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Contents

ARTICLES

Alternative Paradigms for Research in Instructional Systems
Marcy P. Driscoll 2

Systematic Development of an Applied Phonetics Course
Barbara A. Petry and Mary Louise Edwards 6

An Approach to Colleague Evaluation of Classroom Instruction
Mary Deane Soricelli 11

Instructional Development Through a National Industry-Education Partnership
Howard J. Sullivan 17

DEPARTMENT

DID Awards Program for Outstanding Achievements in
Instructional Development 22

Index to JID Volumes 6 and 7 24
Alternative Paradigms for Research In Instructional Systems

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Introduction
According to Kuhn (1970), no paradigm for research ever solves all the problems it defines, nor do two competing paradigms leave the same problems unsolved. When planning research and deciding among paradigms, the question is: Which problems most urgently require solutions? It is important to answer this question because adherence to particular research paradigms may affect which problems we are ultimately able to solve.

The paradigms that guide our research necessarily delimit our problems, theoretical assumptions and methodologies. In a mature science, one paradigm typically dominates. Progress occurs when this dominant paradigm, unable to account for a growing number of anomalies discovered in the course of normal scientific inquiry, is replaced or "overthrown" by a competing paradigm (Kuhn, 1970). In a developing science, by contrast, numerous paradigms may vie for acceptability and dominance.

Instructional systems is such a developing science. Its practitioners draw from the research and theory of several fields, including psychology and information systems, to establish a basis for their own theory development and research. As they do so, they will also reflect shifts in theoretical or research paradigms within the field. Heinrich (1970), for example, documents the shift from behavioral to cognitive that has occurred in psychology and research in instructional technology. New research paradigms are also finding their way into educational research (e.g., natural-

<table>
<thead>
<tr>
<th>Research Paradigm</th>
<th>Study Utilizing the Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5. Klauer (1984)—a meta-analysis of the effects of pre-instructional acts, such as behavior objectives, questions, and learning directions, on intentional and incidental learning.</td>
</tr>
<tr>
<td>Case Study/Ethnography</td>
<td>6. Baird &amp; White (1982a)—a case study in which the process of acquisition and the nature of retention of intellectual skills were studied on three adults.</td>
</tr>
</tbody>
</table>
istic inquiry in evaluation, Guba, 1978; developmental research, Sanders, 1981; practical research, Schubert, 1980), and many of these hold promise for research in instructional systems. Because of the developing nature of instructional systems, instructional systems researchers should embrace a wide variety of research paradigms and not yet yield to the dominance of any one.

While the traditional experimental paradigm plays an important role in our search for functional laws and cause-effect relationships, the focus of this paper will be on alternative paradigms to experimental inquiry that may be useful to instructional systems researchers. Cook and Campbell (1979) note the difficulty in the theoretical systems of the social sciences of maintaining experimental control over all outside variables that may impinge on a dependent variable under investigation. They offer a variety of quasi-experimental designs to permit valid causal inference even in the absence of rigid experimental control. In instructional systems, we also face interesting and important questions that are noncausal in nature and thus not amenable to solution through experimental or quasi-experimental designs. A variety of alternatives to experimental inquiry will be presented in this paper. Each will be discussed in relation to the types of instructional systems research problems they will enable us to investigate. Finally, specific examples will be described of some of the alternative paradigms as they have been implemented in instructional systems research.

Alternative Paradigms for Research in Instructional Systems

A variety of alternative paradigms for research and specific examples of research studies in instructional systems that have employed these paradigms are summarized in Table 1. Each is discussed below, both in terms of how it might generally apply in the field and how at least one researcher has employed it.

**Quasi-experimentation.** Quasi-experimental designs for research represent a step between strictly experimental and nonexperimental paradigms. They deserve attention because they solve some of the problems raised with respect to experimental control in instructional research. For example, it is not always possible or desirable in instructional research to randomly assign individual students to treatment conditions or to assign some students to receive a particular treatment which others will not receive. For example, a study investigating achievement differences between students receiving instruction via computer versus those receiving a traditional format. Teachers (or parents or administrators) might insist that all students should receive the computerized instruction.

Other problems stem from the myriad of uncontrolled factors present in classroom settings that can nullify the application of laboratory findings to these settings. Effects found in short term experimental studies may also fail to hold up in the long term because of these mitigating classroom influences. Studies conducted directly in these settings will face problems with experimental control. Cook and Campbell (1979) present numerous designs for field settings in which all the controls of the laboratory cannot be maintained. They discuss statistical as well as design strategies for use in these settings that
will permit valid causal inference despite the lack of controls.

A specific example of a quasi-experimental study in instructional systems is Hannafin (1983), who investigated achievement differences in mathematics between Anglo and Hispanic students assigned to either traditional instruction or to an empirically verified instructional system. The study took place over a period of 8 months, and is one of the few studies to examine performance effectiveness of instructional systems over an extended time period (see also Ebmeier and Good, 1979, and Grabe and Latta, 1981).

Meta-analysis. Meta-analysis is a nonexperimental technique that uses previously reported research findings as its "subjects," meta-analysis (Glass, 1977) can serve an increasingly important function in instructional systems research. It provides a statistical means for synthesizing research findings, a task that typically precedes the planning of a "next step" in any line of research. It can help us come to global conclusions as to whether a previously researched instructional technology has an effect on learning and how large the effect is. This is particularly important when controversies exist in the literature over the effectiveness of a particular technology.

Kulik and his associates have been responsible for a number of recent meta-analyses of research on the personalized system of instruction (Kulik, Kulik, and Cohen, 1979), computer-based college teaching (Kulik, Kulik, and Cohen, 1980), and mastery-based approaches to high school instruction (Bangert, Kulik, and Kulik, 1983). In addition, Krueger (1984) synthesized effects of such pre-instructional acts as behavioral objectives, questions, and learning directions on intentional and incidental learning.

Case Study and Ethnography. While quasi-experimental designs help us to account for contextual influences on learning variable, these influences become an integral part of the investigation in case studies (cf. Glaser and Strauss, 1967) and ethnography (Rist, 1977). Both assume that phenomena cannot be validly studied in isolation, that context in part determines and defines any phenomenon in question. Researchers employing these paradigms argue, for example, that different contextual influences will be operating in different settings, mitigating the effects of any particular learning variable or technology. Explanation of effects must therefore directly consider what contextual factors were operating and how they affected results in a given situation.

Baird and White (1982a,b) use case study to more directly investigate the individual's involvement in learning than is permitted by experimental designs. They assume that general learning principles will be so masked by context and individual differences that they should not be specified a priori but rather allowed to emerge as an investigation proceeds. In two studies examining how several adults learn and retain genetics concepts and skills, Baird and White identified and described two different learning styles and specific recurring learning deficiencies that led to inadequate learning.

One type of case study, ethnography, draws from the assumptions and methodologies of anthropology. Those applying ethnography to education seek to study the "culture" of a teaching-learning environment, and employ such techniques as naturalistic observation and unobtrusive measurement. The Center for New Schools (1974) study of student-teacher relations in an alternative high school is one of several examples reviewed by Wilson (1977).

Systems-based Evaluation. Factors stemming from the context in which a new technology or instructional system is implemented can also greatly affect its success or effectiveness in the setting. Social, political, or economic problems can impair technology effectiveness to a great or greater degree than some inherent problem with the technology itself. To monitor these types of influences, then, systems-based (Cooley and LohNES, 1976; Borich and Jemelka, 1982) or naturalistic (Guba, 1978) approaches to evaluation offer more than experimental, comparative designs. Systems-based designs will enable us to define what makes technologies effective in some settings and not others, so that we will be less likely to discount a technology simply because it was not the solution to our educational ills.

Hanson and Schutz (1978) followed a systems-based, developmental approach and presented both benefits and problems that resulted from it.

Golas (1982) also utilized Beilby's method of cost analysis in a study looking at a specific instructional design technique rather than an entire program. She determined that providing designers with guidelines for making revisions in print materials, based on empirically derived features of effective instruction, was equally effective but less costly than having the designers gather student data on which to base their revisions. Such a finding certainly has implications in tight economy where ways of cutting costs while maintaining effectiveness are welcomed. Other cost effectiveness/cost benefit findings might also help to broaden the application of instructional
systems technology.

Technique and Model Development. Briggs (1982a) suggests that future research in instructional systems include both model and technique development. As learning environments grow more diverse and learners participate more in determining what they will learn, new models of instructional design or substantial revisions to old ones may be warranted. Similarly, as content-to-be-learned grows more problematic, new techniques for analyzing and presenting it may be required.

Technique and model development were the object of inquiries conducted by Driscoll and Tessmer (in press) and Reiser and Gagne (1983), respectively. Driscoll and Tessmer developed a new method for systematically creating examples for teaching concepts and testing student acquisition of them. The method produces examples that cover a full range of concept discrimination and generalization. Reiser and Gagne developed a model for selecting media for instruction on the basis of both practical factors and learning effectiveness.

Summary. The examples described above are by no means exhaustive of what new approaches are being applied in instructional systems research. See Briggs (1982b) for a discussion of some other research paradigms and dissertations that have employed them. These examples are indicative of new directions in which we can and should be heading. It is also worth noting that research paradigms need not be applied singly to answer questions of interest. It may be to our advantage to combine them, as for example, a hypothetical quasi-experimental study investigating differential effects of two instructional strategies that also includes measures of development time and cost. In addition, time and cost data might be readily collected in development projects to serve as a comparison base in later research.

Conclusion

We will miss asking and investigating important questions concerning our instructional design models, their implementations and applications, if we hold to a narrow view regarding research. Traditional experimental research designs do answer some of our questions, particularly with reference to single and interacting learning variables, but they leave much of the story untold. It is time we embraced a range of inquiry paradigms for research in instructional systems.

