attitude or value.

Avoid Prompting Specific Behavioral Expression: Attitudes and values require both cognitive expression and behavioral expression. It is desirable and necessary to verbalize the value for the student. It is also desirable for him to see behavioral expression of the value. However, he must not be told the specific behavioral expression which will be used to assess his attitude or value change, because to do so may prompt him to respond after remembering how he ought to act rather than on the basis of how he feels.

Illustrate Attitude or Value: Carefully designed presentations can have a significant effect in changing attitudes and values. The procedures which make such presentations effective are those which cause the student to carefully examine his existing values and realize they are inconsistent with other values which have even more importance to him. The procedure required is as follows: Identify those values or attitudes about which the student has strong positive or negative feelings. During the presentation, demonstrate that the new attitude or value will preserve conditions associated with the old positively held attitude or prevent conditions associated with the old negatively held attitude.

Different Presentations: Because the same values are not held by all individuals to the same degree, a very effective presentation for one person may have little or no effect on another person. It may be necessary, therefore, to prepare several presentations, each based on different previously held values. Students could then be grouped according to their previous values and shown the appropriate presentation. If the student experiences a presentation based on an attitude he strongly opposes, he may be adversely affected. However, in most cases, it is acceptable to show all presentations to all students.

We have looked at the important basic concepts of individualized instruction, systems and mastery learning. Now we can start with constructing our own module! To do this we will progress through each of the seven components (or steps) in turn.

Pretest Step 1

1. What is meant by "learning outcomes"?

____

____

2. Do you agree with this statement:

   "Learning outcome indicates what the instructor will do during instruction".

3. When determining if a topic is suitable for your module, what are the main questions to ask?

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

____

Check your answers on the next page. If you had all the answers, you may wish to skip step 1 (after quickly skimming through it).

Pretest Step 1

Answers

1. Learning outcomes are the abilities or capabilities that become part of the learner after instruction.

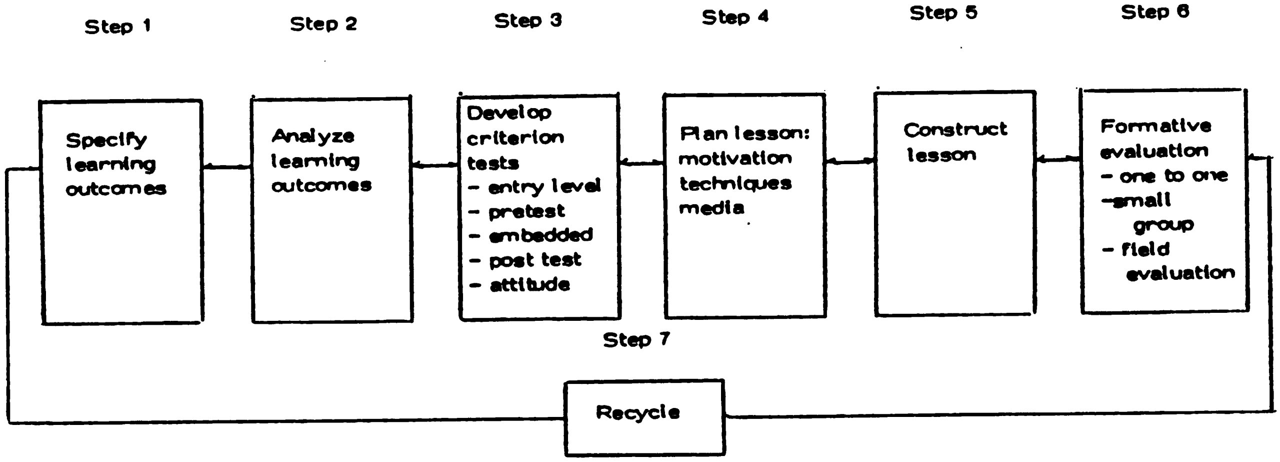
2. No. A learning outcome indicates what the student will be able to do after studying the unit.

3. a. Is there an actual need for instruction in this area?

   b. Will the content change drastically or remain reasonably constant?

   c. Is the content of reasonable length--not too short or too long?

   d. Do students find difficulties in these areas?



Step 1. Determine Learning Outcomes*

Learning Outcomes:

1. You will be able to identify learning outcomes which meet the criteria for initiating the design of an effective module.

2. You will be able to state learning outcomes for a module of your own choosing. The learning outcome will meet the major criteria required for initiating the development of a module.

*Learning outcomes are the abilities or capabilities that become part of the learner after instruction.

The learning outcome is a statement which indicates what it is that the student will be able to do after completing a lesson. It should describe the major culminating or synthesizing behavior which results from studying the unit. It should not be inferred that this is the only behavior the learner will know or be able to perform as a result of studying the module, but that he will at least have this capability. Learning outcome indicates what the student will be able to do after studying the unit, and not what teachers will do during the unit.

Since a module is only one component of a total curriculum, it is clear that the learning outcome is only a description of the terminal abilities expected of a student after completing that particular module. The different abilities and capabilities you expect from a student will be specified in various modules as the curriculum builds toward higher levels of knowledge, skills with regard to that particular module. The learning outcome for one module may well be a description of skills a student must perform as the curriculum builds toward higher levels of knowledge, skills and understanding. This building process can be achieved through the integration of several modules specifying learning outcomes to interrelate various modules one to another.

The first consideration in identifying learning outcomes is determining whether there is an actual need for instruction in a particular area. The importance of this factor is not to simply avoid re-inventing the wheel, but there is also a psychological consideration. As a module developer, you will be investing a great deal of your own time, energy, and creative talents in your materials. The need for a particular instructional package can be highly motivating to the designer, and when the going gets rough in the design process, this motivation becomes important.

A concern when identifying learning outcomes is directly related to the content itself. Is it content which will not change drastically every several years? Does it have a somewhat logical structure to facilitate development of instruction? Is the content a reasonable length to be incorporated into a module? One way of answering these questions is to determine the usual length of time required to teach a particular topic using traditional teaching methods. The rule of thumb advice is that to progress through a module will take at least twice as much time as to progress through a conventional lesson.

Another factor in determining learning outcomes is the identification of areas where students have had difficulty learning in the past. Experienced teachers can identify particular concepts, principles, and problem solving tasks which almost always prove to be difficult for students; these difficult topics may be ideally suited for a module.

There are two other factors which should be taken into consideration after identifying the learning outcomes. The first is to examine the objective to identify quite precisely the type of capabilities the student will demonstrate to indicate achievement of the goal. You may find, for example, that they are primarily writing information which they have memorized from the instructional materials. On the other hand, they may be solving a very complex problem based upon concepts and principles which they learned in the module. The nature of what the students will be doing is determined primarily by the verb in the learning outcome statement. Examine the verb and ask yourself whether that is really an important capability; does that capability merit the hours required to develop instruction for students to perform the objective?

For example, the verb <u>state</u> usually calls for just memory or low level cognitive capability; as in "state the procedure for cleaning a meat slicer". You may find that while your instructional goal meets many of the criteria listed above, it simply does not appear to be an important capability for students to have. Don't throw out the goal -start again. Re-examine it and determine whether through rewording; particulary the verb, you have a more valuable learning outcome. Remember, College teachers are often accused of teaching at the low information or memory recall level.

In order to assure yourself that the learning outcome does reflect a meaningful statement of what a student will be doing, ask a colleague for a description of what the student will be doing to fulfill the instructional goal. These responses should indicate to you the clarity of your statement. You may find that you obtain a much more detailed description than you anticipated. However, this is not a problem unless behaviors are described which you have not anticipated or cannot accept. On the other hand the verb <u>generate</u> usually calls for higher order cognitive capability, such as in "generate a POMR note". If the latter is the case, then it is important that you reword the instructional goal to reflect exactly what it is that you want the student to be able to do.

You will need to identify the desired learning outcomes. At the time of writing, there did not exist a national set of competencies for entry level dietitians from which goals could be formulated. However, with American Dietetic Association guidelines a number of Universities have been hard at work to identify competencies required of an entry-level Dietitian. An excellent source is the list of Dietetic competencies developed at Michigan State University.

Some may prefer to carry out their own needs assessment. Such a study would identify not only the goals but also the present level of attainment of these goals. The discrepancy between the present status and the desired goal becomes an identified need.

Other ways of identifying goals are by expert opinion, obvious needs of learners, job or task analysis, and interest surveys.

Practice

I. The first step in building a module of instruction is to select and state the desired learning outcomes. Several criteria can be used to help you select a topic suitable for you.

1. Below is a list of statements of consideration for selection of a learning outcome. Identify those which are important considerations for selection.

______________________stable content area

______________________time required for designing instruction vs. the importance of students possessing that knowledge or skill.

______________________area in which students have difficulty learning.

______________________few materials available on the topic though instruction is considered important.

______________________content area is fairly logical.

2. Make a tentative topic selection for an instructional module which you would be interested in writing. To determine whether you have the topics clearly in mind, state the learning outcomes on paper.

II. Now that you have identified the learning outcome which meets the selection criteria, you need to state it as clearly as possible. Below is a list of considerations for writing learning outcomes. Select those which are important considerations for writing instructional goals.

1.

______________________ Learning outcomes are clearly specified

______________________ Capabilities required of the student are obvious in the statement.

______________________ Behavior in the goal can be measured.

______________________ Capabilities in the goal can be measured to determine whether students have reached the goal.

2.

______________________ Learning outcomes are stated clearly with a topic, intended capabilities, and any limitations stated which will be imposed on the outcome or the topic.

3.

______________________ Approximate instructional time required for students to reach the goal.

______________________ Approximate writing time you can devote to writing and revising instruction.

Feedback

I. 1. If you answer yes to all of the previous criteria, you are correct. Each of these criteria is an important consideration in developing an instructional goal.

2. With the goal written on paper, refer back to question 1 in the same section. Evaluate your topic using each criterion statement.

a. Does your goal meet each criteria?

b. If it does not meet some criteria, can it be revised to do so?

c. If it does not meet a particular criterion and cannot be revised to do so, you may want to write another instructional goal and try again.

You may need help determining whether your goal meets some of the criteria for topic selection such as need or interest. You might discuss these issues relative to your goal with colleagues and target students. Revise and rewrite your instructional goals as needed to meet the above criteria.

II. If you believe that all the considerations in Section II of Practice are important, you are correct. You may check the clarity of your goal by asking colleagues and intended students to verbally interpret the instructional goal you have written. Do they interpret the goal and the required behavior exactly as you intended? You may need to revise. If your goal is too big for the instructional time available (30 minutes, 1 hour, etc.) you may want to divide the goal into its logical major parts, reword each part as an instructional goal and then select the part most suited to your needs and time constraints as the instructional goal for your materials. If you goal is too small for the amount of time you desire, consider the skills the student will need to enter your module and the skills the student will be ready to learn as a result of completing your module. By considering skills related to your goal in this fashion, you can identify the appropriate instruction to include in a module for a specified period of time. Of course you will want to revise your instructional goal to include more skills or information as required.

WRITING LEARNING OUTCOMES

Here is a summary and a short exercise to help you with writing learning outcomes. (We go into the specifying of learning outcomes in more detail later.)

Instruction outcomes have three elements:

1. the performance required by the student
2. the conditions under which the student must perform
3. the minimum acceptance level of performance

In other words:

1. Do what?
2. Under what conditions?
3. At what performance level?

Here is a learning outcome:

> Given an example of a dairy food, the learner will rank and compare the nutrieint parts of that food, without error.

In this example, the learner will:

1. Do what? ______________________________

   ____
2. Under what conditions? ______________________________

   ____
3. At what performance level? ______________________________

   ____

We will get on fine if you wrote:

(1) rank and compare the nutrient parts of the given food

(2) given an example of dairy food

(3) without error

Now, write a learning outcome of your own choosing:

____

____

____

Look at your learning outcome and see if it has these parts:

1. Do what (performance) ______________________________________

____

2. Under what conditions ______________________________________

____

3. At what performance level (criterion) ______________________

____

If you are having problem in writing objectives, then refer to a number of excellent guides available including:

Preparing Instructional Objectives by Robert Mager (Palo Alto: Fearon Publishers Inc.) 1962.

Important

It was mentioned earlier that it is necessary to be particularly careful with the verb in our objective -- e.b. identifies the various parts of meat such as fat, loin, muscle-because the verb (identifies) will determine the level of complexity of any given objective. For example, Gagne's Domains of Learning lists a hierarchy of objectives. On a following page is Gagne's Domains of Learning. Notice the hierarchy under "intellectual skill" - there are 5 levels, starting with the lowest level which is discrimination and moving to the highest level which is higher order rule. Notice also that Gagne suggests a verb to identify each domain. Later we will take a much closer look at hierarchies of learning.

HIERARCHIES OF LEARNING

Human learning is a complex matter. There are so many theories, experts, methods and new ideas that they confuse rather than clarify. To complicate matters, each learner is different and learns in ways unique to her.

It is no wonder then that most instructors can pay very little attention to all these exhortations and revert to teaching in ways which closely resemble the way they were taught.

This clearly is not a satisfactory situation. There are new ways to make our teaching much more effective.

This short module has been designed to help you understand some important concepts. These concepts are vital if we are to improve learning.

The majority of human learning falls into three domains. They are the cognitive, affective and psychomotor domains.

Learning outcomes specify learning which fall into one of these domains.

<u>Remember</u>:

Cognitive - to promote abilities in thought and understanding.

Affective - to promote changes in attitude, feeling or emotion.

Psychomotor - to promote improvement in physical or manipulative skills.

For which types of learning outcomes do instructors typically teach?

You were correct if you said "cognitive".

This is true even though we know that a major portion of educational failure is actually due to negative attitudes. Still, that is another story. In this module we will deal with the cognitive domain. Later we will see how cognitive and affective learning can be integrated. The cognitive domain deals with ________________ __________. Another term for mental ability is intellectual skills.

---

mental ability

It is possible to talk about the level of complexity of any given learning outcome. Sometimes these are referred to as hierarchies. For the cognitive domain Bloom has published a hierarchy of cognitive learning outcomes.

Learning outcomes can be determined as to their c__________. Often we specify the complexity of a learning outcome by stating where it falls in the H_________. A h_________ indicates that cognitive learning outcomes can be ordered as to their difficulty or c___________.

---

complexity

hierarchy

hierarchy

complexity

Bloom's <u>Taxonomy</u> lists a hierarchy of cognitive learning outcomes. Here is a brief summary of <u>Bloom's</u> Taxonomy; note that knowledge is the lowest level and evaluation is the highest.

Knowledge - to recall and recognize

Comprehension - to translate from one form to another

Application - to apply or use information in a new situation

Analysis - to examine something complex and break it down into its parts

Synthesis - to put together information in a unique or novel way to solve a problem

Evaluation - to make a judgment about something in light of some criteria

How can I make it clear that my learning outcome belongs to a particular level of complexity? Simple - by the verb. If your learning outcome uses the verb define or list, then you are specifying for learning outcomes at the knowledge level. On the next page is a list of possible verbs and the levels of complexity which they represent. The verb judge indicates learning outcomes at the e_______ level, and so do verbs such as appraise and evaluate. At the synthesis level the first verb listed is c_________.

---

evaluation

compose

To translate from one form to another means operating at the c________ level according to Bloom's hierarchy. C_______ is a (low/high) level cognitive process.

At what level do most instructors teach? At the k___________ level. At the k_________ level the student is merely required to recall or recognize.

It would seem that at University level students should reach the _________ level by the end of this course. At the ____________ level students are asked to make judgments based on criteria.

