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Foreword

Robert M. Morgan
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A revival meeting of sorts was held this past spring in the lake country outside Bloomington, Indiana. Attending were invited faculty members from many, if not most, of the graduate training programs in instructional systems and technology throughout the nation. It was fun, interesting, and in the long term may prove to be useful. IID’s editorial staff has decided to devote this issue to some reports and reactions from this meeting. The University Consortium for Instructional Development and Technology (UCIDT) was responsible for organizing the meeting and Indiana University, a UCIDT member, agreed to serve as host.

In addition to Indiana University, UCIDT includes Arizona State, Florida State, Michigan State, the University of Southern California, the University of Georgia, and Syracuse University. Representatives of these universities met from time to time to discuss the state of our discipline, to compare notes on our programs, and to do other good things. For some time now the group has been discussing the need for more thinking and discussion on where we are as a field, and more importantly, on where we are going. As a recognizable academic field, instructional systems and technology has been around for twenty or so years. Our graduates—both masters and doctoral—are in high demand and the number of graduate programs has steadily grown. Despite our successes, some have argued that our influence in public education has declined in the past few years, that we are not doing enough research and publication, and that perhaps we have developed a premature mid-life complacency. We also concluded that the existing organizational mechanisms, like AECT, NSPI, and AERA, had not provided optimal forums for us to deliberate these issues. For these reasons, UCIDT decided to call a meeting of faculty to talk about our mutual opportunities and problems—thus the Indiana conference.

Institutions with at least a masters degree program were contacted and invited to send, at their own expense, one or two faculty representatives to the sessions. We also decided not to emulate the usual academic meetings, with a full program of invited presentations, in order to maximize the time we would have to talk to one another. Three presentations were invited in order to help focus discussion. The presenters, all senior statesmen in our field, were Charles Schuller, Robert Gagne, and Robert Heinch. The papers by Schuller and Gagne are included in this special issue. Heinch’s presentation drew heavily on his earlier ECTI paper, “The Proper Study of Instructional Technology.” Because of its prior publication it is not included here. We also drafted three younger statespersons to record their observations of the meetings and to share their reflections with us. These were Carol Carrier, Robert Reiser, and Michael Hannafin, whose papers are also included in this issue.

In retrospect, I believe that the participating faculty would agree that the conference served some useful purposes. An important dialogue among some of the principals of our field has begun. We are better informed about the programs at other institutions and are better acquainted with some of our colleagues than before. Areas of future mutual support have been identified. And we have agreed to continue. If you were overlooked in the initial invitational process, and would like to be included in the future, contact Tom Schwen at Indiana University for information.
Some Historical Perspectives on the Instructional Technology Field

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I have been asked to give a brief historical overview of developments in the field of educational technology. I assume I was chosen for this task in part because of my long involvement in the field. My work in education and media technology spans nearly 50 years. During those 50 years I have been involved with projects in a wide variety of public school, university, and military settings. I suppose this qualifies me to provide a personal perspective on the history of the field. Some have even referred to me as "history personified."

Nature of the Problem

In education, as in most other human endeavors, lengthy experience does not necessarily bring about greater functional knowledge or improved performance. If you are not changing and adapting to new conditions and needs as time goes on, you’re merely perfecting your old bad habits—and congealing the ideas that go with them.

To no small extent this is the problem today with education generally and with higher education in particular. It is also a significant part of our problem in educational technology. I think Bob Heinich’s (1984) insightful and penetrating article on the “Proper Study of Instructional Technology” analyzes the “guts” of the problem. Unlike many scholarly critics, he suggests some useful directions in which to move: (a) shifting the intellectual base of instructional technology from education to technology, (b) moving from experimental to field based, naturalistic studies, and (c) studying educational institutions as complex organizations whose policies are amenable to inquiry and eventual change.

The Michigan State Experience

The following experience illustrates Heinich’s first suggestion. In the early 50’s I was invited to join the faculty of Michigan State University. The university administration was already well aware of the need to bring about fundamental changes. I came in as an Associate Professor of Education with the understanding that I would develop an academic program in audiovisual materials and methods. Central administration, aware of the need for change, provided us the freedom and financial backing needed to develop both service and academic programs with an eye to the future. As our service programs increased, new department heads were brought in with the central administration providing the budget for most of these positions.

We had a great “crew” and must have done something right, for we had excellent relations with most departments and faculty across campus, as well as with central administration. It was nonetheless electrifying to hear President John Hannah, in his State of the University address to the faculty in March 1961, state as part of a seven-point program, that:

It is proposed to put to use discoveries already made concerning the learning process itself, and to stimulate further research, through the establishment of an Instructional Development Service to include and encourage the use of closed circuit television, film, teaching machines, programmed studies, and other aids.

And further, That the Board of Trustees and officers allocate the financial resources of the University so as to support and encourage those colleges and departments actively engaged in the process of redesigning their programs in keeping with the overall development framework. (Davis, Abedor, Allan, & Witt, 1976, pp. 7-8).

This, bluntly interpreted, was to say (as he did), “We’ve got $200,000 for next year that I’m recommending to the Board be allocated only to those departments and colleges who demonstrate their willingness to ‘move’ on this program!”

There was much more to this development program than media alone and, in the beginning, as you can guess, there was plenty of resistance from faculty. Parenthetically, I would like to emphasize that I am not interested in simply touting Michigan State University, even though it was unquestionably one of the “garden spots” of that time with respect to bringing about significant change in higher education. I am only using it as an illustration of two important axioms of administrative leadership:

1. To bring about significant change, top administrative leadership is, without question, the most powerful single influence that can be brought to bear; and

2. Money talks! It is the one ingredient in the change formula that all professors, department heads, and deans can understand, regardless of their views on the proposed changes themselves.

We could elaborate more on this development program by describing (a) how we won faculty support, (b) the 400 plus projects funded over the 10-year period from 1964-74, (c) the impact of the development projects on the university as a whole, (d) what happened to the development program after its initial surge and after key personnel left the university, and (e) where the program stands today. For those who want more details about the Michigan State experiences, see Dietrich and Johnson (1967) or Gustafson and Schuller (1984).
The University Consortium for Instructional Development and Technology

There is another fundamental element to discuss in this historical overview, and that is the University Consortium for Instructional Development and Technology (UCIDT) which generated this conference. The Consortium came about initially some 21 years ago through the efforts of Jim Finn, Don Ely, and myself. We met at conventions and other meetings to discuss ways we might benefit each other's programs. Ideas which were considered included exchanging faculty and graduate students and joining forces to secure funded projects of mutual interest.

In education, as in other endeavors, lengthy experience does not necessarily bring about greater functional knowledge or improved performance.

It was the latter idea that suddenly jelled. One afternoon in Washington D.C., Jim Finn was in Don Bigelow's office in the U.S. Office of Education, proposing special media institutes for college and university professors in academic areas such as history, geography, mathematics, and English. Because prospective teachers, as well as practicing teachers, take academic courses in their substantive degree areas, the hypothesis was that if college professors could be taught to use the new media, instruction in university classes would be improved and effective teaching techniques would be transferred to the public school teachers. The project was quickly approved under Title 13 of the National Defense Education Act and put into effect by the Consortium. Jim Finn and his staff at the University of Southern California headed the project, which was called the National Special Media Institutes (NSMI).

The Teaching Research Division of the Oregon State System of Higher Education was invited to join the Consortium. This enabled NSMI to cover more subject areas. Over the next few years the project flourished. Some 600 college and university faculty from institutions across the United States received five days of intensive training in the effective use of new instructional media available in their subject areas. If faculty enthusiasm was any indicator, the special media institutes were highly successful.

Additionally, the U.S. Office of Education commissioned a group of prominent university academicians to evaluate the overall impact of the NSMI project on instruction in the various subject areas addressed in the Institutes. Results showed that, while the program was effective in promoting the use of media in university courses, it was disappointing in terms of the overall impact on public school instruction in these subject areas.

Unfortunately (and this is an important historic factor to remember) funds were not provided for thorough and systematic evaluation or follow-up on this project. Substantial final reports were written, but there was little evidence of either short or long term benefits derived from the heavy federal expenditures. The final reports gathered dust on the Office of Education shelves and were seldom referred to again.

Now, if I may digress for a moment, there was nothing new about that situation. I had been involved in getting media equipment included in the provisions of the old National Defense Education Act. In 1960, as President of AECT's Division of Audio-Visual Instruction, I made a plea in my "Farewell Address" to the convention for the conscientious development of evidence that federal monies had accomplished something for schools (besides having greatly improved business for materials and equipment producers and distributors). Not only was useful research evidence lacking, as it still is, but also missing was qualitative evidence such as opinion polls and testimonials from teachers, administrators, students, and parents on the benefits of having media materials and equipment.

The materials bonanza continued for some years because the National Audio-Visual Association people, representing the production and equipment industries, were good lobbyists, as were the library people. But the lack of adequate comparable efforts by AECT as well as most other educational organizations led to the undercutting and eventual demise of many once flourishing federal support programs for education.

This loss of federal support points to two thoughts for our purposes: (a) a need for instructional technology people to be able to effectively demonstrate the importance of what they are doing, and (b) the need for administrators of instructional technology to be trained in the techniques and uses of evaluation and persuasion. The use of this evidence and those techniques could be effectively applied on the local level to obtain adequate budgets and new positions. (Note that this merely enables one to perform better within the confines and restraints of traditional institutional relationships.)

The UCIDT Instructional Development Institutes Program

Jim Finn's untimely death in 1969 was a great loss not only to his host of students, friends, and colleagues but to the Consortium as well. Nonetheless, a solid foundation had been built and enough energy and momentum generated to keep the "show on the road," as he would have expected us to do.

Work had already begun in the early 60's on the development of instructional systems based on Charlie Hoban's presentation at Lake Okoboji on the application of engineering systems principles to audiovisual communications. In 1962, Michigan State secured a U.S. Office of Education contract to explore, with three other universities, possible patterns of application of the systems approach to instruction. I brought in Dr. John Barson from Wayne University to head up the project. Syracuse University, the University of Colorado and San Francisco State College also cooperated with us in the study. Together we explored and tested certain assumptions about a model developed at Michigan State for systematic development of college level courses. While the model itself...
proved deficient in certain respects, the project team learned how to use the model to get desirable results. Their findings, in part, were a set of 18 heuristics. These, in effect, were practical suggestions from "action research" to guide future action in developing effective instructional systems.

The Behavioral Science Seminars

Another historic benchmark in which the Consortium played a role was the Behavioral Science Seminars. These were also sponsored by the U.S. Office of Education and were coordinated by the National Special Media Institutes through the Teaching Research Division of the Oregon State System of Higher Education during the late 1960's. These seminars were prompted initially by Jim Finn's conviction of the need for new ideas in the growing field of instructional technology. The behavioral sciences were selected as the substantive areas most likely to assist instructional technology people in the transition from an audio-visual product orientation to the process emphasis required in systems analysis and applications to instruction.

Leading behavioral scientists (primarily psychologists) from around the nation who had a strong interest in instruction, were commissioned to prepare papers which they presented at seminars of selected instructional technologists. The first seminar was devoted to the cognitive area, the second to the affective area, and the third to the psychomotor area of learning. From the subsequent discussion, questions, suggestions, and criticisms received, the specialists went home and revised their papers for publication in a series of three books entitled Contributions of Behavioral Science to Instructional Technology: 1) The Cognitive Domain, 2) The Affective Domain, and 3) The Psychomotor Domain.

These are all out of print now, but probably can still be found in many of your libraries or through the ERIC center at Syracuse University. When studying them for purposes of preparing this paper, I was impressed with the fact that much of their content is as valid and useful today as when it was written.

The Instructional Development Institute Program

The real nationwide push came when the Consortium received a substantial U.S. Office of Education grant through Michigan State University in 1969 to create Instructional Development Institutes (IDI's) for public school personnel. MSU's Education Development Program, begun in 1964, had greatly enhanced instructional development efforts through the addition of staff and the infusion of dollars for experimental programs. This was a persuasive factor in getting the grant. Many participants in this conference were involved as staff members, graduate students, or participants. Jack Edling, who directed the project for the Consortium, and his staff from the Teaching Research Division of the Oregon State System of Higher Education first did a thorough review of the literature on system approaches and design, and then proposed several possible approaches. From this came a model and a plan of action. All four Consortium institutions assumed part of the massive job of developing print and media materials for the Institutes along with manuals and evaluation instruments. It was during this period that the Consortium changed its name to the University Consortium for Instructional Development and Technology.

Money is one ingredient in the change formula that all professors, department heads, and deans can understand.

