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What Are the Implications of Technology Usage on Students' Levels of Academic Engagement?

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Abstract

What are the implications of technology usage on students' levels of academic engagement? In an age of burgeoning debate on national and state accountability it is imperative that educators need to find ways to engage students to learn in order to demonstrate high levels of achievement. Recent literature, from 2000 to the present, revealed that technology usage does motivate students in academic settings. The psychological constructs of constructivism and flow offer a theoretical foundation. The charge for educators is to continue to develop meaningful ways to integrate technology into instructional practices and to continue to find ways to extend access to rich, technologically sound pedagogy for all students.

What Are the Implications of Technology Usage on Students' Levels of Academic Engagement?

As a former middle school administrator and long-time teacher, my interests revolve around students. My interest in student engagement and technology usage partly derives its source from the current reality. Adolescents are early adopters using technology. Richardson (2006) explained that Prensky called them digital natives while we adults are labeled digital immigrants and suffer similar struggles and frustrations as classic immigrants moving to a new country. We are at a crossroads. Our students have embraced new technology while teachers and administrators are moving forward at an un-even pace holding onto out-dated instructional practices and concurrently experimenting with new technology-based strategies and instructional designs. Every year teachers' usage of technology is growing due to the ubiquitous nature of accelerated change. Much remains to be learned about the positive outcomes of technology usage in schools.

Most teachers, from my experience, are energized and excited about teaching and love to see students succeed yet feel pressured by mandated accountability measures. Most teachers want to do their best, for their students' sake, and hold themselves to high standards. Most teachers are deeply concerned about student learning and work hard to meet student needs. However, current strict accountability legislation affects the educational landscape in much of the western world and this country specifically.

Preventing student failure is now the primary charge of education. According to the law, if students fail it is the fault of their teachers, and the state and federal government will dispense strict negative consequences to the school or district. The idea behind creating fail-safe schools is a valiant concept yet rife with gaps in implementation. For example, educators are fully accountable for aspects of children's education that are beyond their control. Teachers cannot force students to perform at high levels. Parents may withdraw students from mandated testing; while the student has a break from school the school suffers negative marks from the state. Teachers cannot force students to attend after-school study sessions, much less to attend school. School personnel cannot force students to engage in a meaningful, positive learning-centered dialogue; school personnel can only invite participation and attempt to facilitate high levels of cooperation and performance. Students make decisions about school based upon their own family values, opinions, and goals. Public school may or may not be part of that purview.

Engaging students is paramount to learning in any context. Educators are well aware that, while learning is the ultimate goal, having students engage in the work, be attentive, and exhibit interest is the immediate challenge (Becker, 2000b). In the area of technology and student motivation, my underlying interest is the practical issue of why capable students decide not to complete their schoolwork or really engage with school. How does technology usage influence student motivation and what do students have to say about it? Adolescents today have a plethora of out-of-school experiences and distractions that include digital electronic devices, family or social issues, employment, and sports to list a few. School is no longer the exclusive or primary activity of high school-aged students. It is well known that students who do not achieve in school are at risk for dropping out of high school.

Although there is disparity in state-by-state graduation rates, the National Center for Education Statistics (2006) reported an average high school graduation rate of 73.9% in 2002. This includes a range spanning from New Jersey, with an 87.0% rate, to the District of Columbia with a rate of 59.6%. Whether we test students or not, these rates are un-acceptable. To ameliorate the issue of low high school graduation rates we need to keep studying the student perspective. Questions to keep asking include (a) what do students think about school? (b) How can we invite more students to be full participants in the learning process at school? (c) Will using technology engage more students and thus increase our numbers of students graduating and finding success in later years?

My purpose in this paper is to analyze the research on adolescents and their use of technology as a motivating factor in their engagement with learning at school. Specifically, is there empirical evidence that using technology increases the likelihood that students will engage and do their work? First, I will discuss the theoretical underpinnings of constructivism and the psychological construct of flow which contribute to the discussion of student engagement and technology. In the following section I will explain the framework used to analyze the literature and the specific findings from the literature. In the final section I outline recommendations for the future of technology integration in schools and implications for effective use of technology in schools.

