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ABSTRACT

A content analysis was performed to determine the trends and issues in educational technology for the period from October 1, 1987 through September 30, 1988. Sources for the analysis included five leading professional journals in educational technology, papers given at annual conventions of three professional associations, dissertations from five universities that have a high level of doctoral productivity, and the educational technology documents entered into the ERIC database. The analysis was complemented by the examination of supplementary documents to determine the political, social, and economic reasons for the findings. The top trends identified in the study are: (1) design, development, and evaluation of instructional products and procedures is a primary concern; (2) professional education for teachers in the use of educational technology is seen as a basic need for present and future professional service; (3) distance education is becoming a significant instructional delivery system that uses technological means to reach its goals; (4) the computer is the dominant medium in the field, and after computers, telecommunications and video are emerging as major delivery systems; (5) the role of the educational technologist is unclear and varies from location to location; (6) case studies serve as models to follow in the implementation of educational technology applications; (7) the field of educational technology is concerned about its status as a profession; and (8) educational technology principles, products, and practices are just beginning to be integrated into courses and curricula. (24 references) (GL)

Purpose of This Study

The Educational Resources Information Center (ERIC) attempts to generate syntheses of the literature of various academic disciplines and other areas that contribute to the field of Education. The purpose of this publication is to provide some indication as to where the field of educational technology is going. The identification of emerging trends and issues is a first step in this endeavor.

The ERIC Clearinghouse on Information Resources specializes in the areas of educational technology and library/information science. One objective of this study is to provide an indication of the emerging trends and issues in the field of educational technology. A parallel study of trends and issues in library and information science was conducted at the same time using the same methodology. Findings from that study are reported in IR No. 81, Trends and Issues in Library and Information Science 1988, which is available from the ERIC Clearinghouse on Information Resources. Because the sample of the literature that was included in this study was drawn from a single-year period (October 1987-September 1988), the ability to verify trends is somewhat limited. Another objective of this particular study, then, is to develop a database that will serve as a reference point for trends in the area of education technology to facilitate their identification and analysis in the future. A third objective is to develop a methodology for the identification of emerging trends that would allow a large number of documents to be reviewed in a reasonably short period of time without relying too heavily on purely quantitative forms of analysis.

Content Analysis: Some Background

Content analysis was used to determine the emerging trends and issues relevant to educational technology. A trend is considered to be a cumulative indicator of activities or products that shows direction. An issue is considered to be a problem or a question for which there are multiple points of view. It is important to note that a trend may be considered by some to be an issue. As a problem or question develops within an academic field, it may be considered an issue. The distinction between these two concepts is not as clear as one might like it to be.

Content analysis is intended to be a method for the objective and systematic collection of pre-specified data for the purpose of identifying the special characteristics of those data (Carney, 1972). It is a broad concept that can be used in any attempt to practice research or science. Whenever symbolic action or communication is the subject of investigation, the analysis of content is involved (Janowitz, 1976).

Not all content analysis is the same: there are both quantitative and qualitative strains of content analysis. A common form of the qualitative type of content analysis is conceptual analysis, i.e., the investigation of the use and meaning of particular words. A common type of quantitative content analysis is the measurement of the length of articles that deal with a predetermined topic. A tabulation of the results of either of these forms

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of content analysis is required in order to make any inferences about trends. Examples of the use of content analysis as a methodology have appeared in both the popular and the academic press. John Naisbett's Megatrends (1982) identified 10 trends that he thinks will become influential in our lives.

Morris Janowitz (1976) outlines the application of content analysis to determine socio-political trends from a sampling of our nation's newspapers.

Reviews of the advantages, limitations, and features of content analysis can be found in Janowitz (1976), Carney (1972), and Hosti (1969).