The IDI's were designed to train teams of administrators, teachers, curriculum and other specialists in the principles and operation of instructional development programs for the public schools. After tryouts and revisions in the Detroit, Phoenix, Atlanta, and St. Paul school systems, and after the selection and training of teams in some 20 states, 350 to 400 IDI's were conducted in school systems across the United States from 1971-1974. The impact both on trainees and trainers was indeed substantial.

It was again unfortunate that cutbacks in funding eliminated much of the follow-up, refresher and additional training, and summative evaluation that had been planned. Residual benefits, however, were extensive. Large numbers of staff members and graduate students across the nation received invaluable first-hand experience on "the firing line" of the Institutes. In addition, much of the Institute material was used in graduate courses in the Consortium and other institutions. The combined effect of the experience, and the use of the materials helped bring about constructive changes in instructional technology programs across the country.

Subsequently, the Institutes were modified and introduced to the Philippines and other southeast Asian countries, the Middle East, and Europe. Modifications ranged from an initial emphasis on educational institutions to personnel training programs in religion, government, business, industry, and community development. I might add that the unique program developed in the Southeast Asia Interdisciplinary Development Institute in Manila by Dr. Jacqueline Blondin, one of our graduate students at MSU, proved to be an excellent example of what can be accomplished in an environment unhindered by traditional institutional constraints.

Summary

OK! So what does this brief analysis of a slice of historical events in our field suggest? Quite clearly, a great deal has been accomplished. There's been no shortage of effort, energy, or intelligence applied. And the results, by and large, have been good—many of them, in fact, outstanding. So why don't more people love and support us? Why have we lost our influence in education and in agencies that support education projects?

What needs to be done is the classic first step in instructional or organizational development, namely, analysis of the problem. Because if you don't ask the right questions, the answers you get aren't likely to solve the problem. Even with a sound and thorough analysis of the problem, you've just made a good start on what has to be a tough, rigorous process to find solutions that will work in your individual situations.
Top administrative leadership is the most powerful single influence in bringing about significant change.

References

Indiana University joined the Consortium in 1971 and participated actively from that point forward. Florida State University became a member in 1975, Arizona State University in 1982, and the University of Georgia in 1984.
Instructional Technology:
The Research Field

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Abstract. Two aspects of the context for research in instructional technology are described—innovations in media technology, and educational requirements. A good deal of education, the survival part, appears to be acquired by incidental learning, and a number of prospects are discussed for research in that area, while more traditional learning research on intentional learning is currently conducted in the framework of cognitive information processing. An important concept to denote what is learned is the schema, and a number of possibilities are described for schema-based research on learning from text.

Evidences are all around us that the technology relevant to instruction is being developed at what appears to be an accelerating pace. As is usually the case, the hardware innovations outdistance the development of software—of procedures for use—so that we seem constantly to be in the position of asking how we can best employ this or that marvelous new invention.

For example, we scarcely have had time to contemplate the marvel of desktop computers, when we are made aware that the necessity of speaking to these computers in machine language is fast disappearing. While programming is, of course, still necessary, it is not being done by the user and is unlikely to be in the future. We appear to be at the point of communicating with these machines in our natural language, and even of having them address us in oral speech.

One more development is virtually upon us, not exactly hardware-based, but pertaining to programming logic. This is the artificial intelligence development that appears to make possible intelligent computer operation, or what some have called knowledge engineering. When applied to such tasks as medical diagnosis, one expects such systems to work through successive steps of a diagnostic problem, following the lead of the diagnostician, storing whatever specific knowledge has been uncovered, and displaying relevant knowledge at each step. Thus the intelligent computer system relieves the operator of memory burdens for (a) retrieving systematic problem-relevant knowledge, and also for (b) reinstatement of the rules of logic, thereby making possible the focusing of attention on each particular problem-solving step one at a time. If we are clever enough to avoid superficial and misleading analogies, it ought to be possible to develop intelligent computer-aided instruction. What will be needed for intelligent CAI is a system that truly helps the learner solve the problems of learning and remembering. Presumably, this will be done, not by assuming that learning is always like medical diagnosis, but rather by devising computer programs that truly help the learner take the various steps that we know are involved in learning—from gaining an initial intention, through the various encoding processes, to the verification of a newly acquired performance capability.

Of course, computers are by no means the only technology that is displaying this kind of rapid development. There are new techniques of display and communication of information. For example, continuing research is being done with the aim of improving the quality of TV picture displays; high-definition displays are already available, although costly. Digital processing of the signal is another possibility already with us, making available such interesting features as freeze framing, multiple-channel viewing, and zooming. Even the audio portion of television reception has undergone improvements that permit stereo and foreign language translation, through a multichannel sound system.

Surely, we are hardly able to appreciate the implications of the laser-optical video disc: a system that permits frame selection, slow motion viewing, audio accompaniments, and other flexible procedures. Another feature, not to be overlooked, is the high density of memory storage made available by the videodisc. Systems have been developed to store 20,000 pages of information on a disc as small as 12 inches.

Remarkable developments have also occurred, and are still occurring, in the area of transmission of TV signals. Videotape recorders are in widespread use, giving teachers control over what is displayed in the classroom. In addition, videorecorders make possible new ways of presenting instruction, such as the system of small group discussion with a tutor (Gibbons, Kincheloe, & Down, 1977). The many new developments in broadcast television will also have to be taken into account in considering how instruction can best be done. These include short-range broadcasting (called ITVS), cable technology, and satellite transmission. Singly and together, all of these new technologies make television into a system of information transfer that is greatly different and vastly more capable than is the TV we think of in the typical home-viewing situation.

Where is Education Headed?

Research on instruction is stimulated and defined by the media available for communicating with learners. The future trends of research are determined by the changes that are likely to take place in the kinds of hardware delivery systems that are invented, developed, and put into use. Research on instruction is also defined by the societal context in which instruction occurs or will occur in the future. Such research is constrained by what our society believes and values about education. What are
the purposes of education? When should organized education be given? How should it be supported? What relative priority should it have in calling upon the resources of our society? It is to meet the goals we call education that instruction is given. Accordingly, the societal context of education is bound to have a strong influence in determining what research is considered worth doing.

Several national reports have recently given us new knowledge about the state of education in the United States (National Commission on Excellence in Education, 1983; Boyer, 1983; Goodlad, 1984). Perhaps the best known of these participating in programs of organized education and become certified graduates, are less well educated than such people were in, say, the 1950's. What factors, events, or trends can account for the startling contrast implied by these statements?

There are surely a number of reasons why we find ourselves in this position with regard to the status of education in the United States, and it would not be productive for me to try to identify them in detail. As a summary impression, though, what these statements tell us is something like this: A large percentage of young people we refer to as students are really not participants in educational processes, but would more accurately be described as school attenders. A smaller proportion do in fact become participants, and manage to acquire from planned, systematic instruction, the knowledge and skills that make them recognizable as educated men and women.

Our education system is in trouble, the National Commission thinks—because while there is much learning going on, it does not often result in well-educated people. My extrapolation of these trends runs something like this: We must plan in the future for four kinds of education. First is education in the basic skills, whose importance is very great. If done properly, we should be able to assure mastery of these skills in virtually everyone by age 9 or 10. Second, we must decide what to do about what I would call survival education: a kind of basic education for that large portion of the population whose members do not wish to be considered "well educated." Third, we must provide the kind of classical education in language and the scholarly disciplines—the sort of curriculum Boyer writes about—for that smaller portion of our youth who want to be "educated people." And fourth, we must make provision for education in the practical arts, the trades, and the professions. This kind of education is for anyone who wants to be qualified and at any age—in house wiring, in real estate selling, in veterinary medicine, or whatever.

In these four kinds of education, there are two categories that seem to demand different approaches, and therefore pose different research problems. One category, including the basic skills of elementary education, the instruction of those who would become "educated people", and those who desire to qualify in an occupation, appears to require intentional learning. Those who learn by this route must have an identified intention to learn, and a willingness to undertake the mental effort that the process of learning requires. In a different category, all by itself, belongs common education, or what I have called survival education. Beyond the early exposure to the basic skills, this kind of education can, in our society, be acquired by incidental learning, without any intention to learn whatsoever.

It is noteworthy that the learning of survival knowledge used to require a certain number of years of schooling. In the early years of this century, a prevailing type of education was common-school education, considered as taking place in six grades, or later, eight grades. Graduates of common schools were not looked upon as highly educated—only as educated to an extent necessary for every day living and working—in other words, for survival. In part this was citizenship education, including civics, history, and geography. In those days, it took a common-school education to impart this kind of knowledge.

Nowadays, however, knowledge of the world, of government, geography, natural history, civic affairs, community services, and social and family relations, is gained by youngsters virtually entirely by incidental learning. As a result, it is common to hear the statement that children have enormously greater amounts of knowledge when they enter school than used to be the case. This kind of learning also accounts for the National Commission's statement that the average citizen today is more knowledgeable than the average citizen of a decade ago.

Common Education and Incidental Learning

According to my reasoning, then, a very large part of common education,
perhaps all except the basic skills, is nowadays being attained by incidental learning. Investigators of human learning may not be particularly happy to hear this. Despite the fact that a long line of research shows incidental learning of some kinds of material to be almost as effective as intentional learning, it is nevertheless the latter kind of learning that occupies most of the attention of learning investigators. So it has to be said that not very much is known about incidental learning.

If common education is indeed largely acquired by incidental learning, what are the situations in which such learning occurs? Mainly, these situations seem to me to be the following:

1. Children engage in incidental learning when they hear people talk. Adults may be talking to them (as in a school classroom), or around them (as in a home conversation).

2. Youngsters learn incidentally from a number of people in places where they are required to be. That is, they learn from teachers and fellow-students just by hearing them talk and watching what they do. Or, if they are required to attend church or Sunday School, they learn incidentally from the people with whom they are in social contact. If they are unfortunate enough to go to jail, they learn from those people. I am still speaking of learning that takes place without intention.

3. Everyone learns an enormous amount incidentally by watching television. We are often reminded of the fairly large number of hours spent watching television by the average young person of school age. Many things are learned about the geography and history of the world, about families, about parent-child relationships, about certain kinds of artistic pursuits, and an enormous variety of other knowledge. Also learned, just as obviously, are attitudes—toward adults, towards babies, toward policemen, toward medicine and hospitals, towards love and marriage.

4. Presumably, some intellectual skills are learned from television. Because this medium does not provide for learner interaction, the skills learned are few and perhaps somewhat odd. Very cleverly, *Sesame Street* and *Mr. Roger's Neighborhood* tease children into postures of interactive responding, and thus are able to get across some very simple basic skills—letter recognition, for example, or some elementary social manners. Otherwise, the skills learned seem likely to be grotesque ones, such as how to fasten handcuffs, how to hold a handgun steady, how to address a judge in a courtroom, how to open a metal can, how to pour soap powder into a washing machine, and the like.

Some Research Questions for Incidental Learning

Considering these various sources and settings for incidental learning, we are evidently faced with a great many problems to be investigated. Although we are quite sure much learning occurs this way, there are many things we don't know about it. Here are some research questions.

1. How can the knowledge that is incidentally learned be described, categorized, and measured? If it is true that the average first-grader, say, has much more knowledge now than he or she used to have, what is the nature and extent of that knowledge? Since modern learning research indicates the great importance of prior knowledge for new learning, understanding what such prior knowledge amounts to is likely to be of critical relevance to the design of instruction in the school— that is, for the design of subsequent intentional learning. A method of accurately describing and classifying knowledge would, of course, have very general usefulness beyond the domains served by media and the methods of instructional technology. However, it would appear to be convenient and feasible to study the question initially by way of the learning supported by television watching. This line of thought leads to some more specific questions such as those that follow.

2. When news and sports programs are excluded, what kinds of knowledge are potentially transmitted by a typical day-long viewing of home television? What categories of knowledge are exhibited, and how do these compare with categories of knowledge that have been identified as constituting survival knowledge? Can a test, indicating how much knowledge in these various categories is acquired from television viewing, be designed?

3. The same question, applied specifically to intellectual skills. If a child, or a person of any age, watched commercial entertainment (network) television all day long, what kinds of intellectual skills would be potentially learnable?

Research on instruction is stimulated by the media available for communicating with learners.

4. The same question, but applied to the very interesting domain of attitudes. There have been a good many studies of particular attitudes presumably affected by television, such as attitudes toward personal violence, sexual relations, law and justice. The question I describe here is not oriented toward any particular attitude; instead, it is a question of what are the attitudes communicated by entertainment television—and all of them, good or bad, socially desirable or undesirable. I would guess that many socially desirable attitudes are conveyed by entertainment television, besides some that are often considered undesirable, or those more specific ones oriented toward the choosing of particular commercial products. Soap operas, for example, may convey attitudes of loyalty to friends and family, kindness in personal interactions, responsible caring for children, as well as some others that are less favorable.

