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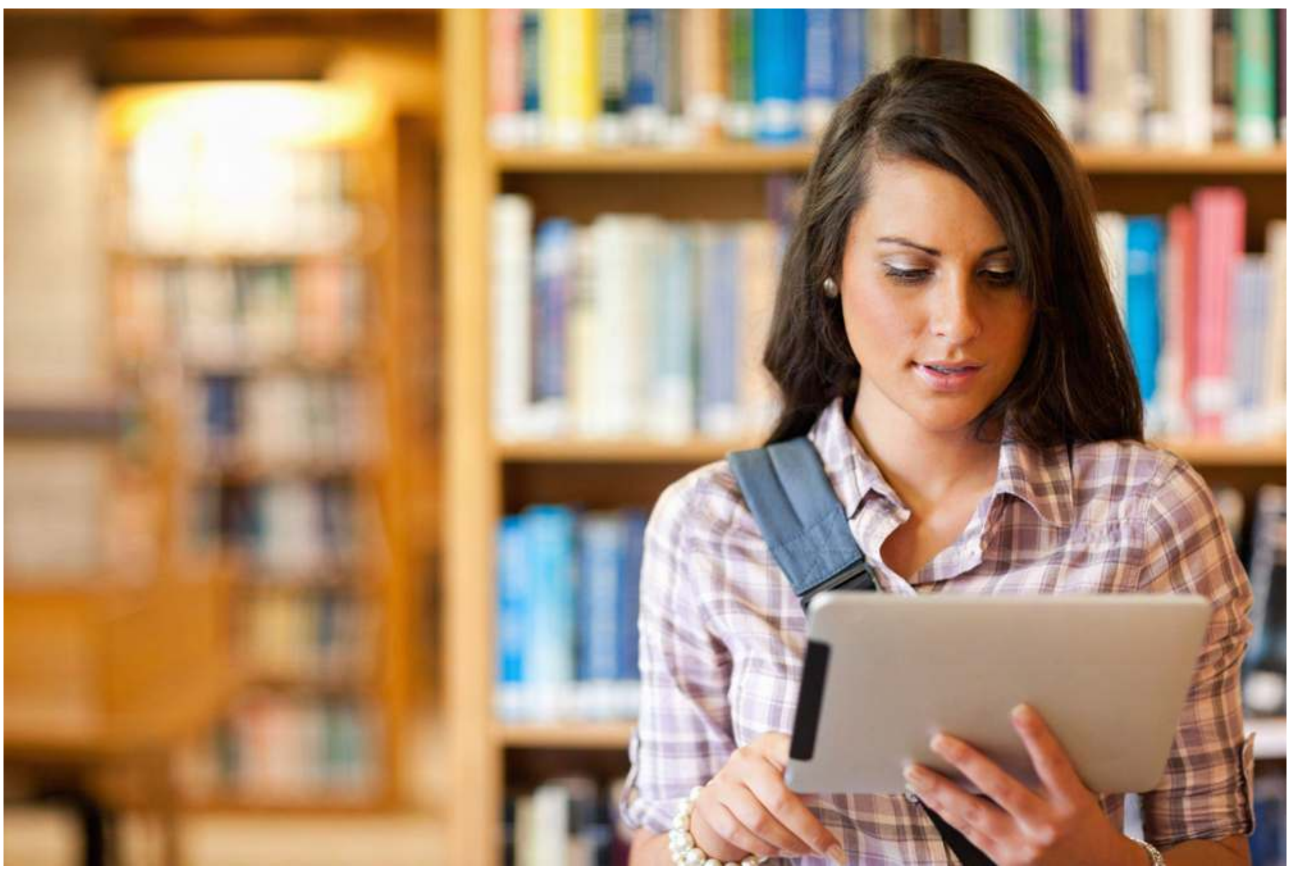
NO CHILD LEFT WITHOUT AN IPAD

THE CONTROVERSIAL ROLE OF TECHNOLOGY IN EDUCATION



ABSTRACT

New technologies are frequently touted with breathless enthusiasm, where celebrity denizens such as Steve Jobs of Apple Computers extolled the potential of electronic gadgetry to transform lives and change the world. Educators however may be more skeptical of the actual learning benefits from spending scarce dollars on the latest and greatest devices that are aggressively marketed to children, teens, and adults. The role, use, and implementation of technology in the classroom are particularly controversial topics as educational psychology research has produced a body of conflicting evidence on both sides of the issue.