References


Systematic Development of an Applied Phonetics Course

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Abstract. The process of building bridges between theory and practice can be a difficult task, and instructional developers have only begun to attempt it. Specific ways in which instructional design theories can be applied within the context of an instructional development model are described in this article. The authors chronicle and analyze the development of a course in applied phonetics which is important both for its contribution to instruction in the field of phonetics and for the way in which it utilizes many different theories of instructional design in a real instructional setting. The authors also discuss how Elaboration Theory was applied, as well as other instructional strategies and evaluation techniques.

The goal of Instructional Development is to create effective and efficient instruction. This is often achieved through systematic application of appropriate instructional theories and strategies in order to solve defined instructional problems. However, the application of theory and research to practice may be difficult. While researchers in the field of instructional design and development have been working steadily to build theory bases for themselves, practitioners continue to pragmatically develop curricula, courses, and instructional materials. In many ways, the field has worked deductively to establish rationales for its activities. Linkages between the broad, inclusive theories which contain only minimal strategies for implementation and the process of solving specific instructional problems have yet to be clearly established. This article provides one illustration of how such linkages can be established by chronicling and analyzing a specific instructional development project and identifying the various theories that were used as the project evolved.

Definition of the Instructional Problem

The Communicative Disorders Program (speech pathology and audiology) at Syracuse University offers an introductory course in applied phonetics. The course instructor desired to individualize the course in order to meet the needs of a diversity of students. Graduate and undergraduate students from both communicative disorders and linguistics typically enroll in the course, including some international students. The instructor believed that the resulting diversity of experience and goals could become a benefit if handled properly.

The phonetics course is essentially a lecture course that includes a laboratory component in which students learn how to phonetically transcribe speech. At the conclusion of the laboratory experience, students are expected to be able to recognize and transcribe all phonemes (the smallest units of speech) of normal adult English. They are also expected to be able to transcribe disordered speech and foreign dialects, using the symbols of the International Phonetic Alphabet. The materials previously used to teach the laboratory part of the course were not effective. In the past students felt that they were given too much content at once, asked to identify too many sounds in one word, and weren't given enough practice with identification of any one sound. It was, therefore, a major goal of the instructor to develop high quality audio tapes and accompanying written materials to teach transcription skills.

When the problems of student diversity and skill development were first identified, the instructor did not see them as being connected. However, in time it became evident that these problems were closely related and had to be addressed together throughout the course development process. The materials that were developed reflect the merging of these two problems.

The Instructional Development Model

In order to pursue a solution to the instructional problems, the instructor worked as part of a team with staff from the Center for Instructional Development (CID) at Syracuse University and a mentor, an experienced teacher with expertise in the content area. The task of the development team in this case was to design instruction which would meet three criteria. First, the transcription component had to fit into the overall structure of the course. Second, the instruction had to be appealing, useful, and understandable to a wide variety of students. Third, the instruction had to be structured in a manner that would provide ample opportunity for practice and success by students so they would achieve a high level of accuracy. Ninety-five percent accuracy was the criterion agreed upon, because phonetic transcription has to be highly accurate to be useful to a speech pathologist or linguist and yet 100% accuracy is unrealistic because of extraneous factors, such as fatigue and environmental noise.

The team followed the instructional development model of the Center for Instructional Development, shown in Figure 1. This model outlines a number of steps in Phase I that precede the actual design of any instruction for a course. This phase includes the creation of a preliminary component sequence, in which an idealized version of the course...
is formulated. This idealized sequence is based on a careful analysis of the content area, students, and priorities. Then, an operational sequence is developed, which modifies the ideal by considering various realities (e.g., facilities, resources, staff, time, etc.). In Phase II of the model, component production is undertaken. That is, each segment of the course identified in the operational sequence is "fleshed out," objectives are determined, instructional strategies are chosen, and materials are designed and field tested. These steps were followed in the applied phonetics project. Specific steps that were especially important will be discussed further in this article.

Sequencing the Course

Creating an idealized version of what the entire course ought to look like allowed the instructional team to identify a more logical way of organizing the content of the course which would help students to more effectively learn transcription skills. This reorganization was based on an extensive content analysis and identification of student needs and backgrounds. For example, acoustic phonetics was integrated into the discussion of specific classes of sounds rather than being a separate unit. The instructional sequence of the course that evolved is presented in Figure 2.

The redesigned course begins (Module 1) with an overview of the characteristics and physical properties of sound, and proceeds to the production of speech in general, and then to specific classes of sounds (listed in Module 3-Articulation). After students have learned all the individual speech sounds and corresponding symbols for transcription, they begin to use them to transcribe whole words, and they later learn rules which modify these sounds and show relationships among them (Modules 4 & 5 Sounds in Context and Phonology).

This sequence is similar to the notion of "zooming in" to a subject in a general to a detailed fashion as prescribed by the Elaboration Theory (Reigeluth & Rodgers, 1980; Reigeluth, 1979; Reigeluth & Stein, 1983). The instruction begins with the "big picture," showing the major elements and their interrelationships, then gradually focuses in on the parts that are most important for the course. Students then "zoom out" to view the larger picture again, and also focus in for further elaboration.

From the beginning, the development team realized the need to tie together what students were learning in class and what they would do in the laboratory sessions where they would practice transcription. One of the problems with the original course had been a lack of direct correlation between class and laboratory sessions. We decided that it would be most effective if the laboratories were organized to closely correspond with and immediately follow the lectures. That is, the conceptual support for the transcription task could be most effectively presented in the lecture setting. The concepts could then be reviewed and practiced in the laboratory.
sessions, which would in turn reinforce the need for the information given in the lectures.

Application of Elaboration Theory

When we originally defined the instructional problem, we believed that we needed to create different forms of instruction for each type of student enrolled in the course. As we looked more closely, however, it became apparent that all the students needed to learn the same process of transcription and that most of them were relatively unskilled in that area, regardless of their background. We kept the idea of individualizing the instruction, but made the unit of individualization each student, rather than a group (e.g., the linguistic students, or the undergraduates).

This led us to take a closer look at what is actually involved in phonetic transcription, that is, using phonetic symbols to capture sounds on paper. Inherent in this process is, first, the recognition of individual sounds. We wanted to begin instruction at the most basic level, the identification of specific phonemes. The instructor's mentor, a linguist who teaches some transcription in her courses in the English Department, was particularly helpful when we designed the laboratory sessions. She knew from experience how to break down the transcription task into its simplest form. Her suggestions very closely resembled the "simplifying assumptions" prescribed for teaching a procedure in the Elaboration Theory (Reigeluth & Rodgers, 1980).

We first performed a task analysis on the process of phonetic transcription in order to determine all of the steps and skills involved. We then made a series of simplifying assumptions by identifying parameters that could be manipulated to increase or decrease the difficulty of the task. These parameters are shown in Figure 3.

Next we arranged the exercises in an easy-to-difficult sequence. That is, the students begin with the easiest case of identifying the phoneme. The student hears the word, and decides whether or not the word contains one of the sounds being focussed on in that unit. The task becomes progressively more difficult as students proceed through the instruction. In the final exercise, the student only hears the word, does not know the position of the phoneme(s) in question, and must use correct symbols to transcribe several sounds in the word. In the final exercise, some of the words are real and some are nonsense words, designed specifically to illustrate the particular group of sounds being focussed upon. Approximately seven exercises of increasing difficulty were created for each group of sounds. An easy-to-difficult sequence of this type is prescribed in various instructional theories (see review in Merrill, 1978), and it was confirmed by the experience of the mentor.

Production of Instructional Components

When we came to the production phase of the model (Phase II in Figure 1), we implemented many different instructional strategies which were selected to best serve our goal of making the instruction interesting and effective.

The laboratories were designed so that students could work on their own time and at their own speed. Clear objectives were stated at the beginning of each instructional unit so that students would know exactly what was expected of them. Instruction was ordered in an easy-to-difficult sequence. A variety of visual and aural representations were provided to help students learn the skills. For one of the more difficult laboratories, a special diagnostic exercise was created so that students would be able to analyze their own performance and, based on the results, do remedial work on exactly the sounds that are most difficult for them. All these strategies were used to give the learner control over the instruction and to help the student achieve mastery of the skills.

A "self-test" was provided at the beginning of each laboratory to allow students to gauge what they already knew about the subject. The test is seen only by the student and assists him or her in selecting further instruction. Some students took the self-test, and then skipped on to the more difficult exercises; others did all the exercises provided. This is similar to the type of formative evaluation that is so important in mastery learning (Ainsworth, 1970).

The final product of our efforts included a student manual which contains information about class meetings, resources for the course, information on the structure of the course, a course calendar, and other course information. A workbook and accompanying audio tapes were also created. Students purchase the workbook at the beginning of the semester, and during the appropriate weeks, they go to the audio area of the library where the accompanying tapes are placed on reserve. Students have a week to complete the exercises for each laboratory. They hand the final test for each laboratory to the instructor at the next class session. Answers for all of the exercises except the final test are included in the workbook so that students can check themselves to see if they have reached the required level of mastery.
Evaluation of the Course

The CID model prescribes the use of appropriate evaluation instruments and procedures throughout the component production stage. Evaluation figured quite heavily in the development of this particular course. Before we began the development process, we conducted an evaluation of students who were enrolled in the phonetics course at that time. In the revised course, a short evaluation form for each lab was included in the student workbook. The student filled out a form immediately after each laboratory session, providing information about the clarity of the materials, the pacing, and other factors. The instructor also kept a log and made written comments after each class session. At the end of the semester, a more comprehensive evaluation was conducted.

We compared the results of the final evaluation of the revised course with the evaluation of the original course. These evaluations were not identical because different questions were asked and the focus of each was quite different. However, it was useful to make some comparisons.

Students in the original course and in the revised course achieved high levels of performance (90.2 percent and 91.4 percent correct transcriptions respectively.) While the overall scores did not differ significantly, the revised course requires students to complete tasks which are both more difficult and more representative of the content domain than the tasks required in the unrevised course. For example, students in the revised course are now asked to transcribe sounds from nonsense words which provides for practice transcribing unfamiliar words. This very closely approximates the task students will have to perform when they are asked to transcribe foreign languages or the language of individuals with speech disorders. In addition, students in the revised course are given twice as many practice exercises for the transcription task. The logical organization of these exercises allows students to learn small bits of information at a time and to practice putting the pieces together for themselves. Because of the comprehensive nature of these exercises, we are convinced that students, upon completion of the revised course, have better transcription skills than students who completed the unrevised course.

