Student Engagement: Views from Technology-Rich Classrooms

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Abstract

Student engagement, an important link to learning, is easy to recognize but difficult to define operationally. Many researchers use "time-on-task," a measurement made by outside observers who watch randomly selected students for short periods. This study, using self-report data from 32 elementary and secondary teachers whose students used technology in an ongoing basis, suggests a different way of measuring engagement. It also challenges the commonly held belief that students' engagement with technology is merely the result of novelty. And it provides guidelines for the classroom use of technology that are necessary to achieving an enduring and positive impact on student engagement.

Introduction

Engagement is difficult to define operationally, but we know it when we see it, and we know when it is missing. Students are engaged when they devote substantial time and effort to a task, when they care about the quality of their work, and when they commit themselves because the work seems to have significance beyond its personal instrumental value (Newmann, 1986, p. 242).

Despite being difficult to operationalize, student engagement is recognized by teachers and researchers alike as an important link to student achievement and other learning outcomes (McGarity & Butts, 1984; Capie & Tobin, 1981; Fisher, Berliner, Filby, Marliave, Cahen & Dishaw, 1980). Studies have been conducted investigating how variables such as teacher management styles (Tobin, 1984), student grouping (Anderson & Scott, 1978), instructional activities (Delquadri, Greenwood & Hall, 1979), and even the day of the week (Cornbleth & Korth, 1979) affect student engagement.

The difficulty researchers have had in operationalizing student engagement has led many to adopt “time-on-task” as a proxy measure for engagement. Time-on-task researchers commonly use observable behavioral measures—such as whether the student is gazing out the window or looking at the teacher while he or she is talking—to determine students’ rate of engagement. Wilson (1987) states,

For the purpose of observation, on-task behavior can be defined as the time a student spends actively looking at some appropriate instructional object or person. . . If students have their eyes closed or oriented toward a window, door, floor, or a nonparticipating classmate, they are considered off-task. . . Of course, there will be errors. Students who are looking out the window but thinking of math will be judged off-task, while those who are looking at the teacher but daydreaming will be rated on-task. Still, these errors occur infrequently, and they tend to cancel one another (p. 15).

Data collection in time-on-task research often involves observing randomly selected students for five or ten seconds of each minute during a short segment of the school day (McGarity & Butts, 1984; MacArthur, Haynes & Malouf, 1986; Magliaro & Borko, 1986).

In related studies of student engagement, researchers have examined Academic Learning Time (ALT)—a variable that combines time-on-task with student success rate—and its relationship to student achievement. The six-year Beginning Teacher Evaluation Study contends that the amount of time a student spends successfully performing relevant and appropriate academic tasks is positively related to basic skills achievement among elementary school children (Far West Laboratory, 1979). Some researchers go so far as to say that “Academic Learning Time is more strongly related to academic success than any other variable over which the teacher can exercise control” (Vockell, 1987, p. 72).

This apparent connection between time and student achievement has led policymakers in some states to increase the length of the school day or school year with the hope that more time in school will mean higher test scores. In some districts, recommendations have been handed down specifying the number of minutes that students should spend studying each subject area or how many minutes students should devote to homework.

Given this emphasis on time, it is not surprising that the introduction of any innovative teaching technique or tool will be closely followed by studies to determine how the innovation influences time-on-task or academic learning time. Such is the case with the increased use of computers and other technology in classrooms. Researchers have examined how technology influences time-on-task in special education classes (Perkins, 1988; MacArthur, Haynes & Malouf, 1986); in specific subject areas such as mathematics (Bright, 1988), reading (Zuk & Danner, 1986), and English (Latham & Stoddard, 1986); and in a variety of grade levels (Mevarech, 1986; Johnston & Joscelyn, 1989). Results of these studies suggest that technology use has a positive impact on student engagement.

Some researchers contend that increases in student engagement in classrooms with technology result from the novelty of the computers. They propose that student engagement may have been enhanced simply because the computers were newly introduced prior to or during the studies (Fish & Feldman, 1988; Hawkins, Sheingold, Gearhart & Berger, 1982). Even in studies where students had been using computers for one or two years, student access to computers was limited and relatively scarce (MacArthur et al., 1986) and the novelty of using computers may not have worn off.

Unlike previous studies, our research investigated the long-term impact of technology on student engagement in classrooms where students have constant access to a multitude of technologies. In the settings for this study, technology has been an integral part of classroom life for over six years, rather than a novel, add-on feature to the curriculum that students use for a few minutes every week. While the initial interest and enthusiasm that technology generates in students often leads teachers to believe that the simple addition of technology will increase student engagement indefinitely, we wanted to determine whether these changes endure over time.

Our research differs from other studies of student engagement in a variety of other ways. In this study, teachers, rather than outside observers, determined if students were engaged. Unlike outside observers who are forced to make inferences based on brief observations of unfamiliar students, teachers are in the position to know how much time and effort individual students devote to different tasks, and how their level of engagement changes from day to day and from month to month as the academic year progresses.

This study also defines engagement in ways that differ from traditional measures. We consider student engagement to include variables such as initiative, self-motivation, independent experimentation, spontaneous collaboration and peer coaching, and enthusiasm or frustration. In addition, we include not only on-task behavior in the classroom, but also time spent on projects both in and out of the classroom. Finally, this paper differs dramatically from other studies because it examines challenges for teachers that resulted from changes in students' engagement. Teachers were challenged when they had to move students from technology-oriented tasks to other classroom activities, to set appropriate boundaries for assignments, or to respond to students' disruption of their plans.