This paper will clearly delineate the debate of computers in the classroom, explain its importance, and provide a short historical perspective of the problem. The bulk of the discussion will look at the pros and cons of incorporating technology into the classroom. Ten broad areas in technology and educational psychology will be examined in brief here: behaviorist, cognitivist, and constructivist views of learning; teacher preparation; testing and assessments; academic motivation; neuroscience; students with special needs; comparative education; cultural diversity; complex cognitive processes; and development of the physical, cognitive, and social self. For each area of discussion, relevant theoretical underpinnings and empirical evidence in the relevant literature are included. Finally, based on this review, a list of ten guidelines for effectively integrating technology into the classroom is presented as a possible solution. This paper concludes with the author's personal stance on the perils and potential of educational technologies.

INTRODUCTION

Former U.S. president George W. Bush signed the No Child Left Behind Act (NCLB) in 2001, which mandated that all students be technology-literate by the end of the eighth grade. To achieve this objective, funds are channeled for equipment, teacher training, and research through the Enhancing Education Through Technology Program (EETT). Funding, however, has continually diminished for this and other NCLB programs while the demand for technology in schools appears to increase every year.

NCLB failed to address the quality and effectiveness of which technologies are purchased and how they are implemented in schools. The inherent role of technology, as one variable among many factors in the learning environment, is ill-defined and leaves teachers and administrators to grapple with both technical and conceptual limitations. The consensus appears to be that children will need computer skills when they enter the workforce; therefore, we must have computers in school. By clearly defining this controversy, looking at the history of schools' struggles with new technologies, outlining the pros and cons of technology in twelve broad areas of educational psychology, and considering the related theories and empirical evidence in the literature, this paper will present ten guidelines for the effective integration of technology into the classroom.

THE PROBLEM

Technology is expensive, and it is an on-going expense. The most advanced and costly computer this year will be half-off on eBay next year and obsolete the year after. Endless upgrades and planned obsolescence may make sense from a market, cultural, and fashion perspective, but many schools are left wondering if the perpetual costs are worth it. Given limited budgets, can administrators justify buying new computers for their labs every year when funds are insufficient to pay teacher salaries? Are the educational software and hardware options available even effective for learning? The first problem is that schools are having a hard time getting funding to purchase equipment in the first place and properly train their teachers. The second problem, addressed in this paper, is that teachers and administrators do not have an adequate framework to evaluate, integrate, and implement these new technologies to create the optimal learning experience for their students.

HISTORY

Depending on one's definition of technology, these issues can be traced back to the earliest institutions of group learning. A teacher can misuse a blackboard and a piece of chalk by spending the entire class writing his or her lesson out by hand and expecting students to copy each word of text verbatim. When slide carousels and film projectors became commonplace in classrooms, teachers fumbled with them in a manner not dissimilar to problems they may face today with Powerpoint and video projectors. Showing films in class even became controversial, as it implied that the instructors could sit back and let the media do the teaching for them. Students could then sleep or pay no attention to the lesson somewhat more surreptitiously.

More recently, advocates pushed to have a computer in every classroom or even for every child, with innovators like MIT's Nicholas Negroponte working to create a $100 laptop computer. Unfortunately for the schools that did manage to acquire the necessary equipment, teacher training and professional development often fell short. When no one knew what to do with the computers and how to incorporate them into daily lessons, they would gather dust or at least serve as a visual prop for the mere presence of technology, if not the actual use of it.

For the schools today that do have computers and even iPads and other electronic gadgetry, other issues must be addressed as well. Is there actual learning taking place in the computer labs or are students checking non-school related email, tweets, and posts on Facebook? Are the educational software and hardware tools at hand appropriate for the given learning objectives? How do teachers design their instruction to be most effective and what exact role does the available technology serve?

PROS AND CONS

The pros and cons of technology in the classroom can be examined through various broad areas of study in educational psychology.