5. Similar questions about what kinds and amounts of knowledge are being displayed can be asked about educa-
tional TV programs, although in this case the questions are of a finer grain and apply to single programs, rather than to day-long viewing. What can be learned from the viewing of a documentary program such as one of the NOVA series? And if this question is answered, then how much of what is available is actually learned, assuming that incidental learning is still the question?

Actually, some techniques appear to be available to make a beginning on such questions. The text analysis procedures described by a number of investigators (Britton & Black, 1965) make it possible to describe prose passages exhaustively in terms of their content of ideas (propositions). This means that the learning of these ideas can be measured on an absolute scale having a zero point and a 100% point. At Florida State, several studies have been done with adults and with college students providing measures of how much is learned of the spoken portion (the sound track) of some TV documentaries, when these are being viewed as entertainment programs. This amount, in several studies, turns out to be around 54%.

Considering the various sources and settings for incidental learning, we are faced with a great many problems to be investigated.

We have an idea, then, of how much is learned from the sound track, but we don’t yet know how much is learned from the picture, or from the combination. So here is a challenging research question—how can we describe and measure the contents of pictures in a way that is at least comparable to the procedures used to describe prose passages? This question refers to the information content of pictures, not to their quality or their artistic merit. An interesting study bearing on the question has been reported by Nugent (1982), who presented various combinations of visuals, print, and audio to school children in elementary grades, beginning with a nonverbal film about the life of a cheetah. Although this investigation didn’t propose a way to describe and measure the information in visuals on an absolute scale, it did provide interesting contrasts between various combinations such as visual alone, visual with print, and visual with audio.

6. These questions about incidental learning from educational TV documentaries have a practical orientation, although they pose some rather fundamental problems, such as how to measure the contents of a picture. Still another form of the question about learning from TV has been with us for a long time: In a TV documentary, what is contributed by the picture? Does the picture enhance the audio message by a redundancy process, or a dual-storage process? Does the picture contribute to learning by a process that could be identified as elaboration? Can a picture produce interference in the learning of the audio message; alternatively, can it function to produce what is called release from PIT? Questions like these are for basic research. As opposed to the descriptive kinds of research previously mentioned, these questions would presumably require experimental types of studies, in educational variety. Once it is possible to assess what is happening in this domain, some basic research studies can be designed to investigate problems of effectiveness of TV presentations. Of course, years of study and experience have put this area of TV development on a fairly firm footing. Much has already been learned about using television to establish and change attitudes, so that research will now need to be designed to build upon this existing technical knowledge.

Bandura’s work (1969, 1977) has demonstrated the crucial effects of the human model on the establishment and modification of attitudes. Observational learning occurs when the potential learner views a human model telling about or showing certain choices of action. For attitudes, learning is most effective when the model is perceived as admirable, powerful, and credible. Imitation is most likely to occur when the model is seen to be rewarded for the action choices made. According to Bandura’s social learning theory, the learner comes to adopt standards of self-reward that are similar to those of the model. Thus, suitable use of presentations with human models can lead children to imitate and adopt the type of moral standards exhibited by an adult model.

Of course there are many particular ways of presenting human models and their action choices to potential learners, whether children or adults. Models can appear in direct presence, or, at the other end of the continuum, by being read about in printed pages. Obviously, the presentation of human models and their behavior is something that television, or any similar combined visual-sound medium, can accomplish with enormous virtuosity. It is this capability of television that leads to the many questions about the social effects of this medium—good and bad. There is a substantial line of research on the antisocial and prosocial effects of television viewing (Rubenstein, 1978), and many questions still to be answered concerning the attitudinal influences of personal violence, violence involving physical objects, personal intimacy, and stereotypic roles of men, women, and members of ethnic groups. The efficacy of television in establishing attitudes is well known and scarcely open to question. Still to be investigated, however, are the variables made apparent by social learning theory: the relation of the human model to the viewers, the in-
fluence of the context with which the model is presented, the nature of the "message" with respect to the kind of action choices being dealt with, and the relation of the message to various background factors in the memories of potential learners.

Some Research Questions for Intentional Learners

I turn now to the kind of learning called intentional learning, a type that has for many years received the greatest attention of research investigators. There is, of course, a vast amount of research literature on intentional learning. However, when one realizes that and proceeds to dig into it with the intention of answering the question, what do we know about learning, one is likely to be brought up short with the second question, what were all these experimental learners intending to learn? Here are some things they were not intending to learn:

1. They were not asked to learn the meanings of sentences, paragraphs, or longer prose passages (with few exceptions).
2. They were not asked to learn procedures, such as those involved in learning to read, to write, or to calculate with numbers.
3. They were not asked to learn how to solve common problems requiring thought, such as occur in arithmetic word problems or in the task of writing a sonnet.
4. They were not asked to learn strategies of learning, such as how to commit names to memory, how to use images, or how to divide learning tasks into parts.

What experimental subjects were asked to learn, usually, were associations between one stimulus event and another, presented together or in close time proximity. The basic conception of this learning might have been the conditioned response, the associative bond, or the stimulus-response paradigm (S-R). My estimate is that there is a good deal of systematic knowledge in the journals dealing with this kind of learning, but it is knowledge about how associations are formed, maintained, and weakened. If one applies to this body of research findings the question, what have we learned, my guess is that there are two prominent, generalizable findings. One is the Law of Effect, or the principle of reinforcement contingencies, if you prefer that language, and the second is the set of principles called interference. While these principles have still not attained the explanatory power that one would wish, the phenomena of interference are nevertheless ubiquitous, general, and scarcely to be ignored as significant events in learning.

For quite a number of years, investigators attempted to view the intentional learning that might have been presented by a textbook, a film, or by other media, within this framework of associative learning—labels and lists. During the last fifteen years or so, however, we have all become used to dealing with learning as a matter of change in cognition by the processing of information. Cognitive learning psychologists have been persuaded by the research on artificial intelligence, and by their own research on computer models, that accounting for the intellectual functioning of human beings requires the postulation of a variety of processes and states internal to the learner. Therefore, we deal now with long-term memory, with short-term memory, and with the working memory and its attentional capacity. We are accustomed to the inference of such processes as pattern recognition, semantic encoding, rehearsal, elaboration, retrieval, and the formation of schemata, in addition to the more familiar process of reinforcement.

These new concepts of information processing provide a virtually new world of research questions about learning and the factors that lead to learning effectiveness. There are several possible frameworks within which to formulate these questions. Psychologists tend to phrase their research questions in terms of theoretical constructs, such as memory structures, schema formation and tuning, knowledge generalization, and the like. But in terms of what I am attempting here, I shall try to adopt a framework of media and their capabilities for affecting learning of the intentional sort.

Intentional learning differs from incidental learning by requiring that some feedback to the learner be provided for any or all of the processes involved in learning. Whereas incidental learning occurs simply with learner viewing of a scene or presentation, the learner responses required in intentional learning may be viewed as evidences of the learner's intent. It has been known for many years that such learner responses must be followed by feedback, else learning of any dependable sort does not occur. For instructional technology, the implication is that the medium for presentation of the instruction must allow for learner interaction. Accordingly, for my discussion of research on intentional learning, I turn to the medium that includes the computer, in the configuration we call computer-based instruction. I used TV presentation as a prototype for incidental learning, so I will use computer-based instruction (CBI) as the model for intentional learning, assuming also that this model can include the presentation of realistic pictures, as in the combination of computer and videodisc. My purpose will be to indicate the research questions to be solved, to assure the most effective intentional learning, given that an interactive medium is available. Notably, these questions involve the direct consideration of the processes postulated by modern cognitive learning theories.

Learning from Pictures

The first category to be considered as a research area is called learning from pictures. The general questions are (1) what various outcomes can be learned from pictorial or diagrammatic presentations, and (2) how can pictures be designed to make these varieties of learning most effective?

1. One kind of task that requires the use of pictures is the learning of spatial relations of objects. Of course, the most obvious task of this sort requires learning of locations on terrain maps, but there are also astronomical maps, maps of the locations of organs in vertebrate animals, and many other kinds. Some recent work has been done by Thorndyke and Stasz (1980) on strategies of learning spatial locations in maps. Additional research is needed on techniques of presentation that will improve learning of spatial relations of this general sort.

2. A second kind of outcome from pictorial learning is the learning of shapes, ranging from regular geometric forms to highly irregular organic forms. The work of Dwyer (1970) comes to mind, indicating that recognition of shapes in pictures of the heart was best accomplished by outlined drawings of the major components. This seminal finding opens up an area of research which is by no means fully explored, particularly when we consider the infinite variety of diagrams and diagram
changes that can be designed by the computer. The questions here can well be framed in terms of the intellectual process called pattern recognition, on which there is already a line of interesting research. Stated in terms that would fit computer-based instruction, the research question takes the following form: If what is to be learned is recognizing an irregularly shaped object (e.g., an organ of the body, or a particular piece of equipment), what variations of features can be used during instruction to bring about most effective learning?

A third variety of learning from pictures is the learning of concepts. It is notable that pictures can depict concrete objects, such as birds and flowers and their parts; and also abstract concepts. The latter can sometimes be learned from verbally stated definitions, but they can also be shown in pictures. For example, a picture of an adult and a child can illustrate such abstractions as threat, sadness, or merriment. Regarding concrete concepts, such as edge, cutting tool, equilateral triangle, and such, much good research has been done, by Tennyson and associates (Tennyson, Woolley, & Merrill, 1972) and by Klausmeier and his associates (Klausmeier, Ghatala, & Frayer, 1974). Their work, however, has left a legacy of an unresolved research question: Are such concepts best learned by instruction on their attributes, by presentation of a prototype, or in some other way? Evidently, a concrete concept can be learned by either method. The question is, given a good definition of what “knowing the concept” means, how can instruction be most efficiently designed? Here again the potentialities of the computer with accompanying pictorial display would seem to be of high value.

Turning to the question of abstract concepts, I think it would be very interesting to attempt to find out what concepts can be learned from pictures alone. Consider a picture showing a heavy safe falling from an upstairs window, aimed at an unsuspecting pedestrian below. Surely, such a picture implies “danger” or “dangerous situation”. As I have pointed out previously, such concepts can probably be acquired by incidental learning, but perhaps dangerous situations such as those that may occur in automobile driving could also be conveyed by pictures. If so, we should probably prefer that this be done by intentional learning, since safe driving is a part of what we want to assure for all drivers. For intentional learning, what has to be added to a picture (if anything) in order to instruct learners in the various driving situations that are dangerous? What varieties of situations must be employed? Do verbal definitions, or other verbal directions, have to be used? What kind of interaction of the learner with the picture, and what kind of feedback, can most effectively be employed?

Of course, this is only one example of an abstract concept. There are many that must be acquired by intentional learning, by children in school, and by adults in school and out. Pursuing this line of questioning—what can be learned from a picture—takes us back to the question posed earlier in connection with incidental learning. What does a picture contribute to a sound-picture combination such as a television program? Part of the answer, no doubt, will derive from research that seeks to find out what can be learned from pictures alone.

New concepts of information processing provide a virtually new world of research questions.

Learning from Printed Text

The other kind of display that can be made to the visual sense is print. There is, of course, a fairly large body of research dealing with the question of how to present instruction in printed form, in textbooks, workbooks, worksheets, outlines, and so on. For this reason, some of the major variables have been investigated, and some replicable findings have been obtained. But, while printed texts can be made to be interactive (as in programmed books), they obviously do not have the inherent flexibility of interaction that is possible to arrange with the computer.

In computer-based instruction, the form of presentation for print is a printed text displayed on a screen. The physical limits of this text display help to define the problem—we shall be dealing with learning from screen-displayed text. Obviously the baseline condition is the display of so many lines of printed text on the screen. The text itself may be what is called descriptive, expository, or of some other form. The question for instructional development is: How can the presentation of text be designed to aid learning and retention?

It seems to me that one way to view the acquisition of knowledge in this situation is in terms of the concept of schema. A schema is an organized body of knowledge, conceived theoretically as a set of interconnected propositions centering around a general concept, and linked peripherally with other concepts. It is assumed that learners come to the learning situation with various schemas (schema) already in memory. Some of these, however, may be quite threadbare (as when a non-biologist learner encounters the concept brachiospida), whereas others may be richly connected (as when a baseball fan encounters the concept National League). Were we to undertake to instruct a learner of the first sort about brachiospids, we could legitimately speak of the learner acquiring a new schema; in the second case, some new descriptive information being added to an existing schema would be an accretion or tuning (Rumelhart & Norman, 1978).