Review of the Literature

Technology is now firmly entrenched in our lifestyle. People utilize computers for daily living, entertainment, work, and learning; computers and technology are slowly becoming ubiquitous. Schools are also enjoying a tremendous growth in computers. “While schools had one computer for every 125 students in 1983, they had one for every 9 students in 1995, one for every 6 students in 1998, and one for every 4.2 students in 2001” (Goldberg, Russell, & Cook, 2003, p. 3).

Constructivism and Flow

Two psychological processes, constructivism and flow, offer a theoretical perspective to understand the relationship between student engagement and technology. Constructivism is based upon an active process, whereby students build upon their earlier knowledge and subsequently develop personal connections to new knowledge (Chen & McGrath, 2003; Pugalee, 2001; Scheidet, 2003). Constructivism is considered student-centered, rather than teacher-centered, and requires teachers to design methods of learning that honor students' past experiences as well as create new shared experiences in which learners to participate (Pugalee, 2001; Scheidet, 2003). Ideally constructivist learning activities engage both mind and hands and enable students to have some degree of choice and control (Pugalee, 2001; Scheidet, 2003). This view of social collaborative learning is a shift from a more traditional teacher-centered model where the teacher is the transmitter of knowledge and information (Gallini & Barron, 2001).

Becker (2000), in his response to Cuban's analysis of teaching and learning using computers, noted that using technology lends itself to a constructivist instructional design. Results from the Teaching, Learning, and Computing Survey in 1998, a national survey of 4,100 educators in 1,000 schools, indicated that the three most common instructional strategies used by constructivist teachers were enabling students to communicate electronically, present information to an audience, and collaborate with other students. For example, students worked after school on their presentations and spent much more time engaged with preparing for the presentation to their peers. Becker further indicated that knowing how to apply knowledge, and knowing when to do so, are critical aspects of the intersection between technology and a constructivist paradigm.

Problem-based learning provides a solid example of an instructional approach that exemplifies constructivism. In problem-based learning students take responsibility for their own learning. This often occurs in small groups where teachers are the guides (not information sources); students use authentic problems as their focus for learning which serve as a vehicle to increase problem-solving skills, collaboration, and deep involvement on the part of the learner

(Liu, 2003; Saul, 2005). Liu's (2003) and Becker's (2000b) analyses of the literature found that students learning in a problem-based learning atmosphere demonstrated higher levels of motivation and positive attitudes toward learning.

Chen and McGrath (2003) briefly discussed the psychological concept of flow in the context of student engagement. Csikszentmihalyi (1996) described flow as a state of deep concentration and enjoyment when a person is engaged in a task or activity. Theoretically, flow crosses boundaries of age, gender, and culture; flow also encompasses all variations of artistic, recreational, academic, professional, or athletic activities. Students who are experiencing flow in their academic studies would be able to concentrate on a challenging yet achievable goal; immediate feedback would sustain their concentration, and they would experience a merging of action and awareness. It is also common for people to lose track of time. The concept of constructivism and flow augment the theoretical foundation to the investigation of technology and student engagement.

Conceptual Framework

Deaney, Ruthven, and Hennessy (2003) examined student themes of technology usage for class projects and developed a framework for discussing those themes: (a) classroom tasks, (b) confidence and attitudes, (c) social learning and collaboration, (d) autonomy and independence, (e) the teachers' role, and (f) new ways to learn.

Classroom Tasks

Students expressed how they could produce documents charts and graphs with less discouragement because technological tools enabled an increase in their neatness and efficiency. They spoke of tasks being easier to do and less mundane using a computer than with traditional paper and pencil tasks (Deaney, Ruthven, & Hennessy, 2003). Increased time-on-task and extending access to literacy learning were two goals of the Community School District in New York City (Zardoya & Fico, 2001). At the time of the study the district had an enrollment of 42,000 students; 87% lived in poverty. The district developed a cost-sharing laptop-leasing plan for 134 students in grades five, six, and seven. Not only did attendance rates increase but students completed their work more quickly and efficiently so teachers could use class time to deepen learning through other activities. Students appeared to be more organized and responsible; students reported they felt smart. After the first year the Board of Education voted to extend the program.