Settings

This qualitative study utilizes data from 32 elementary and secondary teachers in five schools located in four different states. The ACOT project sites represent the diverse populations and conditions found in contemporary public schooling. ACOT teachers are all volunteers selected by individual school districts. Most participants teaching in ACOT classrooms were experienced teachers who were already teaching within the district, but few had worked closely with technology before joining the project.

Each of these sites began with one classroom per school in the fall of 1986, adding classrooms, staff, and students in subsequent years. Although each site serves students from a variety of grade levels, none of the sites encompasses an entire school.

Table 1 summarizes the status of each site. In each of these settings, students and teachers have constant access to interactive technologies. The elementary classes are equipped with Apple® IIe, Apple IIGS,® and Macintosh® computers. The high school is an all-Macintosh installation. In addition to the computers, classrooms are equipped with printers, scanners, laserdisc and videotape players, modems, CD-ROM drives, and
hundreds of software titles.

Site	Grades	Teachers	Students	Community/SES
1	1–4	8	180	Suburban/High
2	5–6	7	180	Rural/Middle
3	4–6	4	90	Inner-City/Low
4	4 & Sp. Ed.	4	80	Suburban-Urban/Low-Middle
5	9–12	9	120	Urban/Low-Middle

The technology is used as a tool to support learning across the curriculum. No attempt is made to replace existing instructional technologies with computers. By design, the classrooms are true multimedia environments where students and teachers use textbooks, workbooks, manipulative math materials, white boards, crayons, paper, glue, overhead projectors, televisions, and pianos, as well as computers. The operating principle is to use the medium that best supports the particular learning goal.

Data Collection

The sources of data for this study, covering October 1985 through February 1991, include bimonthly audiotapes on which teachers reflected about their experiences, weekly reports sent via electronic mail, and correspondence between sites.1 In addition, we reviewed reports of independent researchers who had observed in ACOT classrooms to investigate the impact of technology on various aspects of learning and teaching. In their reports, we looked for evidence related to student engagement (Baker, Gearhart & Herman, 1990; Phelan, 1989).

Audiotape Journals

Teachers recorded their personal observations of events in their classrooms and their reflections on those events on audiotape, producing on the average two 60-minute tapes per month. Instructions about content on the tapes were left purposefully vague, leaving teachers free to report what was most salient to each of them at the time. These tapes are understood by the teachers to be research data, listened to and indexed by research staff. Since these journals are treated confidentially, teachers often took the opportunity to vent their frustrations and share their triumphs, giving the tapes an emotionally charged quality.

Weekly Reports

The teaching staff at each site wrote weekly summaries of major events and developments. These summaries were electronically distributed among all ACOT participants via Apple Computer’s electronic mail system. The content of these reports was also left to the discretion of the teachers. However, because these reports were publicly aired to everyone connected with the project, they tended to be more self-conscious than the personal, frequently introspective reports contained in the audiotape journals. Often they provided either corroboration of events mentioned in teachers’ journals or revealing contrasts.

Correspondence Between Sites (Site Links)

ACOT teachers communicated with their colleagues at other sites via the electronic mail system. This correspondence was initiated by the teachers and typically solicited or offered information related to different software programs, equipment, or classroom activities.

Methodology

Unlike researchers who attempt to reduce qualitative data to quantifiable codes or symbols, we decided at the outset of this study to use as our data source the actual text information generated in the weekly reports, site links, and audiotapes. To facilitate this, we wanted to develop an indexing system that would direct researchers to episodes illustrating various areas of interest—places where the textual data itself could be studied.

Researchers transcribed all written communications and summarized the audiotapes. To facilitate analysis, narratives were divided into episodes; each episode represents an event, with a beginning, middle, and end. Episodes were indexed for retrieval using a variety of categories and subcategories (e.g., participant, affective tone, context, general theme). The development of content categories was an iterative process and followed the principles of “grounded theory” (Glaser & Strauss, 1967), “progressive focusing” (Hamilton, MacDonald, King, Jenkins & Parlett, 1977), and “collapsing outlines” (Smith, 1978). Over the course of the project, the indexing system was revised and expanded numerous times. For example, during the second year of the project, it became clear that the thematic subcategories in the early coding system were too broad to be useful for detailed analysis, so we decided to further refine and define major categories and subcategories to ease data retrieval and analysis. The indexing system currently being used allows sorting and rapid retrieval of descriptive, qualitative data along a number of dimensions for the construction of reports.

To assess the reliability of the indexing process, one of the researchers conducted a detailed analysis of inter-rater reliability (Keirns, 1990). The inter-rater reliability among nine research indexers was computed on three sample episodes using a formula suggested by Miles & Huberman (1984, p. 63):

number of agreements/number of agreements + number of disagreements

Analysis was made of the agreements among the staff in the selection of each index symbol in the 13 major categories that are indexed in the database. Agreement was computed on the selection of an index as either present or not present. Agreements for each category were averaged and a total overall average of agreements for each episode was computed, yielding results of 89 percent, 91 percent, and 86 percent, respectively. These reliability figures are within the range suggested as satisfactory by Miles & Huberman (1984) for groups of field-workers dealing with similar data, and reflect the effect of considering pooled ratings described by Thorndike & Hagen (1986).