Let me just take a moment to review the characteristics of a schema, which I quote from Richard Anderson (1984). I do this because these characteristics are what will tell us when new knowledge from text has been learned.

1. A schema provides ideational scaffolding for assimilating text information. The idea is that a schema provides a niche, or slot for certain text information.
2. A schema facilitates selective allocation of attention.
3. A schema enables inferential elaboration.
4. A schema allows orderly searches of memory.
5. A schema facilitates editing and summarizing.
6. A schema permits inferential reconstruction. (p. 248).

I suggest, then, that learning from text means acquiring new information that
has the properties of a schema. What has been learned is in a form that can have all of these features that are used by the learner—summarizing, inferring, elaborating, searching, and reconstructing memory.

Questions about Learning, Beginning with a Text

Learning from text alone can result in the acquisition or accretion of this sort of schema. The question I want to deal with, though, is how can the presentation of text in an interactive medium make such learning easier, more rapid, more assured of completeness? Evidently, one way that this may be brought about is by adding something to the text, or in some way modifying the text so that it is no longer simply so many lines of print. Of course this is by no means an absolutely new idea. One thinks immediately of the variations of this sort that have been done with print on paper. Pictures have been added, questions have been added, elaborative ideas have been added, practice exercises have been added. Naturally, I would propose that all of these questions be asked over again, simply because the text has been moved from a page to a screen. We do seem to have some dependable and generalizable knowledge about text enhancements arising from previous research, and I should not expect that to be thrown away. However, as many researchers have pointed out, much of this knowledge is not as robust as it might be. Much of it is suggestive of the need for additional research, of the sort that will identify the assumptions and limitations of the generalizations that have already been suggested.

For example, consider a question of central interest to educational technologists—does the addition of a picture or pictures facilitate learning from text? Suppose, for example, that what is being learned is a description of William Tecumseh Sherman (not his appearance, but his place as a figure in U.S. history). Do pictures help the acquiring or accretion of a schema about this man? We really do not have an adequate answer to this question. We may be able to identify some learning tasks in which pictures do help (e.g., learning foreign vocabulary lists), but we cannot confidently answer this question about pictures in learning from a text describing a thing, a place, or a man like William Tecumseh Sherman. This is what I mean when I say that our knowledge is not very robust.

The kinds of deliberate enhancements of text that need to be investigated, and that lend themselves particularly to computer-based design, include the following:

1. A first category is what can be introduced; relevant to the text, before the text itself is presented. These are pre-presentation treatments. The pre-existing schema of the learner could be examined with reference to the characteristics I previously mentioned, and its properties related to ease of acquiring or tuning a new schema. Another way to approach pre-presentation treatments is by way of advance organizers. Again here, the research question is which characteristics of advance organizers facilitate learning, and which do not.

2. A second category of text enhancements is insertions. One thinks first of inserted pictures. There are many unanswered questions about accompanying pictures, as I have already mentioned. Another kind of insertion is questions. Regardless of the fine work of Rothkopf, Frase, and others a few years ago, there are good research questions to be answered about inserted questions. For example, if what is learned is conceived as a schema, one can ask questions that reveal the "slots" in the schema, or that require inferences, or that suggest elaborations. The kind of feedback given to inserted questions is another area apparently in need of further investigation. For example, what sort of corrective feedback is most effective? Should there be a kind of rational explanation or merely a comparison with a model answer?

Still another kind of insertion is verbal elaboration. While the notion of elaboration has some experimental support, we know of its effects only in general terms. What kind of elaboration? The text can be paraphrased, enhanced with concrete examples, analogies can be inserted, or the learner can be asked to supply an elaboration by summarizing, by supplying examples, or in some other way.

3. A third general category of text enhancement may be called text variations. Of course, there are many kinds of these that might be thought about. In terms of the concept of the schema, some particular kinds of variations come to mind. If a schema has "slots" for traditional aspects of its central idea (the traditional items expected in dining in a restaurant, or in solving a murder mystery), one kind of variation of text would be to place special emphasis on these "slotted" items. As opposed to the presentation of a slot straightforwardly. Another variation is called mapping (Armbruster & Anderson, 1980), and refers to the structuring of the text so that certain spatial positions and certain standard symbols are made to stand for certain relationships among the ideas of the text. Thus, new concepts might always appear in a particular screen position, while causal effects might be represented by a particular symbol.

4. The learning effects of any or all of these types of text enhancements are going to be revealed by some dependent measure. What has been learned from the presentation of text? What is the result of intentional learning? I cannot conclude the subject without pointing out what a good deal we still don't know about how to measure the results of learning from text. Free recall of the contents has received much attention, and methods for the scoring of literal content are rather widely known. Methods for scoring cued recall are not nearly so well developed, and we do not know their relation to free recall methods. Referring again to the concept of the schema, its characteristics suggest still other methods for the assessment of learning results. Remember that the schema presumably makes possible the selective allocation of attention, the making of inferential elaborations, editing and summarizing, and inferential reconstruction. These characteristics might form the basis for one or more new techniques for determining how much has been learned from the presentation of text. And we should not ignore, probably, the potential provided by the computer for obtaining measures based upon speed of responding.

Summary

What I have tried to do is to reflect upon the opportunities for research that seem to be provided by the present state of media hardware technology, as well as by its still rapid pace of development. I mean, of course, research related in an ultimate sense to the meeting of educational requirements.

I have described educational requirements as falling into two major categories. There is what I call survival education, composed of the basic skills and what used to be called common school knowledge. The latter category I believe can be and is being acquired nowadays almost entirely by incidental learning. In producing this type of learn-
ing, television plays a highly important role. I suggest, therefore, that there are many research questions to be asked and answered about learning from television. What are children learning when they watch television—what kinds of declarative knowledge, procedural knowledge, and attitudes? Without attempting to change this medium into an interactive type, how can presentations be made most effective for incidental learning? And with particular pointedness, how can pro-social attitudes be most effectively conveyed by this means?

The other set of educational requirements divide themselves into several subsets. Basic skills belong in this category. But other subsets pertain to the attainment of vocational and professional competence, and to the acquiring of masses of organized knowledge that characterize the "educated person". These categories of knowledge must be learned as intentional learning, and if such learning is to be done efficiently, feedback to learner responses is required. This means that the media employed, whether with or without an instructor, must assume the conformation called interactive.

There are many opportunities for research on intentional learning. The great mass of psychological research on this kind of learning, in the period 1950 to 1960, includes very little content on relevant declarative or procedural knowledge. We are only beginning to learn how learning takes place for many of the intellectually demanding tasks of intentional learning, such as those reflected in the curricula of the schools. The interactive media of the computer and the computer-video-disc combination are continuing to provide promising means for investigating the many problems of designing presentations that increase learning ease, rapidity, and effectiveness.

In considering the kinds of research that is needed and could be done with interactive media, I have confined my suggestions to the commonly encountered situation of learning from text. There are, of course, other kinds of situations and other kinds of outcomes that could be discussed. Within this particular framework, however, I have suggested that a variety of questions need to be investigated, falling into the general category of text enhancement. Text can be enhanced in various ways—by altering the pre-presentation treatment or by inserting pictures, questions, or elaboration statements. Variations in the text itself may be undertaken, including paraphrasing and structural mapping, and any of these kinds of treatment of printed text will need to be assessed in their effects in ways that extend beyond the narrow confines of achievement testing as it is usually conceived. The properties of the schema, in providing a slotted structure (the basis for reconstruction and inferential processing), suggest some of the new ways to be sought for assessing the outcomes of learning from text.

In meeting the requirements of education of all types, educational technology will undoubtedly play an increasingly important role in the years to come. A great deal of research on instruction should be added to this body of practical knowledge. As I'm sure we all agree, hardware itself can only accomplish whatever the human imagination can invent for its use.

Author Note. This article is a slightly revised version of an address delivered to the Conference on Educational Technology, organized by the University Consortium for Instructional Development and Technology, at Bloomington, Indiana, April 20-23, 1985.

References


A First Meeting of Professors of Educational Technology: A Summary of Issues

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Preface
I arrived at the Indianapolis airport early on a warm Saturday afternoon in April. After walking from one end of the terminal to the other, I spotted the office of the limo service that would take me to the Shawnee Bluffs Camp. A young man wearing a red baseball cap took my name and suggested that I catch a bite to eat while we waited for several passengers coming in on other flights.

A short time later, six other passengers, myself, and the driver in the red cap were situated in the van and on our way. Conversations quickly turned to work-related topics. How large is your program? Must your students take internships at the MA level? Are you located in a department of curriculum and instruction?

I sensed just a hint of nervousness filtering through our laughter and small talk. Were others wondering, as I was, whether it was a good idea to sacrifice a beautiful spring weekend at home? At this very moment I could have been digging up the flower beds or spending a few hours on a manuscript that I was hoping to finish. What was in store for us at this loosely structured meeting to be held at an isolated camp where the cabins have no bathrooms?

By the time we arrived, a wine and cheese reception was well underway. I checked into my cabin and discovered that I had two roommates who had already settled in. The cabins were sparsely furnished and had a primitive feel about them. I looked for a mirror to give my hair a quick brush but found none. Undaunted, I changed into some camp-type clothes and went out to join the others for a glass of wine. True to Maslow's principles, however, I first located the building with the bathrooms.

Introduction
In this paper, I will provide a brief overview of a meeting of representatives from more than 40 educational technology programs which was held on April 21-23 at the Indiana University Alumni camp outside of Bloomington, Indiana. The two papers which follow by Bob Reiser and Mike Hannafin will provide more in-depth treatments of two of the major topics discussed at this meeting.

Sponsorship of the Conference
The meeting was sponsored by the University Consortium for Instructional Development and Technology (UCIDT). For the past 21 years, UCIDT has attempted to facilitate cooperation and communication among institutions providing educational technology training programs. The consortium, which currently consists of seven universities (Arizona State, Florida State, Indiana University, Michigan State, Syracuse, University of Georgia, and University of Southern California), has the following goals:

1. To strengthen public and institutional support for educational applications of technology in schools and higher institutes of learning.
2. To help improve the quality and effectiveness of professional preparation programs for instructional technologists.
3. To promote the substantive growth and impact of the field of instructional technology.
4. To improve communications and mutual support among professional programs and between such programs and their respective publics and clients.
5. To provide leadership and influence in professional organizations representing instructional technologists and in other organizations, public or private, having strong interest in the improvement of education or training.

UCIDT has cooperated on a number of projects nationally and international-ly including the Instructional Development Institutes which were conducted in hundreds of school districts during the Seventies.

Rationale for the Conference
The rapid development in technology in the Eighties caused UCIDT leaders to consider ways of addressing issues in the field with a larger group of colleagues. One proposed activity was a conference which would include faculty members from educational technology programs across the country. The purpose of this conference would be to address issues such as the status of curricula in training programs, the role of educational technology in the schools and other contexts, and the status of, and future directions for, research in the field.

Structure of the Conference
Three speakers provided direction for the meeting. Robert Heinich from Indiana University, drawing upon his ERIC/ECTJ Annual Review Paper from the Summer 1984 issue of Educational Communications and Technology Journal, discussed the status of the educational technology field. Robert Gagné from Florida State University focused on current and future research directions in the field. Charlie Schuller of Michigan State University provided a historical perspective of the field.

These paper presentations provided the focus for the activities of small working groups which were formed around the following topics: curriculum, research, relationship of the field to public education, relationship of the field to non-school settings, and inter-institutional cooperation. The goal for each working group was to generate a set of action plans that could be pursued in the coming months.

Curriculum
The programs represented at the meeting offered a range of curricula for different degrees and certificates. Some programs offer M.A. degrees only,
while others offer M.A. and Ph.D. degrees along with a certificate. A few programs are experimenting with undergraduate programs in educational technology.

A good deal of discussion focused on the need to identify core content and competencies for educational technology. Most participants were familiar with the work which has been done on defining competencies by the DID/NSPI Joint Task Force. These competencies provide a good starting point for the review of curricula, but most graduate programs have additional goals which similarly influence curriculum decisions.

The question of whether graduate programs might specialize in certain topical areas was raised. From the sample of programs represented, it appears that specialization is occurring to some extent already. Historical traditions, as well as the nature of the institution, type of students, and expertise of faculty all play a role in determining the emphasis a program will acquire.

The relationship of the MA and Ph.D. curricula was suggested as another area needing examination. What are the skills and attitudes we hope to foster in each type of degree program? In some competency areas, the distinction between the two programs is clear. Most participants agreed, for example, that MA students need to be able to read and critically analyze research but need not conduct it. Ph.D. students, on the other hand, should have the skills to conduct research and to complete at least one research study by graduation. Bob Relsar's paper will provide a thorough summary of these and other issues.