---

comprehension	knowledge
comprehension	knowledge
low	evaluation
	evaluation

SOME POSSIBLE VERBS FOR USE IN STATING COGNITIVE OUTCOMES

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
define	translate	interpret	distinguish	compose	judge
repeat	restate	apply	analyze	plan	appraise
record	discuss	employ	differentiate	propose	evaluate
list	describe	use	appraise	design	rate
recall	recognize	demonstrate	calculate	formulate	compare
name	explain	dramatize	experiment	arrange	value
relate	express	practice	test	assemble	revise
underline	identify	illustrate	compare	collect	score
	locate	operate	contrast	construct	select
	report	schedule	criticize	create	choose
	review	shop	diagram	set up	assess
	tell	sketch	inspect	organize	estimate
			debate	manage	measure
			inventory	prepare	
			question		
			relate		
			solve		
			examine		
			categorize		

As educators it is important that we specify our learning outcome in terms of their complexity. We need to ask questions like: Is the cognitive level of the skill sufficient? What is the correct level? By teaching at this level, will the student be able to perform higher level tasks later?

These questions become crucial when we recognize that a high level cognitive task can only be achieved if learning has been carefully built up to it. One researcher who has contributed greatly to our understanding of learning hierarchies and sequences is Robert Gagne.

Gagne has developed a hierarchy of "Learning Capabilities" which is in many ways similar to Bloom's Taxonomy. We prefer Gagne's work because he deals with learning outcomes which makes his work more operational. This will become more apparent as we move along.

On the next page is Gagne's Domains of Learning Capabilities. Particularly note his five categories of Intellectual (cognitive) skills, culminating at the highest order, that of cognitive strategy. To reach concensus, Gagne has designated just the one verb to indicate each level or type of capability. Note that information, identified by the verb states, does not even qualify as an intellectual skill. The lowest intellectual skill is d_______ and the verb used to identify this level of intellectual activity is d_________.

A discrimination requires telling our object apart from another. Because it is a very basic kind of intellectual skill, it is assumed to have been learned early in life. However there may be a place for this level of learning if a student cannot see the distrinction (i.e. discriminate) between a bright and dark boundary, under microscope, which should be identified as a cell wall.

---

discrimination
discrimination

GAGNE: DOMAINS OF LEARNING (CAPABILITIES)

Capability	Verb	Example
Attitude	Chooses	Chooses to eat "junk foods" for main meals.
Motor Skill	Executes	Executes the task of cleaning a meat slicer.
Information	States	States orally foods considered as dairy foods.
Intellectural skill		
1. Discrimination	Discriminates	Discriminates between chalk and cheese.
2. Concrete Concept	Identifies	Identifies the various parts of meat such as fat, lean, muscle.
3. Defined Concept	Classifies	Classifies, by using a definition, the concept "calorie."
4. Rule	Demonstrates	Demonstrates, by verbal explanation, the function of electrolyltes.
5. Higher order Rule (Problem Solving)	Generates	Generates, by taking into account patient variables, an acceptable renal diet.
6. Cognitive Strategy	Originates	Originates a solution to "dumping syndrom" by applying principles of teaching and learning.

Based on R.M. Gagne and L.J. Briggs, <u>Principles of Instructional Design</u>, Holt, Rinehart and Winston Inc., N.Y., 1974. p.85.

Rule

A number of concepts which interact is one way to describe a rule. To see if the learner understands a particular rule we ask her to demonstrate such understanding. The demonstration of knowledge can be verbal.

The action verb associated with a rule is d__________.. By demonstrating the interaction of a number of component concepts, the student is proving that she understands a r________.

---

demonstrate
rule

Higher Order Rule (Problem Solving)

The highest intellectual skill which Gagne identifies is the higher order rule which he also referes to as problem solving. Here we recognize that much of our problem solving is done through the complex combination of simpler rules. The capability of problem solving is, naturally, a major aim of the educational process - we should give priority to teaching the learner 'to think clearly'. When the learner generates a solution to a problem, she has generated a higher order rule. Consequently, the verb generate is used to identify a learning outcome where the complexity of the intellectual process is at the problem solving leve. Gagne's term for problem solving is h________ o________ r_______. The verb which specifies that learning is at higher order rule is g___________. The learner g_________ a solution to the problem by using a number of simpler rules.

higher order rule

generate

generates

Cognitive Strategy

A special kind of intellectual skill, which is in addition a type of prticular importance in problem solving, is called a cognitive strategy. The term cognitive strategy applies to the various skills that are used by the learner to manage the processes of learning, remembering and thinking. A cognitive strategy is an internally organized skill that selects and guides the internal processes involved in defining and solving novel problems. In other words, it is a skill by means of which the learner manages her own thinking behavior. The verb which specifies a cognitive strategy is originates.

When a student originates a novel solution she is operating at the highest level of intellectual skill which is c________ s__________. The verb to indicate operation at cognitive strategy level is o________. Cognitive strategy applies to the various skills that are used by the learner to manage the processes of l________ r_________ and t_________. A c_________ s________ is an internally organized skill that selects and guides the internal processes involved in defining and solving novel problems.

---

cognitive strategy
originates
learning, remembering, thinking

We have looked at a range of human capabilities called intellectual skills. Another way of stating this is that we have looked at learning hierarchies in the cognitive domain.

Gagne does not recognize information as a cognitive skill as i_________ relies on memory. Gagne's intellectual skills begin with d__________ which is specified by the verb d___________. Such discrimination is between object properties.

When a person is asked to identify various parts of the nephron on a model, the skill is at c_________ c________ level.

When the concept is not at a concrete level where the learner can point to it they are moving towards d_______ c_________. Here the learner is asked to classify the concept by using a definition or by giving an explanation. Defined concepts are recognized by the verb c_________.

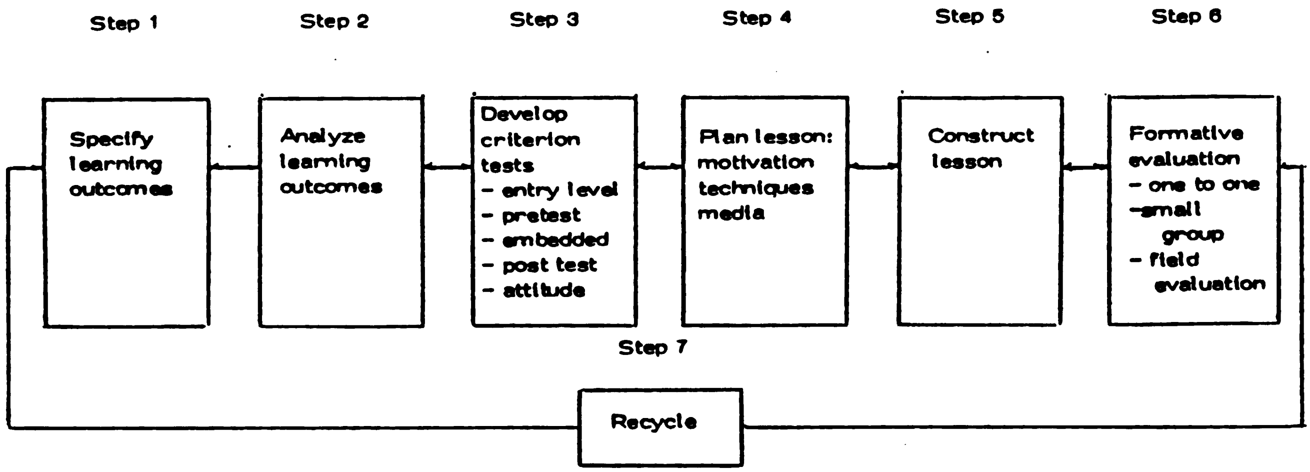
A number of defined concepts add up to a r_______. The learner shows mastery of the rule by d__________ something, possibly by a verbal explanation.

When a person synthesizes a number of rules and solves a problem then she has generated a h_________ o_________ r________.

An additional category of internally organized skills is c_____ s________ which govern the learner's behavior in learning and thinking, and thus determine its quality and efficiency.

---

information
discriminate
discriminates
concrete concept
defined concept
classifies
rule
demonstrating
higher order rule
cognitive strategy



Step 2. Analyze the Learning Outcomes

<u>Learning Outcomes</u>

1. You will be able to identify and describe procedural, hierarchical and combination approaches to instructional analysis.

2. You will be able to describe the relationship among the tasks which are identified through an instructional analysis.

3. You will be able to apply instructional analysis techniques to identify subskills required to attain specified learning outcomes.

4. You will be able to describe entry behaviors and distinguish them from general characteristics of students in a target population.

It has been traditional for the content of instructional materials, typically textbooks, to be defined by experts who have developed a structure for knowledge which makes up a particular discipline. Experienced teachers, using these textbooks, often have varied the instructional approach, sequence, or content as they proceeded to teach students on a somewhat trial and error basis.

In recent years, research has been conducted in an effort to identify more effective procedures for identifying the precise skills and knowledge which should be included in instructional materials for students to efficiently and effectively achieve an instructional goal. For example, rather than defining a course on renal diets in terms of three lectures and 80 pages of text, there has been an effort to identify precisely what it is that students will be able to do when they complete their studies on renal diets. The next step is to identify the subordinate skills which are required for the student to achieve the instructional goal. Several procedures have been developed for identifying major subordinate skills. This chapter will present several such approaches.

The particular approaches chosen for an instructional analysis will depend upon the kind of learning required in the learning outcome. It should be stressed that while researchers do not claim that the instructional analysis approach is the only way to identify content which should be included in a set of instructional materials, their data suggest that the use of these approaches results in the identification of skills which efficiently lead to the achievement of the instructional goal.

Two somewhat different approaches to instructional analysis will be decribed first: the procedural approach and the hierarchical approach.

A third technique which is, in fact, a combination of these two, will also be described. The method to be used is completely dependent upon the type of behavior described in the learning outcomes.

Procedural Analysis

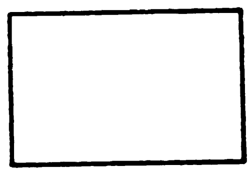
The simplest of the three instructional analysis approaches is the procedural approach. This approach is used when the behavior to be taught is essentially a sequence of behaviors which must be performed one after another in sequence to achieve the instructional goal.

To do this the authors of Learning Systems Design advocate that you first write a task description, then flow diagram the tasks and then identify the concepts, principles, rules, facts, and skills to be taught. Here is the process in more detail.

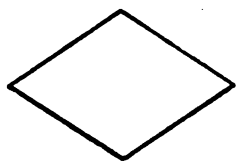
Your Task Description will identify the steps needed to carry out the task. This description will help you to decide what to teach and how to teach it. A task description will also insure that all the essential materials are taught, and at the same time, that no unnecessary information will be included in the course.

Your Flow Diagram is a means of representing fixed sequence tasks in a schematic or digramatic form; it is an aid to visualizing the structure of a task. A flow diagram is a convenient method for describing and clarifying relationships between actions, cues and feedback which might otherwise be obscured or overlooked.

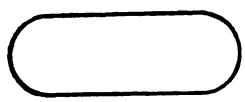
In flow diagraming, the steps in a task are represented by a set of symbols. The shape of the symbol used depends on the function being performed. The use of flow diagrams for describing fixed sequence tasks is relatively new and symbols have not been standardized; however it is possible to use the symbols commonly employed in computer programing, which are shown here.



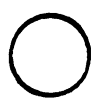
The action or operation function. Generally requires an action such as walks, finds, sorts, etc.



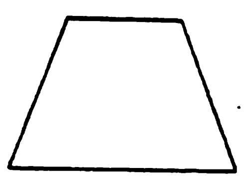
The decision function. Often identifies feedback or cues and branches to alternative action sequences.



The beginning or end of a task.

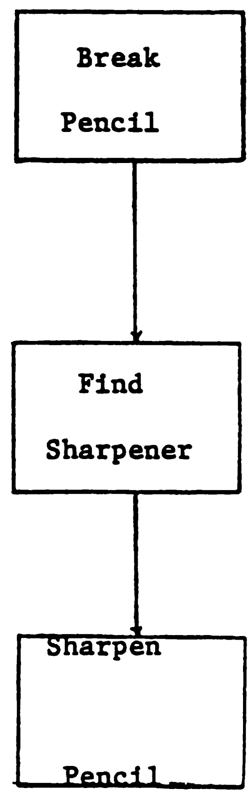


Connector to another point within the flow diagram.



The information function. Making information available, recording information, etc.

In order to clarify how flow diagrams of fixed sequence tasks are written and used, it will be helpful to recall, once again, the example of the pencil sharpener. An oversimplified view of how this task is performed might look like this:



Actually, even such a simple task as sharpeneing a pencil has far more steps than the above description suggests. It can be a valuable exercise to trace an elementary task of this kind from the beginning to end.

Here is an example of a task description:

Say you wish the learners to master the following goal:

The learner can clean an electric food slicer following the procedures presented in the instructional manual and observe safety procedures.

Task Description:

1. Begin - with a recently used food slicer and the necessary cleaning materials (cloth, hot water and cleaning compound, and spatula).
2. Is the motor off?

   If yes, then go on to next step (#3)

   If not, then turn switch to "off" position.
3. Unplug food slicer.
4. Are knife guards in place and slice adjustment is at zero?

   If yes, then go on to next step (#5)

   If not, put knife guards in place and/or slice adjustment at zero.
5. Remove carriage tray assembly unit.
6. Remove excess food from the base of the meat slicer.
7. Wipe entire outside of food slicer.
8. Clean both sides of the guage plates.
9. Remove upper and lower knife guard.

   9a. Open lid of grinder cavity.

   9b. Open guard lock.

   9c. Life upper guard straight up.

   9d. Rotate lower guard to the stop position and lift up.
10. Clean blade.

    10a. Open blade as wide as possible by moving the slicing adjustment to the higher number.

10b. Cover spatula with damp cloth.

10c. Wipe blade on both sides rotating blade with the cloth-covered spatula toward you.

10d. Clean crevices where blade is attached to the unit with the spatula.

10e. Wipe back part of the base close to the blade with spatula.

10f. Is sanitizing of blade required?

If no, then go on to next step (#11)

If yes, then:

-put sanitizer in water

-dampen cloth and wrap it on the spatula

-wipe blade with the cloth-covered spatula

11. Wash upper and lower knife guards and dry.

12. Replace knife guards.

12a. Replace lower guard and rotate it to the bottom.

12b. Replace upper guard.

12c. Lock the guards into place.

13. Wash carriage tray assembly unit.

14. Attach carriage unit and lock into place.

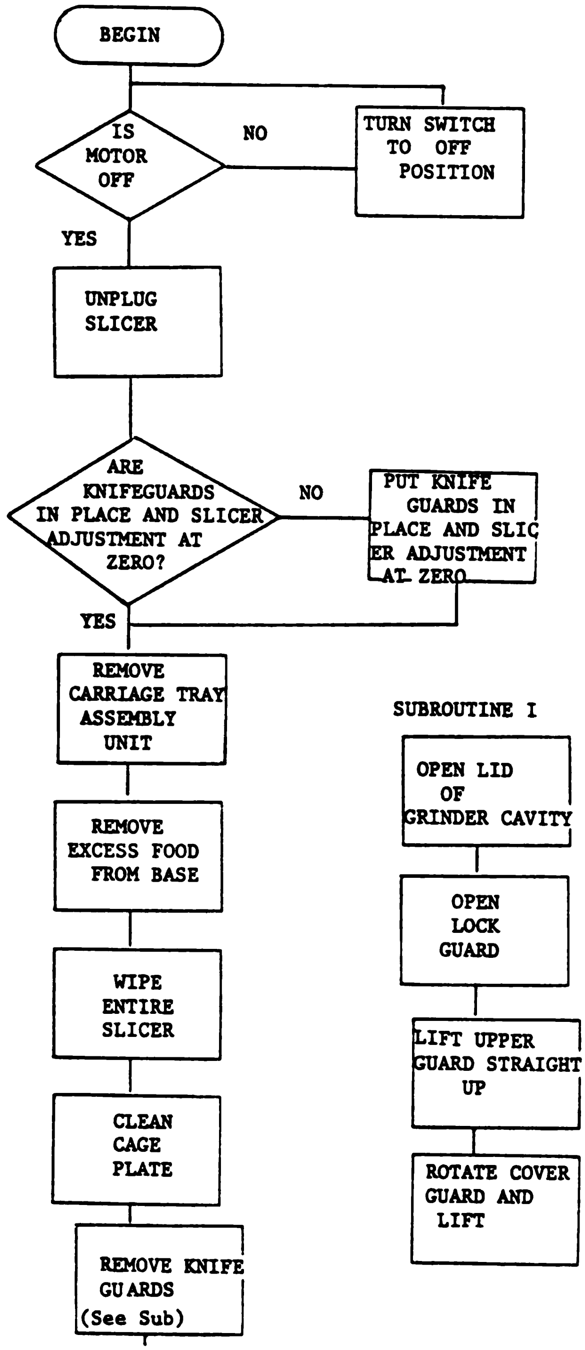
15. Move slice adjustment to 0.

