DOCUMENT RESUME

ED 405 860 IR 018 310

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TITLE	Surprised by Technology: Unanticipated Outcomes of Technology Implementation.
PUB DATE	97
NOTE	7p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, March 24-28, 1997).
PUB TYPE	Reports - Research/Technical (143) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Classroom Research; *Classroom Techniques; *Computer Assisted Instruction; *Educational Technology; Elementary Secondary Education; Interaction; *Outcomes of Education; Problems; Program Implementation; Student Reaction; Teaching Methods
IDENTIFIERS	*Technology Integration

ABSTRACT

Because the disadvantages of technology implementation are not foreseen, they are often referred to as "unanticipated outcomes." Identifying side-effects is important because their negative effects are amplified when they arise without warning. This paper communicates the importance of unanticipated outcomes in educational technology settings, through a variety of examples collected over a decade of technology implementation evaluation in elementary and secondary educational settings. The Concerns Based Adoption Model (CBAM) indicates that teachers implementing an innovation are initially most concerned about their own interaction with the innovation and only later do they shift more of their concern to the students; this can result in many of the "teachable moments" being lost because the teacher was not part of the interaction. Because the teachers were often distanced from the computers while the students used them, their estimation of students' skills was often inaccurate, usually too high. Teachers who were distanced from their students' computer use were usually not aware of the amount of time the students spent on any one program. As a result, many students would switch computer programs as one might switch TV channels. Sometimes software features can be the source of negative side-effects, when students ignore the task at hand or the instructional material. (AEF)

SURPRISED BY TECHNOLOGY: UNANTICIPATED OUTCOMES OF TECHNOLOGY IMPLEMENTATION

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Paper presented at the Annual Meeting of the American Educational Research Association, March 24-28, 1997, Chicago, IL.

1 Introduction

According to Neil Postman (1995), "All technological change is a Faustian bargain. For every advantage a new technology offers, there is always a corresponding disadvantage."(p. 193) Because the disadvantages are not foreseen, they are often referred to as "side-effects" or "unanticipated outcomes." Identifying side-effects is important because their negative effects are amplified when they arise without warning. Strictly speaking, side-effects can be either positive or negative, but are usually seen as the latter. An exception to this rule comes from the experience of Michael Scriven (1974), who found "a product finished up in the 'top ten' in spite of zero results with respect to its intended outcomes because it did so well on an unanticipated effect." (p. 34) Scriven (1991) writes, "Side-effects identification presents a methodological problem in that evaluators are usually cued to find the intended effects and their clients are usually much more interested in progress toward the intended effects." (p. 331) His solution is "goal-free evaluation," in which the evaluator is not informed about project goals until after the evaluation is completed, or nearly complete (Scriven, 1974). In current practice, side-effects may be lost for many reasons, such as a limited study design, the focus of the study on certain fixed dimensions, or the resulting reports omit those results outside of the "main stream" of interest. The purpose of this paper is to communicate the importance of unanticipated outcomes in educational technology settings, through a variety of examples collected over a decade of technology implementation evaluation.

Data Sources

Since 1987, our research team has studied government policy and the adoption of computers in schools. We began when a suburban Toronto school board, having set a long-term goal of (a minimum of) three computers in each of its classrooms, asked us to evaluate a JK-8 pilot site. Our role in this study, observing classroom practice, led to a three-year investigation of the bilateral relationship between educational policy and practice, including the Ontario Ministry of Education, three Boards of Education, and more than a dozen classrooms. A variety of analyses have been carried out on different portions of the resulting textual database.

Observed Outcomes

Monitoring Student Use

The Concerns Based Adoption Model, or CBAM (Hall, 1975) is one approach to implementing innovations and can serve as an organizer for this discussion. CBAM indicates that teachers implementing an innovation are initially most concerned about their own interaction with the innovation and only later do they shift more of their concern to the students. In one Third grade classroom, the teacher was asked how she monitored the activities of her students at the computers, to which she responded, "Oh, I never monitor what they do at the computers. I believe that whatever they do with the computers is important and valuable." In a Second Grade classroom, we saw a teacher make several tours around the room, monitoring all of his students as they worked on a variety of tasks, but ignoring the two students who were using the computers. This was unfortunate, because they were consistently unsuccessful in copying text into the word processing program. After 45 minutes, one had a blank screen and the other had only a few words. These findings are compatible with those of Blackstock and Miller (1988), who observed 7-year old students using a variety of programs and noted that many of the "teachable moments," times when the student-computer interaction had made the student ready for a new concept, were lost because the teacher was not part of the interaction.

In contrast, we were also surprised to find two "new to classroom technology" teachers were very adept at identifying what their students were doing and what problems they were having. The insightful teachers didn't have computers at home, but both of them had worked in business settings where computers were used (car rental and bank). This experience seemed to make a considerable difference in their ability to "see" what their students were doing.

Distancing Teachers from Technology

Both students and teachers were affected by the distancing of teachers from the technology. Because the teachers were often distanced from the computers while the students used them, their estimation of the students' skills was often inaccurate, usually too high. On the other hand, distancing provided an opportunity for students to be virtual experts. In a first grade class, the teacher told us that one boy was the class expert in using the computers. A few moments later, the boy was called over to a computer where a fellow student was having trouble. The expert tried several keys, but nothing worked and he drifted away. A short time later, the problem was resolved by the student using the computer, but on seeing this, the "expert" informed the teacher that he had fixed it and the teacher accepted his claim at face value.