The action items proposed by the curriculum group were the following:

1. Present sessions at AECT which focus on the teaching of single competencies.
2. Compile a bibliography of materials that list competencies for the various specialty areas within the field.
3. Use electronic bulletin boards to communicate information about curriculum, research, materials, and new developments in the field.
4. Conduct a set of mailed surveys to assess questions like the following:
   • How much time is given to instruction on specific competencies?
   • Which programs in the country offer what degrees?
   • What competencies are considered core for educational technology students?
5. Conduct a computer survey at AECT and ask respondents to contribute a few dollars to help cover costs.

Research

Discussions about research in the field followed a presentation by Robert Gagne (see paper published in this issue) on new directions for research. A major theme of these discussions was the need for alternative research methods. All of the major action items from the research centered on this need. These items were as follows:

1. Identify alternative research methods.
2. Identify expert researchers in alternative methods.
3. Commission papers that describe applications of new methodologies to our problems.
4. Distribute and discuss commissioned papers at UCIDT conferences.
5. Refine and publish papers as a professional monograph series.
6. Prepare a proposal that can be used to seek funding for the above actions.

A subgroup within the research group explored the need to generate better theories within the field. These theories might focus on, for example, social aspects of learning and must clarify three different areas: (a) epistemological-axiological questions of education, (b) political-social questions concerning education, and (c) human-historical dilemmas of education. This group recommended that social/critical theory be addressed in our journals and other publications, at conference sessions, and in our graduate curricula. A more detailed analysis of these discussions is found in Mike Hannafin’s paper published in this issue.

Relationships with Public Schools

This group considered issues relevant to the role and influence of educational technologists in public education. Discussions centered around the apparent lack of influence of educational technologists on public school practices. A theme that emerged was that educational technology faculty need to become more involved in research on teacher education. Closer ties with teacher education faculty, for example, might lead to collaborative research and development efforts. Based on their discussions, this group recommended the following action items:

1. Align ourselves with teacher educators so that we become trusted and knowledgeable of their needs, concerns, etc.
2. Use the “seed philosophy” (work with individual teacher education faculty to help them address their specific problems; they then can pass the information to their peers or refer them to you).
3. Seek joint research and publications with teacher education colleagues.
4. Encourage instructional technology faculty to participate in NCATE.
5. Participate with other professional organizations at the local, state, and national levels.
6. Use techniques in presentations that reflect the state of the art of our profession.

Relationships with Business and Industry and Other Non-school Settings

Increasing numbers of graduates from educational technology programs seek and are recruited for employment in set-

A good deal of discussion focused on the need to identify core content and competencies for educational technology.
2. Establish an INFORMATIONAL CLEARINGHOUSE related to instructional technology and non-traditional learning environments.

3. Establish informational communications between the educational technology community and the non-traditional educational/training world.

4. Encourage "contextual" research related to Instructional Technology and non-school domains.

5. Develop a national "Placement Center" for Instructional Technology career placement/development in non-traditional educational/training settings.

Interinstitutional Cooperation

The major recommendation made by the group working on the problem of interinstitutional cooperation was the establishing of a new organization of professors of educational technology. This organization would be open to all institutions with educational technology training programs. It would be independent of all major professional organizations (AECT, NSPI, ASTD, etc.) but would capitalize on the national meetings of each of these groups to hold meetings and to conduct its meetings. In other words, a half-day session of this group might be held in conjunction with the AECT or NSPI annual meeting. The steps in creating such a group are as follows:

1. Create a membership list from existing indices of educational technology training programs. Criteria for membership would need to be established.

2. Generate a program of public relations to make the new organization visible within the broader field of education. It is hoped that these activities would increase the representation of our field on major decision-making bodies.

3. Use the new organization to facilitate communication among educational technology programs on matters of curriculum, recruitment, standards, and research. Specific examples would include the sharing of teaching materials and techniques, collaboration on research and development projects, or faculty exchange programs.

4. Create a career information network that would serve as a clearinghouse in which internship opportunities and position descriptions could be circulated.

5. Hold a one-day pre-AECT conference to formalize the organization. Announcements of the meeting would be sent to all eligible educational technology programs. The purpose of this meeting would be to review the status of various activities suggested at the Bloomington meeting, to explore possibilities for funding of various projects, and to focus on issues important to the field. The group also proposed that a second invitational spring conference be held.

Some Personal Observations, Thoughts, and Comments

On the Curriculum in Graduate Training Programs. Discussions at the conference suggested that, at present, three factors seem especially influential in shaping curricula for graduate programs in educational technology. One of these is the work being done on certification requirements by the DED-NSPI Joint Certification Task Force. This group has identified competencies for instructional designers and is now formulating a plan for a certification program. Under this program, instructional designers would complete a series of assessment activities, and, if successful, be awarded certification by a governing board. Although many questions remain unanswered about the certification process—not the least of which is how to finance such an effort—the Task Force is making progress toward establishing such a program. The implications of a certification program for graduate programs are far reaching. At the very least, program faculties will need to review their curricula to determine how well they prepare students in each of the competency areas deemed critical. The issue of accountability to students will become increasingly important. As a prospective student in a graduate program in instructional design, I would certainly wish to know whether the program's graduates have been successful in becoming certified. Within their home institutions, programs in educational technology should benefit from a more clearly articulated definition of the competent professional. The sharing of teaching materials and methods across program areas should be facilitated by the competency orientation. Such activities have already begun within sessions at AECT.

Another factor which appears to be influencing graduate curricula is the burgeoning market for graduates in business and industry. It seems that at no point in recent history has the job market been more powerful in shaping what is taught in our courses. One example of the "pull" on curricula by business comes from internship programs. Many of the academic programs represented at the conference now have internship requirements for students and many of these take place in business. Companies such as Arthur Anderson and AT&T have large, well-organized internship programs which aggressively recruit students from across the country. Students who return from these internships communicate to faculty their observations about how well their academic training has prepared them to deal with tasks assigned. Areas of

An emerging theme was the need for more faculty involvement in teacher education research.
funds needed to conduct research on the most effective ways to use these new systems. State of the art equipment and applications should be a given for programs, but our locations within Colleges of Education often makes our program low priorities for funding.

**On Research and the Training of Researchers.** Personally, a troubling aspect of the conference were the discussions about the status of research in the field. The old cliche, "everybody talks about it but nobody does it," seems apropos for our field. It would have been interesting to survey participants to determine how many had conducted research (regardless of paradigm used) in the past two years. I suspect that less than a third of those who attended the conference are active researchers even though most are faculty in academic training programs. It is apparent that many academicians in educational technology do not view themselves as researchers. Consider as evidence the small membership of the Research and Theory Division of AECT and the relatively limited number of submissions to ECTJ. These would seem to be indicators that identity with research is rather limited by many in the profession. However, those involved in graduate training might be expected to demonstrate a higher level of activity in research than actually occurs. Hannafin, in his paper in this issue, speculates about why there is a lack of research by people in the field. He discusses a number of barriers to research, including the narrowness of what has been considered acceptable to journals or to colleagues making promotion and tenure decisions. He argues that we need to expand our notions of research by using other research paradigms to investigate questions important to our field. In an interesting paper by Marcy Driscoll (1985) published in a recent issue of this journal, a number of alternative paradigms are presented and applications to our field exemplified by sample studies.

Intricately related to the issue of research productivity by people in the field is the training of future researchers. As a group, those at this conference represented a larger pool of individuals and settings responsible for mentoring new scholars and researchers. As such, we face some new challenges. Many of our doctoral level graduates now go to business and industry post-Ph.D. Unlike in earlier times, few are motivated to seek employment in more traditional academic settings where research is expected and valued. If this trend continues, who will produce scholarship in the future? If our "best and brightest" doctoral students take nonacademic positions which do not include the production of research and scholarship, where will important questions be investigated? I believe that one solution to the problem is research which will increasingly result from partnerships between academic and industry. The high costs of newer technologies may spur many academic researchers to team up with colleagues from business who have the resources and facilities to conduct research. The organizations themselves may be the locus for investigations of instructional technology. One example of such partnerships on a grand scale is a plan for an "Alliance for Learning," which would bring together as many as 40 corporations along with a number of scholars and researchers in a joint effort to conduct research on adult learning and technology. Funding for this operation would be provided by corporate members, and all research would occur within the training settings of these corporations. On a smaller scale, individual efforts involving selected faculty with a single corporation may provide a successful combination.

The longer I work in this field, the more I am impressed by the power of one's doctoral lineage. The roots of scholarly orientation are firmly established during a doctoral program to emerge as an alternative methodology. Some of my fellow students who worked with other faculty were pursuing what Heinich describes as decision-based research in that they were investigating issues related to the delivery and cost-effectiveness of large-scale instructional efforts. At the time, it seemed that the educational technology program was a convenient albeit loose alliance of faculty who focused their professional energy on very different types of problems. The years later, I now understand and appreciate this diversity among faculty far more than I did at the time. Further, it seems that the examination of these different orientations is an excellent mirror for reflecting what we, the developers of graduate curricula, value as a field.

**On the Development of a Formal Organization.** In general, participants at the conference supported in spirit the recommendation to create an organization of professors of education technology. Some expressed concerns, however, about the pitfalls of formalizing what was a loosely structured gathering of individuals with a set of shared concerns. Would the creation of a formal organization result in a proliferation of committees which would feel compelled to create agendas for themselves? Might the energy required to move toward a more permanent structure detract from dealing with important issues we face as graduate training programs? As members become preoccupied with the

For the past 21 years, UCITT has attempted to provide communication among educational technology programs.

shaped for the most part by two factors: (a) the faculty with whom one studies more closely, and (b) the context. For many, these orientations and assumptions which underlie them, remain unexamined until much later in one's career or perhaps not at all.

My own training, which took place at Syracuse, had a strong instructional psychology orientation and a bias toward what Heinich (1984) describes as conclusion-based research or the testing of cause and effect relationships. Naturalistic inquiry was only beginning structure and survival of the organization itself, would they lose sight of its mission? Would such an organization be redundant with existing professional organizations such as AECT or AERA?

While acknowledging these and other concerns, most participants expressed enthusiastic support for the continued alliance of programs and people. If consensus existed, it was the viewpoint that as a group of professors, we have reasons to converse. We need to support one another's work, to encourage joint investigation of research questions, and
to sort out important curricular issues. The recognition of these commonalities was highlighted by the three productive days spent together in Indiana. Tom Schwen offered an invitation for the group to return to the same site for a second meeting next year. The group accepted the invitation with the understanding that other programs might bring invitations to visit other sites for a third year meeting.

Summary

The first meeting of professors of educational technology met the objectives of its organizers. A forum was created in which the issues which affect our lives as professors working in a dynamic and innovative field were discussed and debated. Participants took a break from the day-to-day activities at their respective institutions to think more globally about problems affecting the field, especially those which relate to the training of students. Action items were generated which will give direction to future activities for the group. Old friendships were renewed and new friendships begun. It is these personal linkages that will keep folks communicating and it will be this communication that will generate new ways to work together on productive tasks in the upcoming months. Not a bad outcome for a weekend in the woods.

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Some Questions Facing Academic Programs in Instructional Technology and Some Means for Answering Them

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What are some of the serious questions facing academic programs in instructional technology, and how can communication among the programs be improved so as to help answer those questions? These were the issues that were focused upon by one of the groups (hereinafter referred to as the "curriculum group") at the UCDT conference in Bloomington.

The curriculum group consisted of 15 faculty members representing one dozen academic programs in instructional technology. The nature of these programs was quite diverse. Some of the programs only offered master's degrees, others offered both master's and doctoral degrees. Some of the programs were quite large, having well over 100 students, while other programs were rather small, having less than one-third that number. The number of faculty in the programs also varied greatly, with at least two programs having more than ten faculty members, and several programs having three or less. The programs also differed with respect to the specialty areas they emphasized, with some focusing primarily on media production skills and others focusing on instructional development skills.

Many of the questions raised by the members of the curriculum group surely have been raised before. In addition, it is likely that the group failed to raise some of the important questions facing academic programs in the field. Nonetheless, the conference provided the group members with a unique opportunity to share their questions and concerns with others and to begin to develop a communication network that will, perhaps, help provide answers to some of those questions.

During its meetings, the curriculum group discussed numerous questions and proposed a variety of ways of fostering discussions about those questions. It would be quite difficult to describe all the issues that were raised and I have not attempted to do so. Instead, I have tried to identify the major topic areas that cover most of the questions that were discussed. Within each of these topic areas, I have attempted to describe most, but not all, of the issues that were raised and I have tried to present many of the group's suggestions for fostering discussion of these issues. In other words, while this paper is not intended to serve as a complete report of the activities of the curriculum group, I believe it touches upon most of the important points the group discussed.