Behavioral, Cognitivist, and Constructivist Views of Learning

Figure 1. Elementary school students using "drill and practice" software.

In terms of the behavioral view of learning, changing student behavior patterns as well as the educational environment can shape better educational outcomes (Skinner, 1984). Drill and practice software can train students by giving them math problems to solve. Monitoring programs on computers can help educators observe student behavior and so teachers can guide and modify their activities. While technologies can be designed to promote positive learning behaviors through classical conditional and persuasion, there are significant downsides. Students are treated as passive learners hooked up to a machine. Behaviorism ignores motivation, thought, cognition, and the social dimension to learning.

For cognitivists, then, attention to the underlying mechanisms of learning are most crucial (Reid & Stone, 1991). Learning is an internal, active, and creative process that involves mental states such as memory. Cognitivist technological designs may help educators better understand, manipulate, and assess the internal processes underlying observable behaviors. Simulation and visualization software like Computer Assisted Virtual Environments (CAVE) can play an important role in education. While wearing googles and holding a remote control device, medical students at Weill Cornell Medical College can interact with 3-D models of proteins or MRIs of the brain with a very high level of clarity and precision. The high-definition resolution and projection technology provides detailed images for molecular modeling, medical diagnosis, and scientific research.

Figure 2. Computer assisted virtual environment (CAVE) at Weill Cornell Graduate School of Medical Sciences where a student examines dynamic changes of a 3-D molecular modeling system with a transporter protein immersed in a lipid bilayer environment. Retrieved on June 25, 2011 from http://weill.cornell.edu/news/deans/2008/08_25_08/article_01-08_25.shtml

Digital technologies are thus used for mental model reasoning, which involves imagining possible worlds and evaluating logical statements against these models (Johnson-Laird, 1983). In order to get the right logical reasoning answer, an individual must think of all possibilities; a problem becomes more difficult as the number of possibilities and subsequent errors increase. Content effects apply to mental models as people are more likely to be able to think of all possibilities if they are familiar with the content. The semantic approach of mental model reasoning is as valid as the syntactic approach of logical reasoning. Mental models can be a form of effective instruction by guiding students through actively learning about content material first hand (Black, 2007).

Mental models directly represent entities that are "true" so there is a truth bias (Johnson-Laird, 1983). Reasoning about falsity is more difficult with mental models because it requires an extra step. Therefore, Modus Ponens is relatively easy and natural from the mental model perspective; whereas, Modus Tollens is harder and unnatural as it requires additional falsity steps. Neuroimaging evidence through various fMRI studies is fairly consistent with mental models, where the visual-spatial areas of brain have been implicated. However, the results of these studies are complicated in that temporal lobe, where symbolic-linguistic processing occurs, appear to be used for content with a strong belief. The visual areas seem to be used primarily with a weak or abstract belief.

Technology in the classroom can likewise foster better causal reasoning skills. Simulations of specific cause and effect questions are digitally visualized to illustrate requirements for causation. Causal reasoning involves establishing that events of one kind are systematically triggered by events of another kind. When two variables co-vary, it may be tempting to infer causation. The variables however must be in the correct temporal and spatial proximity. The cause has to come before the effect, and the cause must have sufficient power to result in the observed effect.

The probability contrast is the difference between the probability of the effect occurring if the cause has occurred and the probability of the effect occurring if the cause has not occurred. The larger result for a cause which has the potential power to cause an effect, the more likely it is the cause. The enormous difficulty with causal reasoning is with isolating potential effects from causes compared to other possibilities. Enabling conditions tend to be invisible, and some causes can overshadow others. Causal reasoning is not explained by associations.

Interactive simulations in the classroom can also promote system thinking by illustrating how one entity affects another and that the overall behavior of the system is the sum of these entity interactions. There is also a positive feedback phenomenon that can be effectively visualized, where an attribute of one entity leads to more of that attribute as time progresses.

Conditions that may be problematic could include belief effects – the tendency to think an argument is valid if the conclusion is believed to be valid. The strong content effects of mental models could actually be misleading in this manner. Also, the more situations that have to be imagined for a logical reasoning problem, the harder it is and the most errors will likely occur. Moreover, cognitivist technologies may have an unwillingness to analyze even simple behaviors, which could be important to shape, assess, and reinforce learning.