One should not assume however, that all primary students were deficient in their computer skills. For example, in a Kindergarten class, one student not only gave us a complete and informative overview of the software we were attempting to use, but he also came back later to make sure we weren't having any problems. In another classroom, when a boy was talking to me about his preferences for two programming languages, BASIC and Logo, it was difficult for me to remember that this student was only in the second grade. One first grader had learned the process of animation from watching older boys using computers in the library and became an instructor on animation for his class. Teachers have also used the concept of local expert to good advantage in writing classes, with each student being a source of expertise on one topic, such as quotation marks, or formatting.

Channel Hopping and TV

The computer behavior of teachers and students was in accordance with their own agendas, more so as the distance increased. Teachers who were distanced from their students' computer use were usually not aware of the amount of time the students spent on any one program. As a result, the students would "channel hop," switching computer programs as one might switch TV channels. As teachers became more adept at recognizing what their students were doing at the computers, they often adopted a simple tactic, permitting students to use a computer only when they were able to state a goal and only as long as they continued toward that goal. If the student changed to another program, the teacher would assign the computer to another student.

Of course, not all students tried to channel hop at the computers. Some were very task-oriented and completed one task before moving to anything else. On one occasion, I interviewed two students with vastly different "viewing habits." Not too surprisingly, the student who channel hopped in the classroom, was unable to tell me the complete story from a recently viewed TV program, while the other student was more disciplined both at the computer and with TV, giving me a detailed description of the plot from a recent program. These observations suggest that links between computer and TV behavior might be worth exploring, particularly when viewed in the context of Kubey and Csikszentmihalyi's (1990) findings on TV and the quality of life.

Software Features

We often assume that more features make for better software, but sometimes the features interfere with the intended application. That is, the features can become the source of negative side-effects. On several occasions, we noticed upper-elementary students who were not only using an ornate gothic script for their font, but had also increased the character size so that only a few words filled the screen. In one instance, an argument developed over the spelling of a word because one student couldn't recognize the letters in gothic script.

While considering writing, it is worth noting that the side-effects associated with using word processing, at least among adults, seem to be very personal, suggesting the presence of what might be called "aptitude-feature interactions" (AFI). For example, a number of people have reported a problem in entering a first draft into the word processor. These people are unable to pause in their typing without shifting into "revision mode" and interrupting the flow of their first draft. Some find the act of deleting text to be painful, while others have never experienced either problem and are unable to understand the difficulty. Exploration of these and other AFI's is another promising research avenue.

Agendas and Features

AFI might also stand for "Agenda-Feature Interaction," as in a writing application, electronic mail, which was a disaster at a school that implemented an internal system. In order to send a message, the student had to first create a message file using the word processor, then switch to the mail program to send the file. Unfortunately, students were more interested in sending messages than they were in writing them. As a result, they used the mail program to send whatever files were in their directory, such as drawings, summaries of math quiz results, etc. The mail system soon became clogged with this "junk mail" and on the few occasions when someone did try to send a "real message," they were often unsuccessful because the mail system had no more space for messages.

In contrast, email between schools, particularly between countries, has been very productive in enhancing writing skills by giving meaning to the communications aspects of writing. One reason may be that students are less likely to send junk mail to students they don't know, but the more likely explanation is that a real writing task, one where information is exchanged, is more motivating.

Students are often very skilled at ignoring the instructional material in educational software. In the "Math Maze" program, some students discovered that you could progress through the maze by only using the return key. It took many repetitions of this key, but eventually the software would give the student the answer to the problem and allow him to proceed through the maze. "Cargo Sailer" was a favorite with many students who ignored the stated task of delivering cargo to a specified (by latitude and longitude) port in favor of sailing aimlessly until the food ran out and the crew starved. These students were satisfied to experience the storm scene, complete with howling winds, and other special effects, returning to the program time after time for this reward. They knocked the "edu" out of "edutainment."

A series of historical simulation programs all used the same format: the student would be presented with a social, political, or economic problem and given 3-4 choices from which to choose. Students spent considerable time studying the problem and the options (time for me to read through it at least three times), but spent little time (too short for me to read it) reading the feedback explaining the positive and negative aspects of their choice. In other words, they spent hardly any time with the part of the program that did the most teaching, leaving only the "tainment."

In contrast, a seventh grade girl, on the verge of being assigned to special education, found in these simulations an environment in which she could excel. She would rehearse her skills by repeating these programs until she mastered all the component tasks, as she proudly demonstrated for me. Similarly, a special education teacher spoke in glowing terms about a simple program that had initially annoyed him, until he discovered that "his guys" could experience success with this program.

Gender and Features

The discussion would not be complete without a discussion of "Gender-Feature Interaction" (GFI). Boys are often competitive and their educational use of computers was no exception. Two boys seated at adjacent computers were entering text into word processors. Their attention was directed at the counter indicating how many lines of text had been entered. They entered large portions of short lines of text, and also many blank lines, as each sought to enter more lines than his competitor. The historical simulations also fed into this competitive streak, providing a multidimensional "score" for each stage, and the boys again focused on the numbers, arguing that the dimension on which they had the highest score was the most relevant.

These specific findings may go out of date quickly for a number of reasons, but many of the underlying principals are probably alive and well (Ragsdale, 1988). It would not be surprising to find that students are still skilled at isolating the instructional component from the entertainment. It is also quite likely that students' habits from their out of school activities, particularly TV, are also a big factor in their school use of computers. As we continue to increase the use of technology in classrooms, we must continue to seek out and identify the unanticipated outcomes, so that we can refine our approach to technology and thereby enhance our students' benefits from technology. Our goal should be to change beneficial unanticipated outcomes to anticipated outcomes, while changing the negative unanticipated outcomes to unrealized outcomes.

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