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ABSTRACT

The purpose of this paper is to outline elements that are critical for an effective analysis and revision of instructional units of a learning system. No attempt is made to present an exhaustive list of critical elements nor a list of elements that are necessarily mutually exclusive. The elements that are presented in the paper, although consisting of a first approximation, appear to subsume characteristics that account for most of the ineffectiveness of instructional systems. They are the distillation of extensive experience in the analysis and revision of an actual individualized, performance-based instructional system that constituted the entire teacher education program of a School of Education. Examples to illustrate the categories will be drawn from actual practice. (Author)

CRITICAL ELEMENTS IN ANALYSIS AND REVISION OF INSTRUCTIONAL SYSTEMS[1]

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As increasing concern is being manifest by teachers, students, and taxpayers for instruction that is more relevant, interesting, effective, and efficient, the relative importance of the various roles of the classroom instructor are shifting significantly. This shift in the roles of the classroom instructor is from that of largely a dispenser of information toward that of more of a designer and manager of instruction. Recently, increasing attention is being given to the need for more emphasis of the latter role (e.g. Merrill, 1971, 1968; and Keller, 1968). Increasing interest is also being expressed in the need for a better methodology of curriculum evaluation (e.g. Weiss, 1971). An excellent initial contribution in this area is the recent Handbook of Procedures for the Design of Instruction by Briggs (1970) although it does not attempt to deal at length with the somewhat different tasks in revising instruction. In addition, there is an increasing wealth of information on instructional design, much of which is directly relevant to the problems of the formative evaluation of curriculum developments.

This paper is concerned with some of the "growing pains" of those instructors who are striving to effect such a transformation in themselves. In particular, it is concerned with those, who having started to revise their balliwick of instruction, find that their first draft efforts have not resulted in as much progress as they had anticipated and who even may be sorely tempted to conclude that they are even farther from their goal than when they started.

The problem that arises for these adventuresome individuals (who having departed from the way of their complacent colleagues, but not having attained that blessed state to which they aspire - the well-tempered instructional program - yet still with enough energy, faith, and enthusiasm to keep going) is in the form of questions such as: Where do I go from here? What needs revising? What kind of help could I utilize? What should I start revising first? Perhaps some of these questions cannot be answered satisfactorily, but the fact is that they are being asked, and some useful observations can be made to those teachers who are grappling with these problems for the first time.

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As noted, there is no lack of information on instructional design, although much of it is not popularized or disseminated as well as it could be. Likewise, there is no dearth of admonitions by experienced developers that one should not expect that his first draft version will be satisfactory. Unfortunately, it does not follow that there is adequate information available regarding heuristics and strategies for revising first draft efforts.

It is true that there have been some significant contributions concerning this topic in recent years, among which the work by Scriven (1967) has been a particularly appealing example. It is also true that there is, scattered among textbooks on curriculum, some attention to the problems of revision. But these contributions are focused largely on the comprehensive problems of the manager of large-scale curriculum development projects, rather than on those of a classroom instructor trying to revise a course or a smaller unit of instruction. It is to the concerns of the latter group that this paper is particularly directed.

Much of what follows in this paper is the result of experience of the author for an academic year with the faculty of a school of education dedicated and committed to the revision of their individual instructional units, as well as the overall instructional system of the school of education.[3] Many of the examples used in this paper are drawn from the pilot version of their instructional units. This paper grew out of a concern to define and describe the major tasks that they appear to be facing as they revise their first draft efforts. At this point it is critical to note that before modification of their instructional units and system was initiated, a model of the basic instructional unit was developed. This model contains the fundamental components of an instructional system and therefore a description of its characteristics provides the first approximation of a guide, not only for the development of instruction, but also for the analysis and revision of first draft efforts. The components are as follows:

1. Public behavioral objectives (i.e. they are stated to the student) in all relevant domains of learning and future job tasks (cognitive, affective, motor-skill and social-interactive) with a distinct emphasis upon performance objectives.

2. Criterion-referenced and behavioral objective-referenced testing procedures which require students to demonstrate minimal levels of proficiency on the objectives of a unit of instruction before exiting.

3. Unit pre-testing permitting student competencies to be evaluated to determine which objectives a student may already have accomplished and thereby allow him to bypass the related learning requirements.

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4. Flexible scheduling, permitting students to progress at a pace they set, rather than at an arbitrary rate.

