

## **Educational Technology and Learning Effectiveness**

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*Abstract: As teachers and educators, we have too often focused on instant gratification: are scores higher than last year? Are students meeting minimal standards? But that is not the big picture. Our ultimate goal is to make students productive, employable adults. The purpose of this article is to explore a different view of learning effectiveness, and examines the relationship between technology, pedagogy, and learning outcomes.*

*Keywords: educational technology, learning effectiveness*

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### **1. INTRODUCTION**

Ever since Clark (1983) opened up the question of the effectiveness of media, and the controvertible results of empirical scrutiny, researchers have disputed whether the use of educational technology has resulted in effective learning outcomes. The query involves such diverse concepts as the cost effectiveness of the hardware and software, whether specific learning objectives are met or exceeded, and, inevitably, whether the ephemeral  $p=.05$  has been established.

### **2. EDUCATIONAL TECHNOLOGY: THE GREAT DEBATE**

Researchers have made the claim that, in comparison to the traditional classroom, technology has the potential to improve instruction. For example, in comparison to the traditional classroom, well- designed computer-mediated instruction has been said to improve student scores and attitudes toward learning, and decrease learning time (Baker, Hale, & Gifford, 1997). Okolo, Barth, and Rieth (1993) claim that computer technology effectively improves academic achievement, motivation, and time-on-task, provided that positive outcomes have been demonstrated by objective measures. And Massy and Zemsky (1995) noted that information technology allows for repeated access to large amounts of material at low cost.

Teachers at the forefront of computer use in instruction told McGrath (1998) that in classrooms with computers, students were more motivated, showed more persistence in solving problems, and demonstrated improved oral and written communication.

But not all researchers are in agreement that educational technology is a panacea. In a call for further research, Jones and Paolucci (1998) reviewed over 800 journal articles searching for direct empirical research that supports the claims of published authors. Their conclusion was that researchers have not yet clearly demonstrated quantifiable learning outcomes that can be achieved and sustained through technology adoption.

Clark (1983, 1994) claims that media will never influence learning. His argument is that any advantage is vulnerable to rival hypotheses: (1) the effects of content differences between instructional methods – with and without media - were not controlled, and therefore the medium was not necessarily the cause of any significant effect, (2) the novelty effect caused temporary improvements in learning (i.e., a learning method that is new will automatically be more exciting, and therefore temporarily elicit significant increases in learning), and (3) it is the method of instruction, not the media, that fosters learning.

Before examining rival explanations to Clark's remarks on the influence of media, it is important to note that his initial evidence is based on an examination of the literature prior to 1983. The state of technology and related instructional resources has metamorphosed into user-friendly, graphical interfaces that were undreamed of even in the late 1980's. Attempting to compare Clark's evaluation of pre-DOS technology with today's ubiquitous Pentium or Apple PowerBook is the equivalent of comparing the capabilities of a Model T to a Ford mini-van - it is patently absurd.

Since the appearance of the initial article in 1983, Clark's claims have been hotly debated in the literature (e.g., Bagui, 1998, Kozma, R. B. 1991). Kozma argues that media stand out through their cognitively relevant characteristics such as symbol systems and processing capabilities, thereby enabling students to process information more effectively, and understand it more fully. Bagui also found that, contrary to Clark's belief that media do not influence learning, because multimedia allows guided discovery, student involvement in learning is increased, understanding is greater, and the intrinsic features of the computer (e.g., immediate feedback, animation, and individualization) are more likely to motivate students to learn. In an interesting twist to McLuhan's observation that "the-medium is the message", Kearsley, Lynch, and Wizer (1995) found that on-line activities, specifically, classes taught via distance education, had higher student satisfaction, the same or higher grade point average, and often more discussion among students and instructors.

In a discussion of research on the World Wide Web and its use in the classroom, Windschitl (1998) asserts that there is not enough research examining critical questions such as how the Internet is helping students, or how technology is changing pedagogical practices. Although his goal is to encourage the research community to critically examine the medium's influence, he stops short of disparaging its usefulness. While Windschitl agrees with Clark's (1983) suggestion that the computer is 'just another medium', he acknowledges that the web appears to be reshaping the world as it creates virtual communities. For Windschitl, it appears that the question still remains to be answered: does media influence learning? And he is willing to beg the question, unlike Clark: if it does, how?

### **3. LEARNING OUTCOMES VS. LONG TERM CONSEQUENCES**

Clark (1983) has made the claim that equal learning outcomes are possible with or without technology, as long as the underlying pedagogy is sound. Jones and Paolucci found no empirical evidence in a wide range of research to support the notion of effective learning outcomes with the use of media. Windschitl questions the effectiveness of the World Wide Web. So, is the massive investment in technology in our nation's schools a waste of money? Absolutely not!