Student attitudes about the revised course are considerably more favorable than attitudes reported by students in the unrevised course. The instructor felt that one of the most distressing things about the evaluation of the original course was that 52.6% of students said the course was uninteresting. Students commented that the tapes were frustrating and that the exercises became "too difficult too fast." Improving student interest in the course was a high priority for the development team because transcription is as essential to a speech pathologist or linguist as fielding grounders is to a shorthand. If young players' first exposure to developing this skill is not positive, chances are they will not develop the skill and not become the players they could be. In the same way, students who have a positive first exposure to developing transcription skills will be more likely to continue to perfect their skills. Therefore, the development team was pleased when the evaluation of the revised course showed that student interest levels had risen dramatically. In fact, 100% of the students said that they found the course to be "interesting" or "very interesting." Students commented that they like the laboratory tapes, and felt they were "well coordinated and designed." Some students even requested that the tapes be left in the library for another semester so they could continue to practice. These results were quite gratifying to all involved.

Reflections on the Development Process

One of the most helpful procedures we followed during the development process was the creation of a preliminary, "ideal" sequence of content for the course. By thinking of what we wanted the course to be like and what we wanted students to know and be able to do in "the best of all possible worlds" we were able to consider really creative solutions to instructional problems, freed from constraints of time, money, resources, etc. As we revised the course, the ideal had to be tempered somewhat because of such constraints, but they did not limit our thinking at the outset.

Involving a senior faculty member from the instructor's discipline is not a regular feature of the CID model, but was a particularly useful element of the process described here. This project was originally undertaken by the instructor as part of a Post Doctoral Teaching Award from the Lilly Endowment, and it specified that a mentor be a part of the development process. The mentor, in this case, is an outstanding teacher whose experience in teaching transcription helped us a great deal with the task analysis. She brought another, though closely related, perspective to the development team. She also provided specific instructional strategies that worked especially well for this subject from her own experience. Her suggestions, input, and support were invaluable.

The task analysis which formed the basis of the laboratory instruction (Figure 3) was the key to the success of the course. It allowed students to move through the instruction in incremental steps that they could easily achieve. The feelings of satisfaction and accomplishment from successful completion of the laboratories increased students' enjoyment of the course and motivated their interests. Without the task analysis, the design of the labs would have been less logical and confusing for students, as it had been in the past.

Although each step of the instructional development process was very useful, the amount of time that had to be committed to the project was substantial. In this case, what started out to be a seemingly small, manageable project became a major investment of time and energy for the instructor and other team members. However, what the instructor learned about instructional design and development from her "baptism by fire" in this project will be applicable to future revisions of her other courses.

This examination of an instructional development project shows how instructional design principles and theories can be applied to instruction in phonetics. In addition to documenting the creation of something new and exciting for the teaching of applied phonetics, it shows how theories of instruction can be applied to real situations in the instructional development process.

References


An Approach to Colleague Evaluation of Classroom Instruction

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Abstract. Academic institutions across the country are becoming increasingly interested in involving colleagues in the assessment of classroom teaching. This article will assist instructional developers who consult with faculty members and their departments in an effort to improve and evaluate teaching performance. It briefly reviews the literature on colleague evaluation of classroom teaching, discusses the issues developers should consider when assisting in the design of colleague visitation programs, and suggests guidelines for instituting such programs.

Introduction

National studies of how college teaching is evaluated demonstrate a dramatic increase in the use of faculty colleagues as raters of classroom instruction. Academic deans and department chairs who were surveyed report that use of ratings based on classroom visitations by colleagues or trained consultants is gaining popularity as sources of information on teaching effectiveness for teaching improvement and for promotion and tenure decisions (Centra, 1980; Seldin, 1980, 1984).

By comparison, systematic student ratings of instruction have been and still are more readily accepted and endorsed by faculty. In a recent study, 67% of private and 72% of public institutions surveyed always use student evaluations as a source of information for evaluating teaching performance (Seldin, 1984). At the same time, the study found that 17% of private and 34% of public institutions now regularly use classroom visits, and Seldin highlighted their increasing importance as tools in the assessment of classroom teaching performance.

It seems appropriate that faculty members are questioning the past practice of leaving the formal and systematic evaluation of teaching almost exclusively to students. Not only are there real limitations to student ratings but there are also elements of classroom teaching which colleagues are in a better position to assess. A colleague's observation of aspects such as the appropriateness of teaching methods and materials, the amount of material covered, the currency of course material being presented, and the importance of material taught both within the field and for its value to related fields could offer a more adequate appraisal of teaching effectiveness than could students' perceptions. Such observations have the potential to contribute to a more complete assessment of classroom instruction and deserve consideration in teaching improvement and evaluation processes.

Although faculty are interested in considering a greater variety of evidence about the quality of their teaching, they are usually untrained in formal evaluation procedures. The staff of instructional development centers is one source they can draw upon for professional advice. Instructional developers can play a useful role in assisting departments to plan and implement workable systems for assessing their faculty colleagues' contributions to instruction. This paper is focused exclusively on the responsibilities colleagues can take in evaluating classroom instruction. The literature on colleague evaluation of teaching is reviewed, the issues developers need to be aware of when consulting with faculty on colleague visitation programs are discussed, and practical guidelines for instituting such programs are suggested.

Literature on Evaluation by Colleagues Through Classroom Visitation

Most of the literature on colleague
evaluation of classroom teaching consists of position papers either supporting or opposing the concept. The few formal studies on visitation by colleagues have yielded mixed results. After reviewing the findings by a number of researchers, Seldin (1960) observed that, "if the information is carefully gathered, promptly reported, and judiciously interpreted, colleague evaluation based in part on classroom observation is capable of solid judgments on merit increases, promotion, and tenure" (p. 73).

At the same time, other reviews of research (Cohen & McKeachie, 1981; Centra, 1980) concluded that the value of observing classroom teaching for promotion and tenure decisions was dubious. The reviewers felt it was not at all clear whether the validity and reliability of such procedures warranted their consideration as legitimate elements in personnel decisions. A study by Centra (1975) in which college instructors' classroom teaching was observed and rated twice by three colleagues demonstrated that colleague ratings based on limited classroom observation were extremely generous and not statistically reliable. He concluded that ratings based primarily on classroom observation “were not sufficiently reliable to use in making tenure, promotion, and salary decisions—or would require investing more time in visitations or in training sessions” (p. 336).

In contrast to the controversy over the value of colleague evaluations of classroom teaching for personnel decisions, the literature provides strong support for classroom visitation when the purpose is to improve teaching performance. A number of model programs and their successes have been described (Bergquist & Phillips, 1977; Diamond, Sharp, & Ory, 1978; Sweeney & Grasa, 1978). There is a consensus of opinion among writers that classroom observation by colleagues can be a means for improving teaching. They urge that experimentation and development continue in order to explore the full potential of programs which feature visits by faculty observers to classrooms of instructors who are interested in improving their teaching.

Although the literature on colleague assessment of classroom instruction offers abundant opinions and some research, there is a need for further development of visitation programs that can help both colleagues and their departments to capitalize upon the unique insights and contributions which the peer observer can offer to the evaluation process. Seldin (1964) suggests that peers are best able to judge their colleagues' classroom teaching in the following areas: subject matter knowledge, course structure and goals, instructor-student rapport, and instructor teaching behaviors. Already, both student and instructional development consultants and do make useful evaluative comments in various of these domains. When students rate teaching skills they are capable of judging, such as instructor rapport and ability to stimulate interest in the course, they can provide useful appraisals of the course and instructor. Instructional developers offer yet another viewpoint on instruction since they are trained to observe a broad range of teacher and student skills and behaviors as well as overall classroom environment.

However, it is decidedly more difficult for students and outside observers to examine the domain of subject matter knowledge with the confidence and credibility of the peer observer. Put simply, a colleague from one's own or a related department is in the most advantageous position to observe and evaluate aspects of the instructor’s mastery and selection of course content as well as the classroom teaching effectiveness, and one that can be best critiqued by colleagues (Centra, 1980; Seldin, 1964, 1960). Colleague visitation programs now need to identify and detail the range of skills and behaviors related to this domain and to encourage their careful assessment by the colleague observer. The evaluation system described in this paper takes into account the special vantage point of the peer observer and highlights the areas colleagues are in an especially favorable position to assess, including the domain of content knowledge. It offers a classroom visitation procedure which successfully combines a rating form and a guide for taking detailed classroom observation notes. The rating form provides items directly related to subject matter knowledge as well as other important teaching skills and behaviors. The classroom observation notes allow the colleague observer to elucidate his or her ratings in critical teaching domains. The combination of ratings and notes offers a more comprehensive structure for use by faculty and departments which plan to institute or improve colleague visitation programs.

A review of the literature on evaluation of classroom teaching by colleagues

Ratings based on classroom visitations by colleagues play an increasing role in promotion and tenure decisions.

The literature on colleague evaluation of classroom teaching already recognizes content knowledge as a critical aspect of making it clear that the role of faculty colleagues as evaluators of classroom instruction, although gaining in popularity, has not been adequately defined or systematically studied. It is also evident that the policies and practices colleagues use to evaluate teaching for either improvement of instruction or personnel decisions need to be more explicit and systematic. Visitation programs which provide practical advice on the areas of classroom teaching that colleagues are particularly well suited to assess can assist faculty and their departments to maximize not only the fairness but also
the usefulness of classroom observations by colleagues.