The data have been divided into two databases, which together contain information on more than 20,000 episodes. Double Helix, a relational database, is used to manage and analyze the data. This software program allows data to be organized in a multitude of ways (e.g., by teacher, by school site, by dates, by thematic categories). For this study, 1,707 episodes relating to student engagement were retrieved from the database. These episodes were further analyzed and indexed in subcategories such as changes in student initiative, changes in time spent on projects, etc. Data from all project teachers were included in the analysis.2

Results

The introduction of technology into ACOT classrooms generated an enthusiastic response from both students and teachers, as this quote from Jean, a high school teacher, illustrates:

> Students are answering questions from the board on their computers. . . The attention that they direct to their work compared to the way they did before we had the computers—there's just no comparison. They are much more attentive and enthusiastic. There is almost total silence once they begin work, versus when they were writing everything out. . . I can really see a difference. (AT, 3250, Jean, 10/31/88)

Independent researchers investigating the impact of technology on teaching and learning in ACOT classrooms also commented on changes in student engagement brought about by the use of computers. For example, after observing a second-grade classroom in this project, Phelan (1989) commented:

> It appeared as if children interacted with each other more frequently while working at computers. . . They were curious about what they were doing. They were excited about their own activities and were intently

engaged (p. 1).

Similarly, Baker, Gearhart & Herman (1990) stated, “Observations in some [ACOT] classrooms suggest positive affective impact—e.g., in engagement, commitment, pride in quality. . . “ (p. 34).

Although teachers welcomed increases in student initiative, time spent on projects, experimentation, and on-task behavior, data suggest that students’ enthusiasm for using the technology sometimes led to difficulties for teachers, such as disruption of planned activities, students overstepping boundaries with respect to assignments, and time trade-offs. The remainder of this paper examines these changes in student engagement, describing both the positive aspects and the resulting challenges.

Positive Changes in Student Engagement

Changes in Student Attitude

Early in the ACOT project, teachers noted the marked enthusiasm of their students when working with the computers. Teachers described the students’ excitement, their awe at learning new software programs, and their disappointment at not having more time on the computers. One elementary teacher compared a new piece of software to a new Christmas toy—with children nagging until they got to use it.

This high level of enthusiasm held a number of benefits for both teachers and students. Students learned more quickly when they were anxious to learn, and their interest reinforced the teachers’ efforts. After commenting on students who were “ecstatic” and “absolutely beside themselves,” one teacher reflected: “Their enthusiasm is well worth the effort it [setting up a file server] has taken.”

The teachers naturally made comparisons with the attitudes of their students before the addition of computers to their classrooms. For example, a high school teacher commented about how his students’ interest and motivation typically extend into the last week of school—an uncommon occurrence before the ACOT project began. Over the six years of the project, he remembered only two or three instances where students turned in their home computers a few days early. The majority of the students in the ACOT project—including seniors who had been using computers for their entire high school career—kept their home computers until the last possible day.

A teacher reported that some elementary students requested a make-up session for a day when a field trip caused them to miss a computer club session. Another teacher noticed differences in students' journal entries: one student described spelling as "fun" and another declared, "A computer a day keeps the blues away."

A high school teacher, putting together a course in computer applications, hoped that about 10 students would sign up; he wound up with a class of 34. After writing some music on a synthesizer with three students during study hall, another high school teacher found that "it became a desirable thing for students to work on the synthesizers during study hall." The comment by an elementary teacher probably sums it up best:

The students don't get tired of working on the computer. They actually ask for things to do. In all of my years of teaching, I never had anyone ask for another ditto. (AT, 3770, Steve, 3/17/88)

When given the choice, students began to choose the computer over pencil and paper for writing assignments, test-taking, and even artwork. Teachers also found students more willing to edit their written work. Teachers expressed particular pleasure when students eventually began to edit on their own, making changes spontaneously.

The enthusiasm of individual students motivated other students in the class. For instance, a fourth-grade student who had finished his work asked to use a disk that he had found on a shelf. It turned out to be a mathematics program on multiplication that the teacher had never previewed. Before long, the teacher had a large group of students eager to "get their hands on it." The motivational power of peers exceeds that of teachers. In the words of another elementary teacher:

It's incredible—you get a few people who seem to pick it [Logowriter] up and think it's great and all of sudden, the whole class does. (AT, 4760, Steve, 9/17/90)

A number of students in the ACOT classrooms turned their enthusiasm into financial gain. Through their work on the computers, they developed talents and skills that led to jobs in the community. For example, a sixth-grader was asked to devise a data system for his town's bank. High school students were hired to design templates for community businesses because of their knowledge of spreadsheets, word processing, and desktop publishing. One corporation offered summer jobs to project students and was interested in conducting job interviews with any of the students who did not plan to go to college. In another community, the Center for Science and Industry wanted to hire students to help build a simulation for a “Mission to Mars” project.

The fascination with the computers extended to students not involved in the program. At an elementary school, teachers frequently discovered various first-grade students “on their knees, peering into the computer classroom.” The site coordinator assumed that the children were intrigued by the male teacher, one of only two in the entire school. However, after questioning some of the “peeping toms,” she learned that it was the computers attracting their attention.

Changes in Time Usage

As students became involved in working on the computers, the time they spent on assignments and projects often increased. Teachers discovered, for example, that the 30 minutes they had allotted for an activity stretched into an hour or even an entire afternoon. As a teacher summarized, “Once you get something that piques everyone’s interest, you let them run with it.” One teacher reported even running over into another teacher’s class time, explaining, “I just couldn’t cut them off.”