While the debate has raged over whether technology has been significantly more effective than traditional methods, no one has claimed that technology has actually decreased learning outcomes.

And therein lies the decisive factor: technology does not do any harm to the learning process, and there are benefits that are not directly measured by specific learning outcomes. Woodrow (1998, p5-6) perhaps summed it up best when she said: The question whether computer technology should be in the classroom is about as sensible as questioning the wisdom of Gutenberg's invention: if it is accepted that all humans, rather than a self-selected few, must have access to all knowledge, then the technology essential for access must also be understood and taught - and it is not taught by classes describing the complexities of machinery: it is taught by the direct application of the computers to the learning requirements of the subject.

Our job as educators is more than just to educate. It is to prepare students to be capable, productive citizens when they graduate. As far back as the early eighties, researchers were predicting that many jobs in the 21st century will require computer knowledge, and unskilled members of the workforce will be at a disadvantage (Fary, 1984). Davis (1997) found that current employers have a high expectation of computer literacy in college graduates. Desired skills range from word processing, spreadsheet and database knowledge, to programming and Internet publication. The net result is that future employees will either be able to work with technology, or be replaced by it.

### **4. EDUCATIONAL EQUITY**

An interesting question that arises when discussing technology is the distribution of funds to those who need it most. Even if learning outcomes are identical with or without technology, if computers are not placed in schools for all students, only those students whose families provide them access will develop the necessary skills to compete in a technological world.

According to Kohl and Witty (1996), disadvantaged students should receive more educational funding to decrease the gap between their academic achievement level and that of the average U.S. student. Yet careful inspection of educational practices reveals large gaps between schools. At-risk students do not receive the same kind of opportunities as socially and economically well-off students (Crosby, 1993). If we are to avoid a next generation of "haves"

and “have-nots”, we must provide technology in schools to maintain some level of equity for disadvantaged students.

## **5. TECHNOLOGY AND SELF-EFFICACY**

A summa-cum laude student who is technophobic is potentially unemployable. The days of secretaries taking dictation are over, and even fast-food vendors use computer-operated cash registers. It is the role of educators to give students the knowledge they need to succeed. Knowledge today goes beyond rote learning and test performance. It includes the ability to search for information with all available media, to utilize technological tools to accomplish a variety of tasks, and to display their concepts and ideas in three-dimensional form using multimedia. To do this, students must be self-efficacious in the use of computer technology.

Self-efficacy theory is based on the supposition that psychological assessments afford a means of forming and/or strengthening expectations that one can achieve an outcome (Bandura, 1989). Personal efficacy expectations regarding the use of computers are based on four sources of information: performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal (anxiety producing situations) (Olivier & Shapiro, 1993). Performance accomplishments will raise self-efficacy to the point where it is taken for granted, and occasional failure then will mean much less to the student. Second, students who fear technology may benefit from observing others. Vicarious reinforcement will occur if students observe peers and the instructor successfully performing tasks on the computer. Third, instructors can use verbal persuasion to encourage students, though Olivier and Shapiro point out that verbal encouragement alone is not enough to develop and maintain self-efficacy. Finally, avoiding anxiety producing situations, such as putting a student in a situation where they cannot be successful, will maintain self-efficacy, if it (self-efficacy) is developed using the other three types of interventions.

In other words, in order to build a student’s self-efficacy in the use of computers, so they will be capable of utilizing them successfully beyond school, we must give them the tools in school. Computers in the classroom will provide additional benefits to students beyond immediate “learning effectiveness”: first, students will develop self-efficacy in the use of technology - critical to future employment; second, they will be able to observe others using technology successfully and gain a deeper understanding of its importance and usefulness; third, anxious or computer-phobic students will have the opportunity to face their anxiety in a safe environment, and through the instructor’s verbal persuasion and emotional support may be able to avoid worse anxiety producing situations in the workplace.

## **6. IMPLICATIONS**

Researchers should never concede the quest for alpha: empirical evidence is the scientific method, and a critical source of valuable information to guide policy. However, the definition of outcomes must also be carefully examined before condemning a method as not a significant

improvement or not cost effective. Therefore, in deference to Jones and Paulucci, who suggest that researchers use formal experimental methodologies to demonstrate quantifiable learning outcomes, the consequences of that research alone could be substantially detrimental to the state of education if the bigger picture is not considered.

We must establish a level of research that identifies long-term outcomes, and tests the results of the teaching/learning process involving technology on the success of our graduates. This is not a study that can be done in one semester, one year, or even two. But the foundations of the research must be laid now, before too many administrators, taxpayers, and politicians see the results of studies that demonstrate “no significant difference” between students who learn with a teacher, blackboard, and chalk, and students who had the benefits of multimedia technology. If not, we may do irreparable harm to our educational system before we realize it.

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