In response to these limitations, constructivist practices have emerged where knowledge is constructed by having students work together to solve problems. While researchers are quick to remind teachers that fundamental skills are still critically important as well (Harris & Graham, 1996), the benefits of student problem-collaborations within social networks and other technology-based environments are becoming increasing apparent.

Figure 3. Muslim students working in pairs using math learning software.

With the ubiquity, ease-of-use, and no cost of social media, constructivist problem-solving can be done both inside and outside of the classroom. However, technologies designed from constructivist theories may sometimes be too open-ended. The proper scaffolding is critical to provide sufficient direction for students. And until artificial intelligence tools become more responsive, computing technologies may not be sufficiently adaptive for constructivist approaches.

Teacher Preparation

Training teachers to teach using new technologies pose enormous challenges. Beyond the technical familiarity with how to operate software and hardware equipment, teachers must understand how technological tools play a role in the core content of their subject area. Appropriate uses of technology in mathematics teacher preparation may include the incorporation of multiple representations and connecting topics to the appropriate pedagogies (Garofalo et al., 2000). Integrating literacy and science in biology teaching may be positively influenced by reading apprenticeships for teachers (Greenleaf et al., 2011), which could be facilitated through media and communicative technologies. While several studies try to distinguish the role of cut-and-paste decision making and processing in reading (Igo, Bruning & McCrudden, 2005) as well as the differences between reading on paper versus hypertext, well-researched reading comprehension and teacher preparation strategies may still apply (Williams et al., 2009). For example, a computer program could teach teachers and students alike the Close Analysis of Text with Structure (CATS) strategy (Williams, 2002). A guided process on the computer could help learners, acquire text structure strategies, use clue words, build a graphic organizer, build compare and contrast questions, analyze well-structured texts, learn content, comprehend expository text, apply strategies to the pro versus con text structure, and transfer strategies to expository texts containing content to be learned next.

Technology can also monitor the teaching process itself to improve the educational experience. At the Relay

Graduate School of Education, hand-held Flipcam video cameras capture graduate students teaching their students for later critiques (Otterman, 2011). The potential downside is of course changes in behavior based on the recorded observations.

Testing and Assessments

The use of computer testing and assessments has clear pros and cons. On one hand, computer administered tests may enhance test security. They are easier to score and produce immediate results. These tests save paper, time, and cost to prepare and ship materials, and they are customizable to individual student needs. For example, the Oregon Assessment of Knowledge & Skills offers read aloud questions and an online Braille interface.

On the other hand, technology literacy for both teachers and students vary greatly, and computer equipment is costly. Because of the web-based testing requirement in Oregon schools, many school computer labs are now overwhelmed by student demands. Previously students only needed a number 2 pencil to take a test. Now they need a $650 computer.

Butters & Walstad (2011) compared computer versus paper testing in precollege economics. 8th- and 9th-graders performed better with computer testing than paper testing. Computer testing limited item guessing as it did not have an "I don't know" option. It also reduced item bias from the order of item placement on a test.

Kingston (2009) reviewed 81 studies comparing computer- and paper-administered multiple-choice tests for K-12 students between 1997-2007. There were mixed results, however, the quality of computer-based tests changed considerably. Computer testing had small advantage for English language arts and social studies tests, while paper testing had a small advantage for math tests.

Both computer and paper tests call into question equity and fairness. While calls for reform have been clearly outlined (United States Department of Education, 2010), organizational misconduct still occurs (Pallas, 2011). Also, the reliability and validity of these tests have been challenged (Papay, 2011).

Academic Motivation

As a process that regulates behavior, motivation can be a powerful force in education. Conventional wisdom may suggest that technology will benefit children academically simply because they are frequently motivated by it outside of school. A child who loves playing video games at home should love learning through a video game, correct?

Research suggests that regardless of technology, goals, value, and affect influence student motivation (Anderman & Wolters, 2006). Extrinsic motivation may be powerful, as controlled by external rewards and punishments. Letting students "play" with a fun piece of technology may serve as a useful reward for good behavior.

Figure 4. Bart Simpson from the television show, *The Simpsons*, being motivated by print and digital media to learn about Theodore Roosevelt.