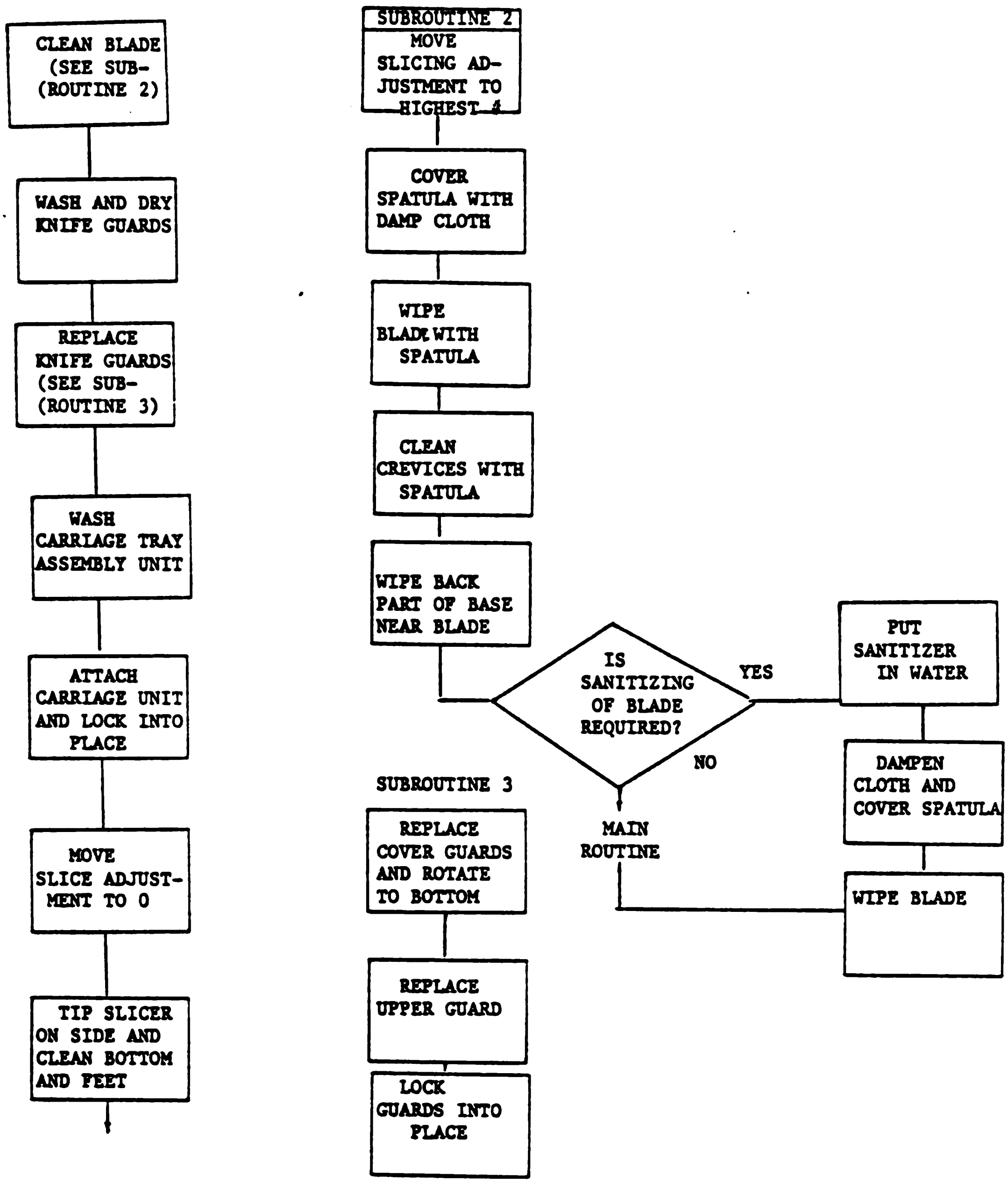
16. Tip food slicer on its side and wipe the bottom and feet with a damp cloth.

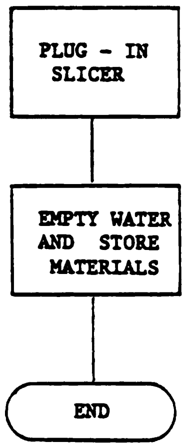
17. Plug in the food slicer.

18. Empty the water and store cloth, pan, and spatula.

19. End - with clean food slicer.


BEGIN
IS MOTOR OFF
NO
TURN SWITCH TO OFF POSITION
YES
UNPLUG SLICER
ARE KNIFEGUARDS IN PLACE AND SLICER ADJUSTMENT AT ZERO?
NO
PUT KNIFE GUARDS IN PLACE AND SLICER ADJUSTMENT AT ZERO
YES
REMOVE CARRIAGE TRAY ASSEMBLY UNIT
REMOVE EXCESS FOOD FROM BASE
WIPE ENTIRE SLICER
CLEAN CAGE PLATE
REMOVE KNIFE GUARDS (See Sub)
SUBROUTINE I
OPEN LID OF GRINDER CAVITY
OPEN LOCK GUARD
LIFT UPPER GUARD STRAIGHT UP
ROTATE COVER GUARD AND LIFT


CLEAN BLADE (SEE SUB- (ROUTINE 2)
WASH AND DRY KNIFE GUARDS
REPLACE KNIFE GUARDS (SEE SUB- (ROUTINE 3)
WASH CARRIAGE TRAY ASSEMBLY UNIT
ATTACH CARRIAGE UNIT AND LOCK INTO PLACE
MOVE SLICE ADJUST- MENT TO 0
TIP SLICER ON SIDE AND CLEAN BOTTOM AND FEET
SUBROUTINE 2
MOVE SLICING AD- JUSTMENT TO HIGHEST #
COVER SPATULA WITH DAMP CLOTH
WIPE BLADE WITH SPATULA
CLEAN CREVICES WITH SPATULA
WIPE BACK PART OF BASE NEAR BLADE
IS SANITIZING OF BLADE REQUIRED?
YES
NO
PUT SANITIZER IN WATER
DAMPEN CLOTH AND COVER SPATULA
WIPE BLADE
MAIN ROUTINE
SUBROUTINE 3
REPLACE COVER GUARDS AND ROTATE TO BOTTOM
REPLACE UPPER GUARD
LOCK GUARDS INTO PLACE


PLUG - IN
SLICER
EMPTY WATER
AND STORE
MATERIALS
END

Task Analysis

Concepts

carriage tray assembly unit

base of food slicer

guage plate

upper knife guard

lower knife guard

grinder cavity

guard lock

sanitize

sanitizer

Principles

Food particles, if not removed from the food slicer, will spoil and may cause food poisoning when the slicer is used again.

Water must be above a certain temperature (120) if it is to be useful in removing grease and sticky food particles.

By opening the blade as wide as possible (setting the slicing adjustment on the higher number), more of it is exposed for cleaning.

When the slice adjustment is a 0, the knife (blade) is full guarded.

Rules

The motor must be turned off and unplugged while cleaning.

Do not touch the slicer blade with hands at any time - use the cloth-covered spatula to manipulate the blade.

<u>Attitude Instructional Analysis</u>

The analysis of how to proceed to teach an attitude requires a different approach. Not only must instructional designers consider and analyze the information which must be presented, but they must also consider issues such as: modeling or dramatization, credibility of source of the information, knowledge of consequences of behavior, the importance or criticalness of the issue to the audience, and the tone with which information and instruction are presented. The environment or what is happening around the presentation of information sometimes seems to have more affect on a person's attitude toward the information presented than does the information itself. For this reason, not only must the information be analyzed, but the instructional situation, the method of presentation, the presenters, and the target audience must also be carefully analyzed.

Here is an exercise. Your goal is for teenagers to develop a positive attitude towards eating balanced meals. Your first step is to do an analysis. While doing this analysis you may want to ask yourself, "Does a person need to know the names of the categories of the four basic foods (step 1) to be able to state why milk is classified into the dairy category (step 2)"? Yes. This is a simple check to determine whether the relationship is hierarchical or just logically ordered. You may find that a combination analysis is required for this task.

An analysis is on page 2-22.

After you have done your analysis, describe how you would create an instructional setting which would account for each of the factors listed below.

II. Modeling:

III. Credibility:

IV. Consequences:

V. Importance:

VI. Tone:

Feedback

II. Modeling:

A. There are several alternatives here. The model(s) should be someone with which teenagers can identify. Some might include:

1. Other students their age or slightly older.

2. Students they would like to resemble.

a. A popular boy or girl

b. An athlete

c. Someone handsome or pretty

d. Someone happy and successful

B. If your audience is mixed boys and girls, have you included models for each? They will probably not both identify with a model from one sex or the other.

III. Credibility:

A. Here again there would be several choices.

1. Would your source be expected to know about the subject?

2. Who would teenagers consider knowledgeable about proper health and diet? Perhaps an athletic coach, school nurse, health teacher, local popular athlete who looks healthy ("Here's how I got this way!"), local physician, or a member of the county health program would be credible to teenagers.

3. Who would they want to see concerned about them and their health?

IV. Consequences:

A. This is where the use of appropriate models is very important. Here you may want to use several examples and several models.

1. Did you consider positive as well as negative consequences?

a. Some positive consequences might include: becoming pretty or handsome, having plenty of energy, being productive, feeling good, being healthy, having attractive skin, being popular, being accepted, and being the right size.

b. Some negative consequences might include the loss of a good complexion, loss of popularity, loss of acceptance, loss of energy, not participating in activities or achieving goals, loss of teeth, overweight, underweight, etc.

V. Importance:

Do you have presentations planned that will convey the message "This is very important to your life and your well being. It is important now and it is important to your future." Messages that convey current importance will probably have more impact than future importance.

VI. Tone:

A. Some questions you might consider to evaluate your ideas are:

1. Do your presenters have the proper attitude?

2. Do they convey a message for fear, "You had better do this or else." Do they appear to be kind, concerned, and helping? Actually a combination of these tones may be effective for this group.

3. Are your models pleased with themselves when eating properly and disappointed in themselves when not eating properly?

Facts

Location of On-Off switch.

" " carriage tray assembly unit.

" " carriage locking mechanism.

" " base of the food slicer.

" " gauge plate.

" " knife guard lock.

" " upper and lower knife guards.

" " blade.

" " slicing adjustment.

" " grinder cavity.

" " crevices where blade is attached to the unit.

Skills

Removing and replacing carriage tray assembly unit.

Removing and replacing knife guards.

Cleaning and rotating blade with a cloth-covered spatula.

Tipping the food slicer on its side.

The procedural or task analysis is basically a set of procedures which, in this case, results in a clean food slicer. Each step is independent, and the steps could be taught separately from one another.

The technique of task analysis or procedural analysis is most effective when applied to motor skills which might be found in a vocational area such as learning to operate or maintain various kinds of equipment.

Cognitive skills which fall into this category are almost always "rule following" types of behavior.

Hierarchical Analysis

The second approach to conducting an instructional analysis is through the application of hierarchical analysis techniques. This technique is generally applied to what Gagne identifies as intellectual skills. Intellectual skills are those capabilities which the individual has and uses to perform the thinking tasks.

Research conducted by Gagne and others, indicate that higher level learning such as the application of principles and problem solving takes place as a result of utilizing lower level intellectual skills such as the integration of concepts, the ability to discriminate, and the ability to make verbal associations. Therefore, it is necessary to identify the type or level of learning which is being required in an instructional goal and to use hierarchical techniques to identify subordinate skills which must be achieved prior to achieving the goal.

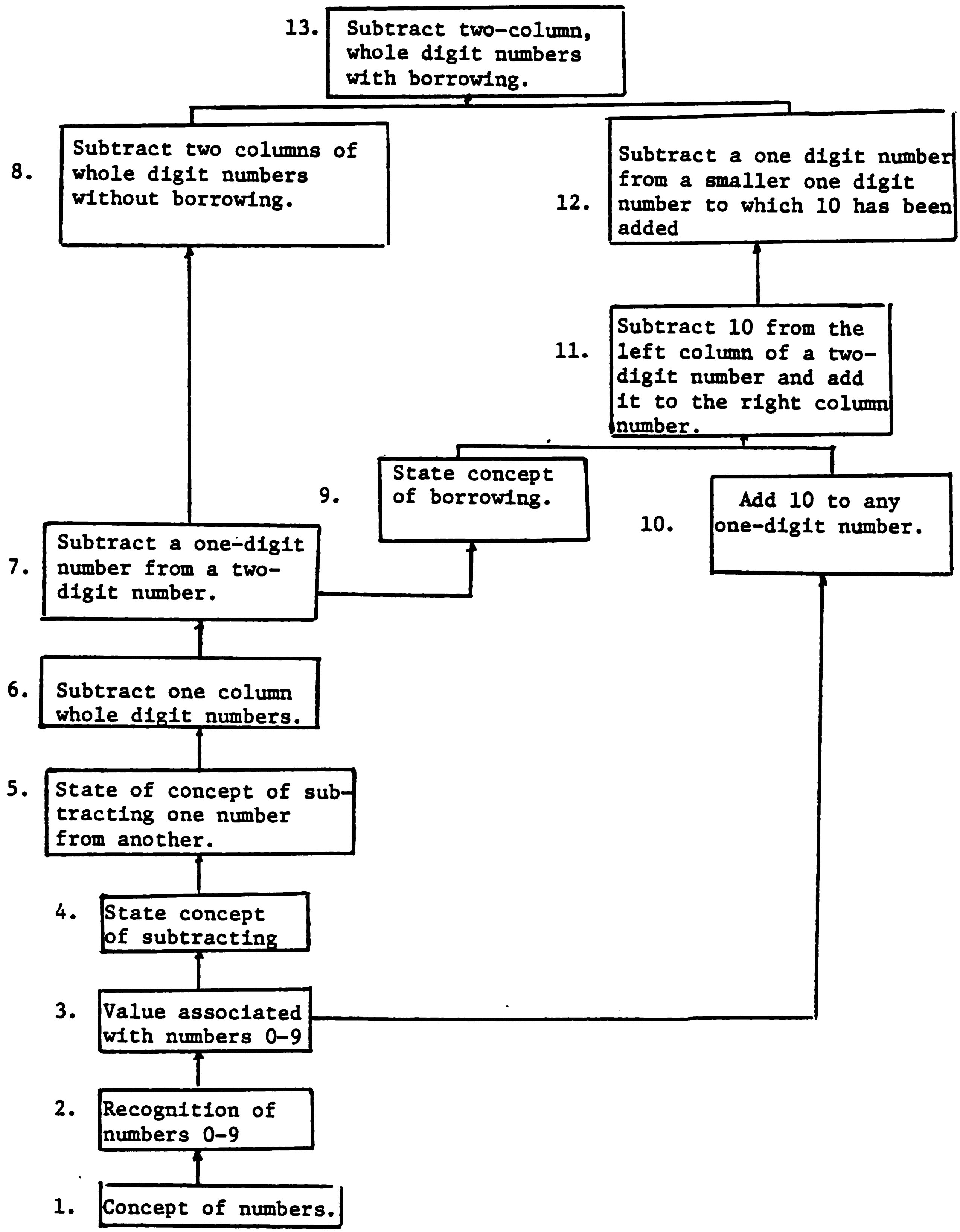
How does the designer go about identifying the critical subordinate skills a student must learn in order to achieve a higher level intellectual skill? The process suggested by Gagne is one of asking the question, "What does the student have to know or be able to do, so that simply given instruction he could perform this task?" By asking this question, the designer can identify one or more critical subordinate skills which will be required of the learner prior to attempting instruction on the final task. After these subordinate skills have been identified, the designer then asks the same question with regard to each of these skills, namely, given a particular subordinate skill what does the learner have to know or be able to do so that simple given instruction the task could be accomplished? This will result in the identification of one or more additional subordinate tasks. If this process is continued one reaches a basic level of performance.