Moreover, when given free time, the students chose to work on the computers rather than on other activities. As one parent of an elementary student observed, the children never seemed to be able to work on the computer for as long as they wanted. In fact, in a second-grade classroom, students asked for more time on the computer following a Halloween party.

In some classrooms, students also came in before and after school, and stayed through recesses and lunch periods, to work with the technology. Teachers discovered that, whereas their students had previously been anxious for school to end, they now voluntarily requested to stay after school.

We are using some cooperative software now that the kids love. When we use it toward the end of the day, the kids don’t want to go home. That didn’t happen in a traditional classroom. (AT, 12350, Mike, 1/4/88)

At one site, after a number of indoor recesses due to rain, students became upset when the teacher announced outside recess. When questioned about their response, the students indicated that they had hoped to stay in and work on the computers.

Teachers also found it unusual that students would stay after school for questions and activities related to instruction rather than the more typical extracurricular activities. For example, one high school teacher indicated that she had never been at a school where students were interested in coming in after school or during their study hall periods to do work. “What I have experienced is students getting out of study hall to play.” Another teacher describes an incident where a high school student engaged a visiting researcher in conversation about Pascal.

Tim is not one of the designated students for the research, but Tim stayed after class when the researcher was here recently just to talk to him about Pascal. Do you know how unusual it is for a student to stay after class to discuss content? (AT, 2569, Carl, 1/29/88)

Based on their previous years of experience in classrooms, teachers viewed the students’ degree of commitment and engagement as “unusual in a group of quite ordinary kids.” As one teacher commented,

We’ve had a great time using LegoLogo! The kids are extremely enthusiastic and productive. I needed to go to a lunch meeting today, and they didn’t want me to go because they were still working and wanted to know more. How often do you see kids working through lunch? It’s fantastic! (AT, 6669, Steve, 1/14/88)

At some sites, before-school sessions eventually became formalized. One site coordinator pointed out that 24 out of 27 elementary students faithfully came to school one hour early each morning to provide time “to work in all of the things we want to do.”

A number of parents also commented to teachers about the amount of time their children spent working on the home computers. Parents expressed pleasure that the computer could lure their children away from the television. The comments of the following parent typify their responses:

Since this class has been in existence, John has . . . a phenomenal interest in computers. Instead of wanting to always watch television or go outside and play, John can be found at his computer a large part of the time trying to learn more and more about programming. (SL, 110729, Tim, 1/7/87)

Changes in On-Task Behavior

Teachers reported that students' enthusiasm and interest resulted in more on-task behavior. They found that, during computer activities, students were highly involved in their assignments and frequently able to work with little assistance. Teachers sometimes expressed surprise at the level of students' interest. As several teachers reflected,

> I am absolutely amazed as to what they are doing and getting out of it [health project]. They're on task most of the time. It's a good example of what can happen if the right motivation is offered to kids to work. (AT, 2556, Rita, 4/20/90)

> This was probably the first time I've ever seen a whole group of students with actually every student on task and excited about their learning. (AT, 12271, Frank, 12/18/87)

A high school teacher who taught both "regular" ninth-grade classes and the technology project ninth-grade classes described the differences she observed in students' behavior.

> The ninth-grade classes I teach are entirely different; they are like night and day. The project students are constantly working. They always have the computers on. They always want to see their work right away. I have never seen students who want to work so much. (AT, 1845, Mary, 9/16/88)

Another high school teacher, amazed at how industrious his students were right before Christmas break, pointed out that "these aren't extraordinary kids; they're 'average' high school kids." At the end of the school year, when most teachers were winding down and gathering materials, teachers in the project classrooms were still beginning new activities. According to an ACOT coordinator at one of the elementary schools, "The students showed no signs of quitting either, so the education process just kept humming along."

Visitors and substitutes also commented on the students' interest and engagement. For instance, a visitor to one of the high school classrooms noted that he saw some students doing five things at once and still paying attention. Other visitors seemed surprised that the students stayed on task with strangers roaming through the classroom. One substitute teacher made the following comparisons between ACOT science classes and regular applied science classes:

All students in the project classroom were aware of what they were supposed to be doing. Their attitude was positive and they showed, in many ways, that they were following the algebra lesson AND had a high interest in what they were doing. They kept their level of effort up for the whole period. . . . The same attention span is not evident in the regular science classes. . . . In the regular class many had trouble just concentrating on what they were doing. The interest level was just not there in doing their assignment. Most were unable to complete the entire assignment. If they didn't get the answer, they just left it blank. In the project class, the questions the students were asking each other had to do with the lesson, while during the regular class, at least half the questions were social or something outside the lesson. (WL, 10259, Paul, 2/16/87)

Teachers also discovered that students who did not do well in a typical setting frequently blossomed when working with the technology. "Low achievers" had a chance to experience success and began concentrating and applying themselves to their projects. In some cases, particular computer projects sparked these students' interest and tapped a hidden skill. For example, two high school students "who are noted as low achievers by everyone, including the students" got turned on by a robotics project and "worked seriously all the time." Some fourth-grade students "who do not usually receive as much recognition as others have proven to be very good at solving multi-stage problems." A first-grade student "who is low to average on academics is a whiz at word processing and finished all 21 lessons of that program today." In a fourth-grade classroom,
a student "who doesn't do well in many courses is a whiz at patterns, and he was the only one to figure it out."