But intrinsic motivations can also be highly influential as well. With a humanistic approach to motivation, there is an intrinsic need for self-actualization. Computers can record student progress and escalate difficulties of challenges based on performance. With a socio-cultural approach to motivation, there is a reward by being a part of the academic community. Social networking sites can bring together – as well as ostracize – students in the learning environment.

A potential downside may be the tendency for technology to promote excessive praise of students. Praise in general can be dangerous to children (Dweck, 1999), and teachers may be less likely to write criticisms via email or even private online forums where the message could be easily reproduced and distributed publicly.

Neuropsychological Pedagogy

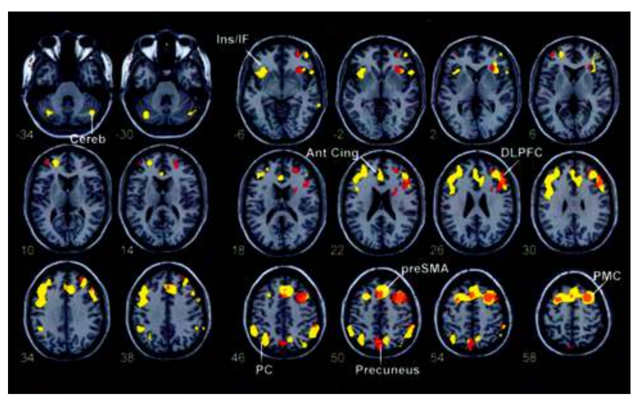


Figure 5. Voxels activated during trial-and-error sequence learning tasks between patients with early Parkinson's Disease and a control group (Mentis et al., 2002).

While behaviorists relied solely on observable actions of students to understand the learning process, neuroscientists can now measure changes in the brain itself through radiographic imaging technologies such as fMRI and PET. The above scans show voxels activated during trial-and-error sequence learning tasks between patients with early Parkinson's Disease and a control group (Mentis et al., 2002). In order to perform learning tasks as well as the control group, early Parkinson's Disease patients had to activate four times as much neural tissue as the control participants. This extra effort involved the recruitment of brain functions from homologous cortical regions and the bilateral cerebellum.

Neuroscience can certainly illustrate these kinds of measurable differences in the brain during a given learning task, but how can educators best apply this predominantly clinically-focused research to the classroom? What are the benefits and limitations of neurological research in educational psychology?

Neuroscience certainly has the potential to inform educational practices in many different ways. Peering into the brain may help us understand possible obstructions to learning such as visual-spatial or phonological processing impairments. It may also illuminate how the cognitive activities of prior experiences benefit learning outcomes (Stern, 2005). As represented in the mature brain, the acquisition of a "final" language state is now better understood neurologically along with cortical plasticity in second language acquisition (Sakai, 2005). The question is how these research findings could aid in shaping actual instructional design in different languages and perhaps working with bilingual students. Stern might help us understand why a child with brain damage to the left frontal regions may be having difficulty processing grammar, but what are the more generalizable and widely useful applications?

If you are trying to make a vacuum cleaner suck up more dirt and work more effectively overall, it seems appropriate to study the mechanisms of how vacuum cleaners actually work. Likewise, in order to understand learning, we must examine the organ that performs the function of interest. The cerebral cortex, specifically, has been implicated in the processing of certain aspects of cognition, movement, and sensation (Sur & Rubenstein, 2005). Recent research has established a basis from which we can gain insights into cortical development and the functions that control cognitive processes. This knowledge could potentially guide strategies in overcoming specific neurological obstacles to learning and comprehension.

However, several important limitations to applying neuroscience to educational psychology are apparent. Unrealistic expectations of neuroscience's impact on understanding education may draw attention away from important research in other areas such as psychology, technology, and instructional science. Policy-makers and educators often mislabel anecdotal strategies as "brain-based learning" without sufficient evidence (Stern, 2005). Examination of the "hard science" of neurological research may also lead to questionable and unsupported conclusions. For example, Lei (2008) claimed that gifted and talented programs in the first grade are "too little, too late," because of myelination, synaptogenesis, synaptic pruning, and neurogenesis in the brain at earlier ages. Lei did not cite any empirical evidence or studies examining interventions between kindergartners and first graders to support her conclusions. He did not even describe the intervention itself, or what the selection criteria would be for a child. Demonstrable skills at an earlier age do not appear to be a significant predictor for future academic success (Tyre, 2006), so how do you even determine if a three-year old is truly gifted and talented? Lei's argument was essentially that brains are more malleable at ages prior to first grade; therefore, gifted and talented programs need to start earlier. The "well-established research findings" he described only supported reasoning that younger brains have greater plasticity; it did not come close to substantiating her decisive conclusion that first graders "miss the boat."