Content Analysis in This Study

The professional literature of a field indicates the concerns, inquiries, and research that are important to that field. Such is the case with the literature of educational technology. It was decided that a review of the professional literature of educational technology would reveal the ideas that were of importance to the field. Through this process it was hoped that indications could be derived about the direction (emerging trends and issues) of the field. The basic idea behind this study was that if one could classify and tabulate pre-selected writings based on interpretations of the authors' purpose it would be possible to indicate current directions in the field.

In order to achieve this end, it was determined that a substantial number of source items would have to be reviewed. Because this study was primarily concerned with the number of times that a topic was discussed (as opposed to the length of the discussion or the particular use of the concepts involved in the discussion), and given the resource constraints (limited time and manpower), it was decided that a content analysis would be the appropriate data collection technique, but that a "hybrid" form of content analysis would have to be developed for the purpose of this study.

It was imperative that the data collection teams be able to review and classify sources efficiently and effectively, while avoiding the pitfall of playing "fast and loose" with the data. The development of this "hybrid" form of content analysis can be outlined as follows:

- The conceptualization of the recording units and categories.
- The determination of the sources to be reviewed.
- The specification of the data collection procedures.
- The analysis of the data.

It is reasonable to state that the vast majority of content analyses that are concerned with determining trends must somehow address these steps. However, these particular tasks do not always occur in the order in which they were performed in this study. A reordering of tasks can be the difference between inductive and deductive studies. In this study we use a

deductive methodology. Because of the nature of the content that is specific to each field in trends research, there is no one right way to do content trends analysis. Hence, by necessity, it is a hybrid methodology. It is important to acknowledge that each type of content analysis has its own advantages.

Conceptual Categories into Operational Definitions

The general content categories that were used in this study were based on the concept of the functions performed by media personnel that were discussed by Chisholm and Ely in 1976. This conceptual scheme reflects the definition of educational technology put forth by the Association for Educational Communications and Technology (1977). These general areas were thought to be indicative of the field of educational technology: Personnel, Management, The Field, Instructional Processes, Information Services, Technical Developments, and Research and Theory. The content categories were determined before the study began rather than during the review of the data sources. In this sense the categories were "imposed" upon the study rather than generated in a more inductive fashion. This conscious decision was based on the need for efficiency in the data collection process. After the general content categories had been identified, subcategories were specified. Some were added later during the data collection process. The specification of these components was based on a thorough knowledge of the literature and extensive experience in professional practice.

An example of one of the conceptual categories is the function of "management." The broad concept of management was operationalized by specifying the following tasks: planning, budgeting, diffusion and implementation, logistics, operations, and facilities.

Two instruments had to be created for this study. The primary instrument allowed reviewers to record both the source of the data and the category into which the source had been classified. The second instrument served as a tally and comment sheet for each item collected and classified on the primary instrument.

Content Source Units

Journal articles, dissertation abstracts, ERIC documents, and professional conference programs were chosen as the content units because they provide a current record of issues and topics that leaders in the field of educational technology have acknowledged as important.

The analysis of the content in professional journal articles and dissertation abstracts is not new to research in the area of educational technology.

Torkelson (1978) reviewed 25 years of the Audiovisual Communications Review (AVCR) as part of an investigation to determine which issues had had the strongest impact on the development of educational technology as a professional field. His article covers his AVCR findings as well as trends and areas identified for further study.

Mayo (1976) analyzed AVCR journals published in a 20-year period between 1953 and 1972 for a doctoral dissertation. The study showed several trends within the context of the journals. These included an increase in the sophistication of research design, the methodology, and the statistical analysis.

Lard (1979) reviewed two journals, Audiovisual Communications Review (AVCR) and Audiovisual Instruction (AVI), the official journals of the AECT. The scope of her study also included the abstracts of dissertations from five universities with major doctoral programs in the field of educational technology. This study revealed that there were three distinct paradigms operating in the field of educational technology during the 21-year period covered by the study: the media movement, systems theory, and behavioral technology.

The journals selected for analysis in this study were those that had been identified as five of the "most influential" professional journals by Moore in 1981 and Moore and Braden in 1987: The Journal of Instructional Development, The Educational Communications and Technology Journal (formerly AVCR), Educational Technology, TechTrends, and The British Journal of Educational Technology.