Considerations When Developing Colleague Visitation Programs

The instructional developer should consider several issues when advising departments interested in developing a system of evaluation by colleagues. First, the department needs to define the purpose of the colleague visitation program. It will have to decide whether information from classroom observations should be used for teaching development, for promotion, tenure, and salary decisions, or both. Each department needs to work out its own specific goals, standards, and procedures for such a program if it is to be generally acceptable to the faculty and provide reliable results.

Second, a department should recognize that using evaluations by colleagues in tenure and promotion decisions could affect the collegiality which is essential within a department. A mandatory or formal system, no matter how fair, may undermine relationships among faculty. Institutions report greater faculty support for evaluation by colleagues when it is voluntary, used primarily to improve teaching, and the individual faculty member has the option to include data in a promotion and tenure file.

Third, developing the materials and implementing the policies necessary to any departmental program which evaluates teaching by drawing on the observations of colleagues in the classroom places a further demand on the service time of faculty members. The assistance of a developer could help to minimize the investment of faculty time. Program designs which assess colleagues every three years, only evaluate colleagues preparing for tenure or promotion review, limit observations to only one course per year, or call on the developer to serve as a trained observer could help to alleviate demands on faculty schedules. In any event, the time and amount of effort invested by faculty members to develop and implement a system would have to be recognized by the department and the institution as a worthwhile investment.

Fourth, a program seeking to evaluate the teaching of faculty members requires materials which will yield systematic and comparable data about the performance of the instructor in the classroom.

It is important to have a set of explicit criteria by which colleagues make their evaluations. The criteria help to guide the classroom observation and to summarize impressions developed from numerous observations. A set of standard criteria should yield data which is sufficiently similar in form to allow departments or the instructor himself to find a pattern in the observations that identifies a faculty member's particular strengths and weaknesses in the classroom. Also, if a number of items are common to evaluations completed by students and those used by faculty observers, then some useful comparisons can be drawn between the ratings by students and colleagues.

Unfortunately, in contrast to the vast number of student forms for evaluating teaching, there are few forms for use by colleagues in observing classroom teaching. The literature suggests that institutions can begin to develop instruments which colleagues can use to evaluate teaching by modifying their student evaluation form, which in most universities is standardized and research-based. For example, Figure 1 is a modified version of the Multi-Option System of Course and Instructor Evaluation (MULTI-OP) developed at Indiana University. Items were selected which reflect dimensions of effective teaching on which colleagues are best able to provide information, and can observe in a

Page 1 of the Classroom Visitation Form contained 17 items to be rated on a 5-point scale from Strongly Agree to Strongly Disagree.

1. The instructor is very knowledgeable about the subject matter
2. The amount of material covered in the class is reasonable
3. The instructor is well prepared for the class meeting
4. The objectives of the class session are clearly stated
5. The instructor is able to explain the subject clearly
6. The instructor makes the subject matter more meaningful through the use of examples and illustrations
7. The instructor summarizes or emphasizes major points in the lecture or discussion
8. The instructor deals with topics in sufficient depth and breadth
9. The instructor uses class time well
10. The instructor uses teaching methods well suited to the objectives of the class
11. The instructor makes students feel free to ask questions or express their opinions in class
12. The instructor answers questions carefully and precisely
13. The instructor seems to recognize when students fail to comprehend the material
14. The instructor emphasizes a conceptual grasp of the material
15. The instructor makes the subject interesting
16. The instructor discusses current developments in the field
17. The instructor demonstrates enthusiasm for the subject matter

Page 2 of the Classroom Visitation Form contained three questions that required written answers.

18. What did you like most about this particular class and/or the instructor's teaching effectiveness?
19. What specific suggestions could you make to improve this particular class and/or the instructor's teaching effectiveness?
20. Did you learn anything in the pre- or post-observation sessions that influenced or modified your responses?

Figure 1. Colleague Classroom Visitation Form
classroom setting. (Content knowledge, on which the colleague observer can offer particularly useful assessments, is represented by items 1, 2, 8, 14, and 16.) In addition, there are three open-ended questions and space for extensive comments. Use of this standardized form in conjunction with detailed classroom notes allows faculty to make useful comparisons among the information they collect on their teaching effectiveness.

Fifth, a department must determine which faculty members will participate as observers in the program. The means by which colleagues are selected as observers may vary, depending on the purpose of the classroom visitation. If the evaluations are used for personnel decisions, several approaches are possible. Senior colleagues within the department who are regarded as effective teachers could be selected to observe the teaching of all junior faculty under consideration for promotion and tenure. Another approach would be to ask untenured faculty to submit names of five or six colleagues willing to assess their classroom teaching. The department chair would select at least three of the names. In either case, colleagues should observe at least two classes, use a standard rating form, and make independent evaluation of the instruction.

If the purpose of classroom visitation is for the improvement of teaching, greater flexibility of methods is possible. The simplest procedure is to observe and review their classroom teaching. In one Danforth program, voluntary arrangements for visiting a colleague's classroom proved to be an efficacious way for faculty members to help each other teach better (Elbow, 1980). The literature suggests, however, that observations by skilled, experienced colleagues or teaching improvement consultants may be more effective (Cohen & McKeachie, 1981). The University of Michigan, for example, has a Faculty Associates Program where faculty who are recognized as effective teachers serve as teaching consultants throughout the university. On the Indiana University campus, the Division of Development and Special Projects/Audio Visual Center offers an individualized, confidential, and systematic teaching consultation process which can include classroom observations and video-tapes, questionnaires for both student and instructor self-assessment of teaching, and a review of instructional materials.

Another successful program model (Sweeny & Grass, 1978) which use observations by faculty members to improve each other's teaching, involves organizing teams of three faculty members. Team members work together for one or more semesters to help each other assess and improve instruction. The key to the credibility and success of this model, and most of the other programs, is the training of participating faculty in what and who to observe. Institutions with such programs found that individual faculty members needed at least three hours of training by a teaching consultant because they were not sure how to conduct classroom observations, or because they used improper consulting methods with colleagues, such as telling them the best way to teach.

Sixth, a department will have to decide on the number of faculty observers and the number of observed sessions which a fair and accurate appraisal of teaching requires. The number of colleagues selected to make independent observations needs to be sufficient to ensure an unbiased and balanced assessment, particularly if the evaluations are used for personnel decisions. The problem with the informal and unsystematic way in which colleagues and administrators often evaluate classroom teaching is that the number of raters is usually small and the amount of instruction given to raters to assure that they are evaluating the same things is usually minimal. Reliability can be increased by asking several colleagues to independently visit a classroom several times. The success of programs at some institutions suggests that two or more separate visits by at least three colleagues would provide representative information on teaching performance for promotion and tenure decisions. An alternative method would be to have one or more colleagues observe an entire course, or one complete segment of it.

Seventh, evaluation by colleagues must be considered as only one component in a system designed for the improvement and evaluation of teaching. A comprehensive assessment of a faculty member's teaching contribution would include observation of students, faculty peers or a teaching consultant, department chairman, and the instructor's self-assessment.

Guidelines for Developing a Colleague Visitation Program

The following procedures for developing a colleague visitation program are drawn from successful programs at Indiana and other colleges and universities. Classroom observation models (University of Massachusetts, 1977; Flanagan, 1978) emphasize a three-step consultation process which includes a pre-observation conference, classroom observation, and a post-observation conference. These guidelines are useful not only to the developer who is assisting departments in designing such programs, but also for the developer who may serve as a trained observer of faculty members' teaching effectiveness.

Pre-Observation Conference

In the pre-observation session, the colleague observer obtains information from the teacher concerning his or her class goals, students, and particular teaching style. An interview schedule provides a brief, structured way of obtaining such information and includes the following questions:

1. Briefly, what will be happening in the class I will observe?
2. What is your goal for the class? What do you hope students will gain from this session?
3. What do you expect students to be doing in class to reach stated goals?
4. What can I expect you to be doing in class? What role will you take? What teaching methods will you use?
5. What have students been asked to do to prepare for this class?
6. What was done in earlier classes to lead up to this one?
7. Will this class be generally typical of your teaching? If not, what will be different?
8. Is there anything in particular that you would like me to focus on during the class?

Details such as the date for the classroom observation, use of particular observation form or method, and seating arrangements for the colleague observer should also be decided by mutual agreement at this session.

Classroom Observation

During a classroom observation, the colleague observer is in the position to collect information on the instructor's knowledge and organization of the content, use of teaching skills, methods and materials, and interaction with students. Some guidelines for classroom observations are presented in Figure 2.

Faculty and students have identified
Figure 1. Some guidelines for classroom observation.

1. Arrive at class ahead of time. Note the physical arrangement of the room, student-to-student interactions, what happens when the instructor arrives, and interactions before class between instructor and students. Listening to students before class often gives clues to their expectations and attitudes concerning the class and instruction.

2. Record as much of what is said and done as possible, creating a "log" of the class session. Record comments verbatim.

3. Write impressions or questions about the teaching in the margins or in parentheses. Separate them from observations.

4. Describe verbal and non-verbal behavior, emphasizing what happened rather than interpretations of events. "Student looking at clock 9:30, 9:34, 9:38" is preferable to "student appears anxious for class to end," or "Instructor talking to board 9:31," rather than "instructor mannerism is distracting."

5. Inform the instructor that times will be recorded and notes will be written during the observation.

6. Wear a watch when observing a class. Every few minutes note the time in the margin so that the class structure can be put in context.

7. Diagrams of instructor and student positions and interactions are helpful for illustrating the degree of student participation, who participates in class and how often.

8. Stay through an entire class session. If you must leave, make sure the instructor knows beforehand.

9. Observe from a position that is minimally distracting to students and the instructor and to have another vantage point of students from that of the instructor—unless he or she requests otherwise.

10. Don't intervene in the teaching during the observation. As exception, only intervene by explicit prior agreement with the instructor.

the following as characteristics of effective teaching: organization and clarity, command and communication of subject matter, instructor-student interaction or rapport, and enthusiasm and intellectual stimulation. The questions listed below will help the observer identify particular skills or techniques in the classroom which illustrate these central characteristics of good teaching.

