1996

Educational technology: a review of the research

Ann Thompson

Michael R. Simonson

Connie Hargrave

Follow this and additional works at: https://lib.dr.iastate.edu/edu_books

Part of the Educational Assessment, Evaluation, and Research Commons, Educational Methods Commons, Educational Technology Commons, Higher Education and Teaching Commons, and the Instructional Media Design Commons
Educational Technology
A Review of the Research
Second Edition

by
Ann D. Thompson
Michael R. Simonson
Constance P. Hargrave

College of Education
Iowa State University
Ames, Iowa
1996

The costs for the development and publication of this document were funded by:
FINE: First in the Nation in Education
Iowa's Education Research Foundation
and by
RISE: Research Institute for Studies in Education
The research institute for the College of Education, Iowa State University
# Table of Contents

**Preface** ........................................................................................................................................... v  
**Introduction** ................................................................................................................................. 1  
Definitions ........................................................................................................................................ 2  
**Theories, Research, and Educational Technology** ................................................................. 5  
Introduction .................................................................................................................................... 5  
Process Theories -Systems and Communication Theory ......................................................... 5  
Learning Theories -Behaviorism, Cognitive Theory & Constructivism ................................ 10  
**Background—Educational Technology Research** ..................................................................... 17  
Introduction .................................................................................................................................... 17  
Evaluation Research ...................................................................................................................... 17  
Media Comparison Studies ........................................................................................................... 18  
Intra-Medium Studies .................................................................................................................... 20  
Aptitude Treatment Interaction Studies ....................................................................................... 20  
Innovative Research Designs ........................................................................................................ 23  
Summary and Conclusion .............................................................................................................. 24  
**Research Reviews** ...................................................................................................................... 25  
Introduction .................................................................................................................................... 25  
Research on Audio ........................................................................................................................ 25  
Research on Still Pictures ............................................................................................................. 28  
Research on Films ........................................................................................................................ 31  
Research on Television .................................................................................................................. 35  
Research on Computer Based Learning (CBL) ........................................................................... 40  
Research on Hypermedia/Multimedia ............................................................................................ 51  
**Educational Technology and Attitude Change** ...................................................................... 57  
Introduction .................................................................................................................................... 57  
Design Guidelines .......................................................................................................................... 58  
Summary and Conclusion .............................................................................................................. 62  
**Summary and Conclusion**  
Research, Theory, and Educational Technology ........................................................................ 63  
Introduction .................................................................................................................................... 63  
Summary of the Research -What it Tells Us .............................................................................. 63  
Recommendations for Future Research ....................................................................................... 64  
**References** .................................................................................................................................... 67
Educational Technology: A Review of the Research, 2nd Edition was written with the teacher, trainer, graduate student, professor, and media specialist in mind. It provides a brief, yet comprehensive, overview of the theories and research that support the use of technology in teaching and learning. In addition to including a historical perspective on the research and theory foundations of the profession of educational technology, Educational Technology: A Review of the Research, 2nd Edition presents current research that constitutes the basis for use of newer technologies. Specifically, this book includes:

- current definitions of the educational technology terminology used by researchers;
- an overview and discussion of the influence of behaviorism, cognitive theory, constructivism, communication theory, and system theory;
- a summary of the evolution of educational technology research and theory building;
- reviews and summaries of research on the production and use of media;
- summaries of research on attitude formation and change;
- over 200 references that represent the foundation of research and theory in educational technology.

Educational Technology: A Review of the Research, 2nd Edition is an essential reference for those who want an overview of the research and theory related to educational technology. It was reviewed by members of the Research and Theory Division of the Association for Educational Communications and Technology, and their comments were used to insure accuracy. Educational Technology: A Review of the Research, 2nd Edition is a tool for those interested in research on the impact of technology in teaching and learning. This edition was revised by Mary Anderson based on comments from users.

Michael R. Simonson
Iowa State University
Ames, Iowa
1996
Introduction

"Whenever you have found a medium or set of media attributes which you believe will cause learning for some learners on a given task, ask yourself if another (similar) set of attributes would lead to the same learning result. If you suspect that there may be an alternative set or mix of media that would give similar results, ask yourself what is causing these similar results. It is likely that when different media treatments of the same informational content to the same students yield similar learning results, the cause of the results can be found in a method which the two treatments share in common... give up your enthusiasm for the belief that media attributes cause learning (Clark, 1994, p. 28)."