The dissertations that were included in this study were produced at the universities that were identified by Moore in 1981 and Moore and Braden in 1988 as being the "most prestigious institutions" in the field of instructional technology: Arizona State University, Florida State University, Indiana University, Syracuse University, and the University of Southern California.

Conference programs and ERIC documents were added to this particular study in order to broaden the scope of the content to be analyzed. It appeared that conference programs would reveal the latest developments in the field of educational technology because conference presentations usually discuss the most recent findings of current research and development efforts. Three professional conference programs, the Association for Educational Communications and Technology (AECT), the National Society for Performance and Instruction (NSPI), and the Educational Technology International Conference (ETIC) were included in the database for this study. The AECT and NSPI programs were included here because these two organizations are considered to be the two most prestigious organizations in the area of educational technology in the United States. The AECT conference is considered to be the one for those interested in the academic aspects of the field of educational technology, while the NSPI conference is considered to be the one that is attended by practitioners of educational technology. The ETIC conference program was included in this study to ensure a more global outlook on the emerging trends and issues in the field.

ERIC documents were included in the scope of this inquiry since the materials entered in the ERIC database represent a cross-section of the contemporary literature of educational technology. Following the basic

premise of Webb (1966), the research team believed that a multiple operational approach should be emulated.

The research team felt that it could have an increased level of confidence in its analysis if it increased the scope and breadth of the data included in the study.

Data Collection Procedures

The data classification and tabulation instruments were tested for their functionality. This was done by asking prospective data collectors to use the instrument to review the same three articles from one professional journal. Particular attention was paid to the conceptual clarity of the content areas, and efforts were made to identify ambiguities and confusing elements within the instruments that might mislead the data collectors into generating erroneous classifications. The graphic design of the instruments was checked to insure the efficiency and the effectiveness of the data recording process.

A training session was held for the data collectors, who were all graduate students at Syracuse University. This session was designed to teach them how to:

- Identify the purpose of an article by reading the introduction, abstract and concluding statement.
- Use the data source and classification instrument.
- Use the tabulation and comment instrument.
- Locate the data sources.

The ability of the data collectors to meet these four objectives were demonstrated by a test for inter-rater reliability.

After a period of one week the data collectors met and compared the results of their interpretations of the articles from three different professional journals. The Pearson Correlation Coefficient (r) that had been calculated for the pairs of data generated by the collectors slightly exceeded r=0.8. To insure further reliability, it was decided that each data collector would designate two possible categories for each of the journal articles, a primary choice and a secondary choice. The employment of this technique virtually eliminated cases of non-agreement among the data collectors. Inter-rater reliability was virtually assured as data collectors discussed those cases where they had disagreed until an agreement could be reached.

At the conclusion of the data source recording and classification phase of the study, the data collectors tabulated the results. They reported the results of all of the dissertations on one tabulation instrument for analysis. Each of the five professional journals and each of the three conference programs that were reviewed was reported separately, as were

monthly entries in the ERIC index, Resources in Education (RIE). This style of reporting allowed for cross-source analysis.

Major reports and position papers published within the time period of the study and personal observations from professional participation in national and international events were also used to provide further input and clarification.

Limitations to the Study

There are a number of limitations to this study. First, as a form of content analysis, the study is a "hybrid." It does not enjoy the advantages of conceptual analysis, i.e., the inquiry into the use and meaning of particular terms that have a bearing on the field of educational technology. Second, it has no quantitative base other than that of tabulation. The methodology did not reveal the depth of the particular content that was used or analyzed in the sources. Third, the decision to use sources that have no precedent in content analysis (e.g., conference programs) raises questions about the data sources that were used in the study. Fourth, there is the possibility that certain items that were reviewed as source data were "specialty items." Special issues of a particular journal or a conference dedicated to a particular theme could "skew" the results of a study. Fifth, it is difficult to make statements about trends based on the data gathered in a single year since there is no earlier referent. Finally, the attempt to emulate the multiple operational model of analysis was not a true one. Since multiple operationalism is an attempt to bring several different methodologies to bear on a particular question or concern, this study could be considered as a cross-methodological, meta-analysis. Although attention was given to increasing and varying the amount and types of data sources used to analyze trends and issues in the field of educational technology, the study used a single methodology.