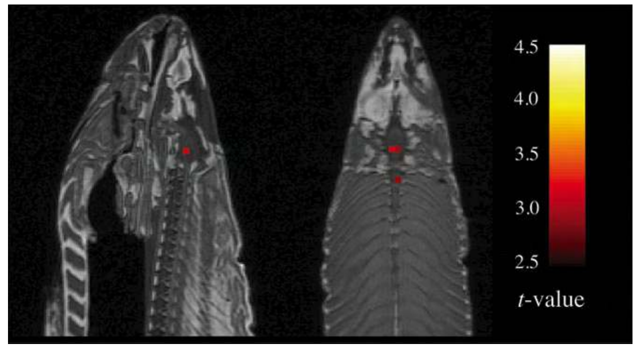


Figure 6. fMRI ostensibly showing brain activity in a dead salmon (Bennett et al, 2009)

There are also clear limits to an important neurological imaging tool that may undermine both clinical and educational research. fMRI measures the hemodynamic response, or change in blood flow, to activity within the brain and has been used extensively in learning and cognition studies. While the extra dimensionality of fMRI has yielded important data on various facets of human cognition and behavior, there are two major limitations to the technology. First, there is an inherent latency between thought and the detectable registration in the fMRI due to the hemodynamic response measurement. Research measurements are therefore "off". Second, there is a very high probability for false positives across the 130,000 voxels in a typical fMRI scan. Investigators generally do not correct for multiple comparisons with the statistical computation of their datasets, and this could significantly affect their results. Researchers at Dartmouth College presented an fMRI scan that ostensibly showed a dead salmon engaging in a perspective-engaging task (Bennett et al, 2009). They demonstrated that, even when using standard statistical thresholds and low cluster sizes, random noise in the EPI time series led to this clearly erroneous and somewhat comical conclusion. Adaptive methods for controlling the FDR and FWER, which are tools widely available in all major fMRI analysis packages, are needed to avoid spurious results.

As neuroscience is a perpetually evolving field of study, the interpretation and application of this research to education must change constantly as well. Given its current limitations, neurological studies should not dictate teaching practices but rather complement other research areas in educational psychology. While the prospective benefits of further understanding how the brain works cannot be understated, teachers should consider neuroscience research as one of many sources to inform the design of effective instruction for their students (Genesee, 2000).

Special Education: Response to Intervention

Help for students with special needs include assistive technologies, which are devices to help overcome or remove a disability, as well as techniques like responsiveness-to-intervention strategies (Fuchs & Fuchs, 2006). The effectiveness of various interventions on middle school with reading disabilities has been studied (Vaughn et al., 2011) and the use of technologies like the reading pen have been shown to be particularly effective in students with special needs.

Figure 7. The reading pen, as used in research to help students with special needs. *Journal of Special Education Technology Index*: http://www.tamcec.org/jset/index

However, technological proficiency may be further decreased in special needs students at the onset. Technological interventions could present additional problems or distractions to more proven approaches.

Comparative Education

Comparative education is the field of study that compares educational systems and approaches within and between different countries. Technology plays a vital role in the work of organizations like the International Association for the Evaluation of Educational Achievement, the Organization for Economic Cooperation and Development, and the Program for International Student Assessment. Media and communicative technologies are critical in collecting, organizing, and sharing data about educational systems around the world.