There were five topic areas around which most of the group's discussions centered. These topic areas were: (a) the skills and knowledge taught in instructional technology programs, (b) the impact new technology has had on programs, (c) the influence the job market has on programs, (d) the role of the programs in teacher training, and (e) the means by which instruction in the programs is delivered. These topics are discussed in the next five sections of this paper.

Skills and Knowledge Taught

Many of the issues discussed in the curriculum group were related to a basic question discussed by the group. This question was, "What skills and knowledge should be taught to students in instructional technology programs?" Surely, faculty members in every instructional technology program have grappled with this question and have arrived at some answer, even if the answer was only a tentative one. However, the answers that have been arrived at certainly have varied across programs, with these variations perhaps being most pronounced when one compares programs that train students for different specialty areas within the field. The AECT Task Force on Definition and Terminology (1977) aptly described this situation: "The field of educational technology is so broad in concept as to defy a single set of certification standards for all practitioners or a single training program for those practitioners (p. 101)." Discussions among members of the curriculum group at the conference revealed that even among programs training students in the same specialty area, there are differences in the skills and knowledge being taught. This situation had been previously noted by Silber (1982), who conducted an in-depth study of nine graduate programs in instructional development.

Over the past few years, there have been several attempts to identify the competencies that professionals in the various specialty areas in the field should possess (e.g., "Competencies for . . . production specialists," 1980; Task Force on ID Certification, 1981). However, there have not been any attempts to identify the extent to which programs in the field have adjusted their course offerings in light of the competency lists that have been produced. One of the recommendations the curriculum group put forth was that a survey of the graduate programs should be conducted in order to ascertain what actions, if any, the programs had taken in light of the publication of these lists. Another recommendation, which is currently being acted upon, was that someone should prepare an annotated bibliography of the various competency lists that describe the skills professionals in the field of instructional technology should possess.

Besides the general question of what skills and knowledge should be taught in instructional technology programs, there arose a series of related questions. These questions included: (a) at what level(s) (undergraduate, master's, doctoral), and for which specialty areas, should a particular skill be taught? and
(b) for which group(s) of students should a particular skill be considered essential? It was suggested that a survey of the programs in instructional technology could be conducted to see how they had dealt with these questions. This survey would differ from previous surveys of graduate programs (e.g., Johnson, 1981) in that it would focus on the skills taught in the programs rather than on the courses the programs offer.

It was also suggested that symposia at various professional conferences should focus on the competencies taught in the various graduate programs in the field. One such symposium has been scheduled for the 1986 AECT conference.

The Impact of New Technologies

Another issue the curriculum group focused upon was the effect of "new" hardware technologies, such as the microcomputer, on the skills and knowledge taught in instructional technology programs. The question raised was whether programs in instructional technology adjust their curricula in light of technological advances, and if so, how? Do the programs attempt to relate the principles of the field to the new technology, allowing the principles to be the guiding force behind the curriculum? Or do the programs allow advances in hardware technology to drive the direction the curriculum takes? For example, as the interest in computers in education increases, do some instructional technology programs become, in essence, programs in computer science?

In addition to examining the impact new technologies may have on programs in instructional technology, the curriculum group also felt it was important to consider how instructional technologists can influence the development, dissemination, and use of these technologies. The opinion was expressed that much of the hardware that schools and businesses purchase are not appropriate to those organizations' needs, and much of the instructional software that is being produced is of poor quality. It was felt that some of these problems might be alleviated if instructional technologists became more involved in the development and evaluation of new hardware and software. While the curriculum group did not discuss strategies for greater involvement, some have been proposed (e.g., Komoski, 1984; Pitts, 1982).

The Influence of the Marketplace

In addition to being affected by new technologies, programs in instructional technology have been influenced by the marketplace; that is, by the types of organizations hiring graduates of such programs. Many members of the curriculum group noted that as compared with just a few years ago, more of their students were taking jobs in business and industry and fewer were taking jobs in the public schools and academia. How do the skills required of instructional technologists in these various settings differ? And what implications do these differences have with regard to the skills and knowledge taught in instructional technology programs?

What skills and knowledge should be taught to students in instructional technology programs?

Although it has been indicated that industry and academia present two very different environments for the instructional technologist (Diamond & Durzo, 1981; Wallington, 1980), several authors have stated that the skills needed by instructional technologists in those two settings may be quite similar (Nitsos, 1981; Rosenberg, 1980; Sullivan, 1984). Have the various graduate programs examined this issue? If so, what have they found? And how have they adapted their curricula in light of these findings? For example, at Florida State University, there are two tracks in the doctoral program in Instructional Systems. One track, designed for students who will be seeking a job in academia, focuses heavily on research skills. The other track, geared for those students who will be seeking employment in business and industry, places greater emphasis on the management of the instructional development process. Have other programs in instructional technology also developed different degree tracks in light of the different job aspirations of their students? What types of skills are focused upon in these tracks? It was suggested that a survey examining these issues be sent out to the graduate programs.

The Role of Instructional Technology Programs in Teacher Training

In discussing the types of organization that programs in instructional technology do not play a large enough role in the training of preservice teachers. It was felt that many of these prospective teachers, when they complete their college training, possess very little knowledge about the field of instructional technology, and possess even fewer skills in that area. This lack of knowledge and skills not only relates to media production and utilization, which occasionally are part of the undergraduate teacher training curriculum, but also relates to the areas of instructional development and individualization instruction, areas in which many students fail to receive any training. What knowledge and skills in these areas should preservice teachers possess, and how can programs in instructional technology gain a greater role in preservice teacher training? These were among the questions related to preservice teacher training that the group felt should be answered.

Several members of the curriculum group also expressed the opinion that graduate programs in instructional technology should make a greater effort to reach inservice teachers. It was felt that few teachers enter graduate degree programs in instructional technology, and many of those who do enter leave the teaching profession after they complete their graduate training. How can the skills associated with the field of instruction?
structional technology be imparted to in-service teachers, and if those skills are successfully passed on, what can be done to encourage those teachers to stay in public education, where the monetary rewards for having such skills are often less than in business and industry?

**Delivering Instruction**

The curriculum group also raised a number of questions related to how instruction is presented in various instructional technology programs. The central question in this area was “What effective teaching methods and training techniques can be used to help ensure that students in instructional technology programs acquire the skills and knowledge they will need?” In order to help answer this question, it was suggested that a series of symposia at professional conferences should be organized, with each symposium focusing on a specific skill. Participants in each symposium would be faculty members from various programs, who would describe the techniques used in their programs to teach a specific skill. For example, one symposium might focus on successful techniques that have been used to teach students in instructional development how to interview subject matter experts.

Many members felt that programs in ID do not play a large enough role in the training of preservice teachers.

It would also be valuable to identify the print and non-print resources used in the programs to help teach various skills. Some preliminary work in this area was done by Reiser (1980). In addition, an extensive list of resources related to each of sixteen instructional development skills has been compiled by Bratton (1983). Several texts in the instructional development field (e.g., Briggs & Wager, 1983; Dick & Carey, 1985) also provide lists of references related to many instructional development skills.

Many of the programs in instructional technology require students to participate in an internship. The nature of the internship and the way it is managed was another concern expressed by several members of the curriculum group. Many were concerned about the relative merits of on-campus versus off-campus internships, the way in which off-campus internships are managed, and the degree to which internships provide students with the professional and practical experience they will need in order to get a good job and succeed at it. It was decided that conference symposia focusing on how graduate programs have set up and managed their internship programs should be organized so that many of these issues can be discussed.

Several members of the curriculum group also expressed concern that the principles of instructional technology were not being used by those individuals responsible for teaching those principles. That is, many felt that the media and instructional methods usually associated with the field are rarely used by the people teaching within the field. In addition, it was felt that many of the people teaching in the field do not employ the instructional development principles they advocate. It was suggested that in order to see whether these perceptions were correct, a survey should be sent to the faculty in various instructional technology programs asking them to identify how, and to what extent, the dated with requests for information. Under such circumstances, it is unlikely that the quantity or quality of the responses to any of the surveys would be satisfactory. Therefore, some members of the curriculum group suggested that the various topics that might be dealt with in surveys should be identified and prioritized, and that a tentative schedule for administering the surveys should be developed. One of the members of the curriculum group is currently working on this task.

Perhaps the first survey that will be administered will deal with the topic of symposia. The number of symposia proposed by the members of the curriculum group was quite large. In order to identify those symposium topics that would be of interest to the greatest number of programs, and in order to identify those program faculty that would like to participate in specific symposia, a survey is currently being prepared.

In addition to surveys and symposia, the curriculum group also suggested several other means of fostering communication among programs in instructional technology. Those suggestions that are currently being acted upon include establishing an electronic bulletin board network among academic programs in the field, using computers to conduct a small survey at the 1986 AECT conference, and using professional publications, such as this journal, to inform professionals in the field about the actions taken with regard to the various suggestions described in this paper. It is hoped that through activities such as these, communication among academic programs in instructional technology can be increased and that many of the questions facing the programs can be answered.

**Conclusion**

As the foregoing discussion indicates, the curriculum group at the conference raised a wide variety of questions about the nature of academic programs in the field of instructional technology. It was not the intent of the group to offer answers to those questions; however, the group did suggest some means by which the questions could be answered. Many of these suggestions involved the use of surveys and conference symposia.

If all of the surveys proposed by members of the curriculum group were undertaken in the next few years, members of the academic programs in instructional technology would be in

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The Status and Future of Research in Instructional Design and Technology

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Abstract. The process of defining a research agenda appropriate for the varied interests of the instructional design and technology profession is difficult. Though unified by a mutual interest in the role of technology in instruction, the backgrounds, orientations, and priorities among members are vastly different. As a consequence, research is often too sporadic and diffuse to impact the field in a systematic manner. In many cases, interest in research seems to have declined. In this paper, many of the problems and issues in developing a meaningful research agenda will be presented. In addition, an attempt is made to set the stage for future research, where the varied interests and expertise in the instructional design and technology profession are supported.

Writing a paper of this type is no small chore. On one hand, representing fairly the valued input of the different schools of thought in research seems essential. However, in many cases simply describing ideas has seldom proven a satisfactory vehicle for encouraging research. Instead, analyzing the various ideas and opinions of colleagues, as well as the instructional design and technology field, requires more than simple reporting. In this paper, a combination of reportorial and analytical styles has been adopted. The paper is intended to stimulate the kinds of thought, evaluation, and action required to generate greater interest in research.

Planning and conducting educational research appears relatively straightforward. The process is simply an extension of the scientific method taught widely across various scientific disciplines (Bachrach, 1965; Karlinger, 1973). In general, research in education involves the definition of a problem, the development of hypotheses, the creation of materials and methods designed to test the hypotheses, the implementation of the research study, the analysis of the outcomes of the research relative to the hypotheses developed for the defined problem, and the conclusion of confirmation or disconfirmation or hypotheses (Gay, 1976; Tuckman, 1978).

One might conclude, therefore, that the principle difference in educational research would be related to subject matter or academic discipline differences. The research priorities of educational administrators, for example, are often fundamentally different from science educators. The issues relevant for one group may overlap with the other but are primarily unique within each discipline. In effect, the unique nature of each discipline plays a dominant role in shaping and unifying research priorities within various disciplines.

What, then, are the research priorities of the instructional design and technology field? On the surface, we appear to have a fairly well-prescribed commonality. We are concerned with the systematic application of instructional systems and technologies. We may have particular interest in specific technologies or delivery systems, but we share common interests in the issues and problems confronting the profession. We are, arguably, a collection of individuals having what should be relatively homogeneous interests in instructional research and development issues.

However, this perception may be more illusion than reality. The academic training of professionals in the instructional development field is not homogeneous but diverse. The context for application of instructional systems and technology is also very broad. While interest in the processes of research may be shared, the nature of the interest is often quite varied. Some individuals focus on immediate learning outcomes, others on social and ethical issues; others focus on longitudinal effects, and still others on the recycling of information gained during the design and development process. As a discipline, greater latitude is required in the pursuit of research interests than a single research agenda or paradigm permits. The instructional development field is one of diverging research issues and interests but is seeking a converging, unified research agenda.

Given this diversity, is a unified research agenda necessary? Is such an agenda possible? Is the diversity of interest within the ID field an asset or a liability in attaining the scholarly goals of the discipline? Does the scope of interest require the use of alternative research methods? What are the issues affecting the quality and quantity of research generated within the field, and what might be done to further the goals of the discipline?