Students thought computers offered tools to help them with such recursive assignments as writing, progressive revision, and editing. Computers were reported to be more efficient with exploratory idea development such as brainstorming and webbing their ideas. Students also reported it was always easier to identify and correct errors using computers. Students engaged with the work and were actively interested in writing when they collaborated with their peers. When students remained engaged with their writing on computer they made revisions and edits more easily thus the quality of their work increased. (Deaney, Ruthven, & Hennessy, 2003; Goldberg, Russell, & Cook, 2003).

Confidence and Attitudes

The classrooms that used technology had a positively charged atmosphere. Students experienced novelty using technology, the class was often in a different location, and different types of interactions occurred among themselves and between themselves and teachers (Deaney, Ruthven, & Hennessy, 2003). An Internet-based group of students demonstrated higher levels of motivation due to the authentic and meaningful text they were reading. Students also exhibited a willingness to persevere in the assignments not noted in the control group (Kramarski & Feldman, 2000).

In a diametrically opposed community in New York, Wolpert (2001) described a study in the Bronx, in which 30 homeless students worked intensively with graduate education students in a tutoring program. The focus of her research was to find out if attitudes toward learning would change among at-risk students. A special computer lab was set up and students met with their tutors weekly for three months. Results of the study indicated that student attitudes toward learning significantly changed and achievement levels went up. Wolpert was quick to assert that more research was required to discern if the effects were due to the technology or the tutoring by a young adult. However, all the students had prior tutoring experiences without access to technology and did not make academic gains.

Students and staff at a rural Norwegian school underwent an 18-month long comprehensive project-based learning technology integration project (Solvberg, 2003). Students expressed an increase in their control beliefs about learning; their confidence levels increased while expectation of failure decreased. Researchers had not anticipated these results and speculated that increased motivation over time may have been due to the school climate and instructional choices, specifically problem-based learning strategies, or that students may have thought about computers differently as they learned more about them.

Mistler et. al (2000) discussed that efficacy is willingness to continue working and students' belief that they could complete the work; they discussed that efficacy is based upon the work of Bandura. Mistler-Jackson (2000) identified five areas of efficacy: self-efficacy, control, interest, values, and goals. Self-efficacy refers to an individual's belief about their performance abilities; another term commonly used is empowerment. Mistler-Jackson et al. (2000) described their small case study of science students as part of a larger study, called Kids as Global Scientists Program (KGS), involving 3,500 students in 80 classrooms. The students in the case study participated in an eight-week atmospheric science study to learn about weather. Part of the students' inquiry-based work was to communicate with other students and actual scientists across North America. Students and scientists developed a reciprocal e-mail exchange; this proved to be highly engaging and students spent extra time after school to make sure they were gathering the correct information for the scientists. Students reported that the authentic nature of the work and being able to communicate with others motivated them the most. One of the participating teachers noted this activity gave the students a new forum in which to interact, changed some classroom dynamics, and offered different types of learning opportunities for students. The teacher discussed one female student at length. The student was extremely thoughtful and quiet; she was a hardworking and serious student who often did not get her needs met in class due a large group of boisterous students who dominated class conversations. Since the Internet offers a more equitable environment, this student was able to have her voice recognized and heard on-line; consequently this student greatly improved her self-assurance as a learner. The results of the case study indicate that the lower and moderately motivated students enjoyed the most significant increases in motivation by participating in the KGS program. Students spent more time on their work which indicated to the researchers a greater sense of self-efficacy and confidence as learners (Mistler-Jackson & Songer, 2000).