Before Class Begins:

Do students arrive noticeably early or late? How are chairs arranged? Do students talk to each other, prepare for class? Do they take out books, notebooks? When does instructor arrive? What does the instructor do before class (write on board, encourage informal discussion with students, sit behind desk, etc.?)

Organizational and Presentation Skills:

Engaging Student Interest - Does the instructor prepare students for what learning is to follow by assessing what they know about the topic through use of analogy, a thought-provoking question, or reference to a common experience, etc.?

Introduction - Does the instructor provide an overview of the class objectives? Does the instructor relate today's lecture to previous lectures? Does he or she use an outline on the board or overhead transparency? Are the class objectives consistent with course objectives?

Organization and Clarity - Is the sequence and content covered logical? Is the instructor able to present content in a clear and logical manner? Is the material explicated to students? Does the instructor provide transitions from topic to topic, make distinctions between major and minor points, periodically summarize the most important ideas in the lecture? Does the instructor define new concepts and terms? Does he or she use examples and illustrations to clarify difficult ideas? Does the instructor use relevant, clear examples to explain major points? Does the instructor provide handouts when appropriate?

Teaching Strategies - Are the instructor's teaching methods appropriate to the goals of the class? Is the instructor able to vary the pattern of instruction through movement around the class, gestures, voice level, tone and pace? Does or could the instructor use alternative methods such as media, discussion, lecturing, questioning, or case study? Is the use of chalkboard effective? Is the boardwork legible and organized? If appropriate, does the instructor use students' own work (writing assignments, homework problems, etc.)? Are the use of various teaching strategies effectively integrated?

Closure - Does the instructor summarize and integrate major points of the lecture or discussion at the end of class? Does he relate the lecture to upcoming classes or topics? Do students start talking or close notebooks before class ends? Is the homework assignment appropriate to the stated class goals and the course level? What happens after class? Are homework or reading assignments announced hurriedly? Are there informal discussions among students or between the instructor and students after class?

Knowledge of Subject Matter:

Does the instructor exhibit knowledge and mastery of the content? Is the depth and breadth of material covered appropriate to the level of the course and this group of students? Does the material covered in this class relate to the syllabus and overall goals of the course? Does the instructor present the origin of ideas and concepts? Does he contrast the implications of various theories? Does he emphasize a conceptual grasp of the material? Does the instructor incorporate recent developments in the discipline? Does the instructor present divergent points of view? Is there too much or not enough material included in the class session? Is the content presented considered important within the discipline and within related disciplines?
Discussion and Questioning Skills:

**Introduction** - How is discussion initiated? Are the purpose and guidelines clear to students? Does the instructor encourage student involvement?

**Kinds of Questions** - Are questions rhetorical or real? One at a time or multiple? Does the instructor use centering questions (to re-focus students’ attention on a particular topic), probing questions (to require students to go beyond a superficial or incomplete answer), or redirecting questions (to ask for clarification or agreement from others in the class)?

**Level of Questions** - What level of questions does the instructor ask? Lower level questions generally have a fixed or “right” answer and require students to recall, list or define principles or facts. Higher level questions ask students to generalize, compare, contrast, analyze, or synthesize information in meaningful patterns.

**What is done with student questions** - Are questions answered in a direct and understandable manner? Are questions received politely or enthusiastically?

**What is done with student responses** - How long does the instructor pause for student responses (formulating answers to difficult questions takes a few minutes)? Does the instructor use verbal reinforcement? Is there a non-verbal response (e.g., smile, nod, puzzled look)? Does the instructor repeat answers when necessary so the entire class can hear? Is the instructor receptive to student suggestions or viewpoints contrary to his or her own?

**Presentation Style:**

**Verbal Communication** - Can the instructor’s voice be easily heard? Does the instructor raise or lower voice for variety and emphasis? Is the rate of speech too fast or slow? Is the rate of speech appropriate for notetaking? Are speech fillers, for example, “you know” or “in fact,” distracting? Does the instructor talk to the class, not to the board?

**Non-Verbal Communication** - Does the instructor look directly at students? Does the instructor scan the class while asking or responding to questions? Does the instructor focus on particular students or sides of the room? Do facial and body movements contradict speech or expressed intentions? Does the instructor use facial expressions (smile, raised eyebrows), body posture (sitting, standing, fold arms), or body motions (proximity to students, clench fists, pointing) to sustain student interest?

**Student Behavior:**

Survey the class every five to ten minutes and note the level of student interest and involvement. What are the notetaking patterns in the class (do students take few notes, write down everything, write down what instructor puts on board, loan over to copy each other’s notes in order to keep up with lecture)? Are students listening attentively, leaning forward, slumped back in desks, heads on hands? Do students listen or talk when other students or the instructor are involved in discussion? How actively are students involved (asking questions, doing homework, doodling on notebooks, staring out windows)? Are there behaviors which are outside of the mainstream of class activity (random conversations among students, reading materials not relevant to class, passing notes)?

Observation notes can be analyzed following the class and a detailed written assessment of the teaching can be attached to the completed Colleague Classroom Visitation Form (Figure 1). The use of both the rating form and a written assessment of the observation provides the instructor with useful quantitative and qualitative data regarding his or her teaching effectiveness.

**Post-Observation Conference**

The post-observation conference is most useful if it occurs within a few days of the classroom observation, while the activities are still fresh in the minds of the teacher and colleague observer. No later than one day following the observation, the colleague should review the notes on the class and complete the Colleague Classroom Observation Form. The colleague observer should then discuss the classroom observation in depth with the teacher. A series of questions with which to initiate a follow-up discussion would include:

1. In general, how did you feel the class went?
2. How did you feel about your teaching during the class?
3. Did students accomplish the goals you had planned for this class?
4. Is there anything that worked well for you in class today—that you particularly liked? Does that usually go well?
5. Is there anything that did not work well—that you disliked about the way the class went? Is that typically a problem area for you?
6. What were your teaching strengths? Did you notice anything you improved on or any personal goals you met?
7. What were your teaching problems—areas that still need improvement?
8. Do you have any suggestions or strategies for improvement?

The colleague observer can reinforce and add to the instructor’s perceptions by referring to the log of class events or the rating form.

An analysis and interpretation of the classroom visit, as well as of the post-observation conference, should go to the instructor. It is crucial that the results of observations be shared with the faculty member being evaluated. (Colleague evaluations could also go to a departmental committee or to the chair, depending upon the departmental policies for sharing such information.) It is also crucial that any colleague observation program emphasize the positive, constructive feature of the observation process—the improvement of instruction.

**Summary**

Nationwide, there is interest among faculty and department chairs in diversifying the kinds and sources of information which are used for both teaching improvement and evaluation. Colleagues can provide unique contributions to both processes, and this paper suggests guidelines and procedures developers need to be aware of when involving colleagues in the assessment of classroom teaching.

Evaluating teaching by drawing on the observations of colleagues in the classroom has the potential to contribute to a more comprehensive assessment and documentation of effective teaching. Offering guidelines for classroom visits by colleagues will help individual faculty and departments in developing procedures, experimenting with and improving different approaches, and evaluating the results. Such efforts would benefit both individual faculty members who are eager to improve their own teaching and departments which are trying to document effective teaching by faculty members who face tenure review. The instructional developer has the expertise to play a key role in developing and im-
Instructional Development
Through A National
Industry-Education Partnership

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Abstract. A Grade K-12 energy education program was developed, field tested, and installed in the schools with more than a million students in 1984 under an industry-education partnership involving several major energy companies and national education organizations. Nationwide field testing during development yielded mean pretest and posttest scores of 52 and 86 percent across the elementary and high school units. Data from 50,000 students using the program revealed similar overall test scores after its installation in regular classes. A set of ID practices that contributed to the success of the project are recommended for instructional developers.

More than a million American school children studied our country’s energy situation during 1984 using a new energy education program developed through systematic, objectives-based instructional development (ID) procedures. Industry-education partnerships involving several major energy corporations and national education organizations were key elements in the program’s development and its installation in the schools.

The Energy Source Education Program was developed and field tested over a three and one-half year period from 1980 until late 1983 at a total cost of approximately $1 million. Financial support for its development was provided by 11 energy companies and trade associations, with major funding supplied by Atlantic Richfield Company (ARCO), San Diego Gas and Electric Company, and Westinghouse Electric Corporation. Participating educational organizations included American Federation of Teachers, Joint Council on Economic Education, National Council for the Social Studies, National Education Association, National Parent Teacher Association, and National Science Teachers Association.

Representatives of the education and industry groups formed an Advisory Council which met twice a year in Washington, D.C., to plan and review the subject-matter content and new materials for the program. The education and industry personnel played complementary roles. The educators reviewed the materials for instructional considerations and served as a support base with key educator groups. The industry representatives supplied information about their particular energy field and provided access to specialized consulting help as needed.

The company employed to develop the program was Educational Development Specialists, a Southern California firm experienced in energy education and in the development of industry-sponsored instructional programs for the schools. The project provided unique opportunities to apply and observe systematic ID procedures across the K-12 grade range in a large-scale cooperative industry-education effort.

The remainder of this article describes the Energy Source Education Program, including its development, field testing, and national installation in the schools. Also included is an “Advice to Developers” section, in which several ID practices that were effective in the project are recommended for general use.

Need For The Program

Historically, energy had been so cheap in America until the 1970s that it
was simply taken for granted. But the 1973 Arab Oil Embargo and the Iranian Revolution in 1979 and 1979 changed all that. By the early 1980s energy costs absorbed 12 percent of our gross national product as compared to only one percent a decade earlier (Cook, 1982). The average American paid $18 at the local service station for a 5-gallon tankful of gas that had cost only $5.40 in 1972 (Monthly Energy Review, 1983). The United States paid foreign nations more than $80 billion a year—$1500 per average family—for imported oil alone (Energy and the Nation's Future, 1981). Headlines like “New Opec Pact,” “Electric Rates Jump,” and “Acid Rain Hits Northeast” had become all too familiar.