As teachers viewed these students in a new light, they provided more praise and encouragement, both privately and publicly. Moreover, other students in the class treated them differently. For instance, the fourth-grade student referred to discovered that the other students in the class spontaneously clustered around his computer, cheered him on, and marveled at his accomplishment. The teacher subsequently provided him with a certificate for being the first to complete the assignment.

Changes in Student Initiative

Increases in student initiative occurred in two ways. First, many students went beyond the requirements of their assignments. For example, high school chemistry students developed a spreadsheet to do the calculations for an assignment. In a first-grade classroom, students independently decided to compile their stories into an illustrated book. As part of an election project, high school students developed a computerized voter registration system—complete with sound.

Second, individual students or small groups of students independently explored new applications and developed skills; they then spontaneously attracted the interest of other students in the class. For instance, students created spreadsheets on their own for everything from baseball cards to paper-route billings. Several sixth-grade boys used HyperCard to create a computer adventure game on their own. In a second-grade classroom, a wave of interest was created among the students after one of them shared a story he had written on his home computer. As the ACOT coordinator described,

The boys formed a mystery story writers group, complete with a name—The Gang. They ask to have free time to write their stories. They even went to the Publishing Center to make an appointment to bind their books. (WL, 13073, Vince, 3/30/89)

Some teachers allowed the students to provide formal instruction to other students in the class.

I was real excited by the interesting things that three students did on their own, not as assignments. . . I asked each of those three students to stand up and give a short demo to the class with the PC viewer. (AT, 7446, Harriet, 11/29/88)

I have two students who are incredibly taken away by Logowriter! They have written many animated and musical programs. They figured out how to create subdirectories and then how to jump from one to the next. They took two days and taught the class how to do it. (WL, 13336, Joshua, 3/8/89)

Increased Student Experimentation and Risk-Taking

The students' enhanced engagement while using technology led them to greater experimentation, which, in turn, further increased their level of engagement. Working independently with the computer, the students seemed willing to take more risks. Through this experimentation, they learned to use new applications without direct instruction. As students made discoveries, they shared them with others in spontaneous peer coaching. For example, in one classroom, the teacher showed only one student how to format the other side of a disk. Before long, everyone had formatted the reverse sides of the disks. As another elementary teacher said,

I often wonder when the children discover and where they learn how to figure out the various pieces of software and the computer. I may have taught one, or none, and they have discovered on their own. (AT, 10795, Bill, 3/21/89)

Through experimentation, students could explore new programs and applications without concern about making mistakes. As one teacher commented, “They get to practice in private with the computer which doesn’t really judge, and nobody keeps a record or a tally of what’s going on.” Moreover, with the computer, when students found out that a particular strategy didn’t succeed, they generally would keep working independently until they figured it out on their own. In contrast, when they worked with a teacher and could ask what to do next, they were less inclined to discover solutions on their own.

One teacher also observed that, unlike many adults, the students seemed unafraid of “crashing or causing any problems”; this attitude enhanced their desire to “try everything.” At one site, a coordinator walked into a classroom and was immediately mobbed with students—“not with inquiries for help, as might be expected with the introduction of software, but rather with pleas to see what each of them had discovered on their own.”

Taking advantage of students’ experimentation and engagement, teachers could introduce an assignment and then focus their efforts on individual students or small-group activities, such as directed reading. The opportunity to experiment and explore also enhanced student creativity.

Challenges Associated with Changes in Student Engagement

Problems with Student Frustration

While increased student enthusiasm provided numerous benefits, it also presented challenges to the teachers. When software programs were used repeatedly, they became routine and boring. And when computer projects were too difficult or too easy, students' enthusiasm turned to frustration. As several teachers summarized,

We have observed how you can lose them if you don't keep them extremely motivated. If a piece of software gets old to them, they won't stick with it.
(AT, 9449, Al, 2/28/89)

The kids need something different. We all seem to be tired of what we are using. (AT, 1531, Louise, 1/23/90)

A high school teacher pointed out that students started to tire of a particular software program because they were using it in all subject areas.

The teachers also began to recognize that some software programs created a great deal of initial enthusiasm but couldn't sustain student interest for more than a few days. For example, students lost interest in software that was directed and didn't allow for sufficient experimentation. The students preferred to explore rather than be told how to do something—whether by a computer or a human. When new software was being introduced, students got bored with the guided tours included in the programs but perked up again when they were allowed to investigate and discover on their own.

Particular computer programs and projects proved too difficult for some students, yet too easy for others in the same class. For example, slow readers quickly became frustrated with certain computer programs such as Carmen Sandiego, and students who had trouble with vocabulary lost interest in programs that focused on word games. Students who could quickly sail through a program also became bored and frustrated if not given additional challenges.

Time Trade-offs

Students' increased interest in and commitment to learning while using technology also led to problems related to time management. Teachers sometimes questioned whether they should allow computer activities to extend beyond the allotted time. One teacher finally instructed a student teacher to stop waiting for the students to finish working at the computer because "they would be at the computer all day if given the choice."

Additionally, teachers expressed concern about students' large investments of time on items such as layout or cover design for a project.

They wondered if the time spent on making the project visually appealing detracted from the time spent on content.

Finally, some teachers and parents questioned the trade-off of time for physical and social activities. For example, an elementary teacher felt that students needed the time at recess to be outside and to learn to socialize with one another, and, similarly, a parent worried that her son was becoming a “computer nerd.”