5. Development of learning experiences that are as relevant as reasonably possible to the attainment of the objectives of a unit of instruction (e.g. observation, practice, experiences, etc., which dramatically drops the amount of passive learning via lectures, etc.).

6. Self-contained units of instruction that are intrinsically cohesive rather than survey type instruction.

7. Alternative objectives (and accompanying instructional units) from which the student can select to complete requirements in a particular area.

8. Shifting faculty tasks more to the roles of designers and managers of instruction from that of dispensers of instruction (e.g. reduction in lecturing).

9. Development of differentiated staffing so that procedural activities such as testing, video-taping, etc., are not the direct responsibility of the instructor.

The above list identifies and makes somewhat explicit the nature of several fundamental components of instruction, namely objectives, evaluation, learning activities, management, and organization of learning activities (e.g. according to task analysis of hierarchical structure). Two other components that have not been mentioned that should be included are prerequisites (entering abilities of students) and theoretical rationale (philosophy, learning theory, etc.). At this point, we have a list of components of instruction which as designer of instruction could use as a guide in evaluating his efforts as well as a brief description of criterion levels of application for most of them.

Some guides for development and revision of instruction tend to peter out after listing similar basic components of instruction with perhaps criterion levels of application in some categories (e.g. Cunningham, 1971; Briggs, 1970). In addition, there has been extensive, although compartmentalized, development of development and revision strategies with regard to some of these components, particularly testing, objectives (behavioral variety), and various specific types of learning and learning activities. Compartmentalized application and thinking about these methodologies has inhibited the development of a comprehensive, general framework in which strategies and procedures for development and revision of all of the components of the instructional unit or system can be organized.

Presentation of the initial draft of such a framework is the major objective of this paper. Figure 1 presents this framework in a two-dimensional matrix form. The elements of the Components dimension have been briefly described above. The remainder of the paper will be concerned with an examination of the Attributes dimension. It consists of categories that have been found useful in analysis and revision activities this past year of the teacher education instructional system described above. In addition, the attributes include categories used by various instructional and test designers and developers in making value judgments (e.g. Briggs, 1970; Scriven, 1967; Weiss, 1971).

This paper is too brief to be able to consider at length what the individual cells of this matrix might represent or contain. Nor can evaluation procedures pertinent to the various areas of the matrix be discussed in detail. Such details will have to be covered in a later, more extensive treatment. In addition, there is yet unexplored and undeveloped territory in this matrix. The primary purpose of this paper is to present this matrix as a possible framework by which increasing information about analysis and revision of instructional systems can be organized and as a guide in developing analysis and revision procedures. Since the principal objective in developing this framework is to develop effective instructional analysis and revision procedures, the attributes will be discussed in terms of the type of analysis that would be done.

Relevance Analysis: This type of analysis is concerned with determining the significance (practical, social, job, etc.) of the various components of the instructional unit. Relevance is a loaded term in these times and the temptation was strong to substitute a more innocuous term such as significance. But in spite of some misuses of the term, it is sufficiently representative of a valid and sincere concern regarding instruction. Questions such as the following are becoming of such great importance to more and more students, taxpayers, educators and pressure groups that often they have to be dealt with first by the innovator:

1. Are the objectives of your instruction the most appropriate (relevant) ones in preparing the students to be effective in the immediate and long-term future. Are they meeting their needs?

2. Are the learning experiences the most relevant ones for the students, given their backgrounds, and the instructional objectives?

3. Are the testing procedures the most relevant that can be developed as a manifestation of the objectives?

Likewise, questions can be asked about the other components.

ATTRIBUTES

COMPONENTS	Relevance	Overlap	Transfer	Motivational	Adequacy	Efficiency
Objectives						
Evaluation						
Learning Activities						
Organization of Learning Activities						
Prerequisites						
Management						
Theoretical Rationale						

Figure 1 Components of instructional systems and attributes of these components.

If one does not have immediate worries about the above mentioned pressures, there is another with which he may become involved. If he wishes to develop a product that may be accepted by others and even marketable economically, he must be concerned with the relevance of what he is producing. In a phrase, he must be up-to-date. It is true that which is of enduring value must be distinguished from that which is of fleeting fashionability, but one must seek to avoid revising and improving material that is obsolete.