An hierarchical analysis is not devised on the basis of one attempt at the process, or even two or three. It takes a number of attempts at identifying the vertical subordinate skills and their interrelationships before you are satisfied that you have identified all the relevant skills and have stated them appropriately.

Unlike the procedural approach, it is almost impossible to know when an appropriate and valid hierarchical analysis of an instructional goal has been achieved. Several suggestions will be presented for testing the hierarchy at this point in the instructional development process. While difficult to validate, the hierarchical approach is the best possible process for identifying skills which should be included in an instructional program for intellectual skills.

On the next page, you will find an example of a hierarchical analysis. The desired learning outcome is:

> When given subtraction problems involving two columns, whole digit numbers with borrowing, the learner will be able to do all such problems without any external help. The learner will achieve at least 90% correct answers.



Hierarchical Analysis of Subtraction Goal

The structure of this analysis can be considered to explain why it is classified as hierarchical. The purpose of the numbers on the boxes in the instructional analysis is to facilitate the discussion of the order of the skills and eventually relating them to the objectives. The numbers on the boxes do not imply a sequence. Refer to box number three. Could you teach the value associated with numbers 1 through 9 if students did not know how to recognize numbers zero through 9 (box number 2)? Likewise, teaching the recognition of symbols 0-9 as numbers (box number 2) would be almost impossible if students did not know the concept of numbers (box number 1). It would be improbable that students could be taught to accurately perform the skills in any one step without first having knowledge and skills related to the preceding step.

An example of hierarchical and non-hierarchical relationships can be illustrated using boxes 5, 8, and 9.

It would be difficult to teach the concept of borrowing (box 9) if students did not first have knowledge of subtraction, because subtraction is a process used in borrowing. Subtraction a one-digit number from a two-digit number (box 7) is also logical before students learn to subtract two column whole digit numbers without borrowing (box 8). Students should possess skills through step 7 before the concept of borrowing (box 9) is attempted. Step 8, subtracting two-column whole digit numbers without borrowing, is not subordinate to teaching the concept of borrowing (box 9), but it is subordinate to subtracting two-column whole digit numbers with borrowing (box 13). The skills in blocks 1, 2, and 3 are all subordinate to the required for addition (box 10). This is true because the concepts required in blocks 1, 2, and 3 are subordinate to both addition and subtraction skills.

A hierarchical analysis of this type not only illustrates skills, concepts, and information which needs to be taught, but it also provides a logical sequence for instruction.

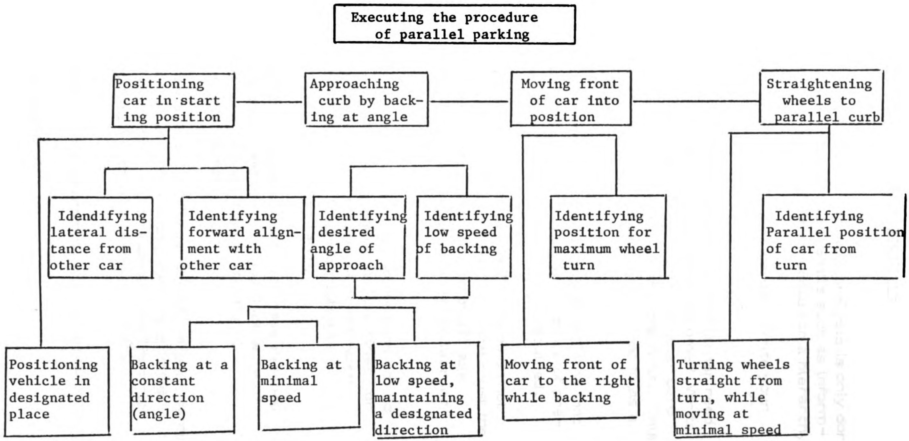
Combination of Procedural and Hierarchical Approaches

There is a third approach to the instructional analysis process which is a combination of both the procedural and hierarchical approaches. This combination process can be seen most clearly when applied to a complex psychomotor skill or a relatively complex linear chain of cognitive tasks. Let us take the psychomotor example first.

Assume that you were going to teach a person to parallel-park a car. This is a task which requires several intellectual skills including various judgements as well as a set of motor skills for actually moving the automobile into several specific locations. This task is represented on the next page.

You can see that the process has been broken down into four basic components. The instructional goal is to parallel-park a car in a particular position on a street. Since positioning a car represents a sequence of movements which must be executed in order, it would appear that the appropriate analysis is the procedural approach. However, for each step in the procedure, there is an intellectual skill as well as a physical skill which must be learned. Therefore, the hierarchical approach has been applied to identify the subordinate skills associated with each of the major skills. In this example, the learner would have to learn the intellectual skill of positioning the front bumper of their car with regard to the car on the right. He/she would also have to learn the motor skill of bringing the car into that position. A similar type of analysis could be made for each of the other steps.

A PROCEDURE: PARALLEL PARKING



Combination Instructional Analysis for Parallel Parking
(Adapted from Gagne, R.M.)

Conducting Hierarchical Analyses

Some Practical Suggestions

1. Remember, a hierarchical analysis is only done for intellectual skills. Skills such as information learning are not sequenced in a hierarchy.

2. Start with some 6" x 4" cards. Write your learning outcome on a card.

3. Ask the question: what must the learner need to know to have this learning outcome? Write this prerequisite knowledge on another card and place it immediately under the first. This prerequisite skill is usually referred to as a <u>subskill</u>.

4. Repeat this process. Soon you will find that there is "branching" where two types of prerequisite intellectual skills are required.

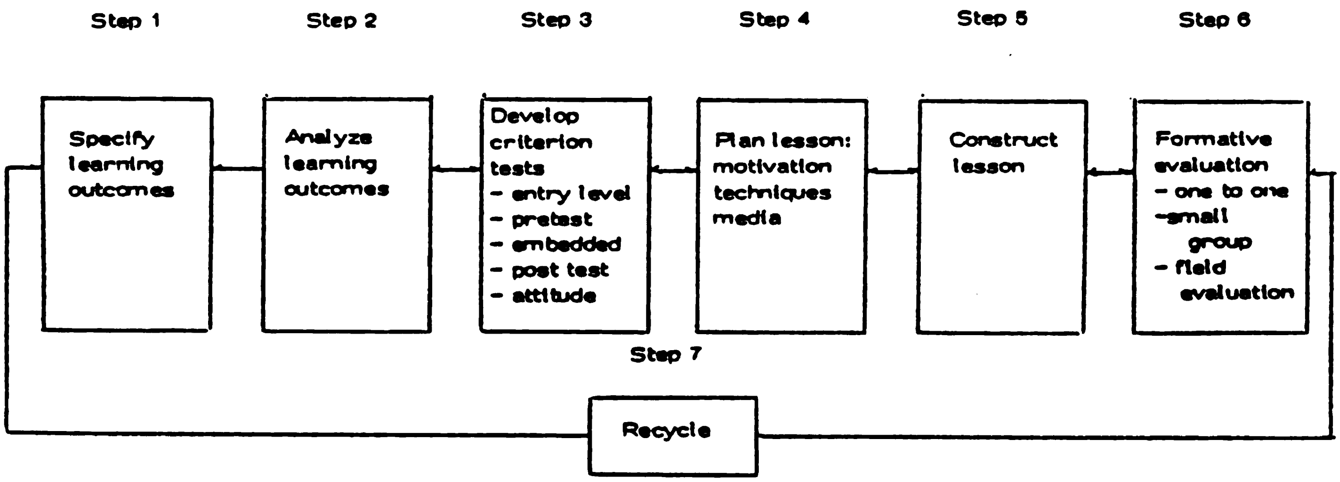
5. Keep building up this "map". If you do not get an answeh to your question "what must the student know to be able to do this?" ask "what can go wrong or confuse the learner at this point?"

6. The statement you write on the card should have an action verb such as "identifies" or "generates", but otherwise do not worry about following a "learning outcome format" (that comes later).

7. Repeat this process until you have reached intellectual skills which you think all your learners already have from other or previous courses.

8. Draw a "map" or "organization" of your cards. Number all your cards, starting with the first prerequisite or subskill you identified and finish with your learning outcome.

An example of a hierarchical map is on the next page, followed by an explanation.



Step 3.

Develop Criterion Referenced Tests

Learning Outcomes

1. You will be able to identify the purposes for entry tests, pretests, embedded tests and post-tests.
2. Given a variety of learning outcomes, you will be able to write appropriate criterion-referenced test items which reflect the learning required of the learner as stated in the learning outcomes.

Criterion-referenced tests are designed to measure explicit learning outcomes. This type of testing is important to: (a) test and evaluate students' progress, and (b) to provide information about the effectiveness of the materials to the instructional designer. The results of criterion-referenced tests indicate to the designer exactly how well students were able to achieve. Thus, criterion-referenced testing is a critical feature of almost every instructional design model.

The term "criterion" is used because test items serve to determine the adequacy of a student's performance in meeting the specified learning outcome; success on these items determines whether a student has satisfied the requirements for that instructional unit. The items serve as criterion for making that decision.

Criterion-referenced: When we compare a measurement not with other measurements, but with some objective standard, we are making a criterion-referenced evaluation. If we measure our automobiles and say "None of them runs," we have compared the state of the car with the criterion of movement and judged that none meet that criterion.

The difference between the norm-referenced and criterion-referenced methods of evaluations was beautifully illustrated a few years ago by an example created by Dr. James Whipple. "The Coffee Pot" example it was called, and it went like this. Imagine that an objective said that a student is to be able to make a pot of coffee. He has all the necessary tools and equipment at his disposal, and his task is to be able to make a pot of coffee. A checklist of each of the steps in the process is prepared, and the students performance scored both on a norm-referenced and a criterion-referenced basis. Look at the Checklist for Making a Pot of Coffee and the scores. Note the difference between the two methods of scoring.

CHECKLIST FOR MAKING A POT OF COFFEE

	Norm-Referenced Scoring	Criterion-Referenced Scoring
Disconnects coffee pot	10	X
Disassembles coffee pot	10	X
Cleans components and pot	10	X
Inspects components	10	X
Fills pot with water	10	X
Reassembles components	10	X
Fills basket with coffee	0	-
Reconnects coffee pot	10	X
Sets dial on cofee pot	10	X
Reports pot is perking properly	10	X
Score	90%	0%

Note that in a norm-referenced system a student can accumulate a score of 90 percent, even though he failed to make a pot of coffee. A criterion-referenced system, on the other hand, gives him a score of zero. Though he acquired most of the skills, he did not accomplish the objective. The objective asked that he be able to make a pot of coffee, and he failed to demonstrate achievement of that objective. Therefore, he is not certified as having achieved the objective.

In regard to instruction, criterion-referenced evaluation refers to comparing a student's performance with a desired standard and judging whether the student did or did not meet or exceed the standard. For example, suppose we expect a student to be able to spell 60 percent of the words in booklet 3 correctly, and he spells 56 percent of them correctly. When we say that he has spelled 56 percent correctly, we are describing the results of a measurement. Now there are two kinds of evaluation that can follow:

Norm-referenced: "Gee, he is better than anyone else in the class. Give him an A."

Criterion-Referenced: "He did not meet the criterion of 60 percent. Give him more instruction.

Though there are some uses for norm-referenced evaluation, the concern here will be with criterion-referenced evaluation. When we want to know whether an expectation (objective) or criterion has in fact been achieved, only criterion-referenced procedures are appropriate.

There are basically four types of tests which the instructional designer may utilize in a model.

The first is an entry test. This is a criterion-referenced test which is designed to measure skills which the designer has identified as being critical to beginning the instructional materials.

The second type of test is a pretest. A pretest is criterion-referenced to objectives which the designer intends to teach in the module. If you consider a hierarchical instructional analysis, an entry test measures all the skills which appear below the "line" while a pretest measures all the skills which appear above the "line".

The third and most common test used by the instructional designer is the post-test. This criterion-referenced test is parallel to and sometimes identical to the pretest. Like the pretest, it measures learning taught in the instructional program.

The fourth type of test is an embedded test. This is not necessarily a single test, but rather represents clusters of criterion-referenced test items which are interspersed throughout the module. These items are intended for practice by students prior to taking the post-test. Sometimes embedded tests are ignored by instructional designers and not included as a part of the instruction. This is more often than not a design error. Embedded test items provide learners with the opportunity to interact with material presented, to evaluate themselves, and to receive feedback. Embedded test items also provide the practice, repetition, and reinforcement needed to help learners remember materials. By providing students with the opportunity to interact with ideas presented in materials, the designer has changed the learner's role from a passive reader to an interactive participator.

How does one go about designing and developing a criterion-referenced test?

Start by carefully evaluating your first (lowest level) enabling objective. What does the verb specify? What is the learner asked to learn? Your test item must assess if this learning did take place.

Ensure that your test item does measure the learning described in the enabling objective. For example, if the enabling objective requires the learner to show understanding of the two concepts "acute renal failure" and "uremic syndrome" by classifying each (Gagne's term for testing whether the learner knows the defined concepts). The test items must ask the learner to show (a) what is meant by the term "acute renal failure" and (b) what is meant by the term "uremic syndrome".

Here is a possible test item:

> In no more than half a page of writing differentiate between "acute renal failure" and "uremic syndrome"

You should then determine the answer which will meet the criterion (e.g. 90%). Such an answer could be:

> "Acute renal failure includes acute cessation of kidney function with the suppression of urine formation. Uremic syndrome is a term used to describe either the critical phase of progressive renal failure after 90% of kidney function has been lost or to the critical phase of acute renal failure due to suddent kidney shutdown."

You should also decide what extra grades to award to learners who demonstrate learning over and above the master level. For example, if the learner also states that the patient with "uremic syndrome" requires renal dialyses, another 2% could be added to the grade.

The important point is to carefully note the learning described as indicated by the verb of the enabling objective. If the verb is to match, to list, to select, or to describe, then you must provide a test which allows a student to match, to list, to select, or to describe. Learning outcomes in the cognitive or intellectual domain generally require paper and pencil assessment items or items which call for a specific product or performance. Generally, it is relatively easy to determine achievement of a cognitive objective; either the student "knows" the appropriate response or he doesn't. Assessment in the affective or attitude domain is not quite as simple. Affective objectives are generally concerned with the student's attitudes or preferences. As there may not be a way to directly measure a student's attitude (e.g., whether he values a good nutritional meal against fad food), items for affective objectives generally require either that the student state his preferences or that the instructor observe the student's behavior.

