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RESEARCH SNAPSHOT

Is multimedia a good education investment?

As educators search for the most effective and engaging methods for teaching our nation's young people, many are turning to technology to assist in accomplishing their goals. Of particular interest is the integration of multimedia devices, applications, and activities into the classroom. But are these new devices and applications appropriate for classroom use? Do they go beyond student interest (they are cool, after all) and move into student understanding and achievement?

Published research focused on these questions suggests they certainly can, though barriers to full integration of such products and services still exist. Specifically, the research tells us:

- That using multiple symbol systems – spoken language, text, still images, moving images – in instruction leads to more impressive learning gains than does using only one primary symbol system.
- That when teachers seamlessly integrate technology into inquiry-based learning student understanding improves considerably.
- That when teachers have students use computers to solve simulations using high order thinking skills, students' math scores increase significantly. Conversely, using computers to teach low order thinking skills can negatively affect student learning. Despite this, low-order "drill and practice" is still the most common use of computers in math classes.
- That nationwide there is one classroom computer for every 7.9 students, compared with 9.2 in 2002. Despite the improvement, research suggests we need even more computers in the classroom (one for every four students) to realize the full potential of this kind of technology integration.

Education is slowly evolving toward classrooms of Teacher-as-Learning-Partner/Facilitator; that should serve students well in the 21st century. The research tells us that technology can and should be a natural and integrated part of that. We aren't there yet, but it appears we're moving in the right direction.

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II. Introduction

"Integrating 21st century skills into K-12 education empowers students to learn and achieve at the level necessary to succeed in this century. Education will become both more invigorating and relevant when it reflects the realities and challenges of contemporary life."

— John Wilson, Executive Director of the National Education Association (Partnership for 21st Century Skills, 2004)

As educators, parents, and concerned community partners endeavor to find the most effective and engaging methods for teaching our nation's young people, many are turning to technology to assist in accomplishing their goals. Of particular interest is the integration of multimedia devices, applications, and activities into the classroom.

On the surface, these offerings certainly seem to meet the initial learning criteria of *engaging* digitally-native 21st century students, known as Generation Y or Millennials. These students have grown up in a multimedia and multitasking world and have little problem absorbing information from a variety of media — television, web sites, email, blogs, printed magazines, MP3 players, mobile phones, Instant Messaging clients — often simultaneously. Of course, this Millennial lifestyle is too often at odds with traditional school-based learning, during which students "are asked to sit and focus on one narrowband issue for 45 minutes" (Apple Computer, 2003).

Think that's a stretch? Consider these results from a 2003 NetDay Speak Up Day survey, in which more than 200,000 students participated:

- Nearly 1/3 of students in grades K-3 (29%) have email accounts. That number increases to 79% for students in grades 7-12.
- 73% of K-3 students know what the Internet is.
- 70% of students in grades 7-12 have 1-3 IM (instant messaging) screen names, while 18% have 4 or more IM screen names.
- 54% of these students know more of their peers' screen names than home telephone numbers (NetDay 2004).

In part, it is the recognition of this new reality that has compelled educators to adjust their teaching styles to use more 21st century technologies in their curricula. But have these adjustments been wise ones? That is, can this integration of technologies such as multimedia devices, applications, and activities take advantage of student engagement and then go beyond the initial (and perhaps superficial) student interest to facilitate increased, demonstrable student learning and achievement?

The research suggests it can, though deficiencies in teacher training and/or access to multimedia and Internet-connected computers may be near-term hindrances to multimedia usage tipping towards widespread adoption by educators. Still, it is encouraging to realize that educators do seem to be moving in the right direction. Some of the research related to integrating technology into education (categorized broadly by subject) is presented below. It is not exhaustive by any means, but it should give readers a feel for the current wisdom on the topic.

III. What the research says

Research is showing that multimedia technology can have a positive impact on learning and teaching in the primary and secondary grades.

Despite the contentions of some critics, research is showing that multimedia technology (software, computers, digital cameras/camcorders, etc) *can*, under the right conditions, have a positive impact on learning and teaching in the primary and secondary grades (Honey, 2001; Norris, Smolka, & Soloway, 2000). Here is (some of) what has been asserted about technology and multimedia integration in the classroom, separated by general themes.

How students learn:

- Use of multiple symbol systems – spoken language, text, still images, moving images – yields greater learning gains than media that rely primarily on one symbol system (Kozma, 1991).
- Multiple modes/symbol systems can portray content through a variety of approaches (e.g., linguistic, aesthetic, logical, or narrational) thus more effectively matching viewers' various intelligence preferences (Gardner, 1999).
- Research has shown that multiple tracks of audio and visual information convey powerful learning benefits. "When presented together, each source provides additional complementary information," thus increasing the chances that comprehension will take place (Kozma, 1991).
- Adding sound to still pictures results in greater learning than merely adding motion (Wetzel et al, 1994).