The purpose of this paper is to describe the status, issues, and future of research in the instructional design and technology field. In addition, several recommendations designed to encourage collaborative research among individuals with diverse interests will be presented.

The Status of Research in Instructional Design and Technology

The instructional development field draws upon the work of individuals from a variety of related disciplines. Some embrace educational and cognitive psychology, others instructional media, and others are aligned with specific content disciplines. A discussion of the status of the field, therefore, could encompass the full scope of research published in the various academic and technical disciplines. While such efforts
are certainly noteworthy, they seldom influence the field directly. For this reason, this paper will focus on research conducted, presented, and published for the purpose of influencing directly the development or refinement of instructional design principles.

The Roots of Experimental Research
Perhaps due to the strong influence of the behavioral sciences on the ID field (Schuller, see article in this issue), experimental paradigms have dominated published research. Some nonexperimental research has been published during the past 20 years, but the overwhelming proportion has featured experimental methodologies.

Experimental paradigms also appear to dominate the implicit definition of acceptable research in the field. This evolved for several reasons. First, many of the same conventions of other “scholarly” disciplines, such as an emphasis on experimental rigor, strict hypothesis testing, and the adoption of widely accepted technical writing and publication guides, were assimilated into the ID field. In effect, the priorities and standards of related disciplines were transferred to the instructional development and technology field.

Next, the promotion and tenure criteria of college and university training programs emphasized experimental research over other kinds of research. This has created an implicit standard for acceptable research. This standard, in turn, has influenced the research of both tenure-seeking faculty and their students at our colleges and universities. Since the majority of published research in the field is generated in academic institutions, where the priority for experimental research is high, most of the published research has reflected an experimental orientation.

Finally, responding in part to pressures to publish the experimental research generated by college and university faculty, the research journals have published proportionately more experimental studies. This was likely a natural consequence of the greater number of experimental research studies conducted and submitted for publication. In any case, an experimental research emphasis was implicitly perpetuated by the dominance of published experimental research studies.

It is important to note that the current situation is not an indictment of experimental research, the publication of priorities of the university training institutions, or the editorial and publication policies of our scholarly journals. The opportunity for pursuing other interests has always existed, albeit a potentially risky option for those seeking tenure and promotion. Scholars in the field have advocated and conducted systematic research using alternative paradigms. Cuba (1981), for example, advocated techniques for naturalistic inquiry. Similarly, Heinich (1984) encouraged field-based studies incorporating naturalistic inquiry methods rather than reliance on the traditional experimental methods of the past.

The Locus of Instructional Design Research
It is also noteworthy that much of the instructional research published during the past 20 years has been generated outside of the instructional development field. While several prominent scholars may be readily identified within the instructional development discipline, the field appears to lack pervasive research activity and interest. Apart from a few productive individuals and institutions, the ID field does not have the generalization of research thrust which is characteristic of the other allied fields. An inspection of the 1970-1984 cumulative author index of the Proceedings of Selected Research Paper Presentations, published by the Research and Theory Division of AECT (Simonson & Treimer, 1985), illustrates the unevenness of research productivity within the discipline. Some individuals have remained very active as researchers, while others contribute very sporadically. Unfortunately, many individuals simply do not contribute research to the field. This pattern can also be found in other scholarly journals serving the instructional development field.

During the same period (1979-84), many educational and cognitive psychologists have become involved with research topics relevant to the design of instruction. By itself, this situation poses no problem. However, when paired with the lack of interest shown within the ID field itself, the scholarly identity of instructional development may be jeopardized. In too many cases, individuals in the field have assumed the role of a consumer rather than a producer of research. We must address why so little research interest has been demonstrated within the instructional development discipline. Is it the result of proportionately fewer instructional designers producing a correspondingly lower proportion of research studies? Or is it the case that we, as a discipline, are not generating our “fair share” of research, assuming instead a consumer rather than a producer role?

A Different Perspective
Why has so little research of any type been published by instructional designers? Has the situation resulted from the prevalence of experimental methods to the exclusion of other methods? Or is it due to indifference to research under any circumstances? The problem is not solely with particular research methods per se, but with the failure of the field to mobilize its researchers. Many have become content with debating the problems with research rather than contributing to solutions. The field may be hampered more by collective inactivity than by the tacit acceptance of a particular research paradigm. As a discipline, instructional designers have failed to become proactive in shaping a research agenda for the future.

Much of the research during the past twenty years has been generated outside of the ID field.
simple: More people are asking the question than responding to it. The pattern has become one of research inactivity in the collective instructional development field. If renewed and broadened enthusiasm for research reverses this pattern, then the efforts will have been successful. If the pattern remains, however, the sobering reality that there is no collective will to engage in research must be faced. Hopefully this will not be the case.

Barriers to Research

Declining Interest

The majority of published educational research is generated by students and faculty in colleges and universities. This does not, however, presume that research is necessarily a welcomed priority for all who must produce it. While research for some may be an intrinsically rewarding process, it is likely that most research is driven by motives such as the pursuit of tenure, academic promotion, or the completion of degree requirements. For many, research is simply not a primary interest. Individuals become involved in a degree, but often lack a commitment to research as a principal role. This is a marked departure from the role perceptions and expectations of several other academic disciplines—especially those in the "hard" sciences.

Academic Identity

Underlying the research dilemma could be a fundamental loss of academic identity. In many ways, instructional development has become a market-driven field, emphasizing the preparation of professionals to fill the growing need for instructional designers—especially in business and industry. Several institutions are engaged in extensive proprietary development projects with corporations, often reducing both the amount of time available for research and the impact of such efforts on the field. While partnerships are not necessarily an impediment to research, they often commit valuable talent to specific corporate priorities rather than toward the broader goals of the ID field.

Competing Priorities

Due to preference for other roles, some faculty choose not to engage in research. Individuals believe that their expertise is better used in the pursuit of different priorities. Others prefer to attend to the immediate and pressing issues of the field, believing that they have more impact through direct as opposed to indirect effort. Still others have turned their efforts toward the organizational needs of the ID field. It is difficult to fault individuals who direct considerable energy in these worthy endeavors.

Local Support

Those actively engaging in research are more likely to possess a supportive environment, access to the required technical resources, the necessary hardware and software to conduct research, and perhaps modest economic and career incentives to excel as researchers. However, considerable untapped expertise exists in settings where support is lacking. The issue of how to provide the needed support to those who indicate interest in research, but lack necessary resources, may be a key to increasing the scope, quantity, and quality of research in the ID field.

Overcoming Barriers to Research: The Future of ID Research

One of the impediments to research, the perception of singularity in the definition of "appropriate" research topics and methods, may be the simplest of resolve. Given the diversity of the ID field, it seems counterproductive to presume that the topics and methods for research can be rigidly prescribed. If the acceptance of alternative topics and methods as valid will improve the quality of research, then the commitment must be made.

Coupled with this commitment, however, is the recognition that competence in the varied research methods is not likely to be as pervasive as the interest expressed in such methodologies. "Alternative paradigms" cannot be a euphemism for poorly organized and implemented research. As a discipline, the notions of appropriateness can be easily expanded and even supported directly. Individual researchers must at-

The problem is not solely with particular research methods, but with the failure of the field to mobilize its researchers.

Role Models

One of the most serious long-term implications of the diminished research activity in the field is the legacy this trend portends for the future. Faculty at academic institutions model those activities deemed most important. If the models emphasize research, it is more likely to be valued. If the models do not emphasize research, future generations of graduates will develop neither interest nor competence in research. The fate of instructional development research could be sealed through the passivity and indifference of faculty models who are preparing each new generation of instructional developers.

On the other hand, many members of the ID field express interest in research but feel constrained by various influences. The limited money available to support research is often cited by many as a major obstacle. Some individuals express interest in research but are constrained by heavy teaching loads, a lack of facilities, or available research subjects. Others, though interested in engaging in research, feel poorly prepared to design and implement research studies.

Inflexibility in Topics and Methods

Some individuals believe that there is an intolerance for the study of certain topics believed to be relevant to the ID field. The preoccupation with learning outcomes to the exclusion of other topics such as the social impact of technology is evidence of an implicit standard of acceptability. Organizations interested in the broader implications of instructional technology (e.g., Science, Technology and Society (STS)) support this contention. Others maintain that our scholarly journals are "tunnel visioned" in their endorsement of experimental research to the exclusion of other paradigms. A reluctance to engage in research using methods not widely implemented in the ID field is often expressed at the conference. Concern for the lack of a publication outlet due to the differences in methodologies selected—an important concern for academics—was also voiced.

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tain competence in the methods of disciplined inquiry required to pursue individual research interests.

The future of instructional development research lies only partly with the expansion of research topics and methods, and the accessibility of dissemination outlets. There is a more
fundamental issue to be resolved: Is there a collective commitment to research? Assuming greater respect for inherent differences among our ranks, will more and better research follow? The question strikes at the heart of the research dilemma confronting the field.

To grow as a discipline, the importance of research must be acknowledged. To be successful as a discipline, both the skill and the will to excel as researchers must be demonstrated. Some individuals possess both the skill and the will to conduct research, and these are among our most prominent ambassadors to the educational and psychological research communities. Several possess the skill but appear to lack the will, due to preference or imposed constraints. Others have the desire but lack the resources needed to implement research. The final group possesses neither the skill nor the will to engage in research, opting (hopefully) to direct their talents elsewhere. The goal of more and better research requires the mobilization of individuals with either the skill or the will to become more active in pursuing research activities. This can be accomplished by first committing to the research priorities of the discipline, by clarifying the position of the discipline on research standards, and by providing the support needed to mobilize researchers.

The following statement, drafted jointly during the UCIDT conference in Bloomington by the research subcommittee, capsulizes the commitment, the need for alternative research methods, and the range of topics advocated for research:

The knowledge base of instructional systems technology can be expanded using a variety of research methodologies. We advocate the utilization of traditional and alternative research methods in examining the processes, outcomes, and contextual variables which guide the design of instructional systems. We further advocate the study of the processes and effects of the implementation and impact of instructional systems in varied contexts.

This statement, while providing a commitment to the goal of research, does little to mobilize individuals within the ID profession to greater involvement. The statement does, however, provide the basis for prescribing and implementing recommendations to meet the spirit of the commitment. Such recommendations, and the impact on individuals within the profession, could result in increased interest in conducting research.

Recommendations to Encourage, Improve, and Expand
ID Research

The steps recommended to encourage, improve, and expand research fall into four general needs: (a) identifying topics and methods, (b) improving the quantity and quality, (c) providing greater opportunities, and (d) increasing dissemination.

Topics and Methods

Identify topics relevant to the different interests expressed within the ID field. As suggested by Gagne (see article in this issue), a wide range of learning, cognition, and technology topics are available that are appropriate for study. Many of these topics pivot around the notion of designer versus learner intent in the acquisition of knowledge. Heinisch (1984) has also suggested several researchable problems based on the "Craft versus Engineering" dilemma endemic to the instructional technology field. Additional interest has been expressed in the study of contextual issues in the design systematically. Specific researchable problems, irrespective of the methods of research, must be articulated before a judgment of the need for research methods can be made.

Identify research methods and options appropriate for specified topics. Once problem areas have been specified, appropriate methodologies for study can be selected in an informed manner. It makes little sense to insist on the adoption of any research methodology, experimental or other, without first specifying the nature of the problem to be studied. Once the requirements of the problems are known, a variety of research models and paradigms are available for consideration. Considerable interest remains for experimental and quasi-experimental techniques, but field study techniques, naturalistic inquiry methods, integrative methods, and other methods of inquiry have been recommended. Models developed and applied in other disciplines may also prove very useful in ID research, ranging from sociological, to art criticism, to engineering models. Alternative methods for data analysis, synthesis, presentation, and interpretation might be considered. In addition to traditional statistically-based hypothesis testing models, interest in variance-accounted for by instructional treatments, meta-analysis techniques for more global research questions, and comparisons based on sigma differences is increasing. Researchers have available a wide range of methods and data analysis techniques to support their unique interests.

Partnerships with schools, businesses, and government should be formed to pursue common interests.

Quality

Evaluate proficiency in utilizing the methodologies for specified problems. For reasons previously addressed, most researchers have greater facility with experimental research methods than other techniques. A few may be proficient with alternative methods appropriate for the problem to be studied. For others, however, many alternative methods will be unfamiliar. The par-
First, most are affiliated with training programs offering a significant reserve of untapped but motivated research talent. This includes faculty, graduate students, and potential research audiences. Next, the nature of the problems and interests of potential researchers can be identified clearly. Methods for supporting desired research activity can be better prescribed.