Increased Student Distractibility

Despite the positive effect of technology on most students’ level of engagement, teachers continued to be challenged by some students’ off-task behavior. For instance, some students became distracted by the increase in noise level caused by the printers, the keyboards, and the students moving freely around the classroom. Although most students adapted to the computerized environment, others seemed unable to handle the sharing among students and the various activities going on simultaneously. An elementary teacher believed that “the child who is off task with pencil and paper is off task on the computer and maybe more so because of the many distractions going on around him with technology.” Another elementary teacher prohibited game-type software programs in class because the students became so noisy and excited when using them. He decided this type of program had become “a problem instead of an asset.”

Teachers also puzzled over some students’ unwillingness to complete homework assignments on their home computers. For example, a team of sixth-grade teachers reported how the students had been “itching to do something on their own home computer;” but only 27 out of 71 students completed the first assignment. A fourth-grade teacher couldn’t understand why some of her students would “work on their computers at school but do very little at home.” A high school teacher became discouraged by a group of seniors who were “not completing any homework assignments.”

Although the time students voluntarily spent on computer projects far exceeded the typical 20-minute attention span of elementary students, teachers discovered that the students had a saturation point. After working on the computers for six hours as part of a videotaping project, one elementary student said, “I never thought I would get tired of the computer, but I don’t care if I don’t see one for a while.” The point at which students began to lose their concentration varied across individuals and depended on the type of computer assignment. An elementary school project coordinator observed that minor off-task behavior started after students had been working for one-and-a-half hours on a computer project.

Problems with Setting Boundaries

While teachers generally appreciated the increase in students' willingness to go beyond the requirements of their assignments, and encouraged their independence while exploring new applications, they also had to grapple with the question of boundaries. As one teacher described, "Sometimes the kids get ahead of us. The question is, do we let them go or do we hold them back a little bit?" The response to this query varied across teachers. Some teachers reported having "to keep the kids from going too far" while others purposely developed assignments that allowed students with the interest and ability to go beyond the minimum requirements. In the words of one teacher,

I was really pleased with the way these kids are taking risks and going beyond what is expected of them and being able to explore. They are more imaginative and creative in their thinking. (AT, 9194, Bill, 3/8/89)

In one fifth-grade classroom where students were "really stretching the boundaries of Logowriter," the teacher supported students' initiative by calling the publisher's technical assistance group to determine the feasibility of the students' ideas.

Distruption of Teacher Plans

Student experimentation with the computers also presented challenges to the teachers, particularly with respect to classroom plans. Students often became so engrossed in their work on the computers that they ignored other assignments or continued to work when they should have been listening. For example, when working with new equipment, students often wanted to stick with their experimentation until they solved their "problem." Certain software programs held such appeal that many teachers eventually monitored and limited their use. When one teacher tried reorganizing the schedule so that the introduction of new software followed another assignment, she noted that some students became "clock-watchers." She went on to say,

The students are so eager to get into some of the computer programs that they aren't taking classwork seriously. Somehow I have to communicate to them that there is a time for everything and each thing has its place. (AT, 2040, Rita, 10/3/88)

One teacher, after attending a workshop, developed greater empathy toward the students' difficulty in moving to other classroom activities. As he described,

I notice it is hard for the kids to break away when I say “Stop!” in class too. Recently I found myself doing the same kind of thing during a PageMaker workshop. I just kept right on showing somebody something when the presenter asked for our attention. (AT, 3996, Carl, 11/7/87)

Teachers varied in their reactions to the disruption of their plans. Some teachers viewed it as a significant problem, while others saw it as a potent opportunity for learning.

Summary

The introduction of technology into the classrooms described in this study brought about numerous changes in student engagement. Students displayed increased initiative by going beyond the requirements of assignments, and by independently exploring new applications. The time students spent on assignments and projects increased when they used the computers, and they chose to work on the computers during free time and after-school hours. Students' independent experimentation at the computer led to spontaneous peer coaching and cooperative learning. Increased student enthusiasm facilitated their learning and reinforced the teachers' efforts. The enthusiasm of individual students also motivated other students in the class.

Although teachers primarily viewed the changes in student engagement as positive, the changes also produced challenges for them. Teachers wondered to what extent students should be allowed to go beyond assignments and they questioned the amount of time the students spent on computer activities. Teachers found it difficult to move students to other classroom activities and frequently found their plans disrupted. Student enthusiasm turned to frustration when software programs were used repeatedly and when computer assignments were too easy or too difficult. In addition, some students had difficulty adjusting to the computerized environments with the increased noise, the sharing among students, and the simultaneous activities.

Discussion and Implications

Conditions for Creating Enduring Student Engagement

The initial interest and enthusiasm that technology generates in students may lead teachers to believe that the simple addition of technology will increase student engagement. We found that technology had an enduring, positive impact on student engagement in classrooms only under certain conditions. First, in classrooms where teachers used technology as one tool among many in their instructional repertoire, students were less likely to reach a saturation point on the computers. In such classrooms, computers were used only when they were the most appropriate tool for completing an assignment, not simply because they were available.

Second, student engagement remained high in classrooms where technology use was integrated into the larger curricular framework. Learning how to use the technology was not viewed by teachers in this project as another subject to fit into an already full curriculum, as so often happens in schools with computer labs. Teachers who allowed students to learn computer skills within the context of a meaningful assignment—rather than setting aside a block of “computer time” during which students would practice keyboarding or learn how to do word processing—were generally rewarded with higher levels of student engagement.