Teachers/Instruction:

There are six key elements for fostering 21st century learning (Partnership for 21st Century Skills, 2003):

- Emphasize core subjects
- Emphasize learning skills
- Use 21st century tools to develop learning skills
- Teach and learn in a 21st century context
- Teacher and learn 21st century content
- Use 21st century assessments that measure 21st century skills

"Materials are far more likely to be used if teachers can see easily how they connect to their existing classroom curriculum. If the materials (no matter how educationally rich) do not map onto the curriculum that a teacher is obligated to meet, then the materials are likely to be treated as a nice 'extra' to be used only if time permits" (Fisch 2004).

The value of video/multimedia is highly correlated to its integration within the curriculum – how closely the content fits into the overall instructional sequence (Wetzel, 1994).

"There is a significant and substantive correlation between technology access and use; almost without exception, the strongest predictors of teachers' technology use were measures of technology access. Conversely, and contrary to conventional wisdom, teacher characteristics and demographics (time on the job, subject matter, gender, etc) were of relatively little consequence in predicting technology use" (Norris, et al, 2003).

Contrary to conventional wisdom, teacher characteristics do not accurately predict technology use.

Once technology is adequately available, the role of the classroom teacher is the most crucial factor in the full development and use of technology in the schools (Office of Technology Assessment, 1995; Trotter, 1999).

If technology is to be used to produce improvements in student achievement, teachers must see a direct link between the technology and the curriculum for which they are responsible (Byrom, 1998).

Specific content can help teachers analyze, synthesize, and structure ideas into projects that they can use in their classrooms (Center for Applied Special Technology, 1996).

When inquiry-based learning and true technology integration are put together "there's a synergy created that really boosts student learning" (Brannigan, 2002).

Application (web and software) development:

Research has shown that, depending on its features, different kinds of software lead to vastly different educational outcomes (Haugland & Wright, 1997).

Well-designed software should:

- Be visually engaging
- Encourage active participation (as opposed to passive sitting and watching) in a process of exploration,
- Maintain children's interest over time (Judge, 2001)
- Be open-ended and child-directed (Haugland, 1992, 1999).
- "Individualize and customize the curriculum to match learners' developmental needs as well as personal interests" (Judge, 2001; Valdez et al, 2000).
- Include "embedded cognitive strategies" (Sivin-Kachala & Bialo, 2000). Helpful cognitive strategies include:
    - Repetition and rehearsal of content
    - Outlining
    - Cognitive mapping or diagramming
    - Drawing analogies and inferences
    - Generating illustrative examples
    - Using pictorial information

For 4th and 8th graders technology has "positive benefits" on achievement as measured in NAEP's mathematics test. (Wenglinksy,1998). HOWEVER:

Simply using computers to teach low order thinking skills could be worse for a student's academic achievement than doing nothing.

- Using computers to teach low order thinking skills "was negatively related to academic achievement." That is, this type of computer use was worse than doing nothing.
- By contrast, teachers who had students use computers to solve simulations saw their students' math scores increase significantly.
- Professional development is typically the difference between those teachers who use "drill and practice" and those who used software that could creation simulations
- Despite this research, "drill and practice" is the most common use of computers in 4th grade math classes in the US. Very few surveyed teachers are using computers for higher-order-thinking tasks such as simulations (Technology Counts 2004).

Hardware/Classroom Realities:

- Classrooms should be equipped with one computer for every four students in elementary classrooms, and they should be located where social interactions with peers and teachers during computer use can be encouraged (Becker, 2000; Skeele & Stefankiewics, 2002).
- Nationwide, counting computers in classrooms only, there is one computer for every 7.9 students, compared with 9.2 in 2002. Further, while there are 4.3 students per Internet-connected computers in schools nationwide, there are 8.4 students per Internet-connected computer located in classrooms, which improved from 11.1 in 2002. (Technology Counts 2004)

This table gives results from 2002 Snapshot Survey regarding Technology Availability (Norris, et al, 2003):

# of Classroom Computers	# of Responses	Percent	Cumulative Percent
None	574	15.8	15.8
1	1724	47.4	63.2
2-5	1036	28.5	91.7
6-10	140	3.8	95.5
> 10	163	4.5	100
Total	3637		

- "14% of US K-12 teachers make no use whatsoever of computers for instructional purposes, and nearly half (45%) use it with their students less than 15 minutes per week…. Only 18% report using computers for instructional purposes more than 45 minutes per week." Meanwhile, 1.4% of US K-12 teachers makes extensive use of the Internet for instructional purposes. In contrast, over a quarter report not using the Internet

at all, and two-thirds of respondents make minimal or no use (< 15 mins/weekly) of Internet technologies with their students (Norris, et al, 2003). Norris and his colleagues' assert that this lack of use of technology is directly linked to the limited access, rather that as a result of a lack of professional development, as others assert.

Technology can and should be a natural aspect of the migration of classrooms to an Information Revolution model.

It is an exciting time to be involved in K-12 education – as a student, as a teacher, as a parent, and as a community partner. Education is slowly evolving away from the Industrial Revolution model of Teacher-as-Classroom-Boss/Knowledge-Giver used for many decades to an Information Revolution model of Teacher-as-Learning-Partner/Facilitator that should serve Millennials well in the 21st century. The research tells us that technology can and should be a natural and integrated part of that. We aren't there yet, but it appears we are moving in the right direction.

IV. Resources

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