Technologies can foster learning and collaboration across geographic boundaries through different distance learning programs. While many educators may prefer being in the same physical room as their students, online learning does present opportunities unique to the virtual environment. For example, medical students at Imperial College in London are treating virtual patients in Second Life without harming real-life patients. Educational technologists created a full-service, virtual hospital where students can work with each other to order x-rays, CT, MRI, and PET scans and other diagnostics as well as provide treatment protocols to non-existent patients (Bradley, 2009). The digital hospital in Second Life was designed to resemble the actual campus at Imperial College, including a replica of the landmark Queen's tower.

Each student's avatar can fly into the virtual hospital, check-in at a reception desk, wear an access badge, and then pick-up an assignment from the professor. The avatar then must wash its hands before coming into contact with a virtual patient. In the patient's room, the student avatar can access recordings of real-life patients' breathing, for example, or other diagnostics. The avatar can also walk down to the radiology department as they would in the actual hospital. Protocols and procedures can be easily practiced in this imaginary world.

Figure 8. Medical students at Imperial College London are treating virtual patients in Second Life as part of a multimedia learning program.

Weill Cornell Medical College has a sister medical school in Doha, Qatar. Both institutions offer an identical curriculum, and students receive a medical degree from Cornell University upon graduation. Video streaming allows for lectures in New York to be broadcast live or on demand in Doha – and vice versa. These technologies allow for a cross-cultural exchange among like-minded colleagues on opposite sides of the world that would be far more difficult to accomplish otherwise.

Figure 9. The auditorium of Weill Cornell Medical College in Qatar streaming a video of a Cornell University professor teaching a Grand Rounds session in New York City.

Cultural Diversity

The role of technology in fostering diversity in education has had mixed results. A web-based visual interface for learning vocabulary had a negative effect for girls but a positive effect for boys (Hakuta, 2011). A digital learning classroom for improving English language learners, however, showed more consistent success in improving academic scores in math and reading using interactive whiteboard technologies (Lopez, 2010). The performance gap was reduced between English language learners and native speakers in 3rd and 5th grade math.

The "digital divide" refers to inequalities between groups in terms of access to, use of, or knowledge of information and communication technologies. Not surprisingly, Valadez & Duran (2007) found that teachers in schools with greater financial resources had significantly more access to computers and the Internet. There was more creative use of new technologies in instruction and more extensive communication online between teachers and students. Unfortunately, knowledge and use of technology is still lagging for urban students from economically, linguistically, and ethnically diverse backgrounds (Macias, 2009). English language learners that fall into these groups face significant challenges (Padilla, 2006; Enright, 2011; Ehri, 2009), which could be facilitated by new technologies – if only they had access to them.

Complex Cognitive Processes

There are also potential benefits to technology that helps shape students' complex cognitive processes like metacognition and metacomprehension. Intelligent tutoring systems (ITS) allow for students to monitor their own thinking and understanding of materials during the learning process. ITS are based on artificial intelligence algorithms and cognitive psychology theories to be adaptive to individual differences. Essentially, this technology can accommodate students of different levels of ability and different types of thinking. Studies have specifically shown that ITS are effective in teaching mathematical proofs to students with differing skill levels (Anderson, Boyle, & Reiser,1985). Individual differences could also be addressed in absolute and relative metacomprehension accuracy (Maki et al., 2005) as well as metacognition and agency across the human lifespan (Metcalfe, Eich & Castel, 2010).

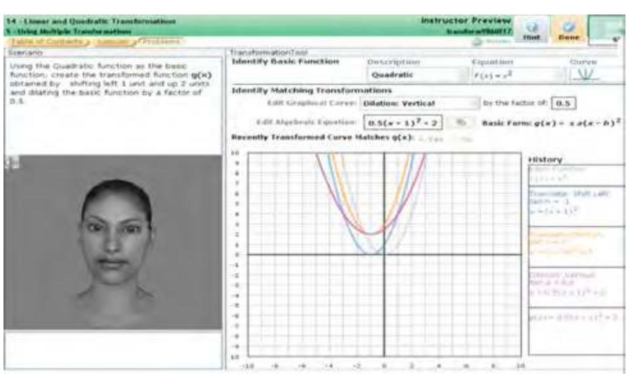


Figure 10. Screenshot of intelligent tutor system (ITS) by Carnegie Learning software: http://www.carnegielearning.com/galleries/8