These results concur with results from the rich qualitative data from the 1985 - 1991 Apple Classroom of Tomorrow (ACOT) study discussed by Becker (2000b). Computers were found to be more engaging for students when used as a means to achieve learning objectives. Students were highly engaged when allowed to explore and experiment while creating documents instead of using drill and practice or game-type applications. Students brought their own level of technological expertise to the learning experience; students were more involved when the teachers gave them more responsibility. When teachers relaxed strict unit design to accommodate individual students engagement and motivation levels increased. The ultimate goal for students is to develop and maintain positive attitudes about school and learning; computers are only one method to engage students (McKinnon, Nolan, & Sinclair, 2000).

Social Learning and Collaboration

Social learning and collaboration positively effect student writing as discussed in a meta-study of technology and writing (Goldberg, Russell, & Cook, 2003). When students wrote using computers there was more opportunity for peer editing and peer mediated work. Students talked with each other differently when they used computers; students also talked more with each other in technology-based classrooms while in traditional classrooms the students talked to the teacher and not to each other.

Other researchers (Chen & McGrath, 2003) analyzed student engagement levels in high school sophomore science classes found similar evidence. Science students who had the opportunity to design hyper-media instead of reading the science textbook reported higher levels of student control and reported the design experience was a fun and effective way to learn. One student said, “It is a lot harder for people to concentrate when you are just sitting there than to actually get up and do something and get involved with your own learning” (p. 414). Student interaction was the key motivating factor in sustaining engagement with learning tasks (Deaney, Ruthven, & Hennessy, 2003). Being part of a learning community, experiencing a sense of playfulness, with immediate feedback and results, and feeling ownership over the project were strong indicators of student engagement (Chen & McGrath, 2003; Deaney, Ruthven, &

Hennessy, 2003). These studies offer strong evidence of constructivist classrooms with the possibility that some students may have experienced flow which is outside the primary purpose of this paper.

Autonomy and Independence

Students reported higher levels of independence, ownership, and autonomy, especially during Internet searches and the production of digital documents such as hyper-media or short films (Chen & McGrath, 2003; Deaney, Ruthven, & Hennessy, 2003; Saul, 2005). Producing these types of digital documents and participating in these problem-based learning processes enable students to make choices. Students are also able to work collaboratively with peers which is strongly valued among adolescents.

A study from an upper-middle class community in New York analyzed results from two side-by-side global history classes. The same teacher taught both classes; one section was Web-based while the other section was a more traditional textbook-driven class. Both classes were to prepare students for the mandated New York Regents exam. The goal of the research was to analyze achievement rates on the New York Regents exam in global history and to gauge interest and motivation levels in students. Students' comments reflect their appreciation of working in groups, having choices, responsibility, and independence. Students in the Web-based class expressed comments such as these:

> I feel like I have learned three times the amount this year.
>
> There should be more classes like this.
>
> I have been better able to learn and understand history and facts.
>
> I like that we do projects as groups.
>
> Freedom makes learning much easier.

I have the freedom to work at my own pace.

I have the ability to figure things out on my own.

Working on the computer makes learning fun and it's easier to access information.

(Scheidet, 2003 p. 92)

Independent observers concurred and noted student behaviors in both sections of the global history class. In the traditional class, students arrived late, and were listless, the teacher had to raise his voice to get their attention; the level of questioning and discussion was low. Students wanted to goof off and talk; they started to pack their books up five minutes before class was over. In the Web-based class students arrived either early or on time, students were full of energy, and quickly logged-on to their computer; students asked in-depth questions and gave their teacher their complete attention. Students were focused and enthusiastic during class, there were many smiles, and students reluctantly left the room when the bell rang (Scheidet, 2003).

Teachers' Roles

Teachers make many decisions every day and deciding how to structure learning opportunities for diverse learners is paramount (Deaney, Ruthven, and Hennessy, 2003). While technology is compelling to both adults, and youngsters, it is the quality of the instructional program that matters most (McKinnon, Nolan, & Sinclair, 2000). Cuban (2006) asserted that teachers are to facilitate discussions, ask questions, interact with students, personalize instruction, and organize learning experiences. He claimed that no machine can do that. Teaching remains a highly human activity.