One application of the use of this category will be illustrated by an example from the area of testing. Typically an analysis of instructor-made tests of college instructors will include sorting the items into categories approximating the Cognitive Taxonomy of Bloom et al. Such an example is presented by Ebel (1966) in which tests are analyzed for the percentage of items in the following categories: Content details, Vocabulary, Facts, Generalizations, Understandings, Applications. Having a specification of the objectives of an instructional unit, one can go a step further and also classify questions as relevant or irrelevant in each of the above mentioned categories. Some examples of irrelevant test items are as follows:

1. Recall of the label of a techniques procedure or criteria that is tangentially related to the objectives of a unit of instruction.

   Example: A question from the proficiency assessment of a unit of instruction on Self-Concept:[4]

   If a self-report instrument is measuring what it claims to measure, it is considered:

   a. accurate
   b. valid
   c. reliable
   d. consistent

2. Recall or application of the characteristics of structure of a discipline (e.g. English, Social Sciences, etc.) at the expense of recall or application of the knowledge of research findings or pedagogic techniques for introducing students at various ages to appropriate aspects of the discipline.

   Example: List the characteristics that define and distinguish the following areas of social science and give examples to illustrate the characteristics.

[4] This question was an excellent discriminator although a bit hard. 43% chose b, the correct answer, and 57% chose c. The discrimination correlation of alternative b was .56 and alternative c was -.56. Therefore, it represents an item that would probably remain in most tests. It found its way into this test because the information was briefly referred to in one of the reading assignments.

3. Recall or application of facts that are relevant to the discipline but which are not relevant to the area of overlap between that discipline and teacher education.

   Example: Questions concerning developmental characteristics of children ages 1-5 in a unit on Growth and Development for Elementary Teachers.

Overlap Analysis: This analysis would be concerned with ascertaining the degree of agreement of the various components of the instructional unit (or system). This term was chosen because of its descriptiveness. For example, what is the degree of agreement between the stated objectives and the manifest objectives that constitute the evaluation procedures? What is the degree of agreement among both of the above and the content of the learning experiences? What is the degree of agreement among the pre-test, any self-test, and the post test (proficiency assessment). Are alternate forms of the various tests reasonably equivalent?

Scriven (1967, p. 57) has referred to the analysis of such cohesiveness as consistency analysis. To some degree it is similar to relevance analysis. But even though these categories are not mutually exclusive it is included because it is felt that it will have a practical influence on the extensiveness of ones' analysis activities. Appendix A contains an example of the analysis of the degree of overlap between (1) the stated objectives that appear in the beginning of the printed materials of this unit of instruction and (2) the manifest objectives represented by the tasks of the self-test and proficiency assessment.

It will be noted, in this particular example, which is a first draft effort, that six of the nine types of tasks on the tests do not overlap and that two of the nine tasks are not represented by a stated objective.

Transfer Analysis: Another type of "overlap" is that of the content of the instructional and evaluational tasks of an instructional unit with the content of the day-to-day activities of the student after graduation. In the case of the instructional system the author has been working with, it would be teaching tasks in the classroom of the future teacher. A basic question to be asked is: What percentage of the criterion level of performance of the tasks of the proficiency assessment will be utilized, what percentage of time, in the applied day-to-day tasks of teaching?

This type of analysis can be subdivided into more detailed questions such as, What percentage of criterion performance is relevant to the dominant tasks of the first year or so of teaching versus later years? Also, it can be subdivided into analysis of intermediate steps to full application such as, how much transfer occurs to intermediate activities such as peer-teaching, microteaching, student teaching, etc?

As may have been noticed by the use of relevance and overlap in preceding sentences, this category has much in common with the previous two categories. But the term transfer has been purposely chosen to represent a specific type of relevance and overlap. Also, use of this term will facilitate the utilization of the wealth of research concerning transfer.

Motivational Analysis: This deals with the assessment of the arousal value of the instructional components. Some, and sometimes much, of the success or failure of a set of instructional materials depends upon how the students view the materials. If the students are actively and diligently participating in the learning experiences, achieving criterion on the proficiency assessment, expending an appropriate amount of effort on the learning and testing exercises and have a positive attitude toward their learning experiences and accomplishments, then the instruction would seem rather successful (although it could possibly not be relevant). If one of these aspects is missing, or if another element is involved such as a high expenditure of time and energy on tangential administrative procedures by the students, the intended outcomes can be inhibited from occuring. In order to determine if such is the case, a representative sample of the students must be observed and consulted.

Typically, if student initiative and effort is not at a desired level, it is because the student does not see the need for such effort. Furthermore, even though he may see the need but can "pass" with a minimal amount of effort, he will probably do so. For example, if students find out that they can achieve criterion on the proficiency assessment without engaging in some of the learning experiences, it could either mean that the proficiency assessment is inadequate, that the learning experiences are superfluous, or that the objectives are too elementary for the student population.