One of the major issues associated with criterion-referenced testing is how many items should be written for an objective; or asked in another way, how many items do students need to answer correctly to be judged successful on a particular objective? If students answer one item correctly, can you assume they have achieved the objective, or if they miss a single item, are you sure they have not mastered the concept? Perhaps if you gave the students two items per objective and they answered both correctly or missed both, you would have more confidence in your decision as to whether they have mastered the objective. You can see this argument could lead to writing many, many test items per objective. There is no correct answer as to how many items you need. What little research has been done in this area generally indicates that the more narrowly stated an objective is, the fewer items are required to be assured you will make the correct judgment about students' performance. If an ojbective is very global or hazy, it will require many more items to determine whether students have mastered it.

As you design the instructional strategy for your unit, you may find it is very valuable to have a number of criterion-referenced test items which are parallel to the objectives. These can be divided into the pretest/post-test, and inserted into the instruction for students to use as practice. These embedded items help students to understand the level of criterion performance which is expected of them and to determine if they have sufficient understanding and skills to successfully take the post-test.

A Pause for Evaluation of Your Design

It is important at this stage in materials development to evaluate the design you have created. The materials you have at this stage are the framework for many hours of future development and conceptualization. By determining whether flaws exist in your design and correcting errors that are found to exist, many hours of less-than-satisfying developmental work may be saved.

Exactly what is to be evaluated? The materials that should be evaluated are: (a) the learning outcome, (b) the instructional analysis, (c) the performance objectives, (d) the criterion-referenced test items, and (e) the adequate selection and description of the target population.

Who should evaluate your design? There are several options here, and the nature of your materials and time you have available for the evaluation will be major factors in selecting the evaluators. Some persons you might want to consider are:

1. Content experts and/or instructional designers who can validate (a) the need for such instruction, (b) the importance of the behavior stated in the instructional goal, (c) the accurateness of the subskills that were identified in the instructional analysis, (d) the accurateness of the sequencing of subskills in the instructional analysis, and (e) the relationship among subskills identified in the instructional analysis, (f) the parallelism between subskills in the instructional analysis and enabling objectives, (g) the clarity of performance desired and criteria established for the behavioral objectives, (h) the parallelism between enabling objectives and test items, and (i) the equality of multiple test items constructed to measure performance on the same objective.

2. Peers could be asked to evaluate whether: (a) there is a need for instruction identified, (b) it is an area in which their students often experience learning difficulties, (c) whether such instruction would be feasible in their classroon (equipment, space, etc.), (d) any subskills have been omitted from the instructional analysis, and (e) there is any deviation from the required parallelism among the instructional goal, instructional analysis, enabling objectives and test items.

3. Target students could react to whether: (a) they would find learning the material interesting, (b) they perceive a need for the ability identified in the instructional goal, and (c)

they experience any difficulty understanding vocabulary and required procedures when explained. Given time, the designer may also choose to administer a sample pretest to determine how target students can perform on the tasks without previous instruction. This may provide an early indication of whether an appropriate level of students have been identified as the target group. If they can already perform most of the skills or if they are totally baffled, they may be the wrong group.

How to Organize Your Design

On this page is how you should organize your design. On the opposite page is an example.

Learning Outcome

Subskills	Enabling Objectives	Test Item(s)
Subskill 1	Enabling Objective 1	Test item (a)*
		Test item (b)
		Test item (c)
		Test item (d)
Subskill 2	Enabling Objective 2	Test item (d)
		Test item (b)
		Test item (d)
		Test item (d)
.		
.		
.		
.		
Subskill n	Enabling Objective n	Test item (a)
		Test item (b)
		Test item (c)
		Test item (d)

---

*(a) Test item(s)	for entry test
(b) Test item(s)	for pretest
(c) Test item(s)	for post-test
(d) Test item(s)	for embedded test

Quiz on Criterion Referenced Testing

Here are some statements about criterion referenced testing.

Mark the item T if you believe it is a correct statement and F if you believe it is an incorrect statement.

_____ 1. A criterion referenced test is composed of items which measure learning outcomes.

_____ 2. The word criterion is synonymous with the word mastery when used in a criterion referenced test.

_____ 3. Test items for criterion referenced tests are developed directly from enabling objectives identified in the instructional analysis.

_____ 4. Entry tests are developed to measure skills students should possess before entering instruction.

_____ 5. Embedded tests provide students with practice and feedback on their performance as they work through the module.

_____ 6. Pretests are used prior to instruction to indicate a student's prior knowledge about what is to be taught.

If you have marked all of the above as true then we are in complete agreement.

Pre-Test for Step 4

Part A: Answer True or False.

1. University level students are highly motivated when they come to class. ____________.

2. You should not waste time and therefore, you should start with formal instructional activities from the word go. ____________.

3. You should spend a few minutes at the start of the module with activities which will help the student to concentrate. ____________.

4. To be able to motivate your students, you need to know them well because individuals differ as to what motivates them. ____________.

5. Motivation, then, is getting the learner's attention in such a way that the learner has a better attitude toward the instruction to follow. ____________.

Part B

6. For the motivational part of the lesson, you may choose from a number of activities. Can you state three activities designed to motivate students?

   1. ____
   2. ____
   3. ____

7. Can a human interest story be used as motivation?

8. Do you consider the following statement as sufficient motivation? "At the end of this session, there will be a quiz."

9. Do you agree that for some students a good motivation is to tell them, in lay terms, the learning outcome of the module? yes/no

10. Do you agree that it is motivational for the learner to be reminded about knowledge which they have already acquired which will relate directly to what they are about to learn? yes/no

Part C

11. When considering the sequence in which you will present information, the simple rule is to start with lower level skills. true/false

12. How can you determine which skills are higher level and which skills are lower level? ______________________________

____

____

13. Educational psychologists urge that instruction be provided in small "chunks". Students are encouraged to make responses at the end of each "chunk" to see if they have learned or not. What do you consider is an appropriate size for a "chunk"? ______________________________

____

____

14. Do you agree that all knowledge should be taught in the same way, be it concept, fact or principle? yes/no

15. How would you present a rule? ______________________________

____

____

Part D

16. Giving students constant practice with feedback each time you have taught a sub obective is:

    a. too time consuming

    b. necessary

    c. not often enough

    d. practice should be left to the end of the lesson

17. Feedback is not essential to learning. __true/false__

18. What kind of reinforcement can you provide for adult learners?

    ____

    ____

    ____

19. Can the tests that you use during the module be also used at the end of the module (in the post-test)? __yes/no__

20. When the learner does not respond correctly to an embedded test, then the learner is encouraged to:

    a. go on and try harder

    b. told that one little mistake is nothing to worry about

    c. go back and review that section again

    d. start the module all over again

Part E

21. State the difference between testing and evaluating. ______________

    ____

    ____

22. Criterion levels must be determined:

    a. before a learner starts working through the module.

    b. after a number of learners have worked through the module.

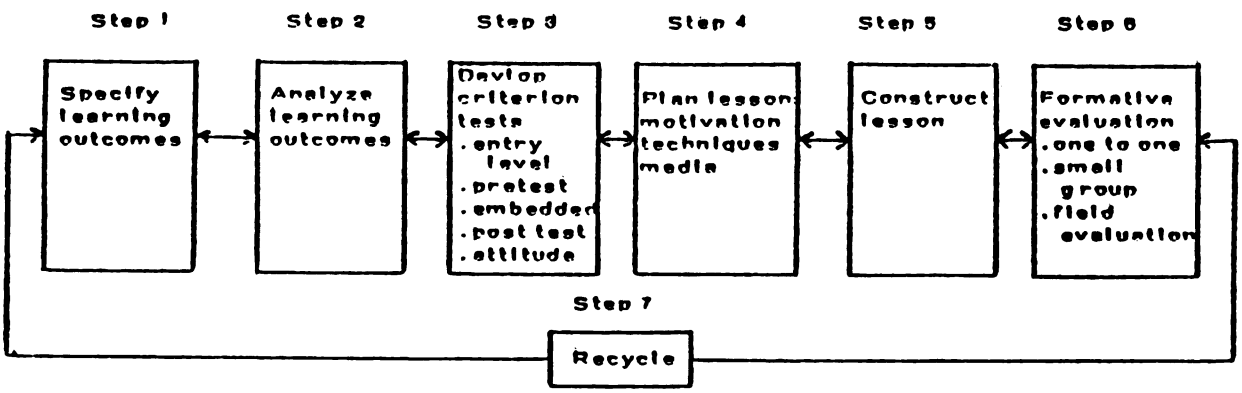
23. The criterion level will clearly show if the learner has failed or passed; no further decisions need to be made. true/false

Answers

1. False (usually).
2. False. You should start with a motivational activity.
3. True. Some students need to be motivated while others may need to be reassured and their anxiety level lowered.
4. Generally true.
5. True.
6. Here are three that come to my mind:
    1. A well-considered human interest story.
    2. A well-developed, interesting presentation, such as a film.
    3. Telling students the relevance and need for the information to be presented.
7. Yes.
8. No - bad.
9. Yes.
10. Yes.
11. True.
12. Look at your instructional analysis (or do an instructional analysis).
13. Usually, your sub objective is a suitable "chunk". If the "chunk" seems to be big (more than, say, six minutes) it may be that your sub objective should really be broken into further parts.
14. No.
15. One method, suggested by Gagne, is to present a variety of examples of that rule through verbal stimuli.
16. Both (b) and (c) are the expected answers.
17. False. Feedback _is_ essential to learning.
18. Usually a statement commending their performance.

Answers, continued.

19. Yes.
20. The expected answer is (c) unless the mistake occurred at the start of the module, in that case, the answer is (d).
21. Testing means giving a person a score, such as: You got 10 items right. Evaluation means using the test results, then considering the criterion level and then making a decision such as: The student did not reach the criterion level and therefore, must get more instruction by proceeding to the alternative module.
22. The expected answer is (a). Criterion levels must be determined before learners start working through the modules.
23. While partly True, most educators would prefer False as the answer. There need to be decisions on the evaluation of the performance, e.g., this learner can skip Part A of the next module because the score of 100% demonstrates that the learner already can master that part of the next module (which is mainly revision).



Step 4. <u>Plan Lesson</u>

<u>Learning Outcomes</u>

1. You will be able to identify and describe the major components of an instructional strategy.
2. You will be able to develop an instructional strategy for a set of objectives for a particular group of learners.

In this step we plan our lesson and develop an instructional strategy which will elicit stated learning outcomes from students. Stating an instructional strategy is not simply a description of the content which will be presented to the learner; it indicates what you will do before you present that information, what students will do with that information, and how it will be tested.

There are four major components to an instructional strategy:

1. Motivational activities
2. Information presentation
3. Student participation
4. Testing

We will look at each one of these components in some detail, because the instructional designer must plan an approach to each of these steps.

Motivational Activity

Prior to beginning the formal instructional activities, there are a number of activities which you should consider. The first of these is the motivation level of the learners who will use your instructional module. You may assume that students will be assigned this module or that you will be dealing with highly motivated adults and therefore effort is not required on your part to establish a high motivation level. You may be correct, however, you may wish to use some type of special techniques such as an attractive color scheme, a cartoon, a human interest story, or some other approach to gain the attention of the learners and "hook" them into your module. In order to do this properly, it takes a great deal of knowledge about the learners and what will in fact hook them and what will turn them off.

Part of the motivational process may include showing students what they will be able to do when they have completed the module. For certain learners it may be sufficient to state the learning outcome in the same form that you have in your instructional design. For others, you may wish to reword the learning outcome to lay terms so that students will better understand what the module is about. There may be situations in which the learning outcome is so remote from the students' present level of understanding that it would be distracting and discouraging to be told about it. In this rare case, you might consider the wisdom of describing that type of learning outcome.

Another source of motivation may be to remind the learners about knowledge which they have already acquired which will relate directly to what they are about to learn. This can serve not only to inform the learners that this is appropriate material for them but also serve as a bridge into the instructional materials.

Presenting Information

One of the questions you will need to answer is: What is the sequence which I should follow in presenting information to the student? The most useful tool in determining the answer to this question is your instructional analysis. If you have done a hierarchial analysis, then you would begin with the lower level skills, that is, those just above the line which separates the entry behaviors from those skills which are to be taught, and then progress up through the hierarchy. At no point would you present information on a particular skill prior to having done so for all related subordinate skills.

The instructional sequence for a task which is a procedure would of course, logically be sequenced from the left or beginning point and proceed to the right or terminal objective. If there are subordinate capabilities for any of the major steps in the procedure, they would be taught these prior to going on to the next major component. As an aside, some psychologists have argued that with a learning task which essentially is a linear string of tasks, it is more efficient to begin with the final task and to work backwards, e.g., start by testing the lemon pie. However, for beginning design efforts, an orderly progression from the first step to the final step is the recommended approach.

The next question in your instructional strategy deals with the size of "chunk" of material which you will provide in your module. The two extremes in this regard are the linear programmed instruction approach which tends to break all the information down into very small units and requires constant responding by the student. At the other end of the continuum is the conventional textbook in which a chapter is usually the unit of information. A good way to determine the size of the chunk is to limit it to one enabling objective.

The next step is determining exactly what information, concepts, rules and principles need to be presented to the student. This is the basic explanation of what the unit is "all about". The primary error in this step is presenting too much information, much of which is not related to the learning outcome. It is important not only to define any new concepts but to explain their interrelationships with other concepts. You will also need to determine the types and numbers of examples which you will provide with each of the concepts in your module. Many research studies have investigated how we learn concepts and how we use examples and non-examples to accomplish that task. We know that learning is facilitated by the use of examples and non-examples. These should be included as a part of your instructional strategy.

As concepts are learned differently to say, principles there is a chart at the end of this step which will help you to decide the most appropriate teaching strategy.

Student Participation

One of the most powerful effects in the whole learning process is that of practice with feedback. The learning process is greatly enhanced by providing the student with activities which are directly relevant to the objectives. Students should be provided an opportunity to practice what you want them to be able to do. Not only should they be able to practice, but they should be provided some type of feedback or information about their performance. Feedback is sometimes referred to as "knowledge of results". That is, students are told whether their answer is right or wrong, or are shown a copy of the right answer from which they must infer whether their answer is correct. Feedback may be provided also in the form of reinforcement. Reinforcement for adult learners is typically in terms of statements commending their performance. Young children often respond to forms of reinforcement such as "happy face" or even the opportunity to do some other activity.

It is important when considering the student participation component of your module to relate that participation to the learning outcome which you have stated. You may wish to use embedded criterion-referenced test items which are parallel to those which will be used to assess the student's final performance. Through practice and feedback with these embedded items, students can determine whether they understand the material and can keep moving ahead in the module or whether they should go back and review certain concepts.

Testing

Part of your instructional strategy will involve the testing or evaluation of the learner. The student participation activities discussed above are a part of that testing procedure in the sense that students are assessing for themselves their level of competence as they go through the module. You should also determine as part of your instructional strategy how the data from the pretest and post-test will be used with regard to student performance. For example, if you were teaching a topic in which some of the students had prior knowledge of the content, you could use that information to branch or direct students directly to those parts of the module which they had already mastered. This would save them time by not repeating material which they already knew.

You will also be required to make decisions about the module with regard to differing levels of performance on the post-test for the module. Recommendations should be made to the teacher and student as to what should be done as a result of particular outcomes. For example, if students do not reach some predetermined level of performance such as 80% on the post-test, what should they do? Will they simply be branched back to repeat certain parts of the module or will other materials be made available to them? If students do reach the predetermined level of mastery, should they continue with the next module or will there be other enrichment activities available to them?