Third, student engagement was more likely to endure in classrooms that emphasized the use of tool applications such as word processing programs, desktop publishing software, and HyperCard® applications. While drill-and-practice software had its place in some classrooms, overreliance on materials such as these generally led quickly to student boredom and frustration. Students were most engaged when using programs that allowed experimentation and exploration.

Finally, student engagement was fostered in classrooms where teachers adjusted the use of technology to individual differences in both interest and ability. Just as students will lose interest in a mathematics assignment that is too simple or too difficult, so, too, will they become frustrated when using technology if teachers do not take their individual needs into account.

Teacher Beliefs About Their Role

In addition to benefits such as increased student engagement and enthusiasm, the introduction of technology into the classroom can also pose challenges for teachers. However, a close examination of the challenges discussed in this paper reveals that many of the dilemmas faced by these teachers related more to their beliefs about the traditional teacher role than to problems inherent in using technology.

For example, in classrooms where teachers were willing to relinquish their role as “dispenser of knowledge” and allowed students more control over their own learning, concerns about issues such as overzealous student experimentation and disruption of teacher plans became less paramount than in classrooms that remained more teacher-directed. And, as teachers moved away from the belief that they had to break learning into discrete subject areas such as mathematics and language, they started relying more on project-based instruction, and became less concerned that the computer was “taking away” time from other subject areas. Thus, we found that the dilemmas brought about by the introduction of technology challenged teachers to reexamine beliefs about their role in the classroom, and in many cases, led toward more child-centered rather than curriculum-centered instruction and toward more active rather than passive learning (Dwyer, Ringstaff & Sandholtz, 1990). We believe that fundamental instructional changes such as these will have an impact on student engagement far more lasting than that of any technological tool in and of itself.

Support for Technology Integration

As technology is provided to teachers for use in their classrooms, in-service programs can aid them in incorporating this tool productively into their instruction. However, in-service programs aimed simply at training teachers to hook up and operate equipment or run certain types of instructional software are not sufficient.

Our overall experience with the ACOT project suggests that lasting, significant change—in teachers’ beliefs about their role, in instructional practices, and in student outcomes—will not occur simply by giving teachers the latest technological tools. Rather, teachers must be provided with ongoing support, something that is available only if the larger system in which they are working changes as well. In this project, organizational supports for teachers included the following:

- Training workshops
- Ongoing technical support
- Release time to attend professional conferences
- Time during the school day for joint planning and team teaching
- A telecommunications network that allowed interaction across sites and with project staff
- The opportunity for routine peer observations and group discussions

Administrators interested in creating instructional change must be willing to implement structural or programmatic shifts in the environment for teachers who are evolving their instructional outlook. Furthermore, teachers must be given time to reflect upon their experiences so they can evaluate the consequences of different instructional approaches. Unless teachers are given the training and support to integrate technology, rather than simply to use it, the positive effects of technology on student engagement may not endure.

Student Engagement Revisited

Teachers, administrators, parents, and researchers alike agree on the importance of student engagement. When students are actively engaged and involved in a task, learning is a likely result. The disagreement emerges as researchers attempt to operationalize student engagement. In devising discrete measures, researchers have disregarded the teachers' judgment, relying instead on outside observers who decide if a student "is looking at some appropriate instructional object or person" (Wilson, 1987, p. 15) for five or ten seconds of each minute during a short segment of the school day. These types of measures are extremely limited and provide little useful information for teachers anxious to increase student engagement. The frequent responses to these time-on-task studies are new policies aimed at lengthening the school day and specifying time allocations for various subject areas. Although well-intentioned, these approaches ignore the larger instructional framework and may lead to greater student disengagement if teaching practices remain unchanged. By looking at student engagement more broadly and over longer period of times, we can begin to find the conditions that support it.

Although various studies indicate that technology has a positive impact on student engagement, these increases are often attributed to the novelty effect. By looking at the long-term impact of technology on student engagement, our research shows that the critical factor is not the novelty of the computer but rather the way in which the technology is being used in classroom instruction. Students can be disengaged just as quickly with technology as with traditional instruction, and drill-and-practice exercises on the computer differ very little from drill-and-practice exercises on paper.

Reform efforts in education propose moving toward instructional practices that are interdisciplinary, student-centered, and project-based. For example, the California Elementary Grades Task Force recommends reducing the amount of time spent on skills-based activities in favor of authentic learning tasks based on discovery and active student participation (California Department of Education, 1992). Although "the traditional skills-based curriculum lent itelf to short blocks of time for each subject area," the thinking curriculum requires "longer blocks of time—extending not just over several hours but over days or even weeks of effort" (p.26). The California High School Task Force points to the need for flexible use of time, driven by the curriculum and controlled by an interdisciplinary team of teachers (California Department of Education, 1992). The premise underlying these recommendations is that students' schoolwork must be "interesting and engaging" (p.29).

These proposed reforms are inconsistent with a narrow view of student engagement. When learning activities extend over hours, days, and weeks, it is meaningless to measure engagement in terms of seconds and minutes. In assessing the impact of multidimensional learning approaches, researchers must move beyond the limited measures of student engagement utilized in traditional time-on-task studies.

References

Anderson, L. & Scott, C., (1978). The relationship among teaching methods, student characteristics and student involvement in learning. Journal of Teacher Education, 29,
52–57.

Baker, E., Gearhart, M. & Herman, J. (1990). The Apple Classroom of Tomorrow: 1989 evaluation study (Report to Apple Computer). Los Angeles: UCLA Center for the Study of Evaluation.