In an article with the provocative title, "Media Will Never Influence Learning" (1994) Richard Clark rejoined the media effects debate that has raged in the field of educational technology for decades. Clark’s article was the cornerstone of an issue of the journal Educational Technology Research and Development (ETR&D) that attempted to clarify the discussion about media effects and learning. Clark reiterated a long-held position that the research literature clearly demonstrates that media do not determine learning.

On one side of the media effects issue are those such as Clark who advocate the following position. Educational media alone do not influence the achievement of students. Media permit the delivery and storage of instructional messages, but do not determine learning. Researchers who have attempted to demonstrate the superior influence of educational technologies on achievement have been unsuccessful. On the other hand, researchers who have attempted to identify the appropriate techniques of message organization and the correct process of instructional delivery with technology have been more in the mainstream of what is appropriate. Researchers who in the past designed experiments that compared one medium to another realized that they did not report usable results. Researchers who studied how mediated messages were designed and how technologies were used in teaching have published an important collection of practical and generalizable recommendations. Clark and his proponents are adamant about the lack of media influence on educational outcomes. Other researchers feel that Clark’s position is wrong.

In 1983 in the Review of Educational Research, a prestigious journal that reports educational research, a paper by Clark was published that articulated what many now agree was the best summary of the previous seven decades of media research. This paper became one of the most widely cited references of the following decade, and clearly was the force behind a rethinking of research on and about educational technology.

Clark’s argument was not widely accepted at first, and was the focus of a series of rebuttals that amounted to one of the most interesting continuing controversies ever reported in educational technology literature. Many media practitioners who had a professional interest in demonstrating the superiority of mediated instruction were stunned to read that the research indicated that instructional media were not inherently “better,” and many media researchers were disappointed to learn that their research efforts seemed to have been wasted.

At the heart of the 1993 Review of Educational Research article was an analogy that clearly established the theme of the entire paper, and which became the clarifying argument of the media effects debate. Clark, a respected technology researcher, later said that the fervor created after the publication of his paper demonstrated to him the power of an analogy. Clark stated that:

"The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than
the truck that delivers our groceries causes changes in nutrition...Only the content of the vehicle can influence achievement (Clark, 1983; p. 445)."

Clark then went on to convincingly substantiate his argument that media were not superior, but were techniques for message storage and delivery. Efforts to prove otherwise, Clark argued, were ill-conceived at best, or ignorant at worst. Clark's argument was so articulately presented and persuasively argued that there was a rush to read his entire paper.

Since 1983 a number of counter-attacks have been published in educational technology journals (Petkovich, M. & Tennyson, R. 1984; Kulik, J., Kulik, C., & Bangert-Downs, R., 1985; Cunningham, D. 1986). Robert Kozma (1994) presented one of the most convincing arguments when he stated that the field should move to a study of ways the capabilities of media can be used to influence learning of particular students for certain tasks and in specific situations. Kozma offered an interesting analogy of his own. He compared media, especially computer based systems, to buildings in which various activities can take place. The configuration of the building, such as its size and construction, make some events more likely to occur, and others less likely. For example, it may be possible to play basketball in a media center, but not as efficiently as in a gymnasium. Similarly, some media are more appropriate for some educational activities.

During the last decade, Clark's premise about the relationship between educational technology and learning has become a widely accepted foundation on which to develop an understanding of media effects. It is not universally, or even widely, accepted, but the logic of the argument helps define what the literature says about educational technology.