Pretest--Step 5.

1. When trying to determine the most appropriate media to use, what considerations should you take into account?

2. When teaching psychomotor skills state some of the appropriate media you could use.

3. For the teaching of learning outcomes where problem solving is involved, what media or methods would you suggest?

4. Often the best medium cannot be used for various practical considerations. State some of these considerations.

Check your answers with those on the next page. If there is a high level of agreement you may wish to merely skim Step 5 and go on to Step 6.

Feedback

1. a. The type of learning involdved in the objective.

   b. Availability of media.

   c. Ability to design materials.

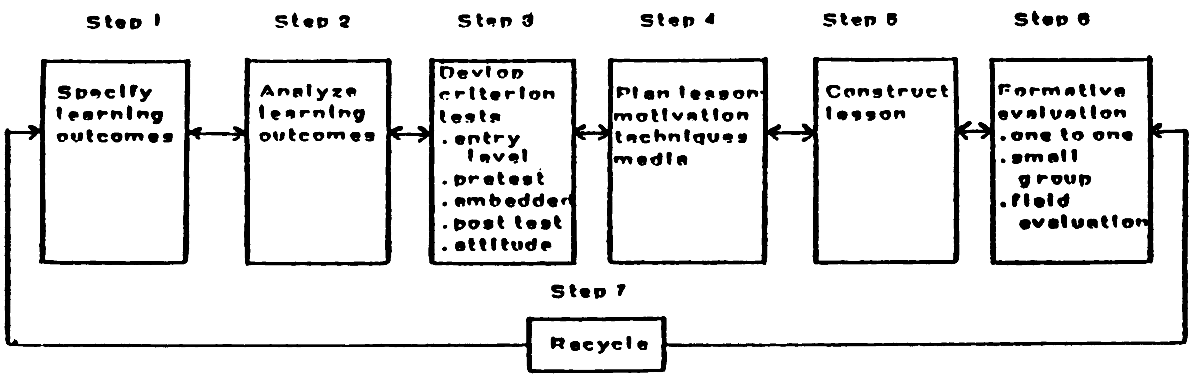
   d. Cost effectiveness of materials.

   e. Practical considerations such as flexibility, durability and convenience of materials.

2. Moving pictures such as film or video; demonstration of the skill itself.

3. Simulation or role playing.

4. Availability of medium; cost; complexity of the medium; lack of expertise to operate the medium.



Step 5.

Construct and Design Lesson

<u>Learning Outcomes</u>

1. Given an instructional strategy, you will be able to describe the procedures for developing instructional materials.
2. You will be able to develop your own instructional materials based on a given instructional strategy.

An important step, which is often overlooked in instructional design efforts, is to determine if there are <u>existing materials</u> which would fit your objectives. In some situations you will find there is a prolifera of materials available, all of which are either superficial, greatly detailed or not directed to the target population with which you are interested. On the other hand, occasionally it is possible to identify materials which will serve at least part of your needs in terms of your overall package. When you consider the cost of developing a video tape, or a slide tape, it is clearly worth the effort to spend several hours examining existing materials to determine if they meet your needs.

If no appropriate materials exist, you are in the instructional design business, and you must make an additional decision with regard to your instructional strategy. What type of media will be employed for those materials which you must develop? There are five important considerations with regard to the selection of this medium.

Start by considering the type of learning involved in your objectives. If, for example, you are teaching a psychomotor activity of some type, it is important to use pictorial or moving visuals in order to demonstrate criterion performance to students. If you are teaching students to make auditory discriminations, then clearly some type of audio medium should be employed as a part of your instruction. If the task is one of shaping fine discriminations among concepts, then perhaps you wish to use a medium which can supply feedback to students on their performance.

A second important consideration in media selection is the projected availability of various media in the environment in which the instructional package will be used. If the materials will be used in a learning resource center of a public school, community college, or university, then a whole array of media devices would probably be available. However, if the package is designed for home study or use in a community center where mediated equipment is not likely to be available, then you must either develop a means of making that equipment available or limit yourself to paper and pencil types of instructional materials. A related to view again and again as needed. This would free the lecturer or specialist to work with students in a discussion/problem solving atmosphere.

It would be difficult to illustrate the total process for developing a set of instructional materials. The decisions you need to make will be based on the subject matter, the learning outcomes you have specified, your own knowledge, and skills, your financial and facilities constraints, the time required to develop and test the instructional package, your target population, and the many, many other factors which must be dealt with as they arise. Instead of trying to construct one example that would illustrate all these issues, perhaps a suggested step by step procedure may be more helpful. This procedure is not being promoted as the only way to develop an instructional package. In fact, you may find that you need to change the order of events here and there as you go along. The procedure is provided here for consideration as one way to order the events in the construction of an instructional package. You have already completed many of these steps.

Suggested Procedure for Developing an Instructional Package

Step Activity

1. Select topic.
2. State learning outcome.
3. Perform an instructional analysis of the specified learning outcome.
4. Describe the target population as specifically as possible and identify entry requirements.
5. Write subskills and enabling objectives.
6. Develop criterion-referenced tests for the objectives
    a. Determine whether your testing purpose will be to diagnose entry requirement, to branch students, to evaluate students, to evaluate materials, or all of these.
    b. Determine whether a test over expected entry requirements is necessary or advisable.
    c. Divide parallel questions written for each objective such that some can be included on a pretest (if a pretest is advisable), some can be used for embedded questions for practice and feedback during instruction, and some can be included on the posttest.
7. Develop the instructional strategy.
    a. Review the subskills included in the instructional analysis and determine which should be included in instructional materials and which should be included as expected entry behaviors.
    b. Consider the target population relative to their attention span, work and study habits, responsibility, and motivation. Then estimate an average "best" time for each instructional activity for the group.
    c, Consider the enabling objectives in the instructional analysis relative to the type of learning and learning activity required for each objective, and the logical sequence in which you believe objectives should be presented.

d. Cluster objectives. Each cluster might have one or more objectives depending on the difficulty of explanation or time required for practice feedback. There are no rules for clustering, and you have only the instructional analysis as a guide to develop the first set of materials.

8. Survey the literature and subject matter experts to determine what instructional materials are already available.

9. Consider how available materials might be adapted for use using a manual to guide students throught the materials.

10. Determine whether new materials need to be designed. If yes, proceed to 11. If no, begin organizing and adapting available materials.

11. Given each cluster or set of instructional activities, make decisions about relevant motivational materials, necessary review, presentation procedures, student participation, practice, feedback, evaluation, and follow-through activities for each cluster or instructional activity.

12. For each cluster or instructional activity, consider the best medium to present the materials, to monitor practice and feedback, to evaluate, and to pass student to the next instructional activity whether enrichment, remediation, or the next activity in the sequence.

    a. Make decisions about the ideal media for the type of learning (stories for attitude, sound tape for language pronunciation, printed materials for spelling and punctuation, relief maps for contouring or geography, etc.)

    b. The types of media required for a large set of materials may be many and varied. Cost effectiveness of developing materials using varied equipment and subskills should be considered.

    c. Availability of materials, portability of materials, availability and appropriateness of equipment should be considered.

d. Tentative decisions about the best medium or media combinations should be made based on studying types of learning, activities required, physical and technical constraints, finances and facilities are but two possible problems.

13. Determine the format and presentation procedures for each objective or cluster of objectives. Outline the materials if necessary (using the behavioral objectives as a guide). Plan any general format or presentation pattern you believe is necessary or would be effective.

14. Write the instructional materials for each objective or cluster of objectives in rough form. A rough slide/tape may have the sound recorded on a simple cassette recorder with indicators for changing visuals, and the accompanying visuals can be magic marker stick figures on 3 by 5 index cards. Printed, visual, or auditory materials in this very rough form will allow you to check your sequence, flow of ideas, accuracy of illustration of ideas, completeness, pace, etc. Make a rough set of materials as complete as possible for each instructional activity.

15. Consider each completed instructional activity, or cluster of objectives, for clarity and flow of ideas. Does it go from easier to most difficult, from the complete skill (behavioral objective for that activity) back to the basic components or subskills, etc.?

16. Using one complete instructional activity, write the students' manual or accompanying instructions to the students for that activity. This could include the objectives, directions, and possibly motivational materials.

17. Using the materials developed in this first inexpensive, rough draft, you are ready to begin evaluation activities.

Pretest on Step 6

1. What is the purpose of formative evaluation?

____

____.

2. What is the purpose of summative evaluation?

____

____.

3. How rigorous should formative evaluation be?

   a. Very rigorous, taking nearly as long as the design phase. Usually involves a number of one-to-one situations, a small group situation and a field test;

   b. quite rigorous, taking about half as long as the design phase. Usually involves working through the lesson with one or two students;

   c. not at all rigorous, usually involves giving the materials to the class and observing their reactions.

4. List some of the ways of displaying data from your formative evaluation.

____

____.

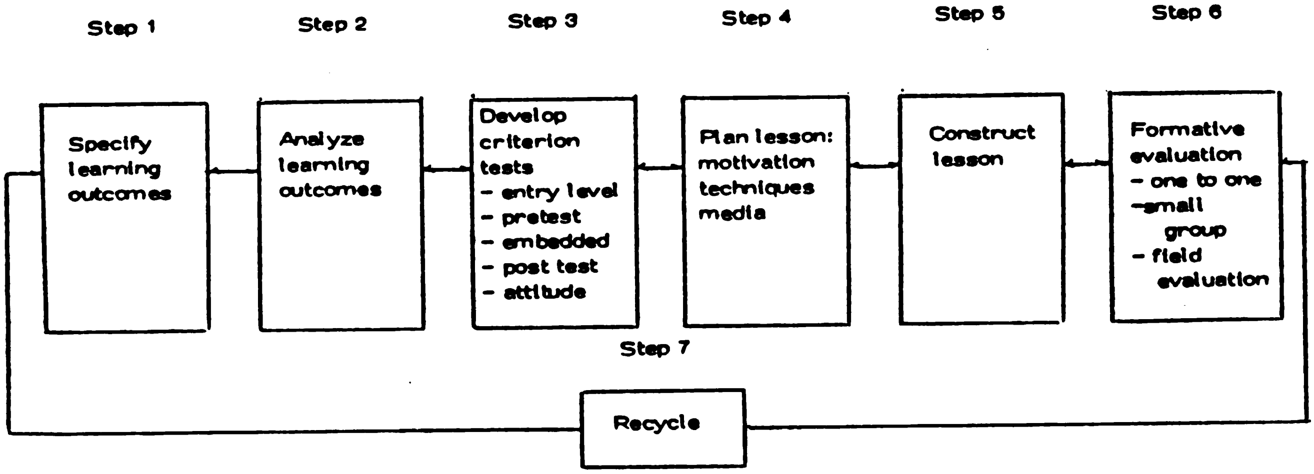
Answers

1. The purpose of formative evaluation is to obtain data to increase the efficiency and effectiveness of the lesson (in order to revise the instructional materials).

2. The purpose of summative evaluation is to determine whether the materials should be used in a particular setting or whether they are as effective as claimed.

3. The expected answer is (a) very rigorous.

4. Some of the ways that data can be displayed includes tables, graphs, histograms.



Step 6

Formative Evaluation of the Lesson

1. Be able to state the purpose of formative evaluation.

2. Be able to state the purpose of summative evaluation.

3. Be able to state the procedures of formative evaluation.

4. Be able to state various methods of collecting data for formative evaluation.

Step 6

Formative Evaluation of the Lesson

Formative evaluation is the process used to obtain data to increase the efficiency and effectiveness of the module. The emphasis in formative evaluation is on the collection of data in order to revise the instructional materials rather than to determine whether materials are of any value or whether they are better than another set of materials. In essence, at this point in the development process, every effort is made to make the materials as effective as possible. When they reach a final version, other people may collect data to determine whether the materials should be used in a particular setting or whether they are as effective as is claimed. This latter type of evaluation is often referred to as summative evaluation.

There are three stages of formative evaluation. The first is referred to as <u>one-to-one</u> or clinical evaluation. In this initial phase the designer works with individual students to obtain data to revise the materials. The second stage of formative evaluation is a <u>small group</u> evaluation. A group of 10-20 students, who are representative of the target population, study the materials in an <u>approximate</u> "real life" setting to collect the required data. The third stage of formative evaluation is usually referred to as a <u>field evaluation</u>. The number of students is not of particular consequence; usually 30 is sufficient. The emphasis in the field evaluation is on the testing to the procedures required for the installation of the instruction in as real a situation as is possible. These three phases of formative evaluation will be described in some detail.

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One-to-One-Evaluation

The first type of evaluation conducted by the designer following the development of a draft set of instructional materials is a one-to-one. The term "one-to-one" refers to the fact that, at this stage in the evaluation, the designer selects two or more students who are typical of the target population and literally sits at their side as each studies the materials.

Only the test and instructional materials are used with the student. The designer should pick at least one student from the target population who is slightly above average in general ability and at least one student who is below average, and work on an individual basis with each of these students.

The typical procedure in a one-to-one evaluation is to explain to the student that you are designing a new set of instructional materials and that you very much wish to have a student's reaction of the materials. You should indicate that any mistakes which students might make are probably due to deficiencies in the materials and not theirs. Encourage the student to be relaxed and to talk about the materials. You should not only have the student go through the materials but also take the test(s) which are provided with the materials. You might also note the amount of time which it takes a student to complete the material.

Small Group Evaluation

After the materials have been revised on the basis of information obtained from the one-to-one evaluation, you should next select a group of approximately 10 to 20 students. This number is not selected entirely arbitrarily. If the number of students is less than 10, then the data which you obtain will be suspect in terms of whether you really have a representative sample of the target population. One the other hand, if you obtain data on many more than 20 students, you will find that you have more information than you need, and that the data from additional students will not provide you with a great deal of additional information for careful evaluation and analysis in a small group setting.

The selection of students to participate in your small group trial is a very important procedure. The students used to evaluate the materials should be as representative of your total target population as possible.

The basic procedures used in a small group evaluation are quite different from those used in a one-to-one. The evaluator (or the designer) begins by explaining that the materials are in the formative stage of development and that it is necessary to obtain feedback on how they may be improved. Having said this, the designer would administer the materials in the manner they are intended to be used when they are in final form. If an entry behavior test or a pretest are to be used, they should be given. The students then study the instructional materials and all resources which are available to them. They would take the posttest at the completion of the materials. There should be very little intervention in the process by the evaluator (designer). Only in those cases when equipment does not work or a student has come to a complete halt in the learning process and cannot continue, should the designer work with the student to overcome the problem. The difficulty and the solution should certainly be noted as part of the revision data.

An additional step in the small group formative evaluation is a debriefing of each of the students, and perhaps the administration of an attitude questionnaire. In the attitude questionnaire you might ask a variety of questions about the instructional experience. These questions could deal with the adequacy of the amount of time spent, the interest the student had in the materials, the identification of areas that were too difficult or too easy, and so on. The critical point in designing an attitude questionnaire is to ask questions which will provide data which can be used in the revision process. The type of question which would be of interest but of very little value is: "Did you like these materials?" A very gross yes, no, or maybe response is very difficult to interpret in terms of determining how to use that information in module revision.

In the debriefing discussion with the student after the materials have been finished, all types of questions can be asked about the pacing, interest, and difficulty of the materials. By providing cues to the student, a great deal of information about the relative effectiveness of the materials and areas of misinterpretation may be obtained.

All the data from these various sources are summarized and decisions are made as to how revisions are to be made.

Field Evaluation

In the final stage of formative evaluation, the designer attempts to obtain a learning situation which is, or closely resembles, that intended for the instructional materials.