As energy took on greater economic and political importance, the lack of public knowledge about basic energy issues became evident. A government-sponsored national survey (Energy: Knowledge and Attitudes, 1978) revealed that young people of high school and college age were very poorly informed about important energy topics. More than 90 percent of the individuals in this survey wanted more information about energy and believed that energy should be a part of every school’s curriculum. The need for better energy education in the schools was apparent.

The Energy Source Program

The Energy Source Program is a comprehensive energy education curriculum for kindergarten through high school. Seven instructional units comprise the total program: four spanning Grades K-6, two for the junior high school level, and one for high school. Each unit takes two-to-three weeks to complete at the pace of one class period per day, but may be extended for a longer period through recommended enrichment activities. The four elementary units and the high school unit were developed in their entirety during the three-year Energy Source Program. The two junior high school units were adapted with relatively minor modifications from units produced by the Energy Source Program developer working closely with a team of curriculum consultants and teachers from San Diego City and County Schools.

The program is designed to promote student attainment of an overall set of goals and a set of instructional objectives for each of the seven units. The goals relate to development of long-term values and attitudes that call for learners to believe that energy is important in our society, to stay informed and concerned about it, and to take an active interest in energy affairs. At the elementary levels, the instructional objectives deal primarily with learning important facts about such matters as energy safety, where and how we get energy, present and future sources, energy and the environment, and United States’ and world energy supplies. High school students are expected to state several major energy issues of today, present arguments on both sides of each issue, and state and defend their own positions on the issues. These issues include acid rain, offshore drilling, energy price controls, radioactive waste disposal, and energy independence. Energy conservation is emphasized at all levels of the program.

Each of the seven units consists of a complete set of colorful instructional materials for use by the teacher and students. Included in a unit are:

1. One or more sound-filmstrip programs to introduce the content and stimulate student interest.
2. A student booklet for each student, containing information and practice related to the unit objectives. The booklets range in length from 16 pages for kindergarten to 84 pages for high school.
3. An activity booklet for use at home with parents for each level except high school.
4. A unit pretest and posttest for each level except kindergarten.
5. A record sheet, completed and returned to the program sponsor by the teacher, that lists the pretest and posttest scores by class, student reactions to the unit, teacher comments and suggestions for improvements, and information for reordering the program.
6. A teacher guide that describes the unit and gives lesson-by-lesson procedures for teaching it.

Several design characteristics were intentionally incorporated into the program. All units employ an objectives-instruction assessment approach and follow the competency-based model described by Sullivan and Higgins (1983). Practice on each objective was included in the student booklet and supplemented in activities directed by the teacher. All units were developed so that the teacher can present them effectively by using only the teacher guide and other program materials, with no additional study or outside preparation.

Field Testing

The elementary and high school units were field tested nationally as a part of their regular development cycles. The two junior high school units were field tested in the San Diego schools during their original development. Elementary and high school field testing was conducted in a total of eight separate geographic areas in six states: California, Colorado, Kentucky, Pennsylvania, Utah, and Wisconsin. In all, 151 teachers and approximately 5,000 students, ranging from 750 at the kindergarten level to about 1,500 in high school, participated in the tryouts of the four elementary units and the high school unit. According to teacher reports, slightly more than half of the classes were from middle-income areas, about one-third from low and low-middle income, and the remainder from high income areas.

The field test procedures were prepared in written form by the instructional developers and were distributed to local coordinators at the eight sites nationally. The coordinators included industry employees, a university professor, and school district personnel. Each coordinator contacted the schools and arranged the tryout in the local area according to the national field test procedures. Instruction during the field test was by the regular classroom teachers under normal classroom conditions. To reduce graphic design and printing costs, all print materials were field tested in black-and-white form, rather than in the color form in which they were produced for general use following the field test and final revisions.

To assess student achievement on the instructional objectives for each elementary and high school unit, except for kindergarten for which there was no formal assessment, the classroom teacher administered the pretest and posttest that is a standard part of the unit. The tests range in length from 12 to 30 items, depending on grade level. The pretest and posttest scores by grade level are shown in Table 1.

The table reveals that the average pretest and posttest scores across the four units were 52 percent and 86 percent respectively. The mean posttest score was above 80 percent for each of the four units, ranging from a low of 82 percent for the high school unit to a high of 92 percent for grades 1-2.

The data in Table 1 reflect the first and only field test for all units except for the one at the high school level. Whereas the
Table 1
Student Mean Percentage Scores by Grade Level

<table>
<thead>
<tr>
<th>Grades</th>
<th>No. Classes</th>
<th>No. Students</th>
<th>Pretest Mean</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>30</td>
<td>757</td>
<td>66</td>
<td>92</td>
</tr>
<tr>
<td>3-4</td>
<td>30</td>
<td>836</td>
<td>43</td>
<td>85</td>
</tr>
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<td>5-6</td>
<td>30</td>
<td>1,087</td>
<td>55</td>
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<tr>
<td>9-12*</td>
<td>14</td>
<td>360</td>
<td>44</td>
<td>82</td>
</tr>
<tr>
<td>Totals</td>
<td>104</td>
<td>3,010</td>
<td>32</td>
<td>86</td>
</tr>
</tbody>
</table>

*Grade 9-12 figures are for the second high school field test only.

Initial field test of each elementary unit yielded mean posttest scores above 80 percent as shown in the table, the first high school field test produced an average posttest score of only 62 percent. Consequently, several changes were made in the high school unit to incorporate more written and oral practice on the instructional objectives. Following these revisions, the second field test of the unit resulted in the mean posttest score of 82 percent shown in the table.

Student and teacher attitudes toward the units were assessed with brief attitude questionnaires administered by the teachers at the end of the field test. Attitudes were consistently positive. More than 90 percent of the elementary pupils reported that they liked their unit, that they would try to do more to save energy, and that they learned many important things about energy. Over 80 percent of the high school students responded positively to the questionnaire items “I liked this unit,” “The content is important,” “High school students should study the content,” and “I learned a lot.”

Among the field test teachers, more than 95 percent across the five levels reported that their students reacted positively to the program, that they were satisfied with student learning, that the energy content was objective and unbiased, and that they would teach the unit again.

Program Installation

Widespread installation of the Energy Source Program in the schools was a primary goal of its corporate sponsors from the beginning of the development process. When the first units were ready for general use in the schools, representatives of several development sponsors organized the Energy Source Educational Council, a national nonprofit agency whose mission is to guide and support business and industry in providing the program for American youth. The council publicizes the program to industry executives, educators, government officials, and the public. Council members also encourage energy-related corporations and private foundations to purchase the program and to work with school personnel to install it free of charge in the schools.

The efforts of the National Council and local sponsors resulted in more than $1 million being raised for installation of the Energy Source Program in 1984, the first year in which the complete K-12 program was available for distribution. The program was used during the year by 1.2 million students at a cost of approximately $1.00 per student. Twenty-five corporations and private foundations contributed from $10,000 to $150,000 each to sponsor program distribution, and more than 50 other organizations donated from $1,000 to $10,000.

Installation of the program in a school district typically occurs through the sponsorship of a single company or a consortium of companies active in the local area. The sponsors purchase the program for the schools, and they often install it with the help of current and/or retired employees participating in a company public-service volunteer program. After receiving appropriate training, these company representatives work in partnership with the district administration and teachers to orient them to Energy Source and to provide them with the materials.

A unique feature of Energy Source is that data on student learning from the program are routinely available after it is installed in the schools. The record sheets returned to sponsors by teachers after their classes complete the program contain the unit pretest and posttest scores for their students. For the 1983-84 school year, average test scores were calculated from 1,675 record sheets representing more than 50,000 students from nine sites across the nation. The mean pretest and posttest scores were 54 percent and 84 percent respectively. These scores varied by only a few percentage points from the mean scores of 52 percent and 86 percent obtained during field testing of the program.

Advice to Developers

The Energy Source Program was a unique opportunity to apply instructional development procedures and observe their effects. Its unusual features included its magnitude, the industry-education partnership and the extent of industry involvement, the grade range of the instructional program, and the number of students using the completed program.

Application of basic ID procedures guides a project such as this one. But use of an ID model or standard development process by itself is not enough to produce a successful program. A number of other tactics are also important.

Seven instructional development practices that contributed to the success of the Energy Source Program, and that are also good practices in development projects generally, are listed and briefly described below. They might be labeled “Practical Hints for Developers” or perhaps “Things My ID Model Never Told Me.” With one exception, they were chosen because they are important in the development process but receive little attention in ID models or the professional literature. The exception, “Try it out,” is a step in all of the major models, but is also included below because the Energy Source project yielded particularly good data on its cost-effectiveness.
Do your homework.

Knowing the subject matter for your program may be the most important thing you can do as a developer, aside from using good ID procedures. Take the time to learn it well.

For most instructional programs, you need much greater depth of knowledge about the subject matter than you include in the program itself. The greater knowledge helps you to determine what content should be included and excluded, to organize the content into objectives, and to generalize appropriately across more detailed information when writing the program.

If your program will include a large amount of content, don't expect to get it all first-hand from subject-matter experts (SMEs). Read it yourself, and use the SMEs more as resource persons, sources for hard-to-find information, and reviewers. The SMEs can tell you good reading sources for most of the information you will need, but don't expect them to take the time themselves to supply all the information for you.

The "Do your homework" lesson was demonstrated graphically to an experienced developer on the Energy Source project. At the beginning of her initial meeting with a government liaison employee for a major oil company, who was to serve as an SME on government energy policy, the oil company official asked her if she had read a particular book which at that time was the leading book on U.S. energy policy. When she replied that she had not, he gave her the book and told her to read it and then reschedule the meeting. His action was justified. The developer should have done her homework before going to school—not afterward.

Avoid bias.

The last thing you or any well-intentioned client wants is for your program to be a legimate candidate for a revised edition of Sheila Hart's Hucksters in the Classroom (1979), a well-known little book portraying industry bias in educational materials. Take as much care as possible to see that this does not happen.