The Self, Social, and Moral Development

Technology can provide advantages and disadvantages to self, social, and moral development. In terms of physical development, both electronic and traditional toys are geared towards cultivating play, building motor skills, or perhaps fostering health and well-being in the child. With cognitive development, there are likewise numerous gadgets intended to foster sensorimotor intelligence, preoperational thinking, concrete operational thinking, or formal operational thinking. While empirical evidence have discredited toys produced by Baby Einstein and others (DeLoache et al., 2010), educational research has long nurtured the development of learning tools by Sesame Street (Mielke, 1990). These studies have emphasized social development as well; a parent is generally encouraged to play with the child, using the toy as an instrument of their interaction. Regardless of the technology, it seems that families, peers, and teachers likely play one of the most important roles in the growth of the child. Leaving young children in front of a television or computer alone may even impair language development in children under 2 years of age (Zimmerman, Christakis & Meltzoff, 2007).

Theory of Mind is the awareness of your thinking and the awareness that other people have different thoughts framed by their own experiences (Flavell, 2004). This develops around age two to three and is a precursor to metacognition. Theory of mind can be assessed by looking at the child's false beliefs, awareness of the appearance versus reality of things, and the ability to take different perspectives. Selman's five stages of perspective-taking are undifferentiated (ages 3-6), social-informational (ages 5-9), self-reflective (ages 7-12), third-party (ages 10-15), and societal (ages 14 - adult). An iPad app or other gaming simulation platform could potentially help adults better understand these perspective-taking stages by simulating the child's point of view.

Figure 11. Images of the author's physical and cognitive development iPad app currently being developed with game levels based on Flavell's (2004) Theory of Mind.

POTENTIAL SOLUTIONS

Based on the pros and cons of technology in the ten areas of educational psychology discussed, along with the empirical evidence and theories cited, the following guidelines are offered to better integrate electronic and digital media in the learning environment:

1. A clear problem must be defined first. The technology must be shaped as one part of the solution. Throwing a specific technology into the classroom without a clear problem to solve sets the stage for failure.

2. The technology must be made available and supported by IT professionals. Anything that requires batteries or an electrical outlet has the high likelihood to stop functioning at any given moment. Teachers cannot be expected to have the technical expertise to diagnose and fix technical problems with the equipment.

3. Teachers must be trained in the technology. When the tools are functioning properly, teachers must be expected to be able to use the technology with relative ease.

4. Software has to be selected based on the quality of the user experience and not how many features it offers. Many software developers load every possible feature into their products, because they know that evaluators work from a long requirements list. People often choose products that claim to do it all, but in reality, do not do any of them well.

5. Constraints must be placed on the technology to focus on learning. Students should not be accessing Facebook, Twitter, and email during class unless it is part of the lesson. Similarly, there are usually IP restrictions on library computers to prevent access of pornography or other material considered inappropriate in school. Censorship issues aside, technology can be enormously distracting, especially in a school environment. Focused use of the technology is absolutely critical.

6. A back-up plan must be in place if the technology does not work or is distracting. An instructor should be prepared to write on the board, for example, if her PowerPoint slides are not working. Or if a lesson involves students working in groups with iPads, the teacher should be prepared with an alternate activity in case use of the devices becomes disruptive.

CONCLUSION

The why and how of technology in schools is a complex issue that can have a tremendous impact on both budgets and educational outcomes. Given the historical perspective of the problematic integration and use of media in the classroom long before the ubiquity of computing technologies, this longstanding controversy is likely a constant rather than an anomaly. The many benefits and limitations of educational technology was discussed through a wide range of educational psychology topics: behaviorist, cognitivist, and constructivist views of learning; teacher preparation; testing and assessments; academic motivation; neuroscience; students with special needs; comparative education; cultural diversity; complex cognitive processes; and development of the physical, cognitive, and social self.

Technology has a critical place in schools, but it is not an isolated role. Every child should be equipped with all the resources necessary for academic success, whether it is card to the local library or the latest iPad. The digital divide must be closed. However, just providing the tools is insufficient. Educators must design their instruction where they take advantage of new technologies to optimize the learning experience and teach things that would be more difficult or impossible to explain on a chalkboard. Content is still king – even if we are distracted by the pretty technological packaging. ❖

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