Some consider that asking students to express their opinions concerning the relevance of the objectives, learning experiences, and testing procedures, is a source of "irrelevant" information because students change their minds about their educational experiences after they get on "the firing line". Nevertheless, since students cannot help but form attitudes about the curriculum, and since negative or even neutral attitudes will affect their initiative, it will be advantageous in the long run to adjust one or more elements in the curriculum when low motivation is detected.

Adequacy Analysis: The adequacy of an instructional unit is closely related to the transfer characteristics of the unit. The purpose of this analysis is to determine the adequacy of the stated objectives and learning experiences to cause the student to achieve criterion on the proficiency assessment. It would also include analysis of the adequacy of the proficiency assessment in predicting on-the-job applications, such as teaching. The concepts of validity and reliability, as particularly developed in the area of test construction would be appropriate subsumed in this category. Indeed the general nature of the concepts could be utilized in designing procedures for

evaluating the objectives, learning experiences, and other appropriate components.

The adequacy of the components of an instructional unit may be over-adequate as well as inadequate. At times too much emphasis can be placed on a particular set of objectives (oftimes an instructor's pet objectives) resulting in a stringent criterion level that results in tasks more demanding than those that will occur in the typical classroom. One disadvantage of this overemphasis, aside from those involving motivation, is that the prospective teachers tend to develop expectations of student performance that are unreasonably high. In addition, because less time is spent on the development of other abilities, they are inadequately prepared to cope with other teaching problems.

More often, however, the instructional unit tends to be inadequate rather than overadequate. This is largely due to the fact that the proficiency of the student is determined for only some of the objectives that are necessary for satisfactory implementation of various teaching behaviors. A common example is the development and assessment of the knowledge of various teaching activities (questioning techniques, contingency management procedures, etc.) without practice and application. Almost as bad is the expectation that a few superficial exercises (some almost rote) are sufficient to develop skills which are complex and need to be spontaneous to be effective. Finally, too often the affective area has been completely neglected and no attempt is made to determine, much less modify, the students' attitudes toward the knowledge and skills they should develop.

A thorough analysis of the adequacy of an instructional unit will involve Transfer analysis. However, a preliminary analysis can occur by answering two questions:

1. How many domains of objectives are involved in the teaching tasks with which this instructional unit is concerned?

2. Are all domains appropriately covered in the evaluational and instructional activities?

Inadequacy may be occuring because relevant objectives from domains such as the motor-skill, affective or social-interactive may have been overlooked. They may have been overlooked because some of the steps of the four-step learning model were skipped. The four steps are:

1. Presentation of information.
2. Demonstration.
3. Controlled practice.
4. Applied practice.

Neglect of or inadequate development of any one of the steps may result in the omission of one or more seemingly minor, yet critical, sub-objectives.

Efficiency Analysis: The major purpose of this analysis is to determine how much superfluous effort the students may be expending. It may be well to pay attention to the efficiency of the instructor's activities as well. This category is closely related to the adequacy category. However, adequacy and efficiency are somewhat independent. The analysis of efficiency involves the determination of whether the student is receiving too much or too little information, too much or too little practice, or too many or too few testing tasks. In addition to quantity, the quality of the instruction can be too high as well as too low. Instruction can be too well organized. It can appear so easy that the student is not sufficiently motivated to practice diligently or doesn't gain experience with common problems and thus is inadequately prepared. As well as too much or too little of something, there can be the problem of the inappropriateness of the instruction or the evaluation. (That aspect should show up in the overlap analysis.)

Examples in this area would include the following:

1. The student may be required to practice a skill 200 times when 20 may be adequate, or 2000 may be necessary.

2. The student may be required to read 40 pages when the necessary information could be extracted from two pages.

3. The student may be required to complete tasks that he will never do when he teaches.

4. The student may be required to prepare materials that could have been made in quantity much more efficiently and sold to him at minimal cost.

5. Information may be presented at a slower rate than that possible with other alternatives and in addition no record is available for the student to review. This is typical of the lecture method.