There are several things you can do to attempt to avoid bias in your program. Learn the subject matter well enough yourself to recognize biased or inaccurate information when you see it—that is, do your homework again. Be careful not to unfairly advocate a particular point of view or self-serving position on an issue, even if you hold the point of view yourself. Have the material reviewed by SMEs who are likely to detect and call attention to bias and inaccuracies. On the attitude questionnaire for field-test teachers, ask them whether the content was objective and unbiased and have them note any instances of perceived bias.

Of course, it's important to recognize that to some extent bias is in the eye of the beholder. An amusing, if frustrating, incident occurred during SME reviews of the Energy Source high school unit when the very same short passage brought the following written remarks from a company executive and an environmentalist-author who reviewed the unit independently:

Energy Executive: "An anti-industry position like this is harmful to my company and the industry!"

Environmentalist: "This is totally unacceptable! It's loaded with pro-industry bias."

Call on the experts.

As important as doing your homework is, it won't eliminate your need for outside help. Make yourself familiar with subject-matter experts who can help you, and be considerate about your requests so that they are likely to respond when you really need them.

Content experts can provide needed information at a number of different times. By all means, build an expert review into your development project. Normally, the best time for it is prior to or concurrent with field testing. If the content is controversial or there are credible diverse points of view about it, select reviewers who either are unbiased or represent the different viewpoints. Often, SMEs can also quickly supply needed information that is difficult for you to obtain because of its specialized nature or recency and can provide a good second opinion when you are not fully confident about your treatment of a particular topic.

Calling on the experts and other key persons with a natural interest in your program can have public relations value as well as informational function. Their involvement in the development phase may build a proprietary interest and support base that later will cause them to willingly publicize the program and promote its use.

The Energy Source high school unit alone was reviewed during development by more than 40 industry personnel and educators. The development staff also maintained telephone contact as needed with a number of experts in different energy fields. Virtually all of the expert reviews and on-call assistance were on a voluntary, no-cost basis.

Of course, the 40 reviews exceeded the law of diminishing returns for the purpose of obtaining feedback alone, but the opportunity to review the materials was made available to individuals from all organizations on the Advising Council to foster their identification with the program as well as to obtain their comments. Reading the comments of so many reviewers, deciding on the changes to make, and incorporating them into the material was very time-consuming. Yet the reviews and other information supplied by content experts made a highly significant contribution to the final program.

Make it look good.

The quality and frequency of illustrations, photographs, charts, and other graphics content often influence potential users more than any other characteristic of a program. Good graphics also give a program a professional appearance and enhance its appeal for learners. So insist on high-quality graphics work. If your program does not look good, your elegant ID procedures may never see the light of day.

Looking good is only half the graphics battle, however. As the developer, you must ensure that the graphics content facilitates the desired learning. The typically obliges you to write rather precise specifications for the graphic designers and to work closely with them, rather than giving them a free hand. Unfortunately, turning the designers loose on their own too often results in works of art that are impressive to behold but that either distract students from the learning task at hand or are unrelated to it.

Much to our envy, my development colleagues and I found in the Energy Source project, as we have in previous ones, that the graphics and production costs are about the same as our development budget. We would like to get a bigger share of the funds and we think that we should, but as yet we have not figured out how to do it. Still, good graphics are so important that we are willing to pay the price to get them.
Try it out.

Field testing is a basic step in any self-respecting ID model. Yet only a small percentage of the instructional programs used in the schools actually have been field tested prior to their publication. When post-publication tryouts are conducted, teacher reactions, not student learning, are often cited as the primary evaluation data.

The Energy Source Program serves as a good example of the value of field testing. For public relations and prospective marketing purposes, the units were field tested with far more students than were necessary for formative evaluation purposes only—an average of 30 classes per unit. The cost of field testing was approximately $125,000 out of the total project cost of $1 million. We can estimate conservatively that the sales life of the program is five years at an average of $1.2 million a year, the 1984 sales figure. That is a total of $7 million, $6 million in program sales plus $1 million in development costs. The $125,000 for field testing amounts to less than two percent of the total program expenditure of $7 million.

It is more difficult to calculate the value of the benefits from the field tests than it is to figure their costs. Yet, the revisions in the high school program alone between the first and second field tests resulted in an increase in student achievement from 62 percent on the first tryout to 82 percent on the second, a difference of 20 percentage points. In addition, feedback from the field-test teachers led to numerous changes that made each unit easier to use and improved the units in other ways as well. The field tests had the added informational benefit of revealing the level of student learning from each unit and the nature of teacher and student attitudes toward the units. Clearly, the benefits of improved student learning, greater ease of use, and information about achievement and attitudes from the field testing far outweigh the modest two percent expenditure on this aspect of the program.

Obviously, there are a number of reasons that cost-benefits analysis of field testing in the Energy Source project cannot be generalized freely to other development efforts. Nonetheless, the general result will be similar across projects. The costs of a well-designed field test will consistently be modest relative to the benefits it yields.

Swallow your ego.

In ID projects, you want to have a number of people look at your program and give you feedback on it during the development phase. Rest assured that everyone is not always going to like everything you do, and they may not always be tactful about telling you so. So be prepared to take your share of criticism without firing back at your critics. If you appear too eager to defend yourself, you may give the impression that you don't really want comments or that you are unduly defensive.

Keep in mind that your goal is improvement of the program, and be willing to make it available to qualified people who can help you achieve that goal. If the substance or tone of some comments seem unwarranted, forget it or handle it directly and graciously with the reviewer. Try to get your ego gratification from the quality of the program, not from winning a battle of words.

Two remarks written by reviewers in pre-tryout versions of the Energy Source text still stand out in my mind. One informed me that "People like you who write this kind of Socialist garbage undermine the fabric of American society." The other, which appeared twice in one review, was even more succinct and eloquent. It simply said, "Bullshit!"

Hopefully you won't attract any comments that are quite as extreme as these. Yet, even the extreme ones have some redeeming value. The more you get, the quicker you develop an immunity to them. Sometimes you really need it.

Stick by your ID guns.

It is your advantage in ID projects to have a close working relationship with the program sponsors and SMEs, one in which you are partners in a joint effort to develop the best possible program. The innumerable decisions to be made about the program itself generally deal primarily with either subject-matter content or instructional practices. The best division of responsibility is for the SMEs to have the final word on subject-matter issues and the ID personnel on instructional decisions.

It is almost inevitable that you will occasionally have honest disagreements about the program with its sponsors or with the SMEs. (Because of the nature of your working relationship, it is even more inevitable that you will have them among your own development staff.) As the ID specialist, you are responsible for the instructional integrity of the program. When disagreements about instruction occur, hear them out carefully and make your decision on the basis of your knowledge of sound ID practices and applied learning theory. Then stick by your guns. On instructional matters, the buck stops with you.

There's also the other side of the coin. Of course, you must acknowledge the same final responsibility for SMEs on subject-matter issues that you have on instruction. Deciding whether an issue is a subject-matter one or an instructional one is not always easy. A good reason for learning the subject matter well yourself is to determine whether a proposed or typical way of organizing and presenting it is actually the best possible way for students to learn it. Decisions of this type are instructional ones, but they are often controversial. You must know the subject matter well in order to make them properly.

All of the writing for the Energy Source Program was done by the instructional developers and reviewed by representatives of the sponsor companies, other SMEs, and educators. When significant disagreements occurred, they were discussed in an effort to produce final materials that were acceptable to both groups. Final responsibility on issues was divided as described above between a small group of SMEs and the instructional developers. Not everyone was always happy with every decision, but the overall process worked well and produced mutual respect between the two groups.

Conclusion

The seven practices above share an important characteristic with the basic steps in standard ID models. Both cost money to implement. Homework, graphics, and expert help can be very expensive. Yet, like the basic ID steps, these seven practices must be taken into account in planning and carrying out any well-conceived development effort. Certainly they made the difference between success and failure for the Energy Source Program.

Author Note. The author directed the development of the Energy source program while serving as a consultant to the Educational Development Specialists of Lakewood, California.
Index to JID, Volumes 6 and 7

ARTICLES (By Author)

B

Becker, William E., Jr., & Richard W. Davis. An Economic Model of Training in an Industrial Setting. 6:2, 26-32.

Bonner, Jodi. Systematic Lesson Design for Adult Learners. 6:1, 34-41.

Bratton, Barry. See Gustafson, Kent

C


Carrier, Carol A. Notetaking Research. 6:3, 19-25.

Clark, Richard E. Research on Student Thought Processes During Computer Based Instruction. 7:3, 2-6.

Clymer, E. William. The Project-Oriented Matrix and Instructional Development Project Management. 7:1, 14-17.


D


Davis, Richard W. See Becker, William E., Jr.

Dick, Walter. See Redfield, David D.


Durzo, Joseph J. Getting Down to Business: Instructional Development for a Profit. 6:2, 2-7.

Ely, Donald P. See Daniel, Evelyn H.

Espy, Timm. See Kennedy, Patricia

E

Ely, Donald P. See Daniel, Evelyn H.

Espy, Timm. See Kennedy, Patricia

F


Geis, George L. Checklisting. 7:1, 2-9.

G

Gustafson, Kent & Barry Bratton. Instructional Improvement Centers in Higher Education. 7:2, 2-7.

H

Hanna, Michael J. Measuring the Importance of Learning from Instruction: The Outcome-Consequence Model of Evaluation. 6:3, 14-18.

Hanna, Michael J. Guidelines for Using Locus of Instructional Control in the Design of Computer Assisted Instruction. 7:3, 6-10.


K

Kearsley, Greg. Instructional Design and Authoring Software. 7:3, 11-16.

Kennedy, Patricia, Timm. See Kennedy, Patricia

M

Main, Perry & Dennis Saronco. Distributed Training: Meeting Challenges of the 80's. 6:2, 15-19.


Miles, Gearold D. Evaluating Four Years of ID Experience. 6:2, 9-14.

Mlsanchuk, Earl R. Analysis of Multi-Component Educational and Training Needs. 7:1, 28-33.