Since 1983, increasing numbers of researchers have recognized that media comparison studies are inappropriate, and that research efforts should be based on a new set of questions. For example, researchers have begun to design cost effectiveness and cost benefit studies, and media attributes and symbol systems have become central to experiments reported by others. Theory based and theory building research studies have always been considered central to appropriate scientific inquiry. Unfortunately, as Clark pointed out, many comparison studies of the last few decades ignored the importance of theories. Researchers either did not relate their studies to a theory, or they misinterpreted or misapplied what they thought was a theory. For example, many researchers thought Edgar Dale's (1946) Cone of Experience was the basis for an approach they called Realism Theory. Since the Cone of Experience listed media on a continuum from abstract to real, researchers attempted to demonstrate that media in the lower, more realistic levels of the Cone were "better." Actually, the Cone was not a theory. Rather, it was merely proposed by Dale as a way to logically organize media types. Researchers used Dale's scheme incorrectly, and while a number of studies based on it were interesting, they did not really improve on what was known about educational technology.

The following pages will explain a theory and research base that supports the effective and efficient use of educational technology. The theories presented are not the only ones that provide direction to media research. They are probably the most important. Systems and Communication Theories have been used to explain the relationships between the elements of instruction when media are used. Behaviorism, Cognitive Theory, and Constructivism have been proposed by psychologists who have attempted to explain how learning occurs. These theories do not motivate researchers to try to identify the "best" medium. Rather, they provide direction for investigation of the processes and techniques for effective teaching and learning with media.

Definitions

In 1994, the Association for Educational Communications and Technology (AECT) published Instructional Technology: The Definitions and Domains of the Field. This book updated and clarified the terminology used in the field and attempted to establish a foundation for clear discourse by researchers and practitioners. Instructional technology (IT) was defined as "the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning." Instructional Technology was preferred by the authors instead of Educational Technology (ET) because IT was considered to be more widely used in the United States, it encompassed many practice settings, described more precisely the function of technology in education, and allowed for an emphasis on both instruction and learning. The authors did conclude by saying they considered IT and ET to be generally synonymous.

The 1994 publication replaced one from 1977 that defined educational/instructional technology
as a "complex, integrated process involving people, procedures, ideas, devices, and organization for analyzing problems and devising, implementing, evaluating, and managing solutions to those problems involved in all aspects of human learning." This definition was based on the Domain of Educational Technology (Figure 1), which clarified the components of the process of educational technology.

Several related terms have also been defined. "Technology in education" was defined as "the application of technology to any of those processes involved in operating the institutions that house the education enterprise, including the application of technology to finance, scheduling, grading, and other processes that support education." Technology in education is not the same as educational technology.

Several concepts implied by the definitions of educational and instructional technology require clarification. ET and IT refer to considerably more than devices. Rather, the definitions concentrate on a process that may use devices. Those who practice educational technology and those who do research related to educational technology are interested in much more than things. They are most concerned with the process that produces learning. Also, educational technology is not synonymous with educational computing. There is a disconcerting tendency by some to equate the two terms. Educational computing is a subset of educational technology. The concepts of Systems Theory, which will be discussed below, are the foundation for systematic processes, and while several models for applying systems theory to education have been proposed by media practitioners, they are generally explained by Systems Theory (Bertalanffy, 1968).

In the next section, the basic theories influencing research in educational technology are summarized. Following that is an overview of the basic types of research conducted in educational technology and an overview of current and future directions in the area. In the next section of this monograph, research in each of the basic areas of educational technology is reviewed; these areas are audio, still pictures, film, video, computer based learning, and hypermedia/multimedia. In one sense the newest area of educational technology, hypermedia, combines research findings from all the other areas and emphasizes the interconnections of these areas and findings. Research on the use of educational technology for changing attitudes is contained in the next-to-last section. The final section of the monograph summarizes the major findings identified and provides directions for future research in educational technology.

Figure 1. Domain of Educational Technology

<table>
<thead>
<tr>
<th>Educational Management Functions</th>
<th>Educational Development Functions</th>
<th>Learning Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization Management</td>
<td>Research-Theory</td>
<td>Message People</td>
</tr>
<tr>
<td></td>
<td>Design</td>
<td>Materials Devices</td>
</tr>
<tr>
<td></td>
<td>Production</td>
<td>Devices Techniques</td>
</tr>
<tr>
<td></td>
<td>Evaluation-Selection</td>
<td>Settings</td>
</tr>
<tr>
<td></td>
<td>Logistics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Utilization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Utilization/Dissemination)</td>
<td></td>
</tr>
</tbody>
</table>

Learner