Deaney, Ruthven, and Hennessy (2003) reported that students indicated concern that teachers could disengage from students if there was a heavy reliance on technology. Students expressed that they wanted lessons enjoyed by, and led by, their teacher. In other words, the teachers' role is crucial. Contemporary teachers' charge is to carefully devise educational strategies that match and support individual student learning goals (Deaney, Ruthven, & Hennessy, 2003).

New Ways to Learn

Students realized that using technology offered a new way to think about learning and researchers (Deaney, Ruthven, & Hennessy, 2003) agreed that technology can offer a whole new way of learning. When students used technology as a production tool it was very different than using technology as something to learn with using interactive models, simulations, and visual representations. For example, 155 sixth graders in a southwestern city had the opportunity to learn from a hyper-media science program called Alien Rescue; this problem-based-learning experience required students to find homes for six alien species (Liu, 2003). Alien Rescue was designed using National Science Education Standards and requires that students act like scientists to save the aliens' lives. It is highly engaging and students must explain their choices and decisions by applying their developing analytic, synthesizing, and argument skills. Students expressed high levels of motivation in their post-assessments (Liu, 2003). Across the globe, in New Zealand, data gathered from a five-year study of 415 students (McKinnon, Nolan, & Sinclair, 2000) indicated that one third of the students felt so strongly about technology that they would go to another school if the technology was taken away. In agreement with Cuban (2006) McKinnon, Nolan, and Sinclair (2000) pointed out that educators' primary focus and attention must be to the curricular and instructional goals before thinking of how to sustain student interest and motivation. The ultimate goal for students is to develop and maintain positive attitudes about school and learning; computers are only one method to engage students (McKinnon, Nolan, & Sinclair, 2000).

Obstacles to Using Technology

There are obstacles to student motivation in using technology at school. Deaney, Ruthven, and Hennessy (2003) noted that students demonstrated reduced levels of motivation if their technical ability was of a lower skill than required for curricular integration and application. Students also exhibited lower rates of motivation after a comprehensive three-year long technological integration at their school (McKinnon, Nolan, & Sinclair, 2000). In this instance researchers speculated that the technology was embedded in student instruction to such a degree that students reported it was as commonplace as a pencil or notebook; students' initial fascination with the novelty of fully integrated technology eventually wore off.

Other challenges inherent in using technological hardware and software are familiar to many educators. Technology can be unreliable, students bring varying levels of technological knowledge to the tasks at hand, and learning styles vary (Gallini & Barron, 2001). According to the 1998 Teaching, Learning, and Computing survey Becker (2000a) analyzed, teachers are more constructivist in philosophy than in actual practice because it is difficult to plan and organize daily classroom-learning experiences that are highly constructivist in design. Some teachers have difficulty planning lessons with student interests in mind, allowing simultaneous activities to occur, and allowing students to work in groups. These elements can cause additional noise, a feeling of chaos, and the unpredictability of students engaging with each other instead of the teacher (Becker, 2000a).

Looking to the future

There are several important questions to consider looking at the future of schools, technology, student engagement, and learning. The most important question is: under what effects, and under what conditions, will computers and technology have on student learning at school? (Solvberg, 2003). The public and policy-makers join in on the debate as more dollars, time, personnel, and other resources are allocated to embed more technology and technology instruction into school buildings and professional teaching ranks. Access and equity will continue to be important issues. Students must have access to technology. Content area mastery cannot become a reality unless all students, especially at-risk students or students who have experienced challenges with school and learning, have access to the same types of technology and the concurrent rich instructional pedagogy that other students enjoy (Pugalee, 2001).

Another area to address is the area of teacher training and development. Graduate schools of education may want to incorporate such curricular supports as designing on-line WebQuests (Gallini & Barron, 2001) and other instructional strategies that integrate technology with the curriculum. The more technologically sophisticated our teaching force, the more technology they will use in the classroom (Becker, 2000a). Current teachers will also need on-going professional development how to integrate technology into a rich instructional program (Scheidet, 2003).