Richardson, Penelope L. Issues in Television-Centered Instruction for Adults. 6:3, 6-13.


ARTICLES
(By Title)


Weisberg, Michael. See Locatis, Craig


Checklisting, George L. Gels, 7:1, 2-9.

Citation Patterns in Instructional Development Literature, Stephen G. Sachs, 7:2, 8-13.

A Comparison of the Leadership Behaviors of Instructional Designers in Higher Education and Industry, Barry Wills, 6:3, 2-6.


Saba, Farhad. Instructional Development in Developing Countries. 7:1, 34-36.

Sachs, Stephen G. Citation Patterns in Instructional Development Literature. 7:2, 2-8.

Sarenna, Dennis, See Main, Perry

Silver, Kenneth H. An Analysis of University Training Programs for Instructional Developers. 6:1, 24-29.


Sullivann, Robert F. A Profile of the Instructional Developer in Higher Education and in Business. 7:2, 14-19.


An Analysis of University Training Programs for Instructional Developers, Kenneth H. Silver, 6:1, 15-27.


The Design of Instructional Materials: A Top-Down Approach, Paul Harmon, 6:1, 6-14.

Distributed Training: Meeting Challenges of the 80's, Perry Main, 6:2, 15-18.


Evaluating Four Years of ID Experience, Gearald D. Miles, 6:2, 9-14.


A Functional Analysis of Task Analysis Procedures for Instructional Design, Patricia Kennedy, 6:4, 10-16.


Guidelines for Using Locus of Instructional Control in the Design of Computer Assisted Instruction, Michael J. Hannafin, 7:3, 6-10.


Instructional Design and Authoring Software, Greg Kearsley, 7:3, 11-16.


Instructional Development in Developing Countries, Farhad Saba, 7:1, 34-36.


Instructional Improvement Centers in Higher Education, Kent Gustafson, 7:2, 2-7.


Issues in Television-Centered Instruction for Adults, Penelope L. Richardson, 6:3, 6-13.

Measuring the Importance of Learning from Instruction: The Outcome-Consequence Model of Evaluation, Michael J. Hannafin, 6:3, 1418.

Notetaking Research, Carol A. Carrier, 6:3, 19-25.

The Number of Performance Assessments Necessary to Determine Competence, Robert L. Lathrop, 6:3, 26-31.


The Project-Oriented Matrix and Instructional Development Project Management, E. William Clymer, 7:1, 14-17.

Research on Student Thought Processes During Computer Based Instruction, Richard E. Clark, 7:3, 2-6.


Systematic Lesson Design for Adult Learners, Jodi Bonner, 6:1, 34-41.

The Training Department in an Open Market Environment, Larry Kroh, 6:2, 7-9.


Behavioral Approaches
Harmon, 6:1, 6-14

Case Studies
Daniel & Ely, 6:1, 3-6
Harmon, 6:1, 6-14
Petry & Edwards, 7:4
Sullivan, 7:4

Certification
Daniel & Ely, 6:1, 3-6

Checklisting
Geis, 7:1, 2-9

Citation Patterns in ID
Sachs, 7:2, 8-13

Coca-Cola USA
Kroh, 6:2, 7-9

Cognitive Approaches
Foshay, 6:4, 2-9
Harmon, 6:1, 6-14
Reigeluth, 6:4, 24-30

Competencies
Daniel & Ely, 6:1, 3-6

Computer Based Instruction
Clark, 7:3
Hannafin, 7:3
Hart, 6:2, 20-25
Kearsley, 7:3
King & Robyler, 7:3
Main & Sarenpa, 6:2, 15-19
Reigeluth, 6:4, 24-30
Tennyson, 7:3

Control Data Corp.
Main & Sarenpa, 6:2, 15-19

Conversation and Discourse
Locatis, Welsberg, & Toothman
Design of Print Media
Terrell, 6:2, 33-41

Economics of Training in Industry
Becker & Davis, 6:2, 20-32
Evaluation

Hannafin, 6:3, 14-18
King & Roblyer, 7:3
Lathrop, 6:3, 26-31
Mellon, 7:1, 18-22
Soricinelli, 7:3
Wagner, 7:2, 24-27

Evaluation of ID Experience

Miles, 6:2, 9-14

Events of Instruction

Bonner, 6:1, 34-41
Carrier, 6:3, 19-25

ID Applications—Difficulties

Coldway & Rasmussen, 7:1, 23-27
Miles, 6:2, 9-14
Saba, 7:1, 34-36

ID Competencies

Redfield & Dick, 7:1, 10-13
Durzo, 6:2, 27
Kroh, 6:2, 7-9

ID In Developing Countries

Saba, 7:1, 34-36

ID In Higher Education

Gustafson & Bratton, 7:2, 2-7
Lathrop, 6:3, 26-31
Petry & Edwards, 7:4
Soricinelli, 7:4
Sullivan, 7:2, 14-19
Willis, 6:3, 2-6

ID in Industry

Becker & Davis, 6:2, 26-32
Durzo, 6:2, 2-7
Hart, 6:2, 20-25
Kroh, 6:2, 7-9
Main & Sarenpa, 6:2, 15-10
Miles, 6:2, 9-14
Sullivan, 7:2, 14-19
Willis, 6:3, 2-6

ID—Industry-Education Partnership

Sullivan, 7:4

ID—Interpersonal Aspects

Coldway & Rasmussen, 7:1, 23-27
Locatis, Weisberg, & Toothman

ID—Military Applications

Terrell, 6:2, 33-41

Implementing ID

Harmon, 6:1, 6-14
Lathrop, 6:3, 26-31
Soricinelli, 7:4
Sullivan, 7:4

Implementing ID—Adult Learners

Bonner, 6:1, 34-41
Richardson, 6:3, 6-13

Instructional Analysis

Hoffman & Medsker, 6:4, 17-23

Instructional Improvement Centers

Gustafson & Bratton, 7:2, 2-7

Instructional Television

Richardson, 6:3, 6-13

Leadership in ID

Willis, 6:3, 2-6

Learner Characteristics

Bonner, 6:1, 34-41

Learners as Developers

Geis, 7:1, 2-9
Mellon, 7:1, 16-22

Learning Strategies

Carlisle, 6:4, 31-35
Carrier, 6:3

Lectures

Carrier, 6:3, 19-25

Mathematical Techniques

Becker & Davis, 6:2, 26-32
Lathrop, 8:3, 26-31
Misanchuk, 7:1, 28-33

1984, VOL. 7, NO. 4
Task Analysis
Carilise, 6:4, 31-35
Foshaay, 6:4, 2-9
Harmon, 6:1, 6-14
Hoffman & Medsker, 6:4, 17-23
Kennedy, Esque, & Novak
Reigeluth, 6:4, 24-30

Telecommunications
Richardson, 6:3, 8-13

Training Instructional Developers
Redfield & Dick, 7:1, 10-13
Sibler, 6:1, 15-27

Training: Distributed vs.
Centralized
Hart, 6:2, 20-25
Main & Sarenopa, 6:2, 15-19

Videodisc Applications
Hart, 6:2, 20-25

Xerox Corporation
Hart, 6:2, 20-25

BOOK REVIEWS
(By Title)


Communication and Education: Social and Psychological Interactions, Solomon, Gabriell. Reviewed by Allen, Brockenbrough S., 6:3, 32

Designing Instructional Systems: Decision Making in Course Planning and Curriculum Design, Romiszowski, A. J. Reviewed by Rossett, Allison, 6:3, 32

Designs for Instructional Designers, Markle, Susan M. Reviewed by Foshaay, Wellesley R., 6:3, 32

Handbook of Training Evaluation and Measurement Methods, Phillips, Jack J. Reviewed by Mantzanas, Theophilos, 7:2, 28

Instructional Development Models with Annotated ERIC Bibliography, Gustafson, Kent L. Reviewed by Braden, Roberts A., 6:1, 42

Job Analysis: Methods and Applications, McCormick, Ernest J., 6:1, 42

Survey of Instructional Development Models with Annotated ERIC Bibliography, Gustafson, Kent L. Reviewed by Braden, Roberts A., 6:1, 42


The Technology of Text, Jonassen, David (Ed.). Reviewed by Braden, Roberts A., 7:1, 27

Training and Technology, Kearsley, Greg. Reviewed by Mylona, Martha D., 7:2, 28


BOOK REVIEWS
(By Author)


Gustafson, Kent L, Instructional Development Models with Annotated ERIC Bibliography. Reviewed by Braden, Roberts A., 6:1, 42

Gustafson, Kent L. Survey of Instructional Development Models with Annotated ERIC Bibliography. Reviewed by Braden, Roberts A., 6:1, 42

Jonassen, David (Ed.), The Technology of Text. Reviewed by Braden, Roberts A., 7:1, 27

Kearsley, Greg, Training and Technology. Reviewed by Mylona, Martha D., 7:2, 28

Lakoff, George, and Mark Johnson, Metaphors We Live By. Reviewed by Harmon, Paul, 6:4, 36


Makle, Susan M., Designs for Instructional Designers. Reviewed by Foshaay, Wellesley R., 6:3, 32

McCormick, Ernest J., Job Analysis: Methods and Applications. Reviewed by Morse, Karen, 6:1, 42


Salomon, Gabriel, Communication and Education: Social and Psychological Interactions. Reviewed by Allen, Brockenbrough S., 6:3, 32


BOOK REVIEWS
(By Reviewer)

Allen, Brockenbrough S., 6:3, 32
Bonner, Jodi, 7:2, 28
Braden, Roberts A., 6:1, 42; 7:1, 37
Foshaay, Wellesley R., 6:4, 36; 6:3, 32
Harmon, Paul, 6:4, 36
Mantzanas, Theophilos, 7:2, 28
Morse, Karen, 6:1, 42
Mylona, Martha D., 7:2, 28
Rossett, Allison, 6:3, 32
Wiley, Ann L., and Helene Geiger, 6:3, 32