Some Brief Comments Regarding Implementation

The application of these categories of analysis can occur throughout the development of an instructional unit. If the unit is part of a constantly evolving and self-regulating instructional system, these analyses will continue to some degree. At the beginning stages of development, the nature of the evaluation procedures should be less structured and less obtrusive than in later stages of development. Thus a third dimension is added to the model presented in Figure One, namely the developmental stage of the

instructional unit or system. Atkin (1968), for example, suggests that forcing rigorous articulation at an early date of a curriculum developer's objectives may unduly limit the development and contribution of the project by causing premature closure. Likewise, similar results could occur concerning other components and attributes.

Various classes of individuals as well as techniques should be utilized in obtaining effective evaluations. Some evaluations can be done by the author. Others will require the use of colleagues and peers, students, specialized consultants or prospective customers. Perhaps the taxpayer or special interest groups may also become involved.

Some, in examining an instructional package are tempted to add another category, the So-what Analysis - "Now that you have gone to the work of preparing these materials, requirements, etc. - so what?" Comments such as these occur with sufficient frequency that many of us engage in one of three avoidance behaviors from time to time:

1. We delay analysis as long as possible.

2. If we can't avoid participating in the evaluation of a colleague's work, we superficially examine it with noncomittal praise.

3. If we are playing the innovator role and receive a #2 response, we don't press the issue in order to obtain a more honest and exhaustive evaluation.

Further exploration, amplification, and refinement of the basic concepts presented in this paper can assist in the avoidance of such pettiness. Hopefully, such development can help many would-be innovators through the crushing frustration of the inadequacies of one's first attempt, from which many don't rise. In addition, specification of criteria and accumulation of performance data of other similar instructional units and systems may stir-up undue complacency in those educators who need to be stirred up.

Knowingly or unknowingly we somehow gather some data and evaluate the significance of what we are developing, and conclude that we are on the right track. Otherwise, we wouldn't exert the effort to develop what we do. Courageously utilizing increasingly effective evaluation procedures may not tell us exactly what we want to hear, but if we tune in carefully and listen carefully, we will hear some of what we should hear.

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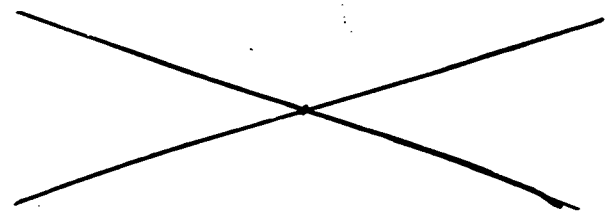
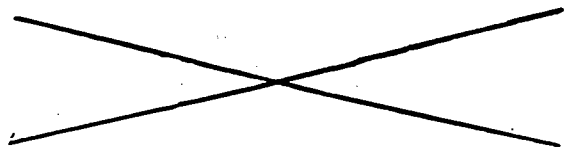
APPENDIX A

STATED AND MANIFEST OBJECTIVES OF INSTRUCTIONAL UNIT X

STATED OBJECTIVES	MANIFEST OBJECTIVES	
	Self-Test (Included with learning materials as an adjunct learning procedure.)	Proficiency Assessment (Final test to determine if student has accomplished the objectives.)
Upon completion of this unit you will be able to demonstrate a comprehension of each of the following areas of content by achieving 85 percent proficiency on an instructor-made test and according to the criteria presented in the Learning Experiences	A. Discuss the following:	~~~~
	B. Describe the following:	~~~~
1. Function or role of this discipline in the school curriculum	C. Define terms such as the following: (17 listed)	~~~~
	D. ~~~~	Given 10 statements about facts of the discipline identify the true ones.
2. Current trends and curriculum projects which are shaping the school curriculum.	E-1. ~~~~	Given the titles of curriculum projects or themes and the names of directors or co-directors, plus one foil, match them correctly.
	E-2. Given a list of names of people, list the curriculum project or discipline with which each is associated.	~~~~

Solid x indicates no equivalent item on the other test
Dashed x indicates partial overlap of the tasks of each of the tests.

3. Categorization of concepts, generalizations, and understandings characteristic of the cognitive structures of this discipline.	F.	Given generalizations such as the following, identify the sub-division of the discipline to which it pertains.	Same
4. Syntactical structure of each sub-division of the discipline which is commonly incorporated into the school curriculum with an emphasis on _____, _____, and _____.	G.	Given the names of the sub-divisions of the discipline, define them using the _____ _____ criteria.	
	H.*		Given definitions of four of the sub-divisions of the discipline, name the sub-division.
	I.*	List the 8 sub-divisions of the discipline.	Same

*No stated objectives correspond to these items.