You should select a group of approximately 30 individuals to participate in your field trial. Again, the group(s) selected should be selected in a manner to ensure that it is representative of the target population for which the materials are intended.

Data Collection

There are some general guidelines that you should consider when planning the procedures for any stage of formative evaluation. The most important suggestion is that you gather all the data which you believe will help you make decisions about improving instruction. Any data which cannot stand up to this test, that is, that you can see how the interpretation of the data could suggest ways in which materials might be revised, should not be collected, because it will be of only limited use to you, and may interfere with the collection of data you really need.

The types of data you will probably want to collect would include the following:

1. Test data collected in entry behaviors, pretests, posttests and embedded tests. (The latter, embedded test data, is often overlooked as a rich source of information about student performance while they are engaged in the learning process).
2. Comments or notations made by students to you or marked on the instructional materials about difficulties encountered at particular points in the materials.
3. Attitude questionnaires and/or debriefing comments in which students indicate their overall reactions to the instruction and their perceptions of where difficulties lie with the materials and instructional procedures in general.

The formative evaluation component in the instructional design model is what differentiates this empirical procedure from a philosophical or theoretical approach. Rather than speculating about the instructional effectiveness of your materials, you will be testing them out with students. Therefore, you will want to do the best possible job of collecting data that is reflective of the effectiveness of your materials. There are several concerns the designer should keep in mind when planning and implementing data collection procedures.

One concern in any evaluation of your materials is that technical equipment is operating effectively. More than one designer has been discouraged because when he tried a new set of instructional materials on a particular piece of equipment, the equipment did not operate correctly. Therefore, the data from students was invalidated, and the designer learned little more than that you need to have the audio-visual equipment operating effectively to try out materials.

The area about which we know the least in the entire instructional design, development and evaluation process is that of revising instructional materials. If you examine almost any instructional design model, you will find major emphasis on the concept of formative evaluation, namely, collecting data to determine the effectiveness of instructional materials. The model will then indicate that after data have been collected and summarized, you should revise the materials appropriately. While a number of studies have indicated the benefit of revising instructional materials, the entire process has been primarily empirical rather than theory based. In effect, we interpret the data in the most reasonable way possible and then make changes which seem to be indicated by the data.

There are two basic types of revisions which you will be considering with your materials. The first changes need to be made in the content or substance of the materials to make them more accurate or more effective as a learning tool. The second type of change is related to the procedures employed in the utilization of your materials.

There are many different ways in which the data collected in the formative evaluation may be summarized to pinpoint areas of student difficulties. Perhaps the most basic table is one which lists the entry behavior scores, pretest scores, and the posttest scores for each student who participates in the formative evaluation study.

Student Performance as a %
of Total Possible Score

Student Number	Entry Behavior	Pretest	Posttest
1	90	15	85
2	90	25	92
3	100	20	87
4	90	10	98
5	60	0	65
6	90	10	82
7	95	15	87
8	100	20	93

More detailed analysis can be provided by displaying the performance of each individual student in the formative evaluation for each objective. Place an "X" in the box for a particular objective and a particular student to indicate whether the student successfully achieved that objective. Such a chart, an example of one follows, indicates the total score for each student, and the percentage of students achieving each objective.

Student Performance on the Posttest
(X indicates objective was achieved)

Objectives

Student	1	2	3	4	5	Percent
1	X	X	X	X		80
2	X		X	X	X	80
3	X	X	X	X	X	100
4	X	X	X	X		80
5	X		X	X	X	80
6	X	X		X	X	80
7	X	X				40
8	X	X	X			60
	100	75	75	75	50	

Percent X=75

An important source of data is the embedded test item. Such data helps to pinpoint the difficulties the learner is having as he/she works through the lesson. A table can be constructed to show this data.

Another way to display data is through the use of various graphing techniques. A graph may show the pretest and posttest performance for each objective in the formative evaluation study. You might also want to graph the amount of time required to complete the instructional materials as well as amount of time required for the entry behaviors test and posttest.

100
90
80
70
Percentage 60
Performance 50
40 0 0 Posttest
30 X X Pretest
20
10
0

1 2 3 4 5 6 7 8

Objectives

Pretest/Posttest Graph Showing Student Performance

The best way to summarize data from an attitude questionnaire is to simply indicate on a blank copy of the attitude questionnaire the percent of students who choose each alternative to the various questions. If you request open-ended, general responses from the students, these can be summarized at the end of the questionnaire.

Self Evaluation on Step 6.

1. Explain in your own words the following terms in relation to your module development:

   a. Formative evaluation ______________________________
   ____
   ____

   b. Summative evaluation ______________________________
   ____
   ____

2. State the major steps in formative evaluation ______________
____
____
____
____

3. What types of data would you collect for your formative evaluation?
____
____
____
____.

4. Given the following results, what conclusions would you make if the criterion level is 85%?

Student Numbers	Entry Ability	Pretest	Posttest
1	90	30	85
2	95	25	96
3	100	90	98
4	90	20	90
5	65	10	50
6	100	20	75
7	90	15	90
8	80	15	85

____

____

____

____

____.

Feedback

1. a. Formative evaluation is the process used to obtain data to increase the efficiency and effectiveness of the module.

   b. Summative evaluation determines whether the module should be used in a particular setting or whether it is as effective as is claimed.

2. The one-to-one or clinical evaluation.

   The small group evaluation, approximating real life setting.

   Field evaluation to see if the module can be installed as part of regular instructions.

3. Test data collected on entry abilities pretest, posttest and embedded tests.

   Comments or notations made by students.

   Attitude questionnaires.

4. a) Student 5 did not meet the criteria, most likely due to inadequate preparation--she did not have the required entry skills.

   b) Student 6 has not used the criterion level. It would seem that the particular module has caused problems; just where the problem occurred may be revealed by a study of formative tests.

You may have already begun work on your module, which is fine. If you have not then now is the time to make a start. The next pages are a point by point summary on the development of your module. It may be helpful to use the guide as a check list.

Guide for Developing a Module

You are now ready to begin the design of your module. Upon completing each component of the model you should have two products: the components for your module and the description of how you developed the module. For example, when you have completed your instructional analysis, you should note which method you used to derive the analysis and why.

For the present, you should identify your learning outcome and state it in terms of some type of student behavior. A primary consideration in the selection of the goal for your module is that you do not select a topic area which will require many hours of instruction. A general guideline is to select something which would normally require 45 minutes of typical classroom time to teach. These time parameters are suggested in order to limit the amount of work you will be required to do in developing, evaluating, and revising the module as well as time required to arrange for students to participate in the formative evaluation process.

A second major consideration is the selection of a topic with which you are already familiar but feel free to consult a content specialist.

The third consideration is the availability of students to use your materials. You might choose a topic which you know well, and could teach in 45 minutes, but if you have no access to the target population for whom the materials are intended, then you should change the topic or the target population.

After choosing your instructional goal and stating it behaviorally, you should choose the appropriate instructional analysis technique. Don't become discouraged or "hung-up" on this step in the model. You may wish to write subskills on 3 x 5 cards so they can be easily changed, added, omitted or recordered. It will take time and thought to get an analysis with which you will be satisfied.

The next step is to identify the required entry behaviors. These should be derived directly from your instructional analysis and should be stated in behavioral terms. You should also be explicit about your target population in terms of their characteristics.

Next you should write the sub-objectives for your module. These should be a clear indication of the relationship between the skills in the instructional analysis and the objectives. You should use the same numbers on the instructional analysis chart and the list of objectives to make the relationship clear.

Then develop the items for the test which you will be using in your materials. The items you produce should be sufficient for a pretest (if needed), embedded tests and posttests. You may also want to develop an entry behavior test. All items should be keyed to the chart, described above, which contains the subordinate skills and objectives.

You are now ready to develop your instructional strategy. Use the five categories that are described earlier in the program. Consider how you will address each of the five critical components of the strategy. Avoid simply listing concepts or skills that you will be teaching. Rather, you should describe the type of preinstructional activities you will include in order to get the students' attention and inform them of the objectives and prerequisites for the module. You should then describe what you will do for each of the other components of the strategy.

You are now ready to develop the first draft of your instructional module. Clearly, it should be developed in correspondence with your instructional strategy.

Commercial modules often include one or more mediated instructional components. However, for your module it may not be possible to develop a filmstrip, videotape or some other special form of mediated instruction.

Be careful to build into your module all the directions a student will need to complete the instruction without any assistance form an instructor.

Some modules require students to work in small groups to achieve some of the objectives.

During the initial stages of development of the module, do not try to produce a "final copy" appearance for the materials. Your first attempt may be simply a long-hard draft which can be tried out with one or more students in a one-to-one formative evaluation.

You will be required to carry out two types of evaluation. The first is the one-to-one evaluation. You should try to select two or more students who are representative of your target population. Sit with the student as he goes through the text and your materials. Answer questions as they arise and make note of your comments and observations. After the initial one-to-one you may want to make some simple revision before working with the second one-to-one student. Based on the performance and observations of the first two students, you may want to make revisions and have additional one-to-one evaluations, or you may be ready to prepare a revision of your materials for the small group evaluation.

In the small group evaluation, attempt to have no fewer than eight nor more than 20 students in the group.

In the small group evaluation, you will want to administer an attitude questionnaire and discuss the materials with some of the students. You may also want to have the students note the time they spend on the module.

After you have completed your small group evaluation, summarize your data for presentation in your report.

Following this guide and checklist is a copy of the criterion referenced instrument which will be used to evaluate your report on the development of your instructional module. It is suggested that you use the headings on the evaluation instrument as headings within your report.

The items listed under each assignment are the components which the instructor will evaluate and to which points will be assigned.

In your report, you should describe how you carried out each step. If there were revisions made in a component, you should always include the final version. You may wish to include the original version in order to show what changes were made. The evaluator will first be looking for the inclusion of each item in the report. Then the quality of the component will be judged. The various revisions made by the author should be described along with the rationale.

The final product is a report of your module development and a copy of the module which was used in the small group evaluation.

Check List for Developing a Module

Step	Activity
1.	Select Topic.
2.	State the learning outcome.
3.	Perform an instructional analysis based on the stated learning outcome.
4.	Describe the target population as specifically as possible and identify entry behaviors.
5.	Write performance objectives and subobjectives.
6.	Develop criterion-referenced tests for the objectives.

a. Determine whether your testing purpose will be to diagnose students' entry behavior, to branch students, to evaluate students, to evaluate materials or all of these.

b. Determine whether a test over expected entry behaviors is necessary or advisable.

c. Divide parallel questions written for each objective such that some can be included on a pretest (if a pretest is advisable), some can be used for embedded questions for practice and feedback during instruction and some can be included on the posttest.

7. Develop the instructional strategy.

   a. Review the subskills included in the instructional analysis and determine which should be included in instructional materials and which should be included as expected entry behaviors.

   b. Consider the target population relative to their attention span, work and study habits, responsibility and motivation. Then estimate an average "best" time for each instructional activity for the group.

   c. Consider the objectives in the instructional analysis relative to the type of learning and learning activity required for each objective, the general amount of time you believe would be required to teach each objective and the logical sequency in which you believe objectives should be presented.

   d. Cluster objectives. Each cluster might have one or more objectives depending on the difficulty of explanation or time required for practice and feedback. There are no rules for clustering, and you have only the instructional analysis as a guide to develop the first set of materials.

8. Survey the literature and subject matter experts to determine what instructional materials are already available.

9. Consider how available materials might be adapted for use using a manual to guide students through the materials.

10. Determine whether new materials need to be designed. If yes, proceed to 11. If no, begin organizing and adapting available materials.

11. Given each cluster or set of instructional activities, make decisions about relevant motivational materials, necessary review, presentation procedures, student participation, practice, feedback, evaluation and follow-through activities for each cluster or instructional activity.

12. For each cluster or instructional activity, consider the best medium to present the materials, to monitor practice and feedback, to evaluate and to pass students to the next instructional activity whether enrichment, remediation or the next activity in the sequence.

    a. Make decisions about the ideal media for the type of learning.

    b. The types of media required for a large set of materials may be many and varied. Cost effectiveness of developing materials using varied equipment and subskills should be considered.

    c. Availability of materials, portability of materials, availability and appropriateness of equipment should be considered.

d. Tentative decisions about the best medium or media combinations should be made based on studying types of learning, activities required, physical and technical constraints, finances, facilities and the target population.

13. Determine the format and presentation prodecures for each objective or cluster of objectives. Plan any general format or presentation pattern you believe is necessary or would be effective.

14. Write the instructional materials for each objective or cluster of objectives in rough form. A rough slide/tape may have the sound recorded on a simple cassette recorder with indicators for changing visuals, and the accompanying visuals can be magic marker stick figures on 3 by 5 index cards. Printed, visual or auditory materials in this very rough form will allow you to check your sequence, flow of ideas, accuracy of illustration of ideas, completeness, pace, etc. Make a rough set of materials as complete as possible for each instructional activity.

15. Consider each completed instructional activity, or cluster or objectives, for clarity and flow of ideas. Does it go from easiest to most difficult, from the complete skill (behavioral objective for the activity) back to the basic components or subskills, etc.?

16. Using one complete instructional activity, write the student's manual or accompanying instructions to the students for that activity. This could include the objectives, directions and possibly motivational materials.

17. Using the materials developed in this first inexpensive, rough draft, you are ready to begin evaluation activities.

18. You may either develop materials for the instructor's manual as you go along, or you can take notes as you develop and revise the instructional presentations and activities. Using the notes, you can write the instructor's guide. If you wait until the end to complete the instructor's manual, you will surely want to at least design the manual and determine what types of information, suggestions, and tests you will want to include in it. By designing the manual early, you will know what information to collect and procedures to note as you go along to be included in the manual.

Formative Evaluation Activities

1. One-to-One Testing

   A. Participation by students from the target population

      1. Identify students that are typical of those you believe will be found in the target population. (Include each type of student that can be found in the target population).
      2. Arrange for the student(s) to participate.
      3. Discuss the process of a one-to-one test with the students.
      4. Evaluate the test you have constructed to measure entry behaviors. a. Can the student read the directions?
         b. Does the student understand the problems
         c. Does the student have the required prerequisite skills?
      5. Sit with the student while he or she goes through the materials.
         a. Instruct the student to write on the materials to indicate where difficulty is encountered or to verbally discuss ideas and problems.
         b. If the student does not understand an example, try another verbal example. Does this clarify the issue? Note in writing the changes and suggestions you make as you go through the materials.
         c. If the student does not understand an explanation, elaborate by adding information or changing the order or presentation. Does this clarify the issue? Note the changes you make in writing.

d. If the student appears bored or confused while going through the materials, you may want to change the presentation to include larger or smaller bits of information before practice and feedback. Record your ideas concerning the regrouping of materials as you go along.

e. Keep notes on examples, illustrations, information you add, and changes in sequence during the evaluation process. Otherwise you may forget an important decision or idea. Notetaking should be quick and in rough form so the student is not distracted from the materials. Even changes that seem trivial should be included in a one-to-one evaluation report.

6. You may choose to test another student from the target population before you make any changes or revisions in you materials in order to verify that the changes are necessary. However, if errors pointed out by your student "consultant" are obvious, you may want to make revisions before testing the next student both to save testing time and to enable the next student to concentrate on other problems that may exist in the materials.

B. Participation by subject matter experts

1. You should provide the expert with: (a) learning outcomes, (b) the instructional analysis, (c) the intended instruction, and (d) the tests. These materials should

be in very rough form, because major revisions could well be the outcome of this one-to-one testing. You may want to present your materials in the order described above.