Bright, G. (1988). Time-on-task in computer and non-computer estimation games. Journal of Computers in Mathematics and Science Teaching, 7(4), 41–46.

California Department of Education (1992). It's Elementary. Elementary Grades Task Force. Sacramento, California.

California Department of Education (1992). Second to None: A Vision of the New
California High School. The Report of the California High School Task Force.
Sacramento, California.

Capie, W. & Tobin, K. (1981). Pupil engagement in learning tasks: A fertile area for research in science teaching. Journal of Research in Science Teaching, 18(5), 409–417.

Cornbleth, C. & Korth, W. (1979). Instructional, context and individual differences in pupil involvement in learning activity. A paper presented at the annual meeting of the American Educational Research Association, San Francisco, California.

Delquadri, J., Greenwood, C. & Hall, R., (1979). Opportunity to respond. Paper presented at the Fifth Annual Meeting of the Association for Behavior Analysis, Dearborn, Michigan.

Dwyer, D., Ringstaff, C. & Sandholtz, J. (1990). Changes in teachers' beliefs and practices in technology-rich classrooms. Educational Leadership, 48(8), 45–52.

Far West Laboratory (1979). Study surfaces helpful hints for teachers. Educational Research and Development Report, 2(3).

Fish, M. & Feldman, S. (1988). Teacher and student verbal behavior in microcomputer classes: An observational study. Journal of Classroom Interaction, 23(1), 15–21.

Fisher, C., Berliner, D., Filby, N., Marliave R., Cahen, L. & Dishaw, M. (1980). Teaching behaviors, academic learning time, and student achievement: An overview. In C. Denham & A. Lieberman (Eds.), Time to Learn. Washington, D.C., National Institute of Education.

Glaser, B. & Strauss, A. (1967). The discovery of grounded theory. Chicago: Aldine Publishing Co.

Hamilton, D., MacDonald, B., King, C., Jenkins, D. & Parlett, M. (1977). Beyond the numbers game. London: MacMillan Education Ltd.

Hawkins J., Sheingold K., Gearhart, M. & Berger, C. (1982). Microcomputers in schools: Impact on the social life of elementary classrooms. Journal of Applied Developmental Psychology, 3, 361–373.

Johnston, J. & Joscelyn, M. (1989). The Computer Revolution in Teaching. National Center for Research to Improve Secondary Teaching and Learning, Office of Educational Research and Improvement.

Keirns, J. (1990). Effects of immediate computer access on teachers' beliefs and practices: A longitudinal case study of the reflections of three teachers. Unpublished doctoral dissertation, University of Southern California, Los Angeles, CA.

Latham, G. & Stoddard, C. (1986). Time on Task Analysis of the Logan High School Wandah Project. Unpublished report, Wasatch Institute for Research and Evaluation, Logan, Utah.

MacArthur, C., Haynes, J. & Malouf, D. (1986). Learning disabled students' engaged time and classroom interaction: The impact of computer assisted instruction. Journal of Educational Computing Research, 2(2), 189–197.

Magliaro, S. & Borko, H. (1986). A naturalistic investigation of experienced teachers' and student teachers' instructional practices. Teaching and Teacher Education, 2(2), 127–137.

McGarity, J. & Butts, D. (1984). The relationship among teacher classroom management behavior, student engagement, and student achievement of middle and high school science students of varying aptitude. Journal of Research in Science Teaching, 21(1), 55–61.

Mevarech, Z. (1986). Time engagement and achievement in CAI. Educational Technology, 26(7), 38–40.

Miles, M. & Huberman, A. (1984). Qualitative data analysis. Beverly Hills, CA: Sage.

Newmann, F. (1986). Priorities for the future: Toward a common agenda. Social Education, 50(4), 240–250.

Perkins, V. (1988). Effective instruction using microcomputers. Academic Therapy, 24(2), 129–135.

Phelan, P. (1989). The addition of computers to a first-grade classroom: A case study of two children. Unpublished report.

Smith, L. (1978). An evolving logic of participant observation, educational ethnography and other case studies. In L. Shulman (Ed.), Review of research in education.
Itaska, IL: Peacock.

Thorndike, R. & Hagen, E. (1986). Measurement and evaluation in psychology and education (4th edition). New York: Macmillan.

Tobin, K. (1984). Student task involvement in activity oriented science. Journal of Research in Science Teaching, 21(5), 469–482.

Vockell, E. (1987). The computer and academic learning time. The Clearing House, 61(2), 72–75.

Wilson, R. (1987). Direct observation of academic learning time. Teaching Exceptional Children, 19(2), 13–17.

Zuk, D. & Danner, F. (1986). The effects of microcomputers on children's attention
to reading tasks. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, California.

1 The data notation system used throughout this paper indicates the source of the data (AT = audiotape data; WL = weekly reports sent via electronic mail; SL = telecommunications sent between sites), the episode's entry number in the data base, the teacher's pseudonym, and the date the data were generated.

2 The actual number of episodes related to student engagement generated by each of the 32 teachers in this study varied tremendously. For example, a few teachers had only a handful of episodes related to student engagement, while others had over two hundred. This wide range can be attributed to a number of factors. First, data for this study were collected over a six-year period, and some of the teachers represented in the database were not involved for the entire time. Second, teachers differed in the number of audiotape journals they completed. Finally, the content of the tapes was left up to the discretion of each teacher, and some teachers were more interested in discussing student engagement than others. The

quotations in this paper represent 18 different teachers.