Becker (2000) strongly advised that teachers needs new kinds of assessment to be able to compare students with and without various computer experiences. These assessments need to be sensitive to particular technological competencies. Using traditional paper and pencil assessments for technological competencies may exclude the very content areas and skills students are learning and are unable to effectively demonstrate using technology.

Recommendations for Classroom Technological Integration

There are essential components to integrating technology into classroom practice and instructional designs which will assist educators make intelligent decisions. These are (a) research-based strategies for integrating technology into the curriculum, (b) understanding the specific instructional program and how technology can support teaching goals, and (c) sharing specific pedagogy with colleagues (Becker, 2000b). Knowing more about these elements will support schools, districts, and states make wise-use of their available yet limited technology funds. Mistler-Jackson et al. (2000) suggest three important instructional strategies based upon their research with the Kids as Global Scientists (KGS) program.

1. Tele-collaboration

   Data from KGS suggest that students felt this type of participation helped them stay engaged enthusiastic and enabled them to feel accomplished.

2. Authentic questions

   Students in the KGS program asked meaningful questions about weather. In one lengthy electronic interaction the students and a scientist were exchanging information about snow and both were asking each other questions which lead to deeper levels of student engagement.

3. Time for the development of understanding

   The authors pointed out this type of learning required extensive time to execute carefully, deeply, and with strong results. Shorter more superficial activities may spark student interest but did not lend themselves to deep analysis and student focus.

There are many instructional classroom strategies used to successfully integrate technology into a rigorous instructional program (Brabec, Fisher, & Pitler, 2004). Brabec et al. cited a meta-analysis of 100 research reports by Marzano et al. that indicated there are nine classroom strategies that work; Brabec et al. directly linked specific examples of integrating technology to each of the nine classroom strategies Marzano discussed. Examples include word processing, creating graphic organizers, software functions in word processing, a variety of Web resources, creation of rubrics, WebQuests, utilizing brainstorming software, creating Venn diagrams, comparison tables or spreadsheets, creating a KWL (what you know, want to know, and have learned) chart, creation of hyper-media, and development of PowerPoint presentation slides. Brabec et al. concluded with an admonition to educators to always start with content area instructional goals and then move to decisions about how technology can enhance student learning.

Convergence Culture

Taking a larger view of culture and schools, major technological development is occurring in the developed world that has tremendous implications for our economic structures and the education of our young people. They will inhabit a world far different than ours and we can see the shifts already occurring today. Popular culture, a mainstay of entertainment for students, is undergoing tumultuous changes (Jenkins, 2006). Jenkins calls this phenomenon convergence culture and discussed how media convergence, participatory culture, and collective intelligence are changing the educational and cultural landscape. Today media is becoming more participatory; people are able to access media from anywhere when they have wireless connectivity. The paradigm of people passively watching or listening to media is rapidly changing as we become a more mobile electronically connected world downloading favorite television programs onto handheld devices. Students are creating and posting blogs, digital images, and hyper-media on-line for fun; students are avid users of social bookmarking sites such as Facebook and MySpace. Many of our young people have highly developed technology skills that they practice in the world of popular culture. What happens when they come to school and we do not enable them to create knowledge and work collaboratively? The whole manner in which we educate our tech-savvy students needs to be under the microscope.

Conclusion

My analysis of the literature indicated that students do engage with their schoolwork more deeply focused when they manipulate technological applications than in traditional book or lecture-driven learning environments. Study after study indicated that students prefer using technology because it fostered their growing independence and autonomy; students also expressed strong preference for active involvement and collaboration with each other. Technology is here to stay; schools are now integrating all kinds of hardware and technological curricular practices. We need to continue to study the instructional decision-making process behind using technology so that students make the most effective and lasting learning gains. Encouraging and inviting our young people to be full participants in the learning process and to develop a love of learning in the 21st century helps ensure their success today, tomorrow, and hereafter.

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