2. You should be looking for verification of the (a) objective statements, (b) instructional analysis, (c) accuracy and currency of the content, (d) appropriateness of the instructional materials in vocabulary, interest, sequence, chunk size and student participation activities, (e) clarity and appropriateness of test items and test situations, and (f) placement of this piece of instruction relative to prior instruction and follow-through instruction.
3. The number of subject matter experts you should approach for assistance will vary with the complexity of the information and skills covered in your materials. For some instruction, one expert will be sufficient while for others four may still seen inadequate. The nature of the teaching task will dictate the number and type of expert consultants you will need.

II. Small group testing

A. Participation by students from target population

1. Identify a small group of students who typify those in your target population.
2. Arrange for a student sample to participate
   a. Adequate time should be arranged for required testing as well as instructional activities.

3. During the student's participation in the pretest, instruction and posttest, you may want to make notes about suggestions for teachers who will use the materials and/or about changes you want to make in the instruction or procedures as a result of observing students interacting with the materials.

4. Administer the test or required entry behaviors if one is appropriate.

    a. Check the directions, response patterns, and questions to ensure the wording is clear.

    b. Instruct students to circle words they do not understand and/or place a (X) beside questions or directions that are unclear.

    c. Do not stop and discuss unclear items with students during the test.

    d. Record the time required for students to complete the entry test.

5. Administer the pretest of skills to be taught during instruction. This test and the test of required entry behaviors could be combined into one test if desirable.

    a. Have students circle any vocabulary which is unclear to them.

    b. Have students place a (X) beside any directions, questions or response requirements that are unclear to them.

    c. Have students write additional comments in the test if they desire.

    d. Record the time required for student to complete the pretest.

e. Do not discuss programs during the test with students.

6. Administer the instructional materials. Have the instructional setting as close to reality as possible with all required equipment and materials present. Any instructional assistance required should also be present during the trial.

   a. Train the needed instructional personnel to use the materials in the intended manner.

   b. Instruct students that you need their help in evaluating the materials.

   c. Have students sign their work so you can compare their performance on the lesson with your expectations of their performance based on their entry behaviors.

   d. Instruct students to circle any unclear words and place a (X) beside any illustrations, examples, or explanations that are unclear in the instruction. Students should keep working through the materials to the end without stopping for discussions.

   e. Record the time required for students to complete the instructional materials. Time required may be distorted if students require instruction on unfamiliar equipment or procedures.

7. Administer the posttest

   a. Have students sign their posttest to enable comparisons with the pretest and embedded tests.

   b. Have students circle any unclear vocabulary and place a (x) beside any unclear directions, question or response requirements.

c. Have students respond to as many items as they can whether they are sure of the answer or whether they are guessing. Often incorrect guesses can provide clues to inadequate instruction. You may want them to indicate which answers required guessing.

d. Record the time required for students to complete the posttest.

8. Administer an attitude questionnaire to students and/or instructors administering the materials.

   a. You may want to ask questions like:

      1) Was the instruction too long or too short?

      2) Was the instruction too difficult or too easy?

      3) Did you have problems with any sections or parts of the instruction?

      4) Were the cartoons or illustrations appropriate or distracting?

      5) Was the color interesting or distracting?

      6) What did you like most?

      7) What did you like least?

      8) How would you change the instruction if you could?

      9) Did the tests measure the material that was presented?

      10) Would you prefer another medium?

9. Arrange for students to verbally discuss the pretest, instruction and/or posttest with you or their teacher after they have completed all the work.

a. You may want to structure the discussion with planned questions.

b. You may want to ask questions like, "Would you change the exercises in section X?" or, "Did you like the example in section X?"

III. Field testing

A. Select an appropriate sample from the target population.

1. Arrange for the selected group to try the materials.

   a. Ensure there is an adequate number of students in the group. Thirty is an often suggested number of students to participate in a field trial.

   b. Ensure that selected students are representative of the range of abilities and skills of students in the target population.

   c. Ensure there are adequate personnel, facilities, and equipment available for the trial.

2. Distribute the instructional materials as well as the instructor's guide, if it is available, to the instructor conducting the field test.

3. Discuss any instructions or special consideration which may be needed if the instruction is out of context.

4. Stay away from the testing situation yourself as much as possible.

5. Summarize the data you have collected. Summarized data may include: (a) the report on the entry behavior test,

(b) the report on pre and posttest scores, (c) the report on the time required for students to complete each test used, (d) the report on the time required for students to complete the instruction, (e) any remediation or enrichment needs that become visible, (f) the report on the attitude survey for students as well as from participating instructors if possible.

The final part of this Manual is a criterion referenced evaluation sheet, followed by rationale for the criteria. The evaluation instrument is based on work done by Dr. Walter Dick of Florida State University.

MODULE EVALUATION

	Maximum Points	Criterion Level	Points Awarded
I. Instructional Goal			
A. rationale for module (criteria used for selecting instructional goal)	5	4	
B. statement of instructional goal	2	2	
II. Instructional Analysis			
A. rationale for methodology selected	2	2	
B. completeness of diagram of subskills	10	8	
C. description of relationship among subskills	2	1	
D. clarification between subskills included as entry behaviors and those included as skills to be learned through materials	2	1	
III. Description of Target Population			
A. description of general characteristics of target population and implications these have for instructional materials	4	3	
IV. Learning Outcomes			
A. derivation from instructional analysis	4	3	
B. statement of the learning outcome	6	4	
V. Criterion-Referenced Tests			
A. relationship of items to learning outcomes	4	3	
B. criterion level or mastery level of performance clearly identified	3	2	
C. appropriate tests based upon materials and target popultaion (pretests, posttest, embedded test, entry behaviors test)	9	7	
VI. Instructional Strategy			
A. preinstructional activities	2	1	
B. information presentation	4	3	
C. student participation activities	4	3	
D. testing (covered in No. V)			
E. follow-through activities	2	1	
F. strategy congruent with materials	6	5	
VII. Formative Evaluation			
A. description of one-to-one data collection procedures	4	3	
B. results and revisions based upon one-to-one testing	6	4	
C. description of small-group evaluation procedures			
1. sample group characteristics	2	1	
2. design of formative evaluation study	4	3	
3. instruments and procedures used for data collection	4	3	
4. data summary and display	4	3	
VIII. Suggested Revisions			
A. materials	2	1	
B. tests	2	1	
C. procedures	2	1	
TOTAL	100	73	

MODULE EVALUATION

I. Instructional Goal

A. The designer should clearly indicate the rationale for selecting the topic for their instruction. The rationale should include such items as their expertise in the content area, ability to provide the instruction within a reasonable amount of time, the availability of students to try out the materials in the formative evaluation, and the need for this type of instruction.

B. The goal statement should be a clear indication of the outcome of the instruction. Although the goal does not need to be stated in precise behavioral terms, it should reflect, in general, what students should be able to do when they have completed the instruction.

II. Instructional Analysis

A. The designer should indicate which instructional analysis methodology has been chosen and why it was selected.

B. The designer should include a complete instructional analysis chart that lists all the subskills associated with the instructional goal. The subskills should be stated in behavioral terms. Entry behaviors should be included on the chart and clearly indicated as such.

C. The designer should describe the diagram previously described in B and indicate the relationship of the subskills to each other.

D. The designer should describe the entry behaviors that have been identified and explain the rationale for including them. For instruction that has no relevant entry behaviors, students should explain why none are required.

III. Description of Target Population

A. The designer should describe the general characteristics of the target population for whom their instruction is being prepared. The target populations may vary from a particular classroom group to a national category of students. Important aspects of this component are that the target population is identified and that there is some statement of the implications of the relationship between the general characteristics of target students and the instruction to be provided for them.

IV. Performance Objectives

A. The designer should include in the documentation report a chart that indicates in one column the subskills and instructional goal as identified in the instructional analysis and in a second column, the corresponding performance objectives and terminal objective for the instructional unit. Subskills and objectives should be numbered similarly in order to indicate their relationship.

B. The objectives for the instruction should be stated using the three components suggested by Mager. These include the conditions, performance, and criteria. The alternative approach to writing objectives suggested by Gagne and Briggs is also appropriate. Student should indicate which format they have used for the objective statements.

V. Criterion-Referenced Tests

A. The designer should provide a clear indication of the relationship between their test items and their instructional objectives. This relationship can be indicated by assigning the same numbers to test items as was used to number the corresponding subskills and objectives, or, a chart can be developed which indicates the item number of each performance objective and the corresponding test items.

B. The designer should indicate the criterion used to judge the mastery level of learners' performance relative to each of the objective and to the total test.

C. After reviewing the test, the instructor should determine if there are an adequate number of test items and whether the items are appropriate for the target population and the content of the instruction.

VI. Instructional Strategy

A. The designer should describe how their instruction will motivate learners, inform them of what they are going to learn, and remind them of related information which they already know.

B. The designer should describe how the content will be presented to learners. This explanation should not simply be a running description of the specific content, but rather an indication of how "chunk" size will be determined and sequenced.

C. A description should be included of the activities provided to learners to practice the behaviors taught in the instruction. The provision of feedback for learners' performance should be described.

D. The evaluation of testing strategies was discussed previously in Section V.

E. Although the designer is not typically required to develop any remedial or enrichment activities, a brief description of suggested ones should be included.

F. After examining the instructional strategies described by the designer, the instructor should examine the instructional unit itself to determine whether the materials are consistent with the strategies described by students in their documentation sections.

VII. Formative Evaluation

A. The designer should describe the preparation of instruction for the one-to-one formative evaluation. This description should include the format of materials to be evaluated, the characteristics and entry behaviors of learners who participated in the evaluations, the criteria for the selection of the learners, and the procedures followed in conducting the one-to-one evaluation.

B. The designer should describe the results of the one-to-one evaluation, particularly the major comments received from learners during the evaluation. There should be a description of the types of revisions made in the materials and the rationale for these revisions based on the results of the one-to-one evaluation.

C. The designer should provide a complete description of the characteristics and entry behaviors of learners who particpated in the small-group evaluation. There should also be a complete description of the procedures employed in implementing the evaluation. The description should include the format of the materials, the procedures which were used for testing, the instructions given to learners, and the feedback received at the end of the instruction. There should be a description of all instruments and procedures used to collect data. These descriptions can be used to document the effectiveness of the instruction and to identify points in the materials that still need revision. Students should summarize the data collected, including the display of such items as pretest and posttest performance, performance on embedded-test items, learning time, performance by objectives, and learner attitudes as indicated on questionnaires.

VIII. Suggested Revisions

A. The designer should describe, based on the data and information gathered during the small-group evaluation, the revisions which remain to be made in their materials. The relationship between these revision recommendations and the data obtained during the small-group evaluation of the materials should be apparent.

B. The designer should indicate revisions that remain to be made in the test instruments as a result of the data and information gathered during the small-group evaluation.

C. The designer should indicate any instructional procedures that need to be revised as a result of information gathered during the small-group evaluation. They should describe any changes in procedures or materials needed if materials were used in a regular classroom setting.

Criteria for Evaluating Designer-Prepared Instructional Materials

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1. Materials should include objectives, pretests/posttests, and the instruction.
2. The instruction should follow the instructional strategy established for the unit as described in the documentation report. Some general guidelines:
   a. Have adequate motivation and attention getting ideas been provided for the content to be taught and the characteristics of the target learners?
   b. Have learners been informed of necessary prerequisite knowledge or skills?
   c. Have students been informed about what they will be learning to do (common language objectives)?
   d. Have ideas and concepts been presented in a logical sequence?
   e. Is enough explanation provided for pupils to actually "learn" the ideas, concepts, and skills?
   f. Are accurate and adequate examples included of ideas, concepts, and skills being taught?
   g. Are there embedded tests to provide pupils with the opportunity to practice skills?
   h. Is adequate and accurate feedback provided to pupils responses to the embedded tests?
3. Are materials legible, clear, and easy to follow?

It may be expected that the instructional materials will be prototype or first drafts that are inexpensively produced. Drawings and illustrations should be stick figures or magic marker drawings and materials should be inexpensively duplicated. This "draft" nature of the materials should not detract from the students' evaluation on their materials. The important issue is that the materials include the information on the right pages, and in the right order, so that it can be tested with target learners, analyzed, and revised before being produced in a more polished format.

Post Module Development Survey:

to the Designer

1. Given the opportunity would you design another module, following this model? ______________________

____

____

2. How long did you spend on the development of this module? (in hours) ______________________

____

____

3. If you were to do another module how long would that take in relation to the first? (e.g. just as long, half as long....)

____

____

4. Has the design of your module changed you in the way you teach? (e.g. greatly, slightly, not at all ....)

____

____

5. Would you recommend this model to anyone else?

____

____

6. Was there an aspect of your design process which proved frustrating because the program was unclear or deficient in that area? ______________________________

____

____

____

7. Can you recall a single most positive aspect about the program?

____

____

____

8. Did you refer to any of the references given? __________
If you did, was it because of need or simply interest?

____

____

APPENDIX E

Post Module Development Survey:

to the Designer

Post Module Development Survey:

to the Designer

1. Given the opportunity would you design another module, following this model? ______________________________

____

____

2. How long did you spend on the development of this module? (in hours) ______________________________

____

____

3. If you were to do another module how long would that take in relation to the first? (e.g. just as long, half as long....)

____

____

4. Has the design of your module changed you in the way you teach? (e.g. greatly, slightly, not at all ....)

____

____

5. Would you recommend this model to anyone else?

____

____

6. Was there an aspect of your design process which proved frustrating because the program was unclear or deficient in that area? ______________________________

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7. Can you recall a single most positive aspect about the program?

____

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8. Did you refer to any of the references given? ____________
If you did, was it because of need or simply interest?

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APPENDIX F

SUMMARY OF PROGRESS OF THE DIETETIC UNDERGRADUATE RESOURCES COMMITTEE (DURC)

The first major task of the committee was to determine the competencies required of an entry level dietitian; the task was completed early in 1976. Next it was necessary to start the process of sequencing competencies and translating competencies into modules. At this stage considerable resistance to the competency based program began to surface from the faculty involved in the preparation of dietitians at M.S.U., mostly among those who were not members of DURC.

To find out more about the opposition to the program, the author and another graduate student spent the summer of 1976 interviewing faculty who opposed the introduction of CBE. The general response from the faculty was distrust, and to some degree, rejection, of a program of instruction which they perceived as running counter to their own beliefs and methods of teaching. In some cases the rejection was based on extensive knowledge of CBE, in other cases (the majority) it was clearly because of insufficient knowledge. Nearly everyone complained of not being consulted or involved.

To remedy the communication gap, efforts were made to involve the outside faculty in the program development by circulating minutes of DURC meetings, and circulating journals and articles. The situation did not seem to improve. Those who were not knowledgeable of CBE were still not receiving the information they needed.

Worse, those who had extensive understanding of CBE found the dissemination process alienating as they perceived it as a method of persuasion, using a downward flow communication model, to bring about dubious education practices. There seemed no place in the process where they could express their concerns and bring about some accomodation of views.

In March, 1977, to deal with this impasse, it was decided that members of DURC should act as change agents and arrange one to one meetings with resistant faculty. Prior to embarking on these meetings a number of DURC members themselves expressed a lack of sufficient knowledge about CBE to be able to conduct interviews. To overcome this, it was agreed to hold a number of training sessions for DURC members where the conceptual matters of CBE would be discussed and processes of consulting would be practiced. After a number of training sessions members still felt they lacked sufficient knowledge to carry out consulting. A major concern expressed was the lack of concrete evidence of the CBE concepts. For example, the concept "module" was difficult to conceptualize without having concrete examples to give. When two more meetings of DURC failed to provide the necessary knowledge on CBE, the idea of working as consulting change agents was dropped.