Establish a network where researchers with mutual interests could collaborate at their discretion. If faculty interests and activities are better known, the opportunities for collaboration should increase dramatically. In addition, the geographic breadth of impact of ID research would be expanded. Mutual research thrusts should become more visible to the professional communities, helping to re-capture some of the collective influence of earlier R&D forefathers, such as the National Special

works, including groups of colleagues from several settings who have expertise in particular research methods, could be formed. Instructive articles could be solicited from recognized research authorities and published in scholarly journals or as monographs. In any case, researchers should commit to excellence through the utilization of those research models where proficiency is greatest. Where proficiency is lacking but desired, the development of the necessary competence should be a precondition to conducting research. Completion of such training, paired with receptiveness to alternative methods, should mobilize those individuals who possess the necessary skills but have elected not to engage actively in research.

Opportunity to Participate

Identify the interests and identities of individuals wanting, but presently unable, to conduct research. Identification offers the potential to expand and improve ID research in several ways. Media Institute (NSMI) described by Schuler (see article in this issue). While potentially beneficial for all, a network may be especially useful for individuals constrained in pursing independent research. Many faculty members are facing new pressure to publish research, but are receiving inadequate support. Inter-university collaboration might enable interested faculty to conduct research while improving research. Finally, the mutual growth experienced through collaboration, paired with the generation of new ideas within the field, sharpens the understanding of all within the discipline.

Form partnerships with constituent organizations. Several individuals, and in some cases institutions, have established partnerships with school systems, businesses, or government organizations to pursue common interests. Usually, the thrust of such partnerships is to support such things as the development of instructional materials, the training of competent individuals to enter the labor force, or the creation of organizations and systems designed to provide training, education, and development. In many cases, however, similar arrangements could be made to pursue joint research interests. For many individuals, partnerships represent a particularly appealing way to tie everyday responsibilities with the desire or requirement to conduct and publish relevant research.

Dissemination

Publish research generated both directly by faculty, as well as that generated through thesis and dissertations, in appropriate scholarly journals. The ID field lacks neither meaningful problems nor publication outlets for scholarly research. The field continues to grow and expand in related disciplines, integrating new technologies in the process. Yet, for many scholarly journals serving the ID field the number of manuscripts submitted for review has declined during recent years. Scholarly journals should present the most rigorous treatment of the most important issues both to the ID field as well as to the educational community overall. The status and credibility of a discipline is shaped largely by the quality and rigor of its journals. When scholarly journals reflect depth, rigor, and quality, the image of the collective field is improved. The decline in submissions is an important early warning sign for the field. It is also vital that the importance of scholarship be reinforced, and that scholarly journals reflect favorably on the breadth and quality of research interest within the discipline. The responsibility for contributing research must be assumed by all who profess allegiance to, and reap the benefits of, the ID discipline. The process of research is not complete until the products are shared. Certainly, our scholarly journals should be the focal point of dissemination for research generated within the field.

Utilize the professional conferences to disseminate research. Professional organization conferences provide a relatively fast method for the dissemination of research. Both AERA and AECT include divisions or interest groups designed expressly for the dissemination of instructional systems research. While a large number of instructional developers are affiliated with organizations such as AECT and AERA, the percentage of individuals actively contributing research to their conference
proceedings is relatively modest. Some are simply not conducting research; others, however, have made no effort to disseminate research already completed. In many ways, the trend toward declining submissions to our scholarly journals and the trend observed in professional conferences appear intermingled. Those who present research at conferences seem more likely to eventually publish their work in journals than those who do not. This appears less a question of natural selection than investment of effort. Once the effort has been invested to prepare a manuscript for presentation and the ensuing feedback is received, the probability of refining the manuscript for eventual journal submission is greater. The probability of acceptance for publication in scholarly journals also seems improved by virtue of the input obtained during paper preparation and presentation. Since professional conferences represent the primary method of professional development for many, effort must be expended to disseminate research during these proceedings.

Establish a dissemination network where published and on-going research activities can be shared among interested parties. The time lag from submission to publication of research presents a problem to researchers attempting to keep abreast of current developments. While conference presentations provide a more immediate dissemination outlet, only a fraction of the overall research conducted is likely to be included. Student thesis and dissertation research, for example, is seldom disseminated beyond the submission of abstracts. Research of this type could be more effectively distributed through a dissemination network. Many ID researchers have also expressed interest in on-going and in-progress research, where parallel interests could be identified and developed. The creation of an ID dissemination network, to focus on the sharing of research in-progress and recently completed, could provide an outlet ideally suited to the unique needs and interests of ID researchers.

Summary and Conclusions

The purpose of this paper was to analyze the status and future of research in instructional design and technology. It has become clear that several hurdles to increasing relevant research exist. Some obstacles cannot be removed directly; however, others can be removed or circumvented fairly readily if there is a commitment to research. The ID field can endure differences in, but not indifference to, the methods and topics constituting meaningful research.

The processes and products of research serve several important functions. The methods of research are judged for appropriateness. The products and processes of research are supported or refuted, dismissed or contradicted because of the evaluation of individual beliefs with the beliefs of others. Individual and collective notions of disciplined inquiry are expanded by testing a new, better, or different way to conceptualize the research issues of the ID field. Research is the life line to self-examination and growth in any discipline. Surely, research can assume a more vital role in the ID discipline.

The key to promoting research rests in part with reconceptualizing notions of appropriate topics and methods for study. Certainly, the ID discipline can embrace scholarship in all relevant aspects of instructional technology. We should not restrict or confine the focus of disciplined inquiry to those aspects deemed popular or acceptable to certain segments of the field. It is necessary and proper to transcend the "members only" image of ID research, embracing instead the varied interests reflected in potential research is wide-reaching. The ID field is not lacking fuel—only fire.

Upon reviewing a number of research manuscripts for possible publications, one somewhat frustrated colleague remarked, "Nothing could be worse than these manuscripts." At the time, the observation appeared an accurate summation to a somewhat frustrating task. The problems seemed ill-defined, the rationales weak, the methods questionable, and so on. Could anything be worse than the manuscripts reviewed? It did not appear possible. My perceptions, however, have since changed. While maintaining an overriding concern for the quality of research, I am also concerned with the decline in research interest and productivity. The absence of research, and the opportunity to reexamine beliefs, expand knowledge bases, and evaluate critically the thinking of colleagues, is a far greater concern than the occasional poor study. Why poor research must certainly be reckoned with, such studies at least permit critical evaluation. What is worse than a bad research study? No research at all.

Author Notes. The opinions included in this paper have been shaped by the ideas of the many talented individuals who attended the UCIDT conference. While not necessarily shared by other participants, the opinions were shaped by the issues, comments, and themes that surfaced during the conference. The author wishes to acknowledge the contributions of all participants, especially those who spent a significant portion of the conference discussing the research issues confronting the instructional design and technology field.

The author has taken the liberty to describe ID as a discipline. The credit (or responsibility) for this designation, however, rests with Dr. Robert M. Morgan, who characterized ID as a discipline in his introductory remarks during the UCIDT conference. The author thanks Dr. Morgan for making this assertion, and removing any burden of proof from the author.

The ID field lacks neither meaningful problems nor publication outlets for scholarly research.

Equally important, however, is the collective commitment of the field to the process and goals of research in advancing the discipline. Without such a commitment, we cannot expect that activity will increase under any circumstances. Support for the differences inherent in the ID discipline has been articulated, but the most important changes are yet to be demonstrated.

To be certain, the range of interests and methods for study provide a vast and extraordinarily fertile base for prospective researchers. The question appears less the availability of researchable topics than which topics and methods should be used. While the cautions related to comparative research must be heeded (Clark, 1983), the range of...
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Andragogy in Action, by Malcolm S.
Knowles & Associates. San Francisco,

Everybody knows that adults are different from children: different in the way they talk, dress, eat, play. Different in the way they perceive the world. But do children and adults learn differently? "Yes," says Dr. Malcolm Knowles, an expert in adult education and human resource development. His specialty (for fifty years) has been andragogy: the theoretical and practical study of how and why adults learn.

Dr. Knowles reminisces about his childhood and adult learning experiences and in doing so, examines and compares the basic assumptions of pedagogical and andragogical theory. As children, many of us were schools according to the tenets of traditional childhood education. Our teachers were the one-way transmitters and directors of learning, if not the source of all knowledge. During the hours we spent at school, we were completely dependent upon them. They decided what content was to be transmitted during each class session, how much, and in what order. They set down rules for our behavior during the learning process, and assigned us homework to reinforce the lesson content. (Some of us got homework in order to keep us too busy to get into trouble.) Teachers took full responsibility for our education.

We were "motivated" by external pressures. We knew that good students sat quietly, followed the teacher's instructions, didn't collaborate with others on their homework or during tests, kept busy, got their assignments in on time, and frequently volunteered to help the teachers.

The andragogical model operates on different assumptions. Effective teachers of adults design, manage, coordinate, and facilitate the learning process. They perceive students as potent synthesizers of experience, not passive recipients. They act as consultants to learners by linking them to appropriate environmental resources. Andragogical teachers maximize participatory activities and use the experience and knowledge of the learners to enhance their custom-made learning plans. They organize the learning experience around life situations, and encourage and support a climate of collaborativeness. Teachers of adults must be sensitive to the learner's limited study time, and the learner's capability of taking responsibility for the development and implementation of new skills and knowledge. And they know that the adult student is cognizant of the desirability of learning as a continual process, rather than a discrete event.

But the focus of Andragogy is not the presentation and comparison of adult and child learning theory. Rather, it is a collection of descriptions of real-life case studies about the application of andragogical principles to training programs in the arenas of business, industry, government, college, university, education for the professions, religious education, remedial and continuing education, and finally elementary and secondary education.

The authors explain, in a series of brief overviews/summaries, how they used the andragogical model to design and implement courses, workshops, and training programs in their respective organizations.

An important contribution of this interesting book is its documentation of the truth that people learn best when treated like enlightened, conscious human beings, and that the ultimate purpose of all education is to empower individuals through a process of lifelong

This paper explores instructional design considerations involved in using level four videodisc systems when designing simulations. Discussion of the hardware and software system characteristics notes that computer based training offers the features of text, graphics, color, animation, and highlighting techniques, while a videodisc player offers all of the traditional audiovisual training media attributes of audio, running video, and still pictures. Various instructional design issues are investigated, including those relating to media characteristics and media integration, interactive videodisc simulation design, and a team approach to designing and developing simulations using these systems and the required skill sets. Additional discussion briefly examines emerging technologies, e.g., artificial intelligence and knowledge-based systems, and their potential for use with simulations. Ten references are listed.—Microfiche 97 cents, paper copy $2.15 plus shipping, as document ED 251 348.


Some factors in the design of instructional microcomputer simulations that high school social science teachers must consider when selecting and using computer software are discussed: (a) instructional computer simulations are adequate instructionally only to the extent that they make explicit the set of relationships underlying the program for the simulation; (b) students must have access to the system model so that they can understand why a particular action leads to a particular consequence; (c) the simulation must accurately model the observed phenomena in the real world; (d) instructional simulations of abstract relationships must, at a minimum, provide both iconic and symbolic representations of the relationships; (e) in addition to iconic and symbolic representations of social relationships and systems, instructional simulations must also provide—in a context external to the computer—for enactive experience to authenticate the parallel enactive-social experience in the real world phenomena; and (f) teachers must be able to differentiate between social and nonsocial content, and when teaching nonsocial content, must be sure to debrief students on the connections between the two.—Microfiche 97 cents, paper copy $2.15 plus shipping, as document ED 252 203.


This paper presents a brief review of the literature on instructional theory and a brief rationale for the development of such theory, then discusses an ongoing project in developing such theory from basic postulates of learning. An overview of a comprehensive, integrated

A model is presented for the development of computer assisted instruction (CAI) for the college classroom teacher. Some common software design models that have been helpful in developing CAI models are briefly reviewed: composite or structural design model, Jackson model, META stepwise refinement model, and higher-order software model. Design principles that encourage the development of good software—modularity, abstractions, localization, and hiding—are also examined. The CAI design model is based on the META stepwise refinement model and comprises five phases: problem clarification, system design, blueprinting, CAI synthesis, and documentation development. The problem clarification phase is composed of three tasks: objective development, content research, and narrative synthesis. The purpose of system design is to prepare the instruction for computer coding. Blueprinting involves the development of a detailed description of the CAI from frame to frame and function to function. This phase involves two stages of development: frame development and frame design. CAI synthesis refers to the actual encoding of the computer, along with debugging and evaluation. Finally, documentation involves the development of manuals and technical data. —Microfiche 97 cents, paper copy $2.15 plus shipping, as document ED 250 982.