Recommendations for the Future

It is more than an exercise in humility to acknowledge the limitations of a particular study: it is intellectual honesty. Three goals were set forth at the beginning of this study. The first was to provide an indication of the emerging trends and issues in the field of educational technology. The difficulty of recognizing trends based on data gathered from a relatively short time span has already been mentioned. But certainly the number and variety of sources utilized make the analysis provided here more than an "educated guess." The second goal of this study was to develop a data source that will serve as a baseline so that trends in the field of educational technology can be more easily recognized in the future. It is much easier to have confidence in having met this second goal. The data that have been gathered during the course of this study will presumably be used by future analysts, as they provide a tabulation of the professional discussions about what comprised the field of educational technology in 1987-88. The third goal of this study was to develop a methodology that will allow an expedient review of the professional literature of the field of educational technology. Here, too, it is easy to feel confident about having met the goal; however, there is still much to be done in this regard. The

instruments require some refinement. Data sources must be reconsidered. Integration of other types of trend and issue analysis into this methodology should be addressed. Webb, Campbell, Schwartz, and Sechrest recommended the technique of multiple operationalism, asserting that "once an idea has been confirmed by two or more in dependent measuring processes the uncertainty of its interpretation will have been greatly reduced" (1966, p.3). Resource and time constraints precluded the use of other data-gathering techniques and contribute to limitations of this study. The decision to broaden the scope and number of content sources sampled, however, increases the level of confidence that can be placed in the data. These are questions that must be faced at the beginning of any such trend analysis. Surely more such questions will emerge. Upon the completion of this phase of this infinite enterprise one can only think that long journeys start with small steps.

Major Trends Identified by the Study

Design, development, and evaluation of instructional materials and procedures is a primary concern among practitioners in the field of educational technology.

A large portion of the educational technology literature is about the design, development, and evaluation of instructional materials. Issues in design include the application of cognitive psychology, such as in helping learners to conceptualize unfamiliar content; semiotics and the effects of message configuration characteristics, such as text design, text density, visual design, and use of symbol systems; and the effects of media use on motivation, including learner interest, achievement, and attitude development. Development includes such activities as needs assessment, course development, and product development. Finally, evaluation is concerned with measures and procedures for determining program effectiveness. Related to this is a call for better procedures for evaluating computer-assisted instruction software and software evaluation databases that are accessible to individuals.

Professional education for teachers in the use of educational technology principles and practices is seen as a basic need for present and future professional service.

Literature in this area is directed both at professional specialists within the field of educational technology and at individuals who teach. Currently, the emphasis appears to be on the teacher/instructor. The basic question is, "What competencies do teachers/instructors need to use technology effectively with their learners?" The assumption is that all classroom presenters should be using media and technology but are not, or that they are using it in less than optimal ways. Much of the literature discusses the use of computers and microcomputers by classroom teachers, and it emphasizes the need for teacher training in the area of information technology rather than educational technology or library instruction. This subtle difference is indicative of the gradual blending of educational media and technology with library and information science in the elementary and secondary schools.

Distance education is becoming a significant instructional delivery system that uses technological means to reach its goals.

Interest in distance education is stimulated in part by concerns over equity of access in the face of shortages of qualified elementary and secondary school teachers. Distance learning protocols have developed in direct response to real teaching/learning problems. Distance education offers practicable solutions to shortages of resources and teaching personnel. To prepare material for delivery requires a systematic approach to instructional design and a concern for the individual student rather than for group teaching. Much of the literature about distance education refers to the use of various telecommunications systems to provide optimum participation by the learners (National Governors' Association, 1988).

The computer is the dominant medium in the field of educational technology.

Statistics show tremendous growth in school use of computers in recent years (Quality Education Data, 1988). It is no longer just the computer-established secondary schools that lead the field; now more than half of U.S. elementary schools have enough computers to provide at least one for every two classrooms. Elementary schools use their micros primarily to supplement lessons with basic skills exercises and opportunities for drill and practice. In secondary schools, the micros are used primarily for teaching formal computer literacy (Talmis, 1988). Teachers express interest in having publishers develop software that teaches problem-solving skills and higher order thinking skills. While the literature reflects the growing enthusiasm for school computer use, it also shows continuing criticism of software quality.

After computers, telecommunications and video are emerging as major media delivery systems.

The apparent preoccupation of educators with computers often overshadows the increasing interest in telecommunications and video. While schools continue to use the traditional audiovisual equipment such as films, filmstrips, slides, audiotape recordings, and overhead transparencies in a more-or-less routine fashion, new development seems to be with video in the classroom for large group instruction, and telecommunications for individuals and small groups within the school and in distance education programs. The Quality Education Data study (1988) notes that over 90% of the schools in the U.S. are using videocassette recorders, while in 1983 only 30% of the schools used VCRs.

The role of the educational technologist is unclear and varies from location to location.

There are very few professionals who actually hold the title of "educational technologist." They are usually represented by such titles as: media specialist, media coordinator, or library media specialist; sometimes they are the director, supervisor, or coordinator of educational media, instructional media, or communications. Newer and more specific titles are emerging, including microcomputer coordinator, instructional computer

teacher, or specialist in educational computing. Although it is now likely that most large schools and school districts have one or more persons who are responsible for the administrative, logistic, and instructional aspects of instructional media (or, in some cases, just computers), these professionals are assuming such roles from a variety of previous positions and with varying types of education and experience. The question that seems to underlie all of the ambiguity is, "What competencies are required of individuals who are designated to be the educational technologists?"

Case studies serve as models to follow in the implementation of educational technology applications.

People who study the adoption of educational innovations know that one of the most powerful factors affecting adoption is evidence that an innovation has worked in a situation similar to the one where it is being considered. Although they do not carry much information in the way of theory, research, or development, case studies serve as "lighthouses" or "pilots" for other institutions or organizations. The value of case studies in the organization and management of educational technology is demonstrated in the Office of Technology Assessment report, Power On! (1988). Spread throughout this document are 29 comprehensive case studies of technology use in schools. Such reports as New York State Teacher Resource Centers and Electronic Networking, Writing by Hand/Writing with a Wordprocessor, and Software Evaluation in California help educational practitioners see how others have successfully used technology to solve specific problems of teaching and learning.

The field of educational technology is concerned about its status as a profession.

Much of the journal literature is about educational technology as a profession, discussing such issues as status, ethics, legal aspects, history, and future developments of the field. It is obvious that practitioners of educational technology are concerned about their professional development and identity. They are attempting to understand who they are, what they should be doing, and how others view them. Such concerns are typical among individuals who feel that they are in an emerging profession without the tradition of an established discipline. It is a generally healthy trend which will probably be evident for many years to come.

Educational technology principles, products, and practices are just beginning to be integrated into courses and curricula.

The history of media in education is one of enrichment or enhancement. Not surprisingly, some of the literature examines the ways in which educational technology and media specialists provide support to teachers/instructors to improve their effectiveness. There is, however, increasing interest in media specialists as curriculum consultants. Komoski (1987) argues that schools must take the initiative and begin designing curricula that will provide teachers and students with a variety of options and strategies for achieving curriculum goals. To this end, he describes the Integrated

Instructional Information Resource, a group of broadly accessible, electronically searchable, and interrelatable databases that are designed to assist educators in developing "opened-out" curricula. Information Power (AASL & AECT, 1988) states that the library media specialist must develop a new, multi-faceted role as information specialist, teacher, and instructional consultant, and offers guidance for assuming these roles.

Select Bibliography

Allen, William H. (1970). Trends in instructional technology. Stanford, CA: ERIC Clearinghouse on Education Media and Technology. ED 043 242.

American Association of School Librarians and Association for Educational Communications and Technology. (1988). Information power: Guidelines for school library media programs. Chicago: American Library Association; Washington, DC: AECT.

Carnegie Foundation for the Advancement of Teaching. (1988). The condition of teaching. A state-by-state analysis, 1988. New York: Author. (Available from Princeton University Press.)

Carney, T. F. (1972). Content analysis: A technique for systematic inference from communication. Winnipeg: University of Manitoba Press.

Chisholm, M. E. & Ely, D. P. (1976). Media personnel in education: A competency approach. Englewood Cliffs, NJ: Prentice-Hall.

Clark, Richard E. & Sugrue, Brenda M. (1988). Research and instructional media, 1978-1988. In Donald P. Ely, (Ed.), Educational Media Technology Yearbook 1988 (pp. 19-36). Englewood, CO: Libraries Unlimited.

Flaxman, E. (Ed.). (1987, January). Trends and issues in education, 1986. New York: Council of ERIC Directors and the ERIC Clearinghouse on Urban Education. ED 281 897.

Hosti, O. R. (1969). Content analysis for the solid sciences and humanities. Reading, MA: Addison-Wesley.

Janowitz, M. (1976). Content analysis and the study of sociopolitical change. Journal of Communication, 26(4): 10-21.

Komoski, P. Kenneth. (1987). Educational technology: The closing-in or the opening-out of curriculum and instruction. Syracuse, NY: ERIC Clearinghouse on Information Resources. ED 295 676.

Lard, Henrietta. (1979). Evolutionary changes in educational technology. Unpublished doctoral dissertation, Syracuse University.

Mayo, D. S. (1976). Twenty years of AVCR: An examination of the research reported in the first two decades of the official journal of the DAVI/AECT. Doctoral dissertation, University of Washington.

Moore, D. M. (1981, February). Educational media professionals' perceptions of influence and prestige in the field of instructional technology. A national survey. Educational Technology, 21(2): 15-23.

Moore, D. M. and Braden, R. A. (1988, March). Prestige and influence in the field of educational technology. Performance and Instruction, 27(3): 19-22.

Naisbitt, J. (1982). Megatrends. New York: Warner Books, Inc.

National Governors' Association. (1987). Time for results: The governors' 1991 report on education. Washington, DC: Author. ED 279 603.

National Governors' Association. (1988). Results in education: 1988. The governors' 1991 report on education. Washington, DC: Author. (ED number to be assigned)

Quality Education Data. (1988). Microcomputer and VCR usage in schools 1982-1988 (2nd ed.). Denver, CO: Quality Education Data.

Roybler, M. D., Castine, W. H., & King, F. J. (1988). Assessing the impact of computer-based instruction. Computers in the schools, 5(3-4): ix-149.

Talmis. (1988). The K-12 market for technology and electronic media. New York: Author. Cited in Goodspeed, Jonathan. (1988, May-June). Two million microcomputers now used in U.S. schools. Electronic Learning, 7(8), 16.

Torkelson, G. M. (197?). AVCR--One quarter century: Evolution of theory and research. AV Communication Review, 26(2): 174-185.

U.S. Congress, Office of Technology Assessment. (1988). Power on! New tools for teaching and learning. Washington, DC: U.S. Government Printing Office. ED 295 677.

Webb, E. J., Campbell, D. T., Schwartz, R. D., & Sechrest, L. (1966). Unobtrusive measures: Nonreactive research in the social sciences. Chicago: Rand McNally.

Young, M. J. (1988). What is educational technology research, who is doing it, where and how. (Unpublished